



# MUD Florence Water Treatment Plant

## Phase II Filter Plant Improvements

### Construction Documents Project Manual

**Issued for Bidding**

**September 14, 2014**

I, Charles A. Haas, am the Coordinating Professional on the Florence Water Treatment Plant Phase II Filter Plant Improvement Project.

**MUD Project Number: 100085000627**

**HDR Project No. 134-225510-003**



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## DIVISION 00

BIDDING REQUIREMENTS, CONTRACT FORMS, AND  
CONDITIONS OF THE CONTRACT







1 2014/09/11

2 **SECTION 00020**  
3 **INVITATION TO BID**

4 **RECEIPT OF BIDS**

5  
6 Sealed bids for the construction of Florence Water Treatment Plant – Phase II Filter Plant Improvements,  
7 will be received for Metropolitan Utilities District of Omaha, represented by Jon Zellars, Director of  
8 Purchasing.

9  
10 Bids will be received at MUD Headquarters Building, Purchasing Agent, Fourth Floor, 1723 Harney Street,  
11 Omaha, Nebraska 68102 until Wednesday, October 21, 2014 at 10:30 AM local time. The bids will be  
12 opened and read aloud shortly thereafter on Fourth Floor, Purchasing of MUD Headquarters Building.  
13 BIDDERS should allow time to be processed through Security upon entering the building.

14  
15 **GENERAL DESCRIPTION OF WORK**

16  
17 The Work includes the furnishing of the labor, materials, equipment, services, and the installation of Owner  
18 procured equipment all for improvements and modifications to the existing Howell Filtration Facility at the  
19 Florence Water Treatment Plant. The Work includes architectural, structural, HVAC, plumbing, electrical,  
20 instrumentation/control, and process features.

21  
22 **TYPE OF BID**

23  
24 Bid shall be on a Total Base Bid for the Work.

25  
26 **DOCUMENT EXAMINATION AND PROCUREMENTS**

27  
28 The Bidding and Contract Documents may be examined at the following locations:

29		
30	Metropolitan Utilities District	HDR Engineering, Inc.
31	1723 Harney Street	8404 Indian Hills Drive
32	4th Floor	4th Floor
33	Omaha, Nebraska 68102	Omaha, Nebraska 68114-4049
34	Contact: Jon Zellars,	Contact: Scott Anderson
35	Director of Purchasing Department	Phone: (402) 399-1486
36	Phone: (402) 504-7253	
37		

38 Obtaining copies of the Bidding and Contract Documents must be arranged through the Issuing Office:

39  
40 Metropolitan Utilities District  
41 1723 Harney Street  
42 Fourth Floor  
43 Omaha, Nebraska 68102  
44 Attn: Jon Zellars, Director of Purchasing  
45 Phone: (402) 504-7253

46  
47 Arrangements that must be made through the Issuing Office include registering as a planholder and  
48 providing contact information.

49  
50 Only electronic copies of the Bidding and Contract Documents are available at the Issuing Office. There will  
51 be no charge for the Bidding and Contract Documents on CD-ROM (PDF format).

52  
53 No partial sets of Bidding Documents will be issued.

54  
55 Addenda will be issued to plan holder by electronic format.

56

1 **DOCUMENT QUESTIONS**

2  
3 Direct questions concerning document interpretation to:

4  
5 Metropolitan Utilities District  
6 9100 John J. Pershing Drive  
7 Omaha, NE 68112-5803  
8 Attn: Mike Koenig, P.E.  
9 402-504-7487

10  
11 See Section 00200 - Instructions to Bidders.

12  
13 **BID SECURITY**

14  
15 Each Bid shall be accompanied by bid security as described in Specification Section 00100 -  
16 INSTRUCTIONS TO BIDDERS.

17  
18 **CONTRACT SECURITY**

19  
20 The successful BIDDER will be required to furnish Performance and Payment Bonds as described in  
21 Section 00700 - GENERAL CONDITIONS.

22  
23 **CONTRACT TIME**

24  
25 The Contract Time is defined in Section 00700 - GENERAL CONDITIONS, and specified in Specification  
26 Section 00500 - AGREEMENT.

27  
28 **QUALIFICATION OF BIDDERS**

29  
30 Requirements concerning the qualifications of BIDDERS are described in Section Specification 00100 -  
31 INSTRUCTIONS TO BIDDERS.

32  
33 **NON-DISCRIMINATION IN EMPLOYMENT**

34  
35 BIDDERS on this Work will be required to comply with the President's Executive Order No. 11246.  
36 Requirements for BIDDERS and Contractors under this order are explained in the Specifications.

37  
38 **OWNER'S RIGHT TO REJECT BIDS**

39  
40 The Metropolitan Utilities District reserves the right to waive irregularities and to reject bids.  
41

42 **END OF SECTION**

1 2014/09/11

2 **SECTION 00100**  
3 **INSTRUCTIONS TO BIDDERS**

4 **1. Defined Terms**

5  
6 1.1. Terms used in these INSTRUCTIONS TO BIDDERS, which are defined in Section 00700 -  
7 GENERAL CONDITIONS, have the meanings assigned to them in the General Conditions.

8  
9 1.2. Certain additional terms used in these INSTRUCTIONS TO BIDDERS have the meanings indicated  
10 below which are applicable to both the singular and plural thereof.

11  
12 1.2.1. BIDDER: One who submits a Bid directly to DISTRICT as distinct from a sub-bidder, who submits  
13 a Bid to a BIDDER.

14  
15 1.2.2. Issuing Office: The office from which the Bidding Documents are to be issued and where the  
16 bidding procedures are to be administered.

17  
18 1.2.3. Successful BIDDER: The lowest, responsible and responsive BIDDER to whom DISTRICT (on the  
19 basis of DISTRICT's evaluation as hereinafter provided) makes an award.

20  
21 **2. Copies of Bidding Documents**

22  
23 2.1. Complete sets of the Bidding Documents in electronic (PDF) format may be obtained at no cost  
24 with arrangements made through an Issuing Office.

25  
26 2.2. Complete sets of Bidding Documents must be used in preparing Bids; neither DISTRICT nor  
27 ENGINEER assume any responsibility for errors or misinterpretations resulting from the use of incomplete  
28 sets of Bidding Documents.

29  
30 2.3. DISTRICT and ENGINEER in making copies of Bidding Documents available on the above terms  
31 do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license or grant for  
32 any other use.

33  
34 **3. Qualifications of BIDDERS**

35  
36 3.1. Within two (2) days after Bid opening, each BIDDER must be prepared to submit, upon DISTRICT  
37 request, detailed written evidence to demonstrate qualifications to perform the Work. This evidence may  
38 include financial data, previous experience on a minimum of three (3) projects of similar magnitude and  
39 complexity, present commitments, and other such data as may be called for below (or elsewhere in the  
40 Contract Documents). Experience of major subcontractors, such as electrical, can also be requested.  
41 DISTRICT

42  
43 3.1.1. Each Bid must contain evidence of BIDDER's qualification to do business in the State of Nebraska  
44 or covenant to obtain such qualification prior to award of the Contract.

45  
46 3.2. BIDDER is advised to carefully review those portions of the Bid Form requiring BIDDER's  
47 representations and certifications.

48  
49 **4. Examination of Bidding and Contract Documents, Other Related Data, and Site**

50  
51 4.1. It is the responsibility of each BIDDER before submitting a Bid to:

52  
53 4.1.1. Examine and carefully study the Contract Documents and other related data identified in the  
54 Bidding Documents (including "technical data" referred to in Paragraph 4.2. below).

55  
56 4.1.2. Visit the site to become familiar with and satisfy BIDDER as to the general, local and site conditions  
57 that may affect cost, progress, performance or furnishing of the Work. A mandatory site visit will be  
58 scheduled immediately following the mandatory Pre-Bid Conference.  
59

1 4.1.3. Consider federal, state and local Laws and Regulations that may affect cost, progress, performance  
2 or furnishing of the Work.

3  
4 4.1.4. Study and carefully correlate BIDDER's knowledge and observations with the Contract Documents  
5 and such other related data.

6  
7 4.1.5. Promptly notify ENGINEER of all conflicts, errors, ambiguities or discrepancies in or between the  
8 Contract Documents and such other related documents.

9  
10 When conflicts, errors, ambiguities or discrepancies are discovered in or between Contract Documents  
11 and/or other related documents, and when said conflicts, etc., have not been resolved through the  
12 interpretations by ENGINEER as described in Paragraph 6., BIDDER shall include in the Bid the greater  
13 quantity or better quality of Work, or compliance with the more stringent requirement resulting in a greater  
14 cost. Such greater cost shall be included in the Bid.

15  
16 4.2. Reference is made to the Supplementary Conditions for identification of:

17  
18 4.2.1. Those reports of explorations and tests of subsurface conditions at or contiguous to the site which  
19 have been utilized by ENGINEER in preparation of the Contract Documents. BIDDER may rely upon the  
20 general accuracy of the "technical data" contained in such reports but not upon other data, interpretations,  
21 opinions or information contained in such reports or otherwise relating to the subsurface conditions at the  
22 site, nor upon the completeness thereof for the purposes of bidding or construction.

23  
24 4.2.2. Those drawings of physical conditions in or relating to existing surface and subsurface structures  
25 (except Underground Facilities) which are at or contiguous to the site that have been utilized by ENGINEER  
26 in preparation of the Contract Documents. BIDDER may rely upon the general accuracy of the "technical  
27 data" contained in such drawings but not upon other data, interpretations, opinions or information shown or  
28 indicated in such drawings or otherwise relating to such structures, nor upon the completeness thereof for  
29 the purposes of bidding or construction.

30  
31 4.3. Information and data shown or indicated in the Contract Documents with respect to existing  
32 Underground Facilities at or contiguous to the site is based upon information and data furnished to  
33 DISTRICT and ENGINEER by owner of such Underground Facilities or others, and DISTRICT and  
34 ENGINEER do not assume responsibility for the accuracy or completeness thereof unless it is expressly  
35 provided otherwise in the Supplementary Conditions.

36  
37 4.4. Provisions concerning responsibilities for the adequacy of data furnished to prospective BIDDERS  
38 with respect to subsurface conditions, other physical conditions, and Underground Facilities, and possible  
39 changes in the Bidding Documents due to differing or unanticipated subsurface or physical conditions  
40 appear in Paragraphs 4.02, 4.03, and 4.04 of the General Conditions. Provisions concerning responsibilities  
41 for the adequacy of data furnished to prospective BIDDERS with respect to a Hazardous Environmental  
42 Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous  
43 Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the  
44 drawings or specifications or identified in the Contract Documents to be within the scope of Work, appear in  
45 Paragraph 4.06 of the General Conditions.

46  
47 4.5. Before submitting Bid, each BIDDER will be responsible to obtain such additional or supplementary  
48 examinations, investigations, explorations, tests, studies and data concerning conditions (surface,  
49 subsurface and Underground Facilities) at or contiguous to the site or otherwise, which may affect cost,  
50 progress, performance or furnishing of the Work or which relate to any aspect of the means, methods,  
51 techniques, sequences or procedures of construction to be employed by BIDDER and safety precautions  
52 and programs incident thereto or which BIDDER deems necessary to determine its Bid for performing and  
53 furnishing the Work in accordance with the time, price and other terms and conditions of the Contract  
54 Documents.

55  
56 4.6. On request, DISTRICT will provide each BIDDER access to the site to conduct such examinations,  
57 investigations, explorations, tests and studies as each BIDDER deems necessary for submission of a Bid.  
58 BIDDER must fill all holes and clean up and restore the site to its former conditions upon completion of such  
59 explorations, investigations, tests and studies.

60

1 4.7. The submission of a Bid will constitute an incontrovertible representation by BIDDER (i) that  
2 BIDDER has complied with every requirement of this Paragraph 4, (ii) that without exception the Bid is  
3 premised upon performing and furnishing the Work required by the Contract Documents and applying the  
4 specific means, methods, techniques, sequences or procedures of construction (if any) that may be shown  
5 or indicated or expressly required by the Contract Documents, (iii) that BIDDER has given ENGINEER  
6 written notice of all conflicts, errors, ambiguities and discrepancies in the Contract Documents and the  
7 written resolutions thereof by ENGINEER are acceptable to BIDDER, and when said conflicts, etc., have not  
8 been resolved through the interpretations by ENGINEER as described in Paragraph 6., BIDDER has  
9 included in the Bid the greater quantity or better quality of Work, or compliance with the more stringent  
10 requirement resulting in a greater cost, and (iv) that the Contract Documents are generally sufficient to  
11 indicate and convey understanding of all terms and conditions for performing and furnishing the Work.  
12

## 13 **5. Availability of Lands for Work, Etc.**

14  
15 5.1. The lands upon which the Work is to be performed, rights-of-way and easements for access thereto  
16 and other lands designated for use by CONTRACTOR in performing the Work are identified in the Contract  
17 Documents. All additional lands and access thereto required for temporary construction facilities,  
18 construction equipment or storage of materials and equipment to be incorporated in the Work are to be  
19 obtained and paid for by CONTRACTOR.  
20

## 21 **6. Interpretations and Addenda**

22  
23 6.1. All questions about the meaning or intent of the Bidding Documents are to be directed to DISTRICT  
24 in writing. Interpretations or clarifications considered necessary by ENGINEER in response to such  
25 questions will be issued by Addenda mailed or delivered to all parties recorded by ENGINEER as having  
26 received the Bidding Documents. Questions received less than 10 days prior to the date for opening of Bids  
27 may not be answered. Only questions answered by formal written Addenda will be binding. Oral and other  
28 interpretations or clarifications will be without legal effect.  
29

30 Address questions to:

31  
32 Metropolitan Utilities District  
33 9100 John J. Pershing Drive  
34 Omaha, Nebraska 68112-5802  
35 Attn: Mike Koenig, P.E.  
36 Phone: (402) 504-7487  
37

38 6.2. Addenda may also be issued to modify the Bidding Documents as deemed advisable by DISTRICT  
39 or ENGINEER.  
40

## 41 **7. Bid Security**

42  
43 7.1. Each Bid must be accompanied by Bid security made payable to DISTRICT in an amount of 10  
44 percent of BIDDER's maximum Bid price and in the form of a certified check, bank money order or a Bid  
45 Bond [on form attached,] issued by a surety meeting the requirements of Paragraphs 5.01 and 5.02 of the  
46 General Conditions.  
47

48 7.1. The Bid security of Successful BIDDER will be retained until such BIDDER has executed the  
49 Agreement, furnished the required Contract security and met the other conditions of the Notice of Award,  
50 whereupon the Bid security will be returned. If the Successful BIDDER fails to execute and deliver the  
51 Agreement and furnish the required Contract security and certificates of insurance within 15 days after the  
52 Notice of Award, DISTRICT may consider BIDDER to be in default, annul the Notice of Award, and the Bid  
53 security of that BIDDER will be forfeited as follows:  
54

- 55 a. Successful Bidder or Surety will pay to DISTRICT upon default of Successful Bidder any  
56 difference between the total amount of Successful Bidder's Bid and the total amount of the Bid  
57 of the next lowest, responsible and responsive Bidder as determined by DISTRICT for the Work  
58 required by the Contract Documents, provided that;
- 59 b. If there is no such next lowest, responsible and responsive Bidder or the difference between the  
60 Bid of the next lowest responsible and responsive Bidder and Successful Bidder's Bid is greater  
61 than the Penal Sum set forth, and DISTRICT does not abandon the Project, then Bidder or  
62 Surety shall only be obligated to pay to DISTRICT the Penal Sum set forth.

1  
2 **8. Contract Times**

3  
4 The number of days within which, or the dates by which, the Work is to be substantially completed and also  
5 completed and ready for final payment is set forth in the Agreement or incorporated therein by reference to  
6 the attached Bid Form.

7  
8 **9. Liquidated Damages**

9  
10 Provisions for liquidated damages, if any, are set forth in the Agreement.

11  
12 **10. Substitute and "Or-Equal" Items**

13  
14 The Contract, if awarded, will be on the basis of materials and equipment described in the Bidding  
15 Documents without consideration of possible substitute or "or-equal" items. Whenever it is indicated or  
16 specified in the Bidding Documents that a "substitute" or "or-equal" item of material or equipment may be  
17 furnished or used by CONTRACTOR if acceptable to DISTRICT and ENGINEER, application for such  
18 acceptance will not be considered by DISTRICT and ENGINEER until after the Effective Date of the  
19 Agreement. The procedure for submission of any such application by CONTRACTOR and consideration by  
20 DISTRICT and ENGINEER is set forth in Paragraphs 6.05A., 6.05B. and 6.05C. of the General Conditions  
21 and may be supplemented in the General Requirements.

22  
23 **11. Subcontractors, Suppliers and Others**

24  
25 11.1. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers and other  
26 persons and organizations (including those who are to furnish the principal items of material and equipment)  
27 to be submitted to DISTRICT in advance of a specified date prior to the Effective Date of the Agreement, the  
28 apparent Successful BIDDER, and any other BIDDER so requested, shall within 7 days after Bid opening  
29 submit to DISTRICT a list of all such Subcontractors, Suppliers and other persons and organizations  
30 proposed for those portions of the Work for which such identification is required. Such list shall be  
31 accompanied by an experience statement with pertinent information regarding similar projects and other  
32 evidence of qualification for each such Subcontractor, Supplier, person or organization if requested by  
33 DISTRICT. DISTRICT, who after due investigation has reasonable objection to any proposed  
34 Subcontractor, Supplier, other person or organization, may before the Notice of Award is given request  
35 apparent Successful BIDDER to submit an acceptable substitute; in which case the apparent Successful  
36 BIDDER shall submit an acceptable substitute. BIDDER shall further indicate that BIDDER's Bid price will  
37 be increased (or decreased) by the difference in cost occasioned by such substitution, and DISTRICT may  
38 consider such price adjustment in evaluation of Bids and making the Contract award.

39 If apparent Successful BIDDER declines to make any such substitution, DISTRICT may award the Contract  
40 to the next lowest BIDDER that proposes to use acceptable Subcontractors, Suppliers and other persons  
41 and organizations. The declining to make requested substitutions will not constitute grounds for sacrificing  
42 the Bid security of any BIDDER. Any Subcontractor, Supplier, other person or organization listed and to  
43 whom DISTRICT does not make written objection prior to the giving of the Notice of Award will be deemed  
44 acceptable to DISTRICT subject to revocation of such acceptance after the Effective Date of the Agreement  
45 as provided in Paragraph 6.06.B. of the General Conditions.

46  
47 11.2 List Subcontractors in Bid.

48  
49 BIDDER shall list on the Bid Form in the place provided the name, address, and description of Work of each  
50 Subcontractor to whom BIDDER proposes to subcontract portions of the Work.

51  
52 11.3. No CONTRACTOR shall be required to employ any Subcontractor, Supplier, other person or  
53 organization against whom CONTRACTOR has reasonable objection.

54  
55 **12. Bid Form**

56  
57 12.1. The Bid Form is included with the Bidding Documents; additional copies may be obtained from the  
58 Issuing Office.

1 12.2. All blanks on the Bid Form must be completed by printing in ink or by typewriter. The Bid Form  
2 must be signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A  
3 Bid price shall be indicated for each Bid item listed therein. In the case of optional alternatives, the words  
4 "No Bid," "No Change," or "Not Applicable" may be entered.  
5

6 12.3. Bids by corporations shall be executed in the corporate name by the president or a vice-president  
7 or other corporate officer accompanied by evidence of authority to sign. The corporate seal shall be affixed  
8 and attested by the secretary or an assistant secretary. The corporate address and state of incorporation  
9 shall be shown below the signature.

10  
11 12.4. Bids by partnerships shall be executed in the partnership name and signed by a partner, whose title  
12 must appear under the signature accompanied by evidence of authority to sign. The official address of the  
13 partnership shall be shown below the signature.  
14

15 12.5. Bids by limited liability companies shall be executed in the name of the firm by a member and  
16 accompanied by evidence of authority to sign. The state of formation of the firm and the official address of  
17 the firm shall be shown.  
18

19 12.6. Bids by individuals shall show the BIDDER's name and official address.  
20

21 12.7. Bids by joint ventures shall be executed by each joint venturer in the manner indicated on the Bid  
22 Form. The official address of the joint venture shall be shown.  
23

24 12.8. All names shall be typed or printed in ink below the signature.  
25

26 12.9. The Bid shall contain an acknowledgement of receipt of all Addenda, the numbers of which shall be  
27 filled in on the Bid Form.  
28

29 12.10. The address and telephone number for communications regarding the Bid shall be shown.  
30

31 12.11. Evidence of authority to conduct business as an out-of-state corporation in the state where the  
32 Work is to be performed shall be provided in accordance with Paragraph 3 above. State CONTRACTOR  
33 license number, if any shall also be shown on the Bid Form.  
34

### 35 **13. Submission of Bids**

36

37 13.1. Bids shall be submitted on the prescribed Bid Form, provided with the Bidding Documents, at the  
38 time and place indicated in the Advertisement or INVITATION TO BID, addressed the Purchasing Agent, 4<sup>th</sup>  
39 Floor, 1723 Harney Street, Omaha, NE 68102, of the Metropolitan Utilities District, and shall be enclosed in  
40 an opaque sealed envelope, marked with the Project title, and the name and address of BIDDER, and  
41 accompanied by the Bid security and other required documents. If the Bid is sent through the mail or other  
42 delivery system, the sealed envelope shall be enclosed in a separate envelope with the notation "BID  
43 ENCLOSED" on the face of it.  
44

45 13.2 BIDDER shall submit three (3) copies of its Bid, one (1) marked "original" and two (2) marked  
46 "copies", each with all support documentation required. Bid Security shall be attached only to original Bid.  
47

### 48 **14. Modification and Withdrawal of Bids**

49

50 14.1. Bids may be modified or withdrawn by a certified or hand delivered letter duly executed and  
51 delivered to the place where Bids are to be submitted at any time prior to the opening of Bids. No other  
52 communication including telephone, e-mail, telegraphic or fax will be acceptable.  
53

54 14.2. If, within 24 HRS after Bids are opened, any BIDDER files a duly signed, written notice with  
55 DISTRICT and promptly thereafter demonstrates to the reasonable satisfaction of DISTRICT that there was  
56 a material and substantial mistake in the preparation of its Bid, that BIDDER may withdraw its Bid and the  
57 Bid security will be returned. Thereafter, that BIDDER will be disqualified from further bidding on the Work  
58 to be provided under the Contract Documents.  
59

1 **15. Opening of Bids**

2  
3 Bids will be opened and, unless obviously non-responsive, read aloud publicly at the place where Bids are to  
4 be submitted. An abstract of the amounts of the base Bids and major alternates, if any, will be made  
5 available to BIDDERS after the opening of Bids.  
6

7 **16. Bids to Remain Subject to Acceptance**

8  
9 All Bids will remain subject to acceptance for the time period specified for Notice of Award and execution  
10 and delivery of Agreement and required Contract security and certificate of insurance by Successful  
11 BIDDER. DISTRICT may, at DISTRICT's sole discretion, release any Bid and return the Bid security prior to  
12 that date.  
13

14 **17. Evaluation of Bids and Award of Contract**

15  
16 17.1. DISTRICT reserves the right to reject any or all Bids, including without limitation the rights to reject  
17 any or all nonconforming, nonresponsive, unbalanced or conditional Bids and to reject the Bid of any  
18 BIDDER if DISTRICT believes that it would not be in the best interest of the Project to make an award to that  
19 BIDDER, whether because the Bid is not responsive or the BIDDER is unqualified or of doubtful financial  
20 ability or fails to meet any other pertinent standard or criteria established by DISTRICT. DISTRICT also  
21 reserves the right to waive all informalities not involving price, time or changes in the Work and to negotiate  
22 Contract terms with the Successful BIDDER. Discrepancies between the multiplication of units of Work and  
23 unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any  
24 column of figures and the correct sum thereof will be resolved in favor of the correct sum. Discrepancies  
25 between words and figures will be resolved in favor of the words.  
26

27 17.1.1. Any or all bids will be rejected if DISTRICT has reason to believe that collusion exists among the  
28 BIDDERS.  
29

30 17.2. In evaluating Bids, DISTRICT will consider the qualifications of BIDDERS, whether or not the Bids  
31 comply with the prescribed requirements, and such alternates, unit prices and other data, as may be  
32 requested in the Bid Form or prior to the Notice of Award.  
33

34 17.3. DISTRICT may consider the qualifications and experience of Subcontractors, Suppliers, and other  
35 persons and organizations proposed for those portions of the Work as to which the identity of  
36 Subcontractors, Suppliers, and other persons and organizations must be submitted as provided in the  
37 Supplementary Conditions. DISTRICT also may consider the operating costs, maintenance requirements,  
38 performance data and guarantees of major items of materials and equipment proposed for incorporation in  
39 the Work when such data is required to be submitted prior to the Notice of Award.  
40

41 17.4. DISTRICT may conduct such investigations as DISTRICT deems necessary to assist in the  
42 evaluation of any Bid and to establish the responsibility, qualifications and financial ability of BIDDERS,  
43 proposed Subcontractors, Suppliers and other persons and organizations to perform and furnish the Work in  
44 accordance with the Contract Documents to DISTRICT's satisfaction within the prescribed time.  
45

46 17.5. If the Contract is to be awarded, it will be awarded to lowest BIDDER whose evaluation by  
47 DISTRICT indicates to DISTRICT that the award will be in the best interests of the Project.  
48

49 17.6. If the Contract is to be awarded, DISTRICT will give Successful BIDDER a Notice of Award within  
50 60 days after the day of the Bid opening. No other act of DISTRICT or others will constitute acceptance of a  
51 Bid.  
52

53 **18. Contract Security**

54  
55 Article 5 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth  
56 DISTRICT's requirements as to Performance and Payment Bonds. When the Successful BIDDER delivers  
57 the executed Agreement to DISTRICT, it must be accompanied by the required Performance and Payment  
58 Bonds.  
59



1 **19. Signing of Agreement**

2  
3 When DISTRICT gives a Notice of Award to the Successful BIDDER, it will be accompanied by the required  
4 number of unsigned counterparts of the Agreement. Within 10 days thereafter CONTRACTOR shall sign  
5 and deliver the required number of counterparts of the Agreement to DISTRICT with the required Bonds and  
6 Certificates of Insurance. Within 10 days thereafter DISTRICT shall deliver one fully signed counterpart to  
7 CONTRACTOR.  
8

9 **20. Prebid Conference**

10  
11 A **mandatory** prebid conference will be held at 10:00 AM local time on Tuesday, October 7, 2014, at the  
12 Florence Water Treatment Plant, 9100 Pershing Drive, Omaha, Nebraska. Representatives of DISTRICT  
13 and ENGINEER will be present to discuss the Project. DISTRICT will transmit to all prospective BIDDERS  
14 of record such Addenda as OWNER and ENGINEER considers necessary in response to questions arising  
15 at the conference. Oral statements may not be relied upon and will not be binding or legally effective.  
16

17 A site visit to the Howell Filter Plant will be scheduled following the prebid conference. The site visit is also  
18 mandatory.  
19

20 Prospective Bidders, Suppliers, and Subcontractors are encouraged to arrive at 9:30 AM to avoid  
21 congesting the entrance gate to the plant.  
22

23 All Visitors will need to have a Government Issue ID (Drivers License) to gain access to the site. Any visitor  
24 without the proper ID will not be allowed on site.  
25

26 **21. Sales and Use Taxes**

27  
28 If prices quoted in the Bid Form are illegible, the total bid may be rejected or the unit price will be declared  
29 by the interpretation of the District's interpretation. The prices quoted on the Bid Form shall be firm, shall not  
30 be subject to escalation clauses. The Bid shall include an itemization of all applicable State of Nebraska  
31 and local sales and use tax.  
32

33 Upon the District's request, the Contractor shall provide to the District the Contractor's calculation of  
34 applicable sales and use taxes or such information as will allow the District to calculate and verify applicable  
35 sales and use taxes.  
36

37 **22. Bid Evaluation, Reciprocal Preference**

38  
39 A resident BIDDER shall be allowed a preference over a non-resident BIDDER from a state that gives or  
40 requires a preference to Bidders from that state. The preference shall be equal to the preference given or  
41 required by the state of the non-resident BIDDER. Resident BIDDER means any person, partnership,  
42 association, or foreign or domestic corporation authorized to engage in business in the State of Nebraska  
43 and meeting the residency requirement of the state of the non-resident BIDDER, or having a bona fide  
44 establishment for doing business within this state for the length of time established by the state of the non-  
45 resident BIDDER, necessary for receiving the benefit of that state's preference law on the date any bid for a  
46 public Contract is first advertised or announced. Reciprocal preference is subject to the provisions of  
47 Nebraska Revenue Statute Section 73-101.01 and Section 73-101.02 as amended.  
48

49 **23. Retainage**

50 Provisions concerning retainage are set forth in the Agreement.  
51  
52

1 **24 Non-Segregated Facilities and Equal Opportunity Agreement**

2  
3 The CONTRACTOR agrees that during the performance of any Contract from the Metropolitan Utilities  
4 District, it will comply with all applicable provisions of the Civil Rights Act as amended, Section 504 of the  
5 Rehabilitation Act of 1973 as amended, Executive Order 11246, the Americans with Disabilities Act, and any  
6 regulations promulgated pursuant to said Acts, Law and Order, and agrees that the "Equal Opportunity  
7 Clause" set forth in paragraph C below, will become a part of every Contract or purchase order between the  
8 CONTRACTOR and Metropolitan Utilities District.

9  
10 A. NON-SEGREGATED FACILITIES

- 11  
12 i. The CONTRACTOR does not and will not maintain or provide for its employees any  
13 segregated facilities at any of its establishments, and does not and will not permit its  
14 employees to perform their services at any location, under its control, where segregated  
15 facilities are maintained. The supplier or CONTRACTOR understands that the phrase  
16 "segregated facilities" includes facilities which are in fact segregated on a basis of handicap  
17 or disability, race, color, religion, sex, or national origin, because of habit, local custom, or  
18 otherwise.  
19  
20 ii. The CONTRACTOR further agrees that (except where it has obtained like certifications from  
21 proposed Subcontractors) it will obtain like certifications of non-segregated facilities from  
22 proposed Subcontractors prior to the award of subcontracts exceeding \$10,000 which are  
23 not exempt from the provisions of the Equal Employment Opportunity Clause; and that  
24 CONTRACTOR will retain such certifications in it's files.

25  
26 B. REPORTS AND ACTION PLAN

- 27  
28 i. The CONTRACTOR agrees to file on or before March 31 of each year, or within 30 days of  
29 acceptance of the Contract if not presently filed, complete and accurate reports on Standard  
30 Form 100 (EEO-1) with its contracting compliance agency.  
31  
32 ii. The CONTRACTOR affirms that it has developed and is maintaining current an affirmative  
33 action program to identify, correct, and improve any and all problem areas inherent in  
34 minority employment and evaluation of opportunities for utilization of minority employment  
35 and minority group personnel. If such program has not been established, it will be within  
36 120 days of the acceptance of the Contract. The program established will include each  
37 establishment under control of the CONTRACTOR.

38  
39 C. EQUAL OPPORTUNITY CLAUSE

40  
41 During the performance of any Contract from the Metropolitan Utilities District, CONTRACTOR or  
42 Supplier agrees as follows:

- 43  
44 i. The CONTRACTOR and any Subcontractors will not discriminate against any employee or  
45 applicant for employment because of handicap or disability, race, religion, sex, color, or  
46 national origin. The CONTRACTOR will take affirmative action to insure that applicants are  
47 employed and that employees are treated during employment, without regard to their  
48 handicap or disability, race, religion, sex, color, or national origin. Such action shall include,  
49 but not be limited to the following: employment, upgrading, demotion or transfer,  
50 recruitment, or recruitment advertising; layoff or termination, rates of pay or other forms of  
51 compensation; and selection for training, including apprenticeship. The CONTRACTOR  
52 agrees to post in conspicuous places, available to employees and applicants for  
53 employment, notices as provided by the Government setting forth the provisions of this non-  
54 discrimination clause.  
55  
56 ii. The CONTRACTOR will, in all solicitations or advertisement for employees placed by or on  
57 behalf of the CONTRACTOR, state that all qualified applicants will receive consideration for  
58 employment without regard to handicap or disability, race, religion, sex, color or national  
59 origin.

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- iii. The CONTRACTOR will send to each labor union or representative of workers with which he has a collective bargaining agreement or other Contract or understanding, a notice to be provided by the Government, advising the labor unions or workers; representative of the CONTRACTOR's or supplier's commitments under Section 202 of Executive Order 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
- iv. The CONTRACTOR will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.
- v. The CONTRACTOR will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to books, records, and accounts by the Secretary of Labor (and contracting agency if applicable) for purposes of investigation to ascertain compliance with such rules, regulations and orders.
- vi. In the event of the CONTRACTOR's non-compliance with the non-discrimination clauses of any Contract or with any such rules, regulations, or orders, any Contract or purchase order may be cancelled, terminated or suspended in whole or in part and the CONTRACTOR or supplier may be declared ineligible for further Government Contracts or purchase orders in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, or by rule, regulations, or order of the Secretary of Labor or as otherwise provided by law.
- vii. The CONTRACTOR will include the provisions of paragraph (i) through (vii) in every subcontract unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each Subcontractor or vendor. The CONTRACTOR will take such action with respect to any subcontract or purchase order as the contracting agency may direct as a means of enforcing such provisions including sanctions for non-compliance; provided, however, that in the event the CONTRACTOR becomes involved in or is threatened with, litigation with a Subcontractor or vendor as a result of such direction by the contracting agency, the CONTRACTOR may request the United States Government to enter into such litigation to protect the interests of the United States.

**D. AMERICANS WITH DISABILITIES ACT**

The CONTRACTOR states that it does not discriminate on the basis of disability in the admission or access to, or treatment or employment in, its programs or activities as required by the Americans with Disabilities Act.

**25. MUD Referenced Specifications, Standards and Drawings**

Reference may be made to MUD Material Specifications, Construction Standards and Drawings within the specifications and drawings. These documents can be accessed on the Internet for use by the CONTRACTOR at <http://www.mudomaha.com/water/watermainspecs/bookindex.html>.

**26. Federal Immigration Verification System**

The Contractor shall use the Federal Immigration Verification System (E-Verify) to determine the work eligibility status of the Contractor's new employees physically performing services under this contract within the State of Nebraska. In all subcontracts that Contractor enters into related to this Contract, the Contractor shall include the requirement that a Subcontractor use the Federal Immigration Verification System (E-verify) to determine the work eligibility status of the Subcontractor's new employees physically performing services under this contract within the State of Nebraska.

Information regarding E-Verify is available at <http://www.uscis.gov/portal/site/uscis>.

1 **27. Background Checks and Drug Testing**

2  
3 27.1. The Contractor shall use One Source, the Background Check Company (One Source) for  
4 background checks and drug testing. A sample of their Contract Agreement listing screening requirements  
5 and associated documents are attached at the end of this section for reference.  
6

7 27.2. All costs associated with the services provided by One Source shall be paid for by the Contractor.  
8 The estimated cost per employee is \$50 for a background check only, and \$90 for a background check and  
9 drug test. The Contractor shall also pay a one time fee for a business and record keeping verification  
10 inspection required by the Fair Credit Reporting Act and performed by One Source. The Contractor will not  
11 be required to submit to this inspection or pay this fee for any subsequent contracts with the District. This  
12 fee is estimated to be \$100. The District shall not be liable for any difference between these estimates and  
13 Contractor's actual costs.  
14

15 27.3. Background and Drug tests shall be performed and written documentation shall be provided to the  
16 District for all Contractors' employees and sub-contractors' employees prior to beginning work on District  
17 property. This does not include suppliers delivering equipment or materials to the project.  
18

19 27.4. **Contractor shall contact One Source a minimum of two (2) weeks in advance of the**  
20 **anticipated project start date to allow for adequate processing time of background and drug testing**  
21 **information.** The Contractor shall not be compensated for any delays due to the Contractor not contacting  
22 One Source a minimum of two (2) weeks in advance of the anticipated start date.  
23

24 27.5. **Contractor shall be responsible for verifying the beginning and end of the required 48-hour**  
25 **testing period with OneSource.**  
26

27 27.6. Contractor shall supply a complete listing of employees passing the background check and drug  
28 testing process to the Engineer prior to the District issuing the Notice to Proceed for the project.  
29

30 27.7. Each employee required to access a District facility unescorted shall be required to pass a  
31 background check every two years. If drug tests are required for the contract, each employee required to  
32 access a District facility unescorted shall be required to pass a drug test a minimum of once per year.  
33

34 27.8. The requirements for this project are as follows (per the checked boxes):  
35

36  Background Checks

37  
38  Drug Tests  
39

40 **28. Contracts to be Assigned (NOT USED)**

41  
42 **29. HAZARDOUS MATERIAL**

43  
44 29.1 If the Contractor encounters material on the Work site reasonably believed to be a CERCLA  
45 hazardous substance in concentrations that may constitute a substantial hazardous waste as defined in 40  
46 CFR Part 261 that has not been rendered harmless, the Contractor may test the suspected material at the  
47 Contractor's expense using the appropriate EPA technology. If the material is determined to be hazardous,  
48 the Contractor shall immediately stop work in the affected area, safely secure the Work site, and  
49 immediately notify the Engineer. The Contractor shall continue work in other areas of the Work unless  
50 otherwise directed.  
51

52 29.2 The Contractor shall treat abnormal conditions with extreme caution. The Contractor shall meet the  
53 requirements and regulations of all applicable local, state and federal agencies when handling, transporting  
54 and disposing of hazardous material or toxic waste.  
55

56 29.3 Unless specifically addressed in the Contract Documents, handling, processing, and disposing of  
57 hazardous material is outside of the scope of the Work. Additional Work associated with handling,  
58 processing, and disposing of hazardous waste or materials shall constitute Additional Work as defined in  
59 Part C Section 33.  
60

1 29.4 The District shall not consider the Contractor the "Generator, Owner, or Responsible Party" for  
2 hazardous waste or hazardous material discovered in the normal performance of Work, nor during the  
3 performance of any "Additional Work" unless such material has been brought to the Work site by the  
4 Contractor.

5  
6 29.5 The Contractor shall maintain sole responsibility for workers' health and safety including, but not  
7 limited to, interpreting, monitoring or sampling results provided by the District or any other governmental  
8 agency or performing the Contractor's own monitoring or sampling to ensure work health and safety.

9  
10 **30. BID FORM OF MEASUREMENT AND PAYMENT**

11  
12 30.1 Instrumentation for Process Control (Bid Item No. 1):

13  
14 30.1.1 Under this item, the CONTRACTOR shall be paid the lump sum price identified on the Bid Form as  
15 full compensation for furnishing said equipment and services for Instrumentation for Process Control as  
16 defined in the attached Quotation/Proposal furnished by Huffman Engineering, Inc. Huffman Engineering,  
17 Inc has been selected by the OWNER as the Systems Integrator on the Project and shall function as a  
18 SUBCONTRACTOR to the CONTRACTOR. The scope of equipment and services as described in the  
19 Quotation/Proposal furnished by Huffman Engineering, Inc. is solely meant to define the equipment and  
20 services associated with the lump sum price included herein for the Bid Item No. 1. Equipment and services  
21 required by these Contractor Documents for the Instrumentation and Control System shall be provided by  
22 the CONTRACTOR even if not included in the attached Quotation/Proposal furnished by Huffman  
23 Engineering, Inc. Huffman Engineering, Inc. Quotation/Proposal/Scope is attached at the end of Section  
24 13440.

25  
26 30.1.2 The amount totaling \$\_\_\_\_\_ (excluding sales tax) is included as line item named "Bid Item 1  
27 Instrumentation for Process Control" in the Bid Form. Include the sales tax for this work which is estimated  
28 to be \$\_\_\_\_\_, on the Sales and Use Taxes line on Bid Form.

29  
30 30.1.3 Instrumentation for Process Control Information:

31  
32 Huffman Engineering, Inc.  
33 402-464-6823

34  
35 30.2 Assigned Valve/Actuator Contract (Bid Item No. 2)

36  
37 30.2.1 DISTRICT, as "Buyer", has executed a procurement contract with a manufacturer, as "Seller", for a  
38 number of valves and actuators and providing various services.

39  
40 30.2.2 BIDDER shall obtain all information necessary to determine the complete cost of receiving, storing,  
41 handling, installing and complete coordination of the inspection, adjustment, prestart-up, start-up,  
42 performance testing and training for the DISTRICT-procured equipment, materials and systems. Bidder  
43 shall obtain information concerning equipment weights and pick points and other information necessary for  
44 receipt of delivery, storage, handling, installation and coordination and scheduling of Seller's Special  
45 Services. These costs shall be included on Bid Form in total cost of work (Bid Item 4).

46  
47 30.2.3 Seller's information:

48

EQUIPMENT AND SECTION	MANUFACTURER (SELLER)	CONTRACT AMOUNT (1,2)	PHONE
Valve/Actuator Equipment Procurement	DEZURIK, Inc. (Steve Symanietz)	\$1,037,148.00	320-259-2355

49  
50 1. A single Contract was awarded for the Valve/Actuator Equipment Procurement.

1 2. *The Contract price for the above equipment does not include Nebraska sales tax. The assigned contract*  
2 *totaling \$1,037,148.00 (excluding sales tax) will be included as a line item named "Bid Item 2*  
3 *Valve/Actuator Procurement Assigned Contract" in the BID FORM. The TOTAL BID shall include the*  
4 *amount identified in the Bid Item 2 Valve/Actuator Procurement Assigned Contract. Partial payments*  
5 *may have been made for approved shop drawings for some of the contract to be assigned. The*  
6 *DISTRICT will provide accounting of the payments processed on each contract. The initial Contractors*  
7 *pay request will acknowledge the amount of payments previously made by the DISTRICT. Include sales*  
8 *tax for this equipment, which is estimated to be \$69,100, on the Sales and Use Taxes line on Bid Form.*  
9

10 30.2.4 The total amount of Contract to be assigned is \$1,106,248 (including sales tax of \$69,100).  
11 Contractor will be paid this amount minus any progress payments made prior to Contract award.  
12

13 30.2.5 CONTRACTOR shall be responsible for the management of the procurement contract, including the  
14 schedule coordination, inspection, logistics planning, receipt, offloading, proper storage and preventive  
15 maintenance, if required, as well as the installation, start-up and other requirements of the Contract as if the  
16 procurement contract was originally executed with Sellers by CONTRACTOR. CONTRACTOR shall  
17 perform such duties in accordance with the requirements of the Contract, comply with the construction  
18 schedule with no delays to the Work and shall accept full care, custody and control of the equipment and  
19 materials.  
20

21 30.2.6 As part of CONTRACTOR's responsibility in performing the scope of Work set forth herein,  
22 CONTRACTOR shall be responsible for, and shall maintain a current inventory of all materials, supplies and  
23 equipment purchased by CONTRACTOR and/or furnished by OWNER for CONTRACTOR's use in  
24 performing the Work. Any lost, damaged or stolen inventory items shall be replaced at the CONTRACTOR's  
25 cost, on a monthly basis. All inventory items remaining at the conclusion of the Work shall be the property of  
26 the OWNER.  
27

28 30.2.7 CONTRACTOR shall make all payments to Seller in accordance with the terms and conditions of the  
29 procurement contract, including any and all fees, taxes, licenses, or other costs required in the supply  
30 contracts or by federal, state or local statute.  
31

32 30.2.8 BIDDERS may examine the Procurement Contract at the Issuing Office. Procurement Contract is  
33 also available in electronic (.pdf) format upon request.  
34

### 35 30.3 Contingency Allowance (Bid Item No. 3)

36

37 30.3.1 Bid Item 3 is a contingency allowance to be used at the discretion of the Owner to cover unforeseen  
38 conditions encountered during construction. See Articles 10, 11 and 12 of the General Conditions. If the  
39 contingency allowance is (1) not used or (2) only partially used, then in Case (1) above, the Contract  
40 Amount will be reduced by \$195,000.00 or in Case (2) above, the Contract Amount will be reduced by the  
41 amount of the allowance not used. Adjustment to Contract Amount will be by Change Order at the end of  
42 the Project.  
43

### 44 30.4 All remaining Work for Florence Water Treatment Plant Phase 2 Filter Improvements (Bid Item No.4)

45

46 30.4.1 Under this item, the CONTRACTOR shall be paid the lump sum price bid on the Bid Form as full  
47 compensation for all other work associated with Phase 2 Filter Improvements as defined in the Contract  
48 Documents. CONTRACTOR shall obtain all information necessary and include in this bid item all costs  
49 associated with the management and incorporation/installation into the Work of Bid Items 1 and 2 including  
50 but not limited to: Schedule coordination, inspection, logistics planning, delivery, receipt, offloading,  
51 handling, proper storage, and preventative maintenance, if required, as well as the additional materials  
52 installation, pre-demonstration, demonstration, training, start-up and other requirements of the Contract  
53 Documents.  
54

### 55 30.5 Additions/Deletions to Total Lump Sum Bid (Bid Items No. 4a, 4b, 4c)

56

57 30.5.1 Provide add/deduct for each line item. The cost for the square footages and linear footage listed for  
58 the concrete repairs (800 SQ FT, 1,850 SQ FT, and 200 Linear FT) shall be included in Bid Item No. 4.

59

## **END OF SECTION**



The Background Check Company

Dear One Source Client:

Thank you for choosing One Source for all of your employment screening needs. It is our wish that your experience will be one of complete security, peace of mind, and high satisfaction.

The following attached forms need to be completed to insure that you receive the level of customer service and product quality you deserve, while maintaining all compliance measures set by the Local, State, and Federal regulatory agencies.

**FORM INSTRUCTIONS:**

\*PLEASE READ ALL FORMS THOROUGHLY\*

**ONE SOURCE CLIENT APPLICATION**

Due to high levels of theft relating to personal information, and One Source's position as a Wholesaler of such personal information, we are required to maintain strict and high standards for those companies or organizations seeking to qualify for its use. This form allows One Source to gain a further "understanding" of your firm, its legal entities, and the general nature of its business. Under FCRA guidelines, firms involved in business of a certain nature(s), are not eligible for the purchase or dissemination of private and personal information. This form allows One Source to provide evidence of due diligence on all clients, protect the overall consumer 'body', and reduce liability for ourselves as well as our Clients.

**SUBSCRIBER FCRA COMPLIANCE & SERVICE AGREEMENT**

This form discloses all of your duties, under the various FCRA policies, regarding the use of Criminal Background Checks. It is a guarantee held by One Source and reported to all regulatory agencies acknowledging your comprehension and obligations for use of Criminal Background Checks under the FCRA Policy. This form also describes One Source's obligations in compliance with the FCRA and Criminal Background Checks.

**SUBSCRIBER FCRA PERMISSIBLE PURPOSE CERTIFICATION**

This form covers the permissible purpose of the company for obtaining consumer reports. Any company requesting consumer reports must be able to provide a valid permissible purpose, whether it be for employment, volunteer, or to gain access to contracting agency sites.

**FCRA DUE DILIGENCE**

The FCRA requires verification that a subscriber is a legitimate business. Please complete the following forms in acknowledgement of these verifications:

**BUSINESS TO BUSINESS VENDOR REFERENCE FORM**-This form requests one business to business vendor reference. Please provide the name of a company with whom you have done business.

**SITE INSPECTION AUTHORIZATION FORM**-Any company requesting consumer reports must prove the legitimacy of the business and the security procedures for storing consumer reports. Any company not undergoing a site inspection will be denied access to consumer reports.

**ONLINE ACCOUNT SETUP FORM / CONTACTS LISTING**

This form allows One Source to expediently set up your company's online account. List persons of contact, contact information, and contact job duties as provided.

**BILLING INFORMATION AND PAYMENT AUTHORIZATION FORM**

The billing contact is the person to whom the invoices should be sent. All invoices are sent via email unless requested. Please provide a credit card number to be used as a monthly auto-debit or as a backup credit card. The backup credit card is only used in the event the account becomes 60 days past due.

*If your Organization does not currently align with FCRA standards regarding Employment Screening, One Source can assist you in developing or correcting HR policy and procedures to fit industry regulations.*

Ashley Azar  
Account Executive-Client Relations  
One Source "The Background Check Company"

## ONE SOURCE CLIENT APPLICATION

### GENERAL COMPANY INFORMATION (PLEASE FILL OUT COMPLETELY)

COMPANY NAME: \_\_\_\_\_ DOING BUSINESS AS: \_\_\_\_\_ FEDERAL TAX ID # \_\_\_\_\_

CONTACT NAME: \_\_\_\_\_ TITLE: \_\_\_\_\_

COMPANY MAIN PHONE: \_\_\_\_\_ ANSWERING SERVICE (YES / NO) \_\_\_\_\_

PHYSICAL ADDRESS: \_\_\_\_\_ STREET: \_\_\_\_\_ CITY: \_\_\_\_\_ STATE: \_\_\_\_\_ COUNTY: \_\_\_\_\_ ZIP CODE: \_\_\_\_\_

NATURE OF BUSINESS: \_\_\_\_\_ DATE ESTABLISHED: \_\_\_\_\_ IS THE APPLICANT ENGAGED IN THE UNDERWRITING OF INSURANCE?  
(YES / NO)

IS THE COMPANY LICENSED OR PROVIDING SERVICE AS AN ATTORNEY OR DETECTIVE / INVESTIGATIVE AGENCY? (YES / NO) – IF YES PLEASE IDENTIFY WHICH

DOES THE COMPANY INTEND TO RESELL OR RELEASE INFORMATION FROM THE CONSUMER CREDIT REPORT TO A 3<sup>RD</sup> PARTY? (YES / NO)

WILL THE COMPANY, OR DOES THE COMPANY PROVIDE CREDIT REPAIR OR CREDIT COUNSELING SERVICES FOR A FEE? (YES / NO)

This agreement shall be renewable at the end of one (1) year from the date of signing for successive terms unless either party gives written notice of its intention not to renew thirty (30) days before expiration of the current term. The pricing of any renewed service will be our then- current rates unless One Source agrees to a different rate at that time. Any other changes to the agreement after the initial term may be made with a 60 day written notice. Please direct all inquiries and questions to a One Source representative at #1-800-608-3645.

**I CERTIFY THAT THE INFORMATION ON THIS APPLICATION IS TRUE. I UNDERSTAND AND GIVE PERMISSION, AS SHOWN BY THE SIGNATURE BELOW, FOR ONE SOURCE TO CHECK THE PERSONAL/ BUSINESS CREDIT OF THE OWNERS/GUARANTORS OF THIS COMPANY IN CONNECTION WITH APPROVAL OF THIS APPLICATION.**

SIGNATURE OF APPLICANT: \_\_\_\_\_ NAME OF APPLICANT (PLEASE PRINT): \_\_\_\_\_ DATE: \_\_\_\_\_



## SUBSCRIBER FCRA COMPLIANCE AND SERVICE AGREEMENT (1 OF 2)

This agreement is entered into this ( ) (DATE), between ( ) (ONE SOURCE CLIENT)  
Hereinafter referred to as "Subscriber" and One Source, hereinafter referred to as "Reseller".

1. Reseller has access to consumer reports from one or more consumer credit reporting agencies.
2. Subscriber is a \_\_\_\_\_ (type of business, e.g. corporation, partnership, etc.) and has a need for consumer credit information in connection with the evaluation of individuals for employment, promotion, reassignment or retention as an employee ("Consumer Report for Employment Purposes").
3. Subscriber shall request Consumer Report for Employment Purposes pursuant to procedures prescribed by Reseller from time to time only when it is considering the individual inquired upon for employment, promotion, reassignment or retention as an employee, and for no other purpose.
4. Subscriber certifies that it will not request a Consumer Report for Employment Purposes unless:
  - A. A clear and conspicuous disclosure is first made in writing to the consumer before the report is obtained, in a document that consists solely of the disclosure, that a consumer report may be obtained for employment purposes;
  - B. The consumer has authorized in writing the procurement of the report; and
  - C. Information from the Consumer Report for Employment Purposes will not be used in violation of any applicable federal or state equal employment opportunity law or regulation.
5. Subscriber further certifies that before taking adverse action in whole or in part based on the Consumer Report for Employment Purposes, it will provide the consumer:
  - A. A copy of the Consumer Report for Employment Purposes; and
  - B. A copy of the consumer's rights, in the format approved by the FTC, which notice shall be supplied to Subscriber by Reseller.
6. Subscriber acknowledges that the FCRA and, in some cases, state law limit the furnishing of consumer reports to certain permissible purposes. Subscriber certifies that it intends to use each consumer report for a purpose permitted under § 604 of the FCRA and any applicable state law, and, in particular, for employment purposes. Subscribers will neither request nor use any such information for any other purpose.
7. Subscriber agrees that it shall use Consumer Report for Employment Purposes only for a one-time use, and to hold the report in strict confidence, and not to disclose it to any third parties not involved in the current employment decision.
8. Subscriber will maintain copies of all written authorizations for a minimum of three (3) years from the date of inquiry, OR a minimum of three (3) years from date of termination.
9. With just cause, such as delinquency or violation of the terms of this contract or a legal requirement, Reseller may, upon its election, discontinue serving the Subscriber and cancel this Agreement immediately.

Please initial here that you have read the above:

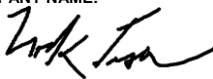
**SUBSCRIBER FCRA COMPLIANCE AND SERVICE AGREEMENT (2 OF 2)**

**CLIENT** hereby agrees to and understands the following:

1. To be in compliance with the Fair Credit Reporting Act (FCRA), P.L. 91-508 when requesting consumer credit information (Consumer Report)
2. Consumer reports requested by agents or employees of the CLIENT will be used solely for the purposes of considering an employee/job applicant for employment, promotion, reassignment or retention, OR for insurance or any other legitimate business need set forth in the FCRA § 604. Any other use of this information is punishable by law
3. CLIENT understands that individual states may have laws that regulate the use of this information and it is up to the CLIENT to identify and comply with such laws. By signing this agreement, CLIENT certifies awareness that the FCRA of 1964 (Amend. 1996 & 1998) creates responsibilities and obligations for the CLIENT. CLIENT understands these obligations and agrees to abide by them.
4. Upon taking adverse action (e.g. denial of hire or refusal of promotion) based whole or in part on information obtained in a consumer report, CLIENT will provide employee/applicant with a copy of said report including name, address and telephone number of the Credit Reporting Agency. CLIENT will further provide pre-adverse action and adverse action letters, along with a copy of the FCRA rights.
5. ONE SOURCE gathers information for consumer reports through a number of databases that have been developed and are maintained by government agencies, private corporations and other fallible human sources and therefore cannot guarantee or warrant the accuracy or completeness of the information.
6. CLIENT is responsible for final verification of an individual's identity and proper use of consumer report contents.
7. CLIENT agrees to indemnify, defend, and hold harmless ONE SOURCE, its officers, directors, employees, agents, and any third party information providers from and against all losses, expenses, damages, and costs, including reasonable attorneys' fees, resulting from any violation of this Agreement (including negligent or wrongful conduct) by CLIENT.
8. CLIENT expressly understands and agrees that in no event will ONE SOURCE'S total liability to CLIENT for any damages, losses, expenses, claims or claim expenses (including attorneys' fees) exceed the cost of the consumer report obtained by CLIENT from ONE SOURCE. Such claims include, but are not limited to, CLIENT'S negligence, errors, omissions, strict liability, breach of contract, or breach of warranty.
9. This Agreement will be interpreted, construed, and enforced according to the laws of the State of Nebraska without regard to its principles of conflicts of law.

**ONE SOURCE** hereby agrees to the following:

1. To provide available information services within a manner congruent with standard business practices.
2. To maintain all information used for consumer reports for a term of no less than two years, and promises to maintain confidentiality by not providing consumer information to outside sources in violation of the current FCRA guidelines, or future amended FCRA guidelines.

RESELLER (ONE SOURCE)	CLIENT
<p style="text-align: center;"><b>ONE SOURCE, THE BACKGROUND CHECK COMPANY</b></p> <hr/> <p>COMPANY NAME:</p> <p style="text-align: center;"> <b>-Nick Jasa</b></p> <hr/> <p>SIGNATURE:</p>	<hr/> <p>COMPANY NAME:</p> <hr/> <p>SIGNATURE:</p> <hr/> <p>DATE:</p>

**SUBSCRIBER FCRA PERMISSIBLE PURPOSE CERTIFICATION**

As a "SUBSCRIBER" of One Source, the Background Check Company consumer reports, I hereby certify the following:

Please describe the nature of the SUBSCRIBER's business:

\_\_\_\_\_

**CHECK AND MARK ALL BOXES THAT APPLY:**

SUBSCRIBER purchases consumer reports from One Source, the Background Check Company® for the following purpose(s) under the Fair Credit Reporting Act and guarantees that said reports will not be utilized in a manner inconsistent with these specified purposes.

- Employment (hiring, termination, promotion, transfer, etc...)
- With written authorization/instructions for volunteering
- With written authorization/instructions for student teaching or other related college internship opportunities
- With written authorization/instructions for gaining access to contracting agency work sites
- With written authorization/instructions from the consumer for any other reason. (If other, please specify intended use):

**CLIENT EDUCATION**

**Please read and initial next to each item below:**

\_\_\_\_\_ I will provide each applicant with a copy of the FCRA rights.

\_\_\_\_\_ I understand that I must provide the applicant a copy of their report, the pre-adverse and adverse action letters, and a copy of their FCRA rights when using information from the background check to deny employment or other benefit.

\_\_\_\_\_ I understand that each applicant must sign a release form prior to requesting background checks. One Source reserves the right to perform an audit of the release forms at any time, and to take action if the release forms are not available. If your company collects electronic signatures, please contact One Source to ensure compliance.

Anyone who knowingly and willfully obtains information on a consumer from a consumer reporting agency under false pretenses or without a permissible purpose may be subjected to criminal fines and penalties, including up to two years in prison, imposed by the Federal Fair Credit Reporting Act.

By signing below I certify that I have direct understanding and knowledge of the facts in this document (Subscriber FCRA Permissible Purpose Certification). I understand that the Federal Fair Credit Reporting Act imposes criminal fines and penalties for the unauthorized use of consumer reports. I further certify that I am authorized to execute this certification on behalf of the company listed above.

SIGNATURE \_\_\_\_\_ DATE \_\_\_\_\_

## BUSINESS TO BUSINESS VENDOR REFERENCE FORM

The FCRA requires verification that a subscriber is a legitimate business. Please provide one (1) current BUSINESS TO BUSINESS VENDOR which we may contact to verify the business reference. A BUSINESS TO BUSINESS VENDOR is a company that you consistently do business with on a monthly basis.

This form serves as written consent for One Source to contact the vendor listed below and for the vendor written below to provide us with confirmation of the business relationship.

### COMPANY INFORMATION\*

<b>Company Name:</b>
<b>Address:</b>
<b>Printed Name:</b>
<b>Title:</b>
<b>X Signature:</b>

PLEASE PROVIDE A CURRENT BUSINESS TO BUSINESS VENDOR REFERENCE\*

<b>Company Name</b>	<b>Contact:</b>
<b>Address:</b>	
<b>Phone:</b>	<b>Fax:</b>
<b>Account Number (If applicable):</b>	

### ATTENTION BUSINESS TO BUSINESS VENDOR!

Your name has been supplied by the above named company as a business reference. Please complete and sign this portion of the form and fax to 402.333.3280 or 800.929.8117. Thank You!

Contact Name:
Signature:
Does your company have a business relationship with the company shown above? <input type="checkbox"/> YES <input type="checkbox"/> NO

**\*This information will be used only for the process as outlined above. This information will not be shared or sold to outside companies for any reason.**

## Subscriber Site Inspection Authorization Form

The FCRA requires verification that a subscriber is a legitimate business. A site inspection by a third party that is endorsed by all three major credit bureaus is required. Please note the following:

- The site inspection could/should take approximately one hour.
- The site inspection of your office will concern the following areas:
  - Location of your business,
  - Nature of the business environment
  - Method of accessing and securing One Source data.
- The site inspection representative will not need to access your sensitive, proprietary or confidential materials as part of the site visit.
- The site inspection representative will ask you questions and complete a questionnaire.
- The site inspection representative will take a photograph of:
  - The work area where One Source data will be accessed and stored
  - Outside signage
  - Business cards
  - Marketing materials-brochures, etc.
- The site inspection and photos will not focus on any of your confidential business processes or practices.
- The site inspection representative is not authorized to give you the questions or results of the site inspection. The representative is not authorized to discuss the physical inspection and has no details of One Source's credentialing process. The representative cannot answer any questions and has no influence on the credentialing decision.

Contact Person for Site Inspection: \_\_\_\_\_

Phone: \_\_\_\_\_ Email Address: \_\_\_\_\_

The inspection will take place at (please check one): Business Hours: \_\_\_\_\_

Commercial Location  Residential Location

I understand the site inspection guidelines as stated above, and agree to the one-time fee of \$95 for inspection of my business premises.

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

## ONLINE CONTACT CUSTOMIZATION PAGE

This page allows you to customize the levels of access your administrative users will have:

- **Enter Orders**-Request background checks for applicants
- **View Reports**-View completed background checks
- **View Invoices**-Access to monthly invoices online

*INVOICES WILL BE DELIVERED VIA EMAIL TO THE PERSON LISTED AS THE BILLING CONTACT ON THE BILLING AND PAYMENT INFORMATION FORM (PAGE 9). IF THE BILLING CONTACT IS NOT ALSO AN ONLINE CONTACT, A USERNAME/PASSWORD WILL BE ISSUED TO ALLOW ACCESS TO STRICTLY VIEW INVOICES.*

PRIMARY CONTACT: \_\_\_\_\_

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

PHONE: \_\_\_\_\_

\*\*The Primary Contact has full access to enter orders, view reports, and view invoices.

\*\*If no recruiter is listed, completed reports will be delivered via email to the primary contact.

\*\*Primary Contact must contact One Source to add or remove users.

CHECK ALL THAT APPLY:

CONTACT NAME: \_\_\_\_\_ ENTER ORDERS

EMAIL ADDRESS: \_\_\_\_\_ VIEW REPORTS

PHONE: \_\_\_\_\_ VIEW INVOICES

CHECK ALL THAT APPLY:

CONTACT NAME: \_\_\_\_\_ ENTER ORDERS

EMAIL ADDRESS: \_\_\_\_\_ VIEW REPORTS

PHONE: \_\_\_\_\_ VIEW INVOICES

CHECK ALL THAT APPLY:

CONTACT NAME: \_\_\_\_\_ ENTER ORDERS

EMAIL ADDRESS: \_\_\_\_\_ VIEW REPORTS

PHONE: \_\_\_\_\_ VIEW INVOICES

**BILLING INFORMATION AND PAYMENT AUTHORIZATION FORM**

BILLING CONTACT

BILLING EMAIL

BILLING PHONE

BILLING FAX

BILLING ADDRESS:

CITY:

STATE:

ZIP

**Please select from one of the following options:**

**Monthly Billing Invoice**

- I hereby authorize One Source, the Background Check Company to send me a bill through **email** or **mail** (circle one) for the month my account is used.

**Monthly Auto Debit**

- I hereby authorize One Source, the Background Check Company to bill my Visa, MasterCard, Discover or AMEX card for all usage charges as made, and invoiced.

**Back-Up Credit Card Number**

- I hereby authorize One Source, the Background Check Company to bill my Visa, MasterCard, Discover or AMEX card in the event that my account becomes 60 days or more past due as per the terms of my signed Subscriber Agreement.

\_\_\_\_\_  
**Credit Card Number**

\_\_\_\_\_  
**Expiration Date MM/YY**

\_\_\_\_\_  
**Signature of Card Holder**

\_\_\_\_\_  
**Date**

\_\_\_\_\_  
**Printed Name as appears on card**

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

\_\_\_\_\_  
**CVV Number**

\_\_\_\_\_  
**Billing Address, City State and Zip Code**

\_\_\_\_\_  
**Phone Number**

# One Source Certified Contractor Agreement

This agreement dated \_\_\_\_\_ is between:

One Source, the Background Check Company \_\_\_\_\_(Supplier)

PO Box 24148 and \_\_\_\_\_

Omaha, NE 68124 402.933.9999 \_\_\_\_\_

MUD requires that Supplier's employees and employees of Supplier's subcontractors, if any, ("Worker") scheduled to work at any MUD site shall meet minimum drug screen and criminal record requirements established by the MUD safety and security policy. The MUD security policy's minimum requirements regarding criminal records are as follows:

1. No felony convictions where the court's jurisdiction is continuing or ended less than seven years ago;
2. No felony charges pending court adjudication or disposition;
3. No misdemeanor convictions (where court jurisdiction is continuing or ended less than five years ago) for a crime involving weapons, drugs, violence, theft, robbery, burglary, terroristic threats, or sexual offenses; and
4. No misdemeanor charges pending court adjudication or disposition for a crime involving weapons, drugs, violence, theft, robbery, burglary, terroristic threats, or sexual offenses.

AND/OR the following minimum requirements apply to drug screening:

1. Supplier must enforce a policy of drug screening of Workers for cause; and
2. Have administered a drug screening to the Worker coordinated by One Source, the Background Check Company ("One Source") using an HHS-approved laboratory to complete a minimum 5-panel specimen drug screening; and
3. Workers must test negative in order to gain access to MUD property.

AND/OR the following minimum requirements apply to E-Verify AND/OR I-9:

1. Supplier must enforce a policy requiring E-Verify AND/OR I-9 on all Workers ensuring Workers' right to work according to the Department of Homeland Security and the Social Security Administration.

MUD mandates several combinations of the above requirements for access to different sites. Sites will be categorized by level and are subject to change.

## **LEVEL 1**

All Workers requesting access to LEVEL 1 facilities will be subject to a criminal record search and must meet the minimum requirements detailed above and on Page 12 of this agreement under the header "CRIMINAL HISTORY". All Workers who do not fail the CRIMINAL HISTORY will be authorized to access LEVEL 1 facilities for a period of two years.

## **LEVEL 2**

All Workers requesting access to LEVEL 2 facilities will be subject to a criminal record search and must meet the minimum requirements detailed above and on Page 12 of this agreement under the header "CRIMINAL HISTORY". In addition all Workers requesting access to LEVEL 2 facilities will be subject to a SAMHSA drug screen and must meet the minimum requirements as described above and on PAGE 12 of this agreement under the header "DRUG TESTING". All Workers who do not fail the CRIMINAL HISTORY or DRUG TESTING will be authorized to access LEVEL 2 facilities for a period of one year. Should the Worker require access for an additional year another DRUG TEST will be required for a one-year extension. Should the Worker not require LEVEL 2 Facility Access their access will be changed to LEVEL 1 for the period of one year. Workers who hold a LEVEL 2 access may also access LEVEL 1 facilities.



**LEVEL 3**

All Workers requesting access to LEVEL 3 facilities will be subject to a criminal record search and must meet the minimum requirements detailed above and on Page 12 of this agreement under the header "CRIMINAL HISTORY". In addition all Workers requesting access to LEVEL 3 facilities will be subject to a SAMHSA drug screen and must meet the minimum requirements as described above and on PAGE 12 of this agreement under the header "DRUG TESTING". In addition all Workers requesting access to LEVEL 3 facilities will be subject to a verification of right to work through the Department of Homeland Security's E-Verify System AND/OR I-9 as required by federal law. All Workers who do not fail the CRIMINAL HISTORY or DRUG TESTING or E-VERIFY AND/OR I-9 will be authorized to access LEVEL 3 facilities for a period of one year. Should the Worker require access for an additional year another DRUG TEST will be required for a one-year extension. Should the Worker not require LEVEL 3 or LEVEL 2 Facility Access their access will be changed to LEVEL 1 for the period of one year. Workers who hold a LEVEL 3 access may also access LEVEL 2 and LEVEL 1 facilities.

Additionally, if the Worker's assignment will require the Worker to drive on MUD property, the Supplier shall determine that the Worker has a valid driver's license issued by the Worker's state of residence and, if the vehicle being driven is the Worker's vehicle, the vehicle is insured and registered by the state in which the Worker resides or, if the vehicle being driven is the Supplier's vehicle or the Supplier's subcontractor's vehicle, in a state in which the Supplier or subcontractor does business, respectively.

Supplier shall implement a policy with all Workers to self-report any criminal arrests and convictions subsequent to hire by Supplier and Supplier shall inform One Source immediately of any violation of the security policy. Supplier's obligation to implement a policy requiring Worker to self-report any violations of security policy speaks directly to ensuring the safety and security of MUD Employees, Property and Equipment and such obligation shall continue throughout Supplier's contract. All Supplier's workers shall be re-screened subject to the requirements of the MUD security policy each year prior to the anniversary date of the Worker's employment, initial certification or contract with Supplier. A Worker will be denied access to MUD sites if the Worker's annual re-screen does not meet the requirements of the MUD security policy (please see LEVEL 1, LEVEL 2 and LEVEL 3 above for information).

MUD has contracted with One Source to ensure that all Supplier's Workers meet the requirements of the MUD security policy set forth in detail above, and also the monitoring of re-screens of Workers and ensuring Supplier has implemented a policy to self report any potential violations of the security policy. One Source will regulate compliance with the Fair Credit Reporting Act as a contractor conducting the minimum requirements verification procedures for MUD.

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One Source Authorized Representative

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Supplier Authorized Representative

# OSCC Contractor Guidelines

## CRIMINAL HISTORY

FELONY		MISDEMEANOR	
No felony convictions (where the court's jurisdiction is pending, continuing or ended less than seven years ago) for a crime involving weapons, drugs, violence, theft, robbery, burglary, terroristic threats, or sexual offenses.		No misdemeanor convictions (where court jurisdiction is pending, continuing or ended less than five years ago) for a crime involving weapons, drugs, violence, theft, robbery, burglary, terroristic threats, or sexual offenses.	
Examples (not a complete listing): <ul style="list-style-type: none"> <li>• Assault</li> <li>• Arson</li> <li>• Burglary</li> <li>• Credit Card Fraud</li> <li>• Damage/Destruction to Property</li> <li>• Domestic Violence</li> <li>• Forgery</li> <li>• Fraud</li> <li>• Harassment</li> <li>• Homicide</li> <li>• Manslaughter</li> </ul>	<ul style="list-style-type: none"> <li>• Murder</li> <li>• Rape</li> <li>• Resisting Arrest/Fleeing Arrest</li> <li>• Robbery</li> <li>• Sexual Assault</li> <li>• Stalking</li> <li>• Theft / Shoplifting / Unlawful Taking / Receiving stolen property</li> <li>• Unemployment Fraud</li> <li>• Violation of Restraining/Protection Order</li> <li>• Weapons Charges</li> </ul>	Examples (not a complete listing): <ul style="list-style-type: none"> <li>• Assault</li> <li>• Arson</li> <li>• Burglary</li> <li>• Credit Card Fraud</li> <li>• Damage/Destruction to Property</li> <li>• Disorderly Conduct (2 convictions in 5 years)</li> <li>• Domestic Violence</li> <li>• Forgery</li> <li>• Fraud</li> <li>• Harassment</li> </ul>	<ul style="list-style-type: none"> <li>• Resisting Arrest/Fleeing Arrest</li> <li>• Robbery</li> <li>• Sexual Assault</li> <li>• Stalking</li> <li>• Theft / Shoplifting / Unlawful Taking / Receiving stolen property</li> <li>• Unemployment Fraud</li> <li>• Violation of Restraining/Protection Order</li> <li>• Weapons Charges</li> </ul>

- A conviction includes a plea, verdict, deferred judgment/sentence or finding of guilt regardless of whether sentence was imposed by the court.

DRUG TESTING	FAILURE TO COMPLY	SEARCH CRITERIA
<b>Minimum Requirements</b> <ul style="list-style-type: none"> <li>• Laboratory testing includes collection of the sample, transport to the laboratory, EMIT analysis, GC/MS confirmation by a SAMHSA-certified laboratory and a test review by a Medical Review Officer, if required.</li> <li>• <b>Contractor must test negative for:</b> <ul style="list-style-type: none"> <li>• Amphetamines</li> <li>• Cannabinoids</li> <li>• Cocaine</li> <li>• Opiates</li> <li>• Phencyclidines</li> </ul> </li> </ul> <p><b>(Only required for Levels 2 and 3)</b></p>	Failure to comply with the testing procedures will be considered a failure to meet the minimum requirements for site access. This includes but is not limited to: <ol style="list-style-type: none"> <li>1. Failure to sign the Applicant Release Authorization</li> <li>2. Failure to sign the OSCC Applicant Release</li> <li>3. Failure to provide a sample for drug testing</li> <li>4. Providing a sample for drug testing which is outside of the minimum temperature / density / etc... requirements</li> <li>5. Any other failure to comply with the program rules</li> </ol>	<b>One Source Total Check Plus</b> <ul style="list-style-type: none"> <li>• Applicant Verification (SSN Trace)</li> <li>• Multi – Court Jurisdictional Database (Over 350 Sources)</li> <li>• National Sex Offender Registry</li> <li>• Global Watch (FBI Most Wanted, DEA Most Wanted, ATF Most Wanted, OFAC, Terrorist Watch List, Etc...)</li> <li>• County Criminal</li> <li>• Statewide Where Available</li> <li>• Federal Criminal Search</li> <li>• SAMSHA Approved minimum 5 panel drug test (Levels 2/3 only)</li> <li>• E-Verify (Level 3 only)</li> </ul>

One Source does not provide any warranties, expressed or implied, that the individuals who meet requirements for site access under the One Source, the Background Check Company Certified Contractors Program. One Source, the Background Check Company searches the name, date of birth, social security number and other identifying information provided to us by the employer. Although One Source, the Background Check Company provides as part of its search a verification service, it is reliant upon the employer who is hiring the applicant to verify the individual's identity. One Source, the Background Check Company has put steps in place to minimize data entry errors at our end but cannot guarantee the accuracy of its reports.

**OSCC CONTRACTOR GUIDELINES ACKNOWLEDGEMENT**

I, \_\_\_\_\_ have read and understand the OSCC Contractor Guidelines for gaining access to any OSCC properties. I understand that non-compliance of any of these guidelines will be considered a failure to meet the minimum requirements for site access. I hereby authorize One Source to disseminate PASS/FAIL, name, company name and expiration date to any and all users of OSCC (no Non-Public Information will be disseminated).

**Specifically, failure to take a drug test, failure to sign release forms, drug test failure, and not completing a drug test within 48 hours of submitting a background check order to One Source will be considered a failure of the meets requirements program, and the contractor will not be allowed access to any OSCC property for a period of 3 months.**

By signing below, I acknowledge receipt and understanding of the OSCC Contractor Guidelines

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

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

# **OSCC Annual Renewal Requirements**

One Source Certified Contractor (OSCC) site access approval for each individual is good for a one or two years from the date that the report is ordered. All contractors participating in the program will receive automatic enrollment in One Source's automatic renewal program. This method streamlines the OSCC process to ensure that there is no interruption in services provided due to expired privileges. Forty five (45) days prior to expiration of a contractor the company will receive notice that the contractor's site access permission is expiring. At this point the company will choose to proceed with the renewal or remove that contractor's name from the list. If they choose to proceed with renewal a new background check and/or drug test will be ordered thirty (30) days prior to expiration.

The program is maintained automatically by One Source's applicant management tool (the same tool utilized to view contractors online). Orders are automatically pulled daily and notices are sent out allowing the 15 day opt out period for those contractors that are no longer employed by the firm or no longer need site access. After the notification period is up, the new report is ordered 30 days prior to expiration of the contractor's site access. This allows the contractor almost a full month to dispute any records that may have shown up on their report in the past year. This will eliminate any reason for not having disputes resolved prior to the expiration of their current site access.

All Workers who do not renew will expire as described in LEVEL 1, LEVEL 2 and LEVEL 3 on pages 10 and 11. Their status will be marked to red according to those rules and Worker will lose all site access. To renew expired site access the contractor will be required to go through the initial process again.

1 2014/09/10

2 METROPOLITAN UTILITIES DISTRICT OF OMAHA  
3 OMAHA, NEBRASKA

4 **SECTION 00410**

5 BID FORM

6 FLORENCE WATER TREATMENT PLANT  
7 PHASE 2 FILTER PLANT IMPROVEMENTS

8

9

10 FROM: \_\_\_\_\_

11 \_\_\_\_\_

12 COMPANY: \_\_\_\_\_

13 \_\_\_\_\_

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

15 \_\_\_\_\_

16 \_\_\_\_\_

17 TELEPHONE: \_\_\_\_\_

18 \_\_\_\_\_

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

20 \_\_\_\_\_

21

22

23 TO: METROPOLITAN UTILITIES DISTRICT OF OMAHA

24 OMAHA, NEBRASKA

25

26 Pursuant to all bidding requirements, specifications and drawings, bidder proposes and agrees, if this Bid  
27 Form is accepted, to furnish all necessary supplies and materials, all construction materials and equipment,  
28 all labor and superintendence to construct the Florence Water Treatment Plant - Phase 2 Filter Plant  
29 Improvements specified or indicated in the Bidding Documents for the prices and in accordance with the  
30 schedule indicated in this Bid Form.

31

32 BIDDER agrees that, in the event the work as shown on the Drawings or as called for in the Specifications is  
33 increased or decreased by a Change Order, the Contract price shall be so adjusted without alterations to the  
34 provisions of the Contract.

35

36 BIDDER states that the BIDDER complies with and will continue to comply with the Fair Labor Standards in  
37 the pursuit of business and in the execution of this Contract; and it is a provision of this Contract that in the  
38 execution of the Contract the Fair Labor Standards, as defined in Section 73-104, Revised Statutes of  
39 Nebraska, shall be maintained.

40

41 BIDDER has made an election with the State of Nebraska under Section 77-2702.05, Nebraska Revenue  
42 Act of 1967, by which the BIDDER shall be responsible for payment of all sales and use taxes on materials  
43 incorporated into this Project.

44

45 BIDDER accepts all of the terms and conditions of the Invitation to Bid and Instructions to Bidders, including  
46 without limitation those dealing with the disposition of Bid security. The Bid will remain subject to  
47 acceptance for 60 days after the Bid opening, or for such longer period of time that BIDDER may agree to in  
48 writing upon request of the DISTRICT.

49

50 BIDDER accepts the provisions of the Contract as to liquidated damages in the event of its failure to perform  
51 and furnish all Work as specified or indicated in the Contract Documents for the Total Base Bid Price and in  
52 accordance with the schedule set forth in the Agreement.

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43

In submitting this Bid, BIDDER represents, as set forth in the Agreement, that:

- A. BIDDER has examined and carefully studied the Bidding Documents, the other related data identified in the Bidding Documents, and the following Addenda, receipt of all of which is hereby acknowledged.

<u>Addendum No.</u>	<u>Addendum Date</u>
_____	_____
_____	_____
_____	_____
_____	_____

- B. If specified, or if in BIDDER's judgment, any local condition may affect cost, progress or the furnishing of the Work, BIDDER has visited the Site and become familiar with and is satisfied as to the local conditions that may affect cost, progress, or the furnishing of the Work.
- C. BIDDER is familiar with and is satisfied as to all federal, state and local Laws and Regulations that may affect cost, progress and the furnishing of the Work.
- D. BIDDER has carefully studied and correlated the information known to BIDDER, and information and observations obtained from BIDDER's visits, if any, to the Site with the Bidding Documents.
- E. BIDDER has given ENGINEER written notice of all conflicts, errors, ambiguities, or discrepancies that BIDDER has discovered in the Bidding Documents, and the written resolution thereof by ENGINEER is acceptable to BIDDER.
- F. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for completing the Work for which this Bid is submitted.
- G. BIDDER further represents that this Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; BIDDER has not directly or indirectly induced or solicited any other BIDDER to submit a false or sham Bid; BIDDER has not solicited or induced any individual or entity to refrain from bidding; and BIDDER has not sought by collusion to obtain for itself any advantage over any other BIDDER or over Buyer.
- H. BIDDER represents that the BIDDER is or will be registered as required with the State of Nebraska.
- I. BIDDER will complete the Work in accordance with the Contract Documents for the costs shown in the Bid Schedule.



1

**ADDITIONS OR DEDUCTIONS TO TOTAL LUMP SUM BID**

Bid Item No. 4a	For more or less than 800 square feet of concrete repairs to the underside of the influent flume operating floor slab shown in detail 3/FPS503 of the Contract Drawings.	Add/Deduct \$ _____/SF
Bid Item No. 4b	For more or less than 1850 square feet of concrete repairs to the underside of the underside of the filter walkway slab shown in detail 4/FPS503 of the Contract Drawings.	Add/Deduct \$ _____/SF
Bid Item No. 4c	For more or less than 200 linear feet of concrete repairs to the roof structure shown in detail 5/FPS503 of the Contract Drawings.	Add/Deduct \$ _____/LF

2

3

BIDDER agrees that all Work will conform to the schedule set forth in the Agreement.

4

5

The BIDDER proposes to use the following subcontractors or equipment manufacturers:

6

	Instrumentation & Control: Huffman Engineering, Inc.
Electrical:	Structural Concrete Repairs:
Piping and Valves:	High Performance Industrial Coatings Applicator:

7

8

The following documents are attached and made a condition of the Bid Form:

9

10

1. Required bid security.

11

12

Enclosed is a certified check or bid bond in the amount of \_\_\_\_\_

13

14

15

16

dollars (\$ \_\_\_\_\_) payable to the Metropolitan Utilities District, Omaha, Nebraska, or a bid bond complying with the bidding requirements. BIDDER agrees, if this Bid Form is accepted, that this bid deposit shall become the property of the Buyer as liquidated damages should BIDDER fail or refuse to execute the Contract and provide surety bond confirmation within the time specified. If this bid is accepted within sixty (60) calendar days after the date of the opening of the bids, or at any time thereafter before this bid is withdrawn, the BIDDER will, within fifteen (15) calendar days after the date of the award of the Contract, execute and deliver a contract and furnish a Surety Bond as required by the attached Contract Documents.

23

24

25

Address for Communications:

26

27

Communications concerning this Bid shall be addressed to:

28

29

30

31

32

33

34

35



1 If BIDDER is:

2  
3 An Individual

4  
5 By \_\_\_\_\_ (SEAL)  
6 (Individual's name)

7  
8 doing business as \_\_\_\_\_  
9

10  
11 A Partnership

12  
13 By \_\_\_\_\_ (SEAL)  
14 (Firm name)

15 \_\_\_\_\_  
16 (General partner)

17  
18  
19 A Corporation

20  
21 By \_\_\_\_\_ (SEAL)  
22 (Corporation name)

23  
24 \_\_\_\_\_  
25 (State of incorporation)

26  
27 By \_\_\_\_\_ (SEAL)  
28 (Name of person authorized to sign)

29  
30 \_\_\_\_\_  
31 (Title)

32  
33 (Corporate Seal)

34  
35  
36 Attest \_\_\_\_\_  
37 (Secretary)

38  
39  
40 A Joint Venture

41  
42 By \_\_\_\_\_ (SEAL)  
43 (Name)

44 \_\_\_\_\_  
45 (Address)

46  
47 By \_\_\_\_\_ (SEAL)  
48 (Name)

49 \_\_\_\_\_  
50 (Address)

51  
52  
53  
54  
55 NOTE: Each joint venturer must sign. The manner of signing for each individual, partnership and  
56 corporation that is a party to the joint venture should be in the manner indicated above.

57 **END OF SECTION**



# BID BOND

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

---

BIDDER (*Name and Address*):

SURETY (*Name, and Address of Principal Place of Business*):

OWNER (*Name and Address*):

BID

Bid Due Date:

Description (*Project Name— Include Location*):

BOND

Bond Number:

Date:

Penal sum

\$

(Words)

(Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

**BIDDER**

**SURETY**

(Seal)

(Seal)

\_\_\_\_\_  
Bidder's Name and Corporate Seal

\_\_\_\_\_  
Surety's Name and Corporate Seal

By:

\_\_\_\_\_  
Signature

By:

\_\_\_\_\_  
Signature (Attach Power of Attorney)

\_\_\_\_\_  
Print Name

\_\_\_\_\_  
Print Name

\_\_\_\_\_  
Title

\_\_\_\_\_  
Title

Attest:

\_\_\_\_\_  
Signature

Attest:

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Title

\_\_\_\_\_  
Title

*Note: Addresses are to be used for giving any required notice.*

*Provide execution by any additional parties, such as joint venturers, if necessary.*

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.

2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation shall be null and void if:
  - 3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
  - 3.2 All Bids are rejected by Owner, or
  - 3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.
6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after the Bid due date.
7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

1 2014/09/11

2 **SECTION 00500**  
3 **AGREEMENT**

4  
5 THIS AGREEMENT is dated as of the \_\_\_\_\_ day of \_\_\_\_\_ in the year 2014  
6  
7 by and between Metropolitan Utilities District of Omaha, hereinafter called DISTRICT, and  
8  
9 \_\_\_\_\_, hereinafter called CONTRACTOR.

10 DISTRICT and CONTRACTOR, in consideration of the mutual covenants hereinafter set forth, agree as  
11 follows:  
12

13 **Article 1. WORK**

14 CONTRACTOR shall complete all Work as specified or indicated in the Contract Documents.

15  
16 The Project for which the Work under the Contract Documents may be the whole or only a part is generally  
17 described as follows:  
18

19 Florence Water Treatment Plant - Phase 2 Filter Plant Improvements  
20  
21

22 **Article 2. ENGINEER**

23 The Project has been designed by HDR Engineering, Inc., 8404 Indian Hills Drive, Omaha, Nebraska 68114,  
24 who is hereinafter called ENGINEER and who is to act as DISTRICT's representative, assume all duties and  
25 responsibilities, and have the rights and authority assigned to ENGINEER in the Contract Documents in  
26 connection with completion of the Work in accordance with the Contract Documents.  
27  
28  
29

30 **Article 3. CONTRACT TIMES**

31  
32 3.1 Time of the Essence. All time limits for milestones, if any, substantial completion and completion and  
33 redlines for final payment as stated in the Contract Documents are of the essence of the Contract.  
34

35 3.2. The Work will be substantially completed as follows:  
36

37 PCS 1 (as defined in Section 01060) Prior to September 1, 2015  
38 PCS 2 (as defined in Section 01060) Prior to July 1, 2016  
39 PCS 3 (as defined in Section 01060) Prior to July 1, 2016  
40

41 Substantial Completion shall be in accordance with Article 14.04 of the General Conditions.  
42

43 3.3 The Work will be final completed as follows:  
44

45 PCS 1, 2 and 3 Prior to September 1, 2016  
46

47 Final Completion shall be in accordance with Article 14.07 of the General Conditions.  
48

1 3.3. Liquidated Damages. DISTRICT and CONTRACTOR recognize that time is of the essence of this  
2 Contract and that DISTRICT will suffer financial loss if the Work is not completed within the times  
3 specified in Paragraph 3.2. above, plus any extensions thereof allowed in accordance with Article 12  
4 of the General Conditions. They also recognize the delays, expense and difficulties involved in  
5 proving the actual loss suffered by DISTRICT if the Work is not completed on time. Accordingly,  
6 instead of requiring any such proof, DISTRICT and CONTRACTOR agree that as liquidated damages  
7 for delay (but not as a penalty), CONTRACTOR shall pay DISTRICT \$1,500 for each day that expires  
8 after the time specified in Paragraph 3.2. for Substantial Completion until the Work is substantially  
9 complete for PCS 1, 2 or 3 individually. After Substantial Completion, if CONTRACTOR shall neglect,  
10 refuse or fail to complete the remaining Work within the time specified in Paragraph 3.3. for  
11 completion and readiness for final payment or any proper extension thereof granted by DISTRICT,  
12 CONTRACTOR shall pay DISTRICT \$750 for each day that expires after the time specified in  
13 Paragraph 3.1. for completion and readiness for final payment.

14  
15 **Article 4. CONTRACT PRICE**

16  
17 DISTRICT shall pay CONTRACTOR for completion of the Work in accordance with the Contract Documents  
18 an amount in current funds equal to the amount shown in Paragraph 4.1. below:

19  
20 4.1. For all Work, a Lump Sum of:

21  
22 \_\_\_\_\_  
23 (use words)  
24 (\$ \_\_\_\_\_).  
25 (use figures)

26  
27 **Article 5. PAYMENT PROCEDURES**

28  
29 CONTRACTOR shall submit Applications for Payment in accordance with Article 14 of the General  
30 Conditions. Applications for Payment will be processed by DISTRICT.

31  
32 5.1. Progress Payments; Retainage. DISTRICT shall make monthly progress payments on account of the  
33 Contract Price on the basis of CONTRACTOR's Applications for Payment as recommended by  
34 DISTRICT, during construction as provided in Paragraphs 5.1.1. and 5.1.2. below. All such payments  
35 will be measured by the schedule of values established in Paragraph 2.05B.3. of the General  
36 Conditions or, in the event there is no schedule of values, as provided in the General Requirements.

37  
38 5.1.1. Prior to Substantial Completion, progress payments will be made in an amount equal to the  
39 percentage indicated below, but, in each case, less the aggregate of payments previously  
40 made and less such amounts in accordance with Paragraphs 14.02B.5. and 14.02D.1. of the  
41 General Conditions.

42  
43 5.1.1.1. 90 percent of Work completed (with the balance being retainage). If Work has been 50  
44 percent completed as determined by DISTRICT, and if the character and progress of the  
45 Work have been satisfactory to DISTRICT, DISTRICT may determine that as long as the  
46 character and progress of the Work remain satisfactory to them, there will be no additional  
47 retainage on account of Work completed, in which case the remaining progress payments  
48 prior to Substantial Completion will be in an amount equal to 100 percent of the Work  
49 completed.

50  
51 5.1.1.2. 90 percent (with the balance being retainage) of materials and equipment not incorporated in  
52 the Work (but delivered, suitably stored and accompanied by documentation satisfactory to  
53 DISTRICT as provided in Paragraph 14.02 of the General Conditions).

54  
55 5.1.2. Upon Substantial Completion, in an amount sufficient to increase total payments to  
56 CONTRACTOR to 95 percent of the Contract Price (with the balance being retainage), less  
57 such amounts as DISTRICT may withhold, in accordance with Paragraph 14.02B. of the  
58 General Conditions.

59  
60 5.2. Final Payment. Upon final completion and acceptance of the Work in accordance with Paragraph  
61 14.07B. of the General Conditions, DISTRICT shall pay the remainder of the Contract Price as  
62 provided in said Paragraph 14.07B. Liquidated damages will be assessed on Final Payment.

1  
2 **Article 6. INTEREST (NOT USED)**  
3

4 **Article 7. CONTRACTOR'S REPRESENTATIONS**  
5

6 In order to induce DISTRICT to enter into this Contract, CONTRACTOR makes the following  
7 representations:  
8

- 9 7.1. CONTRACTOR has thoroughly examined and carefully studied the Contract Documents (including  
10 the Addenda listed in Paragraph 8.) and the other related data identified in the Bidding Documents  
11 including "technical data."  
12
- 13 7.2. CONTRACTOR has visited the site and become familiar with and is satisfied as to the general, local  
14 and site conditions that may affect cost, progress, performance or furnishing of the Work.  
15
- 16 7.3. CONTRACTOR is familiar with and is satisfied as to all federal, state and local Laws and Regulations  
17 that may affect cost, progress, performance or furnishing of the Work.  
18
- 19 7.4. CONTRACTOR has carefully studied all drawings of physical conditions in or relating to existing  
20 surface or subsurface structures at or contiguous to the site (except Underground Facilities) which  
21 have been identified in the Supplementary Conditions.  
22

23 CONTRACTOR accepts the determination set forth in the Supplementary Conditions of the extent of  
24 the "technical data" contained in such reports and drawings upon which CONTRACTOR is entitled to  
25 rely as provided in the General Conditions.  
26

27 CONTRACTOR acknowledges that such drawings and reports are not Contract Documents and may  
28 not be complete for CONTRACTOR's purposes.  
29

30 CONTRACTOR acknowledges that DISTRICT and ENGINEER do not assume responsibility for the  
31 accuracy or completeness of information and data shown or indicated in the Contract Documents with  
32 respect to Underground Facilities at or contiguous to the site.  
33

34 CONTRACTOR has obtained and carefully studied (or assumes responsibility for having done so) all  
35 such additional supplementary examinations, investigations, explorations, tests, studies and data  
36 concerning conditions (surface, subsurface and Underground Facilities) at or contiguous to the site or  
37 otherwise which may affect cost, progress, performance or furnishing of the Work or which relate to  
38 any aspect of the means, methods, techniques, sequences and procedures of construction to be  
39 employed by CONTRACTOR and safety precautions and programs incident thereto.  
40

41 CONTRACTOR does not consider that any additional examinations, investigations, explorations,  
42 tests, studies or data are necessary for the performance and furnishing of the Work at the Contract  
43 Price, within the Contract Times and in accordance with the other terms and conditions of the Contract  
44 Documents.  
45

- 46 7.5. CONTRACTOR is aware of the general nature of work to be performed by DISTRICT and others at  
47 the site that relates to the Work as indicated in the Contract Documents.  
48
- 49 7.6. CONTRACTOR has correlated the information known to CONTRACTOR, information and  
50 observations obtained from visits to the site, reports and drawings identified in the Contract  
51 Documents and all additional examinations, investigations, explorations, tests, studies and data with  
52 the Contract Documents.  
53
- 54 7.7. CONTRACTOR has given DISTRICT and ENGINEER written notice of all conflicts, errors, ambiguities  
55 or discrepancies that CONTRACTOR has discovered in the Contract Documents and the written  
56 resolution thereof by DISTRICT and ENGINEER through issued addendum or addenda is acceptable  
57 to CONTRACTOR, and the Contract Documents are generally sufficient to indicate and convey  
58 understanding of all terms and conditions for performance and furnishing of the Work. When said  
59 conflicts, etc., have not been resolved through interpretation or clarification by ENGINEER because of  
60 insufficient time or otherwise, CONTRACTOR has included in the Bid the greater quantity or better  
61 quality of Work or compliance with the more stringent requirement resulting in a greater cost, and said  
62 greater cost is included in the Contract Price.

1  
2 **Article 8. CONTRACT DOCUMENTS**  
3

4 The Contract Documents which comprise the entire agreement between DISTRICT and CONTRACTOR  
5 concerning the Work consist of the following:  
6

- 7 8.1. This Contract (pages 1 to 5 including Exhibit A-1, A-2(A), and A-2(B) inclusive).  
8  
9 8.2. Performance, Payment, and other Bonds.  
10  
11 8.3. Notice to Proceed.  
12  
13 8.4. General Conditions (Cover Sheet to page 65, inclusive).  
14  
15 8.5. Supplementary Conditions (pages 1 to 8, inclusive).  
16  
17 8.6. Specifications bearing the title "MUD Florence Water Treatment Plant Phase II Filter Improvements".  
18  
19 8.7. Drawings consisting of a cover sheet and sheets bearing the following general title: Metropolitan  
20 Utilities District, Florence Water Treatment Plant Phase II Filter Plant Improvements.  
21  
22 8.8. Addenda numbers \_\_\_\_\_ to \_\_\_\_\_, inclusive.  
23  
24 8.9. CONTRACTOR's Bid marked Exhibit \_\_\_\_\_.  
25  
26 8.10. Documentation submitted by CONTRACTOR prior to Notice of Award (pages \_\_\_\_\_ to \_\_\_\_\_  
27 inclusive).  
28  
29 8.11. The following which may be delivered or issued after the Effective Date of the Contract and are not  
30 attached thereto:

31  
32 All written amendments and other documents amending, modifying or supplementing the Contract  
33 Documents pursuant to Paragraph 3.04 of the General Conditions.  
34

35 The documents listed in Paragraphs 8.2. et seq. above are attached to this Contract (except as  
36 expressly noted otherwise above).  
37

38 There are no Contract Documents other than those listed above in this Article 8. The Contract  
39 Documents may only be amended, modified or supplemented as provided in Paragraph 3.04 of the  
40 General Conditions.  
41

42 **Article 9. MISCELLANEOUS**  
43

- 44 9.1. Terms used in this Contract which are defined in Article 1 of the General Conditions will have the  
45 meanings indicated in the General Conditions.  
46  
47 9.2. No assignment by a party hereto of any rights under or interests in the Contract Documents will be  
48 binding on another party hereto without the written consent of the party sought to be bound; and,  
49 specifically but without limitation, moneys that may become due and moneys that are due may not be  
50 assigned without such consent (except to the extent that the effect of this restriction may be limited by  
51 law), and unless specifically stated to the contrary in any written consent to an assignment, no  
52 assignment will release or discharge the assignor from any duty or responsibility under the Contract  
53 Documents.  
54  
55 9.3. DISTRICT and CONTRACTOR each binds itself, its partners, successors, assigns and legal  
56 representatives to the other party hereto, its partners, successors, assigns and legal representatives  
57 in respect to all covenants, agreements and obligations contained in the Contract Documents.  
58



1 9.4. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or  
2 Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and  
3 binding upon DISTRICT and CONTRACTOR, who agree that the Contract Documents shall be  
4 reformed to replace such stricken provision or part thereof with a valid and enforceable provision that  
5 comes as close as possible to expressing the intention of the stricken provision.  
6

7 9.5. Assignment.  
8

9 9.5.1. The following Procurement Contract between the District as "BUYER" and the listed "SELLER"  
10 of procurement Goods and Special Services will be assigned to the Contractor by the  
11 DISTRICT. CONTRACTOR will accept such assignments. Forms documenting the  
12 assignment are attached as Exhibits A-1, A-2(A) and A-2(B).  
13

Equipment/System Description	Manufacturer (Seller)
1. Valve/Actuator Procurement	DEZURIK, Inc.

14  
15 9.5.2 This assignment will occur on the Effective Date of the Contract and will relieve the DISTRICT  
16 as "BUYER" from all further obligations and liabilities under the procurement contract.  
17 CONTRACTOR will assume full responsibility for the performance of "SELLER" as a  
18 subcontractor. Notwithstanding this assignment, all performance guarantees and warranties  
19 required by the "Procurement Contract" will continue to run for the benefit of the DISTRICT  
20 and in addition, for the benefit of the CONTRACTOR. Except as noted in Contract between  
21 "BUYER" and "SELLER", all rights, duties and obligations of Engineers to "BUYER" and  
22 "SELLER" under the "Procurement Contract" will cease.  
23

24 9.5.3 DISTRICT will provide Contractor with a conformed copy of the assigned "Procurement  
25 Contract" after the assignment is completed.  
26  
27

28 IN WITNESS WHEREOF, DISTRICT and CONTRACTOR have signed this Contract in triplicate. One  
29 counterpart each has been delivered to DISTRICT, CONTRACTOR, and ENGINEER. All portions of the  
30 Contract Documents have been signed, initialed or identified by DISTRICT and CONTRACTOR or identified  
31 by ENGINEER on their behalf.  
32

33 This Contract will be effective on \_\_\_\_\_, 2014 (which is the Effective Date of the  
34 Contract).  
35

36 CONTRACTOR:

METROPOLITAN UTILITIES DISTRICT  
OMAHA, NEBRASKA

37  
38  
39 By \_\_\_\_\_

By \_\_\_\_\_

40  
41 Title \_\_\_\_\_

Title \_\_\_\_\_

42  
43 Executed on \_\_\_\_/\_\_\_\_/\_\_\_\_ (month/day/year)

Executed on \_\_\_\_/\_\_\_\_/\_\_\_\_ (month/day/year)

44  
45 WITNESS - CONTRACTOR:

WITNESS-METROPOLITAN UTILITIES DISTRICT

46  
47 \_\_\_\_\_

\_\_\_\_\_

48  
49 APPROVED AS TO FORM:

50  
51 \_\_\_\_\_

52 General Counsel

53 **END OF SECTION**  
54



**EXHIBIT A-1 to Agreement Between  
Buyer and Seller dated \_\_\_\_**

**ASSIGNMENT OF CONTRACT; CONSENT TO ASSIGNMENT;  
AND ACCEPTANCE OF ASSIGNMENT**

This assignment will be effective on the Effective Date of the Agreement between Buyer and Construction Contractor.

The Contract between Metropolitan Utilities District (“Buyer”) and DEZURIK, Inc. (“Seller”)

for furnishing Goods and Special Services under the Contract Documents entitled MUD Florence Water Treatment Plant Phase 2 Improvements Valve/Actuator Procurement is hereby assigned, transferred, and set over to \_\_\_\_\_ (“Construction Contractor”). Construction Contractor shall be totally responsible for the performance of Seller and for the duties, rights and obligations of Buyer, not otherwise retained by Buyer, under the terms of the Contract between Buyer and Seller.

ASSIGNMENT DIRECTED BY:

\_\_\_\_\_  
Metropolitan Utilities District

Buyer

(If Buyer is a corporation, attach evidence of authority to sign. If Buyer is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of Buyer-Seller Agreement.)

By: \_\_\_\_\_

(Signature)

(Title)

ASSIGNMENT

ACKNOWLEDGED AND ACCEPTED BY:

\_\_\_\_\_  
DEZURIK, INC.

Seller

(If Seller is a corporation, attach evidence of authority to sign.)

By: \_\_\_\_\_

(Signature)

(Title)

ASSIGNMENT ACCEPTED BY:

\_\_\_\_\_  
Construction Contractor

(If Construction Contractor is a corporation, attach evidence of authority to sign.)

By: \_\_\_\_\_



**EXHIBIT A-2(A)**

Dated: \_\_\_\_\_

**AGREEMENT TO ASSIGNMENT BY CONTRACTOR'S SURETY**

Contractor's Surety hereby acknowledges and agrees that the Contract for furnishing Goods and Special Services under the Contract Documents entitled MUD Florence Water Treatment Plant Phase 2 Improvements Valve/Actuator Procurement, by and between Metropolitan Utilities District of Omaha ("Buyer") and DEZURIK, Inc. ("Seller") may be assigned, transferred, and set over to \_\_\_\_\_ ("Construction Contractor"), in accordance with Paragraph 11.02 of Agreement between Buyer and Seller.

Surety further agrees that, upon assignment of the Contract, the Construction Contractor shall have all the rights of the Buyer under the Performance Bond and Payment Bond.

(Corporate Seal)

Contractor's Surety Company

\_\_\_\_\_

By: \_\_\_\_\_

*(Signature)*

*(Title)*

(Attach Power of Attorney)



**EXHIBIT A-2(B) to Agreement Between  
Buyer and Seller dated \_\_\_\_\_**

**AGREEMENT TO ASSIGNMENT BY SELLER'S SURETY**

Surety hereby acknowledges and agrees that the Contract for furnishing Goods and Special Services under the Contract Documents entitled MUD Florence Water Treatment Plant Phase 2 Improvements Valve/Actuator Procurement by and between Metropolitan Utilities District ("Buyer") and DEZURIK, Inc. ("Seller") may be assigned, transferred, and set over to \_\_\_\_\_ ("Construction Contractor"), in accordance with Paragraph 11.02 of Agreement between Buyer and Seller.

Surety further agrees that, upon assignment of the Contract, the Construction Contractor shall have all the rights of the Buyer under the Performance Bond.

(Corporate Seal)

Surety

Company: \_\_\_\_\_

By: \_\_\_\_\_

Signature and Title  
(Attach Power of Attorney)





## PERFORMANCE BOND

CONTRACTOR *(name and address):*

SURETY *(name and address of principal place of business):*

OWNER *(name and address):*

### CONSTRUCTION CONTRACT

Effective Date of the Agreement:

Amount:

Description *(name and location):*

### BOND

Bond Number:

Date *(not earlier than the Effective Date of the Agreement of the Construction Contract):*

Amount:

Modifications to this Bond Form:  None  See Paragraph 16

---

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

### CONTRACTOR AS PRINCIPAL

### SURETY

\_\_\_\_\_  
Contractor's Name and Corporate Seal *(seal)*

\_\_\_\_\_  
Surety's Name and Corporate Seal *(seal)*

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

By: \_\_\_\_\_  
Signature *(attach power of attorney)*

\_\_\_\_\_  
Print Name

\_\_\_\_\_  
Print Name

\_\_\_\_\_  
Title

\_\_\_\_\_  
Title

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

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

\_\_\_\_\_  
Title

\_\_\_\_\_  
Title

**Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.**

1. The Contractor and 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 when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after:

3.1 The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable 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;

3.2 The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

3.3 The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. 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:

5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

5.3 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 a contractor selected with the Owners 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 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven 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 Paragraph 5.4, and the Owner refuses the payment 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.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, 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. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

7.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

7.2 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 5; and

7.3 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.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. 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 or its heirs, executors, administrators, successors, and assigns.

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. 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 a declaration of 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 periods of limitations available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

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 herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

#### 14. Definitions

14.1 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 for the Contractor for 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.

14.2 Construction Contract: The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

14.3 Contractor Default: Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

14.4 Owner Default: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

14.5 Contract Documents: All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

16. Modifications to this Bond are as follows:



## PAYMENT BOND

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *(name and address)*:

### CONSTRUCTION CONTRACT

Effective Date of the Agreement:

Amount:

Description *(name and location)*:

### BOND

Bond Number:

Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:

Amount:

Modifications to this Bond Form:  None  See Paragraph 18

---

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

### CONTRACTOR AS PRINCIPAL

### SURETY

\_\_\_\_\_  
*(seal)*

Contractor's Name and Corporate Seal

\_\_\_\_\_  
*(seal)*

Surety's Name and Corporate Seal

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

By: \_\_\_\_\_  
Signature *(attach power of attorney)*

\_\_\_\_\_  
Print Name

\_\_\_\_\_  
Print Name

\_\_\_\_\_  
Title

\_\_\_\_\_  
Title

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

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

\_\_\_\_\_  
Title

\_\_\_\_\_  
Title

**Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.**

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.
2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.
4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.
5. The Surety's obligations to a Claimant under this Bond shall arise after the following:
  - 5.1 Claimants who do not have a direct contract with the Contractor,
    - 5.1.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
    - 5.1.2 have sent a Claim to the Surety (at the address described in Paragraph 13).
  - 5.2 Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).
6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.
7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:
  - 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and
  - 7.2 Pay or arrange for payment of any undisputed amounts.
  - 7.3 The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.
8. The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.
9. 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 Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.
10. 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 the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.
11. 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.

12. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, 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.
13. Notice and Claims to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.
14. 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 herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.
15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.
16. **Definitions**
  - 16.1 **Claim:** A written statement by the Claimant including at a minimum:
    1. The name of the Claimant;
    2. The name of the person for whom the labor was done, or materials or equipment furnished;
    3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
    4. A brief description of the labor, materials, or equipment furnished;
    5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
    6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
    7. The total amount of previous payments received by the Claimant; and
  - 16.2 **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 Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms of "labor, materials, or equipment" that part of the 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.
  - 16.3 **Construction Contract:** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.
  - 16.4 **Owner Default:** Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
  - 16.5 **Contract Documents:** All the documents that comprise the agreement between the Owner and Contractor.
8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.
17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.
18. Modifications to this Bond are as follows:







# CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

**IMPORTANT:** If the certificate holder is an **ADDITIONAL INSURED**, the policy(ies) must be endorsed. If **SUBROGATION IS WAIVED**, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER	CONTACT NAME:		
	PHONE (A/C, No, Ext):	FAX (A/C, No):	
	E-MAIL ADDRESS:		
	INSURER(S) AFFORDING COVERAGE		NAIC #
INSURED	INSURER A :		
	INSURER B :		
	INSURER C :		
	INSURER D :		
	INSURER E :		
	INSURER F :		

**COVERAGES**

CERTIFICATE NUMBER:

REVISION NUMBER:

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS
	<b>GENERAL LIABILITY</b> <input type="checkbox"/> COMMERCIAL GENERAL LIABILITY <input type="checkbox"/> CLAIMS-MADE <input type="checkbox"/> OCCUR  GEN'L AGGREGATE LIMIT APPLIES PER: <input type="checkbox"/> POLICY <input type="checkbox"/> PRO-JECT <input type="checkbox"/> LOC						EACH OCCURRENCE \$ DAMAGE TO RENTED PREMISES (Ea occurrence) \$ MED EXP (Any one person) \$ PERSONAL & ADV INJURY \$ GENERAL AGGREGATE \$ PRODUCTS - COMP/OP AGG \$
	<b>AUTOMOBILE LIABILITY</b> <input type="checkbox"/> ANY AUTO <input type="checkbox"/> ALL OWNED AUTOS <input type="checkbox"/> HIRED AUTOS <input type="checkbox"/> SCHEDULED AUTOS <input type="checkbox"/> NON-OWNED AUTOS						COMBINED SINGLE LIMIT (Ea accident) \$ BODILY INJURY (Per person) \$ BODILY INJURY (Per accident) \$ PROPERTY DAMAGE (Per accident) \$
	<b>UMBRELLA LIAB</b> <input type="checkbox"/> OCCUR <b>EXCESS LIAB</b> <input type="checkbox"/> CLAIMS-MADE DED \$     RETENTION \$						EACH OCCURRENCE \$ AGGREGATE \$
	<b>WORKERS COMPENSATION AND EMPLOYERS' LIABILITY</b> ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICE/MEMBER EXCLUDED? <input type="checkbox"/> Y/N (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below		N/A				WC STATU-TORY LIMITS     OTH-ER E.I. EACH ACCIDENT \$ E.I. DISEASE - EA EMPLOYEE \$ E.I. DISEASE - POLICY LIMIT \$

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

**CERTIFICATE HOLDER****CANCELLATION**

	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.
	AUTHORIZED REPRESENTATIVE

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This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the controlling Laws and Regulations.

**NOTE:** This EJCDC Document has been modified as indicated herein by HDR, Inc.  
A ~~strikeout~~ indicates that language has been deleted from the EJCDC General Conditions.  
An underline indicates that language has been added to the EJCDC General Conditions.

## STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

**ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE**

and

Issued and Published Jointly by



AMERICAN COUNCIL OF ENGINEERING COMPANIES

ASSOCIATED GENERAL CONTRACTORS OF AMERICA

AMERICAN SOCIETY OF CIVIL ENGINEERS

PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE  
*A Practice Division of the*  
NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

Endorsed by



CONSTRUCTION SPECIFICATIONS INSTITUTE

**STANDARD GENERAL CONDITIONS OF THE  
CONSTRUCTION CONTRACT**

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## ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

### 1.01 *Defined Terms*

- A. ~~Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. Wherever used in these General Conditions or in other Contract Documents, the terms listed below have the meanings indicated which are applicable to both the singular and plural thereof. Said terms are generally capitalized or written in italics, but not always. When used in a context consistent with the definition of a listed-defined term, the term shall have a meaning as defined below whether capitalized or italicized or otherwise.~~

In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
2. *Agreement*—The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.
3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
4. *Asbestos*—Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.
5. *Bid*—The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
6. *Bidder*—The individual or entity who submits a Bid directly to Owner.
7. *Bidding Documents*—The Bidding Requirements and the proposed Contract Documents (including all Addenda).
8. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid security of acceptable form, if any, and the Bid Form with any supplements.
9. *Change Order*—A document, which may be recommended by Engineer, which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.
10. *Claim*—A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.



11. *Contract*—The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.
12. *Contract Documents*—Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.
13. *Contract Price*—The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).
14. *Contract Times*—The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any; (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.
15. *Contractor*—The individual or entity with whom Owner has entered into the Agreement.
16. *Cost of the Work*—See Paragraph 11.01 for definition.
17. *Drawings*—That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.
18. *Effective Date of the Agreement*—The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.
19. *Engineer*—The individual or entity named as such in the Agreement.
20. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.
21. *General Requirements*—Sections of Division 1 of the Specifications.
22. *Hazardous Environmental Condition*—The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto.
23. *Hazardous Waste*—The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.
24. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
25. *Liens*—Charges, security interests, or encumbrances upon Project funds, real property, or personal property.

26. *Milestone*—A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.
27. *Notice of Award*—The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.
28. *Notice to Proceed*—A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.
29. *Owner*—The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.
30. *PCBs*—Polychlorinated biphenyls.
31. *Petroleum*—Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.
32. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.
33. *Project*—The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.
34. *Project Manual*—The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.
35. *Radioactive Material*—Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.
36. *Resident Project Representative*—The authorized representative of Engineer who may be assigned to the Site or any part thereof.
37. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.
38. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.
39. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

40. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.
41. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.
42. *Specifications*—That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.
43. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.
44. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be safely and conveniently utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.
45. *Successful Bidder*—The Bidder submitting a responsive Bid to whom Owner makes an award.
46. *Supplementary Conditions*—That part of the Contract Documents which amends or supplements these General Conditions.
47. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or Subcontractor.
48. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
49. *Unit Price Work*—Work to be paid for on the basis of unit prices.
50. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.
51. *Work Change Directive*—A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner, and which may be recommended by Engineer.

ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

## 1.02 Terminology

A. The words and terms discussed in Paragraph 1.02.B through F are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

### B. *Intent of Certain Terms or Adjectives:*

1. The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09 or any other provision of the Contract Documents.

### C. *Day:*

1. The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.

### D. *Defective:*

1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
  - a. does not conform to the Contract Documents; or
  - b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
  - c. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).

### E. ~~Furnish, Install, Perform, Provide~~ *Furnish, Install, Perform, Provide, Supply:*

1. The word "Furnish" or the word "Install" or the word "Perform" or the word "Provide" or the word "Supply," or any combination or similar directive or usage thereof, shall mean furnishing and incorporating in the Work including all necessary labor, materials, equipment, and everything necessary to perform the Work indicated, unless specifically limited in the context used.

~~1.The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.~~

~~2.The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.~~

~~3.The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.~~

~~4.When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.~~

F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

## ARTICLE 2 – PRELIMINARY MATTERS

### 2.01 *Delivery of Bonds and Evidence of Insurance*

A. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.

B. *Evidence of Insurance:* Before any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

### 2.02 *Copies of Documents*

A. Owner shall furnish to Contractor up to ten printed or hard copies of the Drawings and Project Manual. Additional copies will be furnished upon request at the cost of reproduction.

### 2.03 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the sixtieth day

after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

#### 2.04 *Starting the Work*

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to the date on which the Contract Times commence to run.

#### 2.05 *Before Starting Construction*

- A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review:
  - 1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;
  - 2. a preliminary Schedule of Submittals; and
  - 3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

#### 2.06 *Preconstruction Conference; Designation of Authorized Representatives*

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Subcontractors, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit instructions, receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

#### 2.07 *Initial Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

### **ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE**

#### **3.01 *Intent***

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that reasonably may be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the indicated result will be provided whether or not specifically called for, at no additional cost to Owner.
- C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.
- D. The Specifications may vary in form, format and style. Some specification sections are written in varying degrees of streamlined or declarative style and some sections may be relatively narrative by comparison. Omissions of such words and phrases as "the Contractor shall," "in conformity with," "as shown," or "as specified" are intentional in streamlined sections. Omitted words and phrases shall be supplied by inference. Similar types of provisions may appear in various parts of a section or articles within a part depending on the format of the section. The Contractor shall not take advantage of any variation of form, format or style in making claims for extra Work.
- E. The cross referencing of specification sections under the subparagraph heading "Related Sections include but are not necessarily limited to:" and elsewhere within each specification section is provided as an aid and convenience to the Contractor. The Contractor shall not rely on the cross referencing provided and shall be responsible to coordinate the entire Work under the Contract Documents and provide a complete Project whether or not the cross referencing is provided in each section or whether or not the cross referencing is complete.

#### **3.02 *Reference Standards***

- A. Standards, Specifications, Codes, Laws, and Regulations

1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
2. No provision of any such standard, specification, manual, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

### 3.03 *Reporting and Resolving Discrepancies*

#### A. *Reporting Discrepancies:*

1. *Contractor's Review of Contract Documents Before Starting Work:* Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein ~~and against~~ all applicable field measurements and conditions. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor discovers, or has actual knowledge of, and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.
2. *Contractor's Review of Contract Documents During Performance of Work:* If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) any standard, specification, manual, or code, or (c) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

#### B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:
  - a. the provisions of any standard, specification, manual, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference in the Contract Documents); or



- b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

### 3.04 *Amending and Supplementing Contract Documents*

- A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.
- B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work, not involving a change in Contract Price or Contract time, may be authorized; by one or more of the following ways:
  - 1. A Field Order;
  - 2. Engineer's approval of a Shop Drawing or Sample (subject to the provisions of Paragraph 6.17.D.3); or
  - 3. Engineer's written interpretation or clarification.

### 3.05 *Reuse of Documents*

- A. Contractor and any Subcontractor or Supplier shall not:
  - 1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions; or
  - 2. reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

### 3.06 *Electronic Data*

- A. Unless otherwise stated in the Supplementary Conditions, the data furnished by Owner or Engineer to Contractor, or by Contractor to Owner or Engineer, that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.
- B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving

party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.

- C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

#### **ARTICLE 4 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS**

##### *4.01 Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

1. Where easement lines are shown on the Contract Drawings, they shall be considered as shown in their final location unless stipulated otherwise in the Supplementary Conditions.

- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

##### *4.02 Subsurface and Physical Conditions*

- A. *Reports and Drawings:* The Supplementary Conditions identify:

1. those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site; and
2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).

- B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

#### 4.03 *Differing Subsurface or Physical Conditions*

A. *Notice:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed either:

1. is of such a nature as to establish that any "technical data" on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or
2. is of such a nature as to require a change in the Contract Documents; or
3. differs materially from that shown or indicated in the Contract Documents; or
4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

B. *Engineer's Review:* After receipt of written notice as required by Paragraph 4.03.A, Engineer will promptly review the pertinent condition, determine the necessity of Owner's obtaining additional exploration or tests with respect thereto, and advise Owner in writing (with a copy to Contractor) of Engineer's findings and conclusions.

C. *Possible Price and Times Adjustments:*

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
  - a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and
  - b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:
  - a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or
  - b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or
  - c. Contractor failed to give the written notice as required by Paragraph 4.03.A.
3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, neither Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

#### 4.04 *Underground Facilities*

A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data provided by others; and
2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
  - a. reviewing and checking all such information and data;
  - b. locating all Underground Facilities shown or indicated in the Contract Documents;
  - c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction; and
  - d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated:*

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract

Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

2. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

#### 4.05 *Reference Points*

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

#### 4.06 *Hazardous Environmental Condition at Site*

- A. *Reports and Drawings:* The Supplementary Conditions identify those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at the Site.
- B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:
  1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
  3. any Contractor interpretation of or conclusion drawn from any “technical data” or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.
- D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 4.06.E.
- E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered written notice to Contractor: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.
- F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner’s own forces or others in accordance with Article 7.
- G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition,

provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

- H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

## **ARTICLE 5 – BONDS AND INSURANCE**

### **5.01 *Performance, Payment, and Other Bonds***

- A. Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.
- B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed each bond.
- C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

## 5.02 *Licensed Sureties and Insurers*

- A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

## 5.03 *Certificates of Insurance*

- A. Contractor shall deliver to Owner, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.
- B. Owner shall deliver to Contractor, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.
- C. Failure of Owner to demand such certificates or other evidence of Contractor's full compliance with these insurance requirements or failure of Owner to identify a deficiency in compliance from the evidence provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.
- D. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor.
- E. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

## 5.04 *Contractor's Insurance*

- A. Contractor shall purchase and maintain such insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:
  - 1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;
  - 2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;
  - 3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;



4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:
    - a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or
    - b. by any other person for any other reason;
  5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and
  6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.
- B. The policies of insurance required by this Paragraph 5.04 shall:
1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, be written on an occurrence basis, include as additional insureds (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;
  2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;
  3. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;
  4. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions ~~to whom a certificate of insurance has been issued~~ (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);
  5. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and
  6. include completed operations coverage:
    - a. Such insurance shall remain in effect for two years after final payment.
    - b. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, ~~to whom a certificate of insurance has been issued~~, evidence

satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

7. With respect to all insurance required by this Paragraph 5.04, Contractor agrees to waive all rights of subrogation against Owner, Engineer, and each additional insured identified in the Supplementary Conditions.

8. The Contractor's general liability insurance shall include a per project or per location endorsement, which shall be identified in the certificate of insurance provided to the Owner.

#### 5.05 *Owner's Liability Insurance*

A. In addition to the insurance required to be provided by Contractor under Paragraph 5.04, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

#### 5.06 *Property Insurance*

A. Unless otherwise provided in the Supplementary Conditions, ~~Owner-Contractor~~ shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee;
2. be written on a Builder's Risk "all-risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, explosion, underground exposure, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required by the Supplementary Conditions.
3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);
4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;
5. allow for partial utilization of the Work by Owner;
6. include testing and startup; and

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other loss payee ~~to whom a certificate of insurance has been issued.~~
- B. Owner shall purchase and maintain such equipment breakdown insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee.
- C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other loss payee ~~to whom a certificate of insurance has been issued~~ and will contain waiver provisions in accordance with Paragraph 5.07.
- D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.
- E. If Contractor requests in writing that other special insurance be included in the property insurance policies provided under this Paragraph 5.06, Owner shall, if possible, include such insurance, and the cost thereof will be charged to Contractor by appropriate Change Order. Prior to commencement of the Work at the Site, Owner shall in writing advise Contractor whether or not such other insurance has been procured by Owner.

#### 5.07 *Waiver of Rights*

- A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or loss payees thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) under such policies

for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.

- B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for:
  - 1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and
  - 2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them.

#### 5.08 *Receipt and Application of Insurance Proceeds*

- A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the loss payees, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order.
- B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.

#### 5.09 *Acceptance of Bonds and Insurance; Option to Replace*

- A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the

certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

#### 5.10 *Partial Utilization, Acknowledgment of Property Insurer*

A. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to Paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

1. All insurance required by the Contract Documents, or by laws or regulations shall remain in full force and effect on all phases of the Work, whether or not the Work is occupied or utilized by Owner, until all Work included in the agreement has been completed and final payment has been made.

2. Nothing contained in the insurance requirements shall be construed as limiting the extent of Contractor's responsibility for payment of damages resulting from Contractor's, subcontractor's or supplier's operations under the Contract. Contractor agrees that Contractor alone shall be completely responsible for procuring and maintaining full insurance coverage as provided herein or as may be otherwise required by the Contract Documents. Any approval by Owner or Engineer shall not operate to the contrary.

### **ARTICLE 6 – CONTRACTOR'S RESPONSIBILITIES**

#### 6.01 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances. The superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to or received from the superintendent shall be binding on Contractor.

## 6.02 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.

B. In the absence of any Federal, state or local laws, regulations or covenants, the Contractor may conduct its performance of the Work at the Contractor's sole discretion, except that the cost of any overtime pay or other expense incurred by the Owner for Resident Project Representative, Owner's Representative and construction observation services, occasioned by the conduct of Work on Saturday, Sunday, any legal holiday, or as overtime on any regular work day, shall be reimbursed to the Owner by the Contractor.

~~B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner's written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.~~

## 6.03 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.

1. Where the Work requires equipment be furnished, due to the lack of standardization of equipment as produced by the various manufacturers, it may become necessary to make minor modifications in the structures, buildings, piping, mechanical work, electrical work, accessories, controls, or other work, to accommodate the particular equipment offered. Contractor's bid price for any equipment offered shall include the cost of making any necessary changes subject to the approval of Engineer.

B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

D. All items of standard equipment shall be the latest model at the time of bid, unless otherwise specified.

#### 6.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 as it may be adjusted from time to time as provided below.
  - 1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.
  - 2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

#### 6.05 *Substitutes and "Or-Equals"*

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.
  - 1. "*Or-Equal*" Items: If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:
    - a. in the exercise of reasonable judgment Engineer determines that:
      - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
      - 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and
      - 3) it has a proven record of performance and availability of responsive service.
    - b. Contractor certifies that, if approved and incorporated into the Work:
      - 1) there will be no increase in cost to the Owner or increase in Contract Times; and
      - 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

## 2. *Substitute Items:*

- a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.
- b. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.
- c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented by the General Requirements, and as Engineer may decide is appropriate under the circumstances.
- d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
  - 1) shall certify that the proposed substitute item will:
    - a) perform adequately the functions and achieve the results called for by the general design,
    - b) be similar in substance to that specified, and
    - c) be suited to the same use as that specified;
  - 2) will state:
    - a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time,
    - b) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and
    - c) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;
  - 3) will identify:
    - a) all variations of the proposed substitute item from that specified, and
    - b) available engineering, sales, maintenance, repair, and replacement services; and
  - 4) shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change.



- B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.
- C. *Engineer's Evaluation:* Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by a Change Order in the case of a substitute and an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.
- D. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- E. *Engineer's Cost Reimbursement:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.
- F. *Contractor's Expense:* Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

G. See Specification Section 01640.

#### 6.06 *Concerning Subcontractors, Suppliers, and Others*

- A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.
- B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be

adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.

- C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:
  - 1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity; nor
  - 2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.
- D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.
- E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.
- F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as a loss payee on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

#### 6.07 *Patent Fees and Royalties*

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a

particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

#### 6.08 *Permits*

- A. Unless otherwise provided in the Supplementary Conditions, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

#### 6.09 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

- C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

#### 6.10 *Taxes*

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

#### 6.11 *Use of Site and Other Areas*

##### A. *Limitation on Use of Site and Other Areas:*

1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.
2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.
3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.

- B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

- D. *Loading Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

#### 6.12 *Record Documents*

- A. Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to Engineer for reference. Upon completion of the Work, these record documents, Samples, and Shop Drawings will be delivered to Engineer for Owner. Contractor shall include accurate locations for buried and imbedded items.

#### 6.13 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:
1. all persons on the Site or who may be affected by the Work;
  2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
  3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.
- C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.
- D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
- E. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any

other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

- F. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion) and during the Correction Period to the extent the Contractor or Contractor's Subcontractors are present on the Site to fulfill Correction Period obligations.

#### 6.14 *Safety Representative*

- A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

#### 6.15 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

#### 6.16 *Emergencies*

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

#### 6.17 *Shop Drawings and Samples*

- A. Contractor shall submit required Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals (as required by Paragraph 2.07). Each submittal will be identified as Engineer may require.

##### 1. *Shop Drawings:*

- a. Submit number of copies specified in the General Requirements.
- b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to

show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 6.17.D.

c. Shop Drawings submitted as herein provided by Contractor and reviewed by Engineer for conformance with the design concept shall be executed in conformity with the Contract Documents unless otherwise required by Owner.

d. When Shop Drawings are submitted for the purpose of showing the installation in greater detail, their review shall not excuse Contractor from requirements shown on the drawings and Specifications.

e. For-Information-Only submittals upon which the Engineer is not expected to conduct review or take responsive action may be so identified in the Contract Documents.

2. *Samples:*

a. Submit number of required Samples specified in the Specifications.

b. Clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 6.17.D.

B. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. *Submittal Procedures:*

1. Before submitting each Shop Drawing or Sample, Contractor shall have:

a. reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

c. determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal.

3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawings or Sample submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation, otherwise Contractor will not be relieved of the responsibility of executing the Work in accordance with the Contract Documents, even though such Shop Drawings or Samples have been otherwise reviewed.
  - a. If a Shop Drawing or Sample, as submitted, indicates a variation from the Contract Requirements as set forth in the Contract Documents and Engineer finds same to be in the interest of Owner and to be so minor as not to involve a change in the Contract Price or time for performance, Engineer may approve the Shop Drawings or Samples; provided however, such departure is slight in nature and does not affect the design concept of the Work.
4. Contractor shall submit all Shop Drawings and Samples sufficiently in advance of construction requirements to allow ample time for checking, correcting, resubmitting and rechecking and to avoid any delay in progress of the Work.
5. See Specification Section 01340.
6. Shop Drawings and Sample submittals not conforming to requirements of this Paragraph 6.17C. and Specification Section 01340 will be returned to Contractor without action for resubmittal and the resulting delay shall be entirely the responsibility of Contractor.

D. *Engineer's Review:*

1. Engineer will provide timely review of required Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.



4. Engineer's check and review of Shop Drawings and Samples, Standard Specifications and descriptive literature submitted by Contractor will be only for general conformance with design concept, except as otherwise provided, and shall not be construed as:
- a. permitting any departure from the Contract Requirements;
  - b. relieving Contractor of the responsibility for any error in details, dimensions or otherwise that may exist in such submittals;
  - c. constituting a blanket approval of dimensions, quantities, or details of the material or equipment shown; or
  - d. approving departures from additional details or instructions previously furnished by Engineer. Such check or review shall not relieve Contractor of the full responsibility of meeting all of the requirements of the Contract Documents.

E. *Resubmittal Procedures:*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

6.18 *Continuing the Work*

- A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 *Contractor's General Warranty and Guarantee*

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on representation of Contractor's warranty and guarantee.
- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
  1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
  2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

1. observations by Engineer;
2. recommendation by Engineer or payment by Owner of any progress or final payment;
3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
4. use or occupancy of the Work or any part thereof by Owner;
5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;
6. any inspection, test, or approval by others; or
7. any correction of defective Work by Owner.

#### 6.20 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any ~~negligent~~-act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable .
- B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
- C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:
  1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or

2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

#### 6.21 *Delegation of Professional Design Services*

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable law.
- B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.
- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.
- D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

### **ARTICLE 7 – OTHER WORK AT THE SITE**

#### 7.01 *Related Work at Site*

- A. Owner may perform other work related to the Project at the Site with Owner's employees, or through other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:
  1. written notice thereof will be given to Contractor prior to starting any such other work; and
  2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.

- B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.
- C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

#### 7.02 *Coordination*

- A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:
  - 1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;
  - 2. the specific matters to be covered by such authority and responsibility will be itemized; and
  - 3. the extent of such authority and responsibilities will be provided.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

#### 7.03 *Legal Relationships*

- A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.
- B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's wrongful actions or inactions.
- C. Contractor shall be liable to Owner and any other contractor under direct contract to Owner for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's wrongful action or inactions.

## ARTICLE 8 – OWNER’S RESPONSIBILITIES

### 8.01 *Communications to Contractor*

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

### 8.02 *Replacement of Engineer*

A. In case of termination of the employment of Engineer, Owner shall appoint an engineer to whom Contractor makes no reasonable objection, whose status under the Contract Documents shall be that of the former Engineer.

### 8.03 *Furnish Data*

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

### 8.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

### 8.05 *Lands and Easements; Reports and Tests*

A. Owner’s duties with respect to providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph 4.02 refers to Owner’s identifying and making available to Contractor copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions relating to existing surface or subsurface structures at or contiguous to the Site that have been utilized by Engineer in preparing the Contract Documents.

### 8.06 *Insurance*

A. Owner’s responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

### 8.07 *Change Orders*

A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.03.

### 8.08 *Inspections, Tests, and Approvals*

A. Owner’s responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

### 8.09 *Limitations on Owner’s Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor’s means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply

with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

8.10 *Undisclosed Hazardous Environmental Condition*

- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 4.06.

8.11 *Evidence of Financial Arrangements*

- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents.

8.12 *Compliance with Safety Program*

- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed pursuant to Paragraph 6.13.D.

**ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION**

9.01 *Owner's Representative*

- A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract Documents.

9.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 9.09. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

### 9.03 *Project Representative*

A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided in ~~the Supplementary Conditions~~ Paragraph 9.03B., and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

B. Engineer's Resident Project Representative shall not authorize any deviation from the Contract Documents or substitutions of materials or equipment.

### 9.04 *Authorized Variations in Work*

A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor, who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

### 9.05 *Rejecting Defective Work*

A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

B. The acceptance at any time of materials or equipment by or on behalf of Owner shall not be a bar to future rejection if they are subsequently found to be defective, inferior in quality, or not equal to the material or equipment specified, or are not as represented to Engineer or Owner.

### 9.06 *Shop Drawings, Change Orders and Payments*

A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.

B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.

C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.

D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.05.

9.08 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question.

B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believes that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.

C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.

D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.09 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.



- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to the Resident Project Representative, if any, and assistants, if any.

#### 9.10 *Compliance with Safety Program*

- A. While at the Site, Engineer's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Engineer has been informed pursuant to Paragraph 6.13.D.

### **ARTICLE 10 – CHANGES IN THE WORK; CLAIMS**

#### 10.01 *Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

##### 1. *Change Proposal Request:*

- a. When Owner requests Contractor to present a proposal to accomplish a change in the Work, the request will be made in the form of a Change Proposal Request (CPR) prepared by Engineer. The CPR will describe the change and request Contractor to propose a cost and Contract Price and/or Contract Time change. Contractor will propose cost and/or time changes, if any, sign the CPR and return it to Engineer. If requested by Owner or Engineer, Contractor shall provide an itemized breakdown of the cost of the change. Engineer will make recommendations to Owner concerning acceptance. If the CPR is approved by Owner, the CPR will be included in a Change Order. Contractor is not authorized to proceed with a change contained in a CPR until the Change Order is properly signed and issued.
- b. When the Contractor desires to propose changes to the Work, it may initiate a CPR in the same form as provided in Paragraph 10.01A.1.a. and submit the CPR to the Engineer for the Engineer's review and recommendation.

- B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as

a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

#### 10.02 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.D.

#### 10.03 *Execution of Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:
  - 1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;
  - 2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and
  - 3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

#### 10.04 *Notification to Surety*

- A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

#### 10.05 *Claims*

- A. *Engineer's Decision Required:* All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.
- B. *Notice:* Written notice stating the general nature of each Claim shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30

days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Times shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).

- C. *Engineer's Action:* Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:
1. deny the Claim in whole or in part;
  2. approve the Claim; or
  3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.
- D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.
- E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.
- F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

## **ARTICLE 11 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK**

### **11.01 *Cost of the Work***

- A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 11.01.B, and shall include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.
2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.
4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
  - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
  - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
  - c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

- d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
- e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
- f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.
- g. The cost of utilities, fuel, and sanitary facilities at the Site.
- h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, express and courier services, and similar petty cash items in connection with the Work.
- i. The costs of premiums for all bonds and insurance Contractor is required by the Contract Documents to purchase and maintain.

B. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

- 1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.
- 2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
- 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
- 4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A.
- C. *Contractor's Fee:* When all the Work is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 12.01.C.
- D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

## 11.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.
- B. *Cash Allowances:*
1. Contractor agrees that:
    - a. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
    - b. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.
- C. *Contingency Allowance:*
1. Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

## 11.03 Unit Price Work

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the

actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.

- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item. Work described in the Contract Documents, or reasonably inferred as required for a functionally complete installation, but not identified in the listing of unit price items shall be considered incidental to unit price work listed and the cost of incidental work included as a part of the unit price.
- D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:
  - 1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and
  - 2. there is no corresponding adjustment with respect to any other item of Work; and
  - 3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

## **ARTICLE 12 – CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES**

### *12.01 Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.
- B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:
  - 1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or
  - 2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2), and shall include the cost of any secondary impacts that are foreseeable at the time of pricing the cost of extra Work; or
  - 3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).
- C. *Contractor's Fee:* The Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or
2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
  - a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;
  - b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;
  - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 12.01.C.2.a and 12.01.C.2.b is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;
  - d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;
  - e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
  - f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

#### 12.02 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.
- B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.
- C. No extension of the Contract Time will be allowed for additional Work or for claimed delay unless the additional Work contemplated or claimed delay is shown to be on the critical path of the Project's schedule of construction or Contractor can show by Critical Path Method analysis how the additional Work or claimed delay adversely affects the critical path.

#### 12.03 *Delays*

- A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in



Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

- B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.
- D. Owner, Engineer, and their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.
- E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

## **ARTICLE 13 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK**

### *13.01 Notice of Defects*

- A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. Defective Work may be rejected, corrected, or accepted as provided in this Article 13.

### *13.02 Access to Work*

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

### 13.03 *Tests and Inspections*

- A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.
- B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:
  - 1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;
  - 2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in Paragraph 13.04.C; and
  - 3. as otherwise specifically provided in the Contract Documents.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.
- E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation.
- F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

### 13.04 *Uncovering Work*

- A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.
- B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.
- C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs)

arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); or Owner shall be entitled to accept defective Work in accordance with Paragraph 13.08 in which case Contractor shall still be responsible for all costs associated with exposing, observing, and testing the defective Work, and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.

- D. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

### 13.05 *Owner May Stop the Work*

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

### 13.06 *Correction or Removal of Defective Work*

- A. Promptly after receipt of written notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).
- B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

### 13.07 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. repair such defective land or areas; or

2. correct such defective Work; or
  3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
  4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.
- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.
- E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

#### 13.08 *Acceptance of Defective Work*

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness) and for the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

### 13.09 *Owner May Correct Defective Work*

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days written notice to Contractor, correct, or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.
- C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.
- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

## **ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION**

### 14.01 *Schedule of Values*

- A. The Schedule of Values established as provided in Paragraph 2.07.A will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.

### 14.02 *Progress Payments*

#### *A. Applications for Payments:*

- 1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an

Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

*B. Review of Applications:*

1. Engineer will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:
  - a. the Work has progressed to the point indicated;
  - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and any other qualifications stated in the recommendation); and
  - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
  - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or

- involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or
- b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
    - a. to supervise, direct, or control the Work, or
    - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
    - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
    - d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or
    - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
  5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:
    - a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;
    - b. the Contract Price has been reduced by Change Orders;
    - c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or
    - d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

*C. Payment Becomes Due:*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor.

*D. Reduction in Payment:*

1. Owner may refuse to make payment of the full amount recommended by Engineer because:
  - a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;
  - b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
  - c. there are other items entitling Owner to a set-off against the amount recommended; or
  - d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.
2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor remedies the reasons for such action.
3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1 and subject to interest as provided in the Agreement.

14.03 *Contractor's Warranty of Title*

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

14.04 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

1. If portions of the Work have been determined not to be at a point of Substantial Completion and require re-inspection or retesting by Engineer, the cost of such re-inspection or retesting, including the cost of time, travel and living expenses, shall be paid by Contractor to Owner who will reimburse Engineer. Owner may offset said monies by deducting that amount from payments due to Contractor.



- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the tentative certificate to Owner, notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will, within said 14 days, execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.
- E. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the tentative list.

#### 14.05 *Partial Utilization*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:
  - 1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 14.04.A through D for that part of the Work.
  - 2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
  - 3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will

notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

#### 14.06 *Final Inspection*

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

#### 14.07 *Final Payment*

##### A. *Application for Payment:*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.
2. The final Application for Payment shall be accompanied (except as previously delivered) by:
  - a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.6;
  - b. consent of the surety, if any, to final payment;
  - c. a list of all Claims against Owner that Contractor believes are unsettled; and
  - d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

*B. Engineer's Review of Application and Acceptance:*

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

*C. Payment Becomes Due:*

1. Thirty days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and will be paid by Owner to Contractor.

14.08 *Final Completion Delayed*

- A. If, through no fault of Contractor, final completion of the Work is significantly delayed, and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment (for Work fully completed and accepted) and recommendation of Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if bonds have been furnished as required in Paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.09 *Waiver of Claims*

- A. The making and acceptance of final payment will constitute:

1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and
2. a waiver of all Claims by Contractor against Owner and/or Engineer other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner and/or Engineer in writing as still unsettled.

## ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

### 15.01 *Owner May Suspend Work*

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

### 15.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will justify termination for cause:
1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);
  2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;
  3. Contractor's repeated disregard of the authority of Engineer; or
  4. Contractor's violation in any substantial way of any provisions of the Contract Documents.

B. If one or more of the events identified in Paragraph 15.02A. occur, Owner will provide written notice to Contractor and Surety to arrange a conference with Contractor and Surety to address Contractor's failure to perform the Work. Conference shall be held not later than 15 days, after receipt of notice.

1. If the Owner, the Contractor, and the Surety do not agree to allow the Contractor to proceed to perform the Construction Contract, the Owner may, to the extent permitted by Laws and Regulations, declare a Contractor Default and formally terminate the Contractor's right to complete the Contract. Contractor Default shall not be declared earlier than 20 days after the Contractor and Surety have received notice of conference to address Contractor's failure to perform the Work.

2. If Contractor's services are terminated, Surety shall be obligated to take over and perform the Work. If Surety does not commence performance thereof within 15 consecutive calendar days after date of an additional written notice demanding Surety's performance of its obligations, then Owner, without process or action at law, may take over any portion of the Work and complete it as described below.

a. If Owner completes the Work, Owner may exclude Contractor and Surety from the site and take possession of the Work and of all tools, appliances, construction equipment and machinery at the site and use the same to the full extent they could be used by Contractor and Surety (without liability to Contractor and Surety for trespass or conversion), incorporate in the Work all materials and equipment stored at the site or for which Owner

has paid Contractor or Surety but which are stored elsewhere, and finish the Work as Owner may deem expedient.

3. Whether Owner or Surety completes the Work, Contractor shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds all claims, costs, losses and damages sustained by Owner arising out of or resulting from completing the Work, such excess will be paid to Contractor. If such claims, costs, losses and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and when so approved by Engineer incorporated in a Change Order, provided that when exercising any rights or remedies under this Paragraph, Owner shall not be required to obtain the lowest price for the Work performed.
4. Neither Owner, Engineer, nor any of their respective consultants, agents, officers, directors or employees shall be in any way liable or accountable to Contractor or Surety for the method by which the completion of the said Work, or any portion thereof, may be accomplished or for the price paid therefor.
5. Owner, notwithstanding the method used in completing the Contract, shall not forfeit the right to recover damages from Contractor or Surety for Contractor's failure to timely complete the entire Contract. Contractor shall not be entitled to any claim for damages on account of the method used by Owner in completing the Contract.
6. Maintenance of the Work shall continue to be Contractor's and Surety's responsibilities as provided for in the bond requirements of the Contract Documents or any special guarantees provided for under the Contract Documents or any other obligations otherwise prescribed by law.

~~B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:~~

- ~~1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion);~~
- ~~2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere; and~~
- ~~3. complete the Work as Owner may deem expedient.~~

C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and

damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

- D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.
- E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.
- F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B and 15.02.C.

#### 15.03 *Owner May Terminate For Convenience*

- A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
  - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
  - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;
  - 3. all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and
  - 4. reasonable expenses directly attributable to termination.
- B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

#### 15.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30

days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.

- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

## **ARTICLE 16 – DISPUTE RESOLUTION**

### *16.01 Methods and Procedures*

- A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.
- B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.
- C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:
1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions; or
  2. agrees with the other party to submit the Claim to another dispute resolution process; or
  3. gives written notice to the other party of the intent to submit the Claim to a court of competent jurisdiction.

## **ARTICLE 17 – MISCELLANEOUS**

### *17.01 Giving Notice*

- A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended; or
2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

#### 17.02 *Computation of Times*

- A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

#### 17.03 *Cumulative Remedies*

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this Paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

#### 17.04 *Survival of Obligations*

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

#### 17.05 *Controlling Law*

- A. This Contract is to be governed by the law of the state in which the Project is located.

#### 17.06 *Headings*

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.



1 2014/09/16

2 **SECTION 00805**  
3 **SUPPLEMENTARY CONDITIONS**  
4 **TO**  
5 **EJCDC GENERAL CONDITIONS, 1910-8 (2007 EDITION)**

6  
7 **Supplementary Conditions**

8  
9 These Supplementary Conditions amend and supplement Section 00700 - General Conditions, and other  
10 provisions of the Contract Documents as indicated below. All provisions of the General Conditions that are  
11 amended or supplemented remain in full force and effect as so amended or supplemented. All provisions of  
12 the General Conditions which are not so amended or supplemented remain in full force and effect.

13  
14 **Defined Terms**

15  
16 The terms used in these Supplementary Conditions which are defined in the General Conditions have the  
17 meaning assigned to them in the General Conditions.

18  
19 **Amendments and Supplements**

20  
21 The following are instructions that amend or supplement specific paragraphs in the General Conditions and  
22 other Contract Documents.

23  
24 **ARTICLE 1 - DEFINITIONS AND TERMINOLOGY**

25  
26 **SC-1.01A.3.**

27  
28 Change reference "ENGINEER" to "OWNER and ENGINEER".

29  
30 **SC-1.01A.19.**

31  
32 Add a new paragraph to GC-1.01A.19. which is to read as follows:

33  
34 "a. Whenever the word "ENGINEER" is used in the Contract Documents, it shall be understood to be  
35 HDR Engineering, Inc."

36  
37 **SC-1.01A.20.**

38  
39 Change reference "ENGINEER" to "OWNER and ENGINEER".

40  
41 **SC-1.01A.29.**

42  
43 Add a new paragraph to Paragraph GC-1.01A.29. which is to read as follows:

44  
45 "a. Whenever the word "OWNER," "DISTRICT" or "MUD" is used in the Contract Documents, it shall  
46 be understood to be the Metropolitan Utilities District of Omaha, and duly authorized  
47 representatives thereof."

48  
49 **SC-2.02A.**

50  
51 Delete "ten printed or hard copies" and replace with "three printed or hard copies".

52  
53 **SC-2.03A.**

54  
55 Modify the last sentence of the paragraph to read as follows:

56  
57 "In no event shall the Contract Times commence to run later than the ninetieth day after the day of Bid  
58 opening or the thirtieth day after the effective day of the Agreement, whichever is earliest."  
59

1 **SC-2.06A.**

2  
3 Modify the first sentence of the paragraph to read as follows:

4  
5 "A. After Notice of Award but before any Work at the site is started (except with approval of OWNER),  
6 a conference attended by CONTRACTOR, ENGINEER, OWNER and others..."  
7

8 **SC-2.07A.**

9  
10 Modify the first sentence of the paragraph to read as follows:

11  
12 "A. Unless otherwise provided in the Contract Documents, at least 10 days before submission of the  
13 first application for payment, a conference attended by CONTRACTOR, OWNER and others as..."  
14

15 Modify last sentence of the paragraph by changing reference from "ENGINEER" to "OWNER and  
16 ENGINEER".  
17

18 **SC-2.07A.1.**

19  
20 Change reference "ENGINEER" to "OWNER and ENGINEER".  
21

22 **SC-2.07A.3.**

23  
24 Change reference "ENGINEER" to "OWNER and ENGINEER".  
25

26 **SC-4.02A**

27  
28 **SC-4.02A-1.**

29  
30 Add the following Supplemental Information:

- 31 Filter Plant – 1924 Original Drawings.
  - 32 Filter Plant –1932 Expansion Drawings.
  - 33 Filter Plant –1954 Expansion Drawings.
  - 34 Filter Plant –1977 Restoration and Renovation Drawings.
  - 35 Geotechnical Information Report – Kleinfelder - March.2012.
  - 36 "Lead Based Paint Testing/Survey" - 2012
- 37

38 **SC-4.05**

39  
40 Delete the first sentence of Paragraph GC-4.05A. and substitute the following:

41  
42 "CONTRACTOR shall engage, at CONTRACTOR'S expense, a registered professional engineer or  
43 licensed land surveyor to establish for CONTRACTOR a baseline and datum benchmark necessary to  
44 enable CONTRACTOR to proceed with the Work. Said engineer or surveyor shall submit to OWNER a  
45 plat showing the baseline and datum benchmark, ties to existing permanent physical features, and shall  
46 certify the accuracy of said survey."  
47

48 **SC-5.04**

49  
50 Add a new paragraph immediately after Paragraph GC-5.04B.8. which is to read as follows:

51  
52 "C. The limits of liability for the insurance required by Paragraph 5.04 shall provide coverage for not  
53 less than the following amounts, or greater where required by law:

- 54  
55 1. For workers' compensation, and related coverage under Paragraphs 5.04A.1. and 5.04A.2.:
    - 56  
57 a. Applicable Federal or State: Statutory
    - 58  
59 b. Maritime: Not required
    - 60  
61 c. Railroad: Not required
- 62

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- d. Employer's Liability: \$500,000
- 2. For CONTRACTOR's general liability insurance under Paragraphs 5.04A.3. through 5.04A.5. and Paragraph 5.04B. (including Premises-Operations, Independent Contractor's Protection, Products and Completed Operations, Broad Form Property Damage, Contractual Liability):
  - a. Bodily Injury:
    - \$1,000,000 Each Occurrence
    - \$2,000,000 Annual Aggregate
  - b. Property Damage:
    - \$1,000,000 Each Occurrence
    - \$2,000,000 Annual Aggregate
  - c. Property Damage liability insurance shall provide Explosion, Collapse and Underground coverages.
  - d. Excess Liability Umbrella:
    - \$2,000,000 Each Occurrence
    - \$2,000,000 Annual Aggregate
- 3. For CONTRACTOR's Automobile Liability under Paragraph 5.04A.6.:
  - a. Bodily Injury:
    - \$500,000 Each Person
    - \$1,000,000 Each Accident
  - b. Property Damage:
    - \$1,000,000 Each Occurrence
    - Or Combined Single Limit of \$1,000,000

**SC-5.06A.**

Delete Paragraph 5.06A. in its entirety and substitute the following:

- "A. Unless otherwise provided in the Supplementary Conditions, CONTRACTOR shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof. Any deductible amounts applicable to said insurance are to be for the account of CONTRACTOR. This insurance shall:
  - 1. include the interests of OWNER, CONTRACTOR, Subcontractors at all tiers, ENGINEER, and any other individuals or entities identified in the Supplementary Conditions.
  - 2. be written on a Builder's Risk "all risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, false work, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, and such other perils or causes of loss as may be specifically required by the Supplementary Conditions;
  - 3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

- 1  
2 4. cover materials and equipment stored at the Site or at another location that was agreed to in  
3 writing by OWNER prior to being incorporated in the Work, provided that such materials and  
4 equipment have been included in an Application for Payment recommended by ENGINEER;  
5  
6 5. allow for partial utilization of the Work by OWNER;  
7  
8 6. include testing and startup; and  
9  
10 7. be maintained in effect until such time as the insured property is occupied by the Owner."

11  
12 **SC-5.06E.**

13  
14 Delete the entire paragraph.

15  
16 **SC-6.02B.**

17  
18 Delete the entire paragraph.

19  
20 **SC-6.03A.**

21  
22 Modify General Conditions Paragraph 6.03A by adding the following sub-paragraph:

- 23  
24 "2. Owner represents that the Drawings depict only one arrangement that has been coordinated for  
25 wall penetrations, and interference with existing structural components. As such the Contractor  
26 acknowledges that:  
27 a. The Drawings do not depict every detail of every fitting, device, connection or ancillary  
28 component required for a complete and functioning installation; and  
29 b. Such details of fittings, devices, connections or ancillary components will be developed  
30 through approved Shop Drawings and such fittings, devices, connections or ancillary  
31 components will be provided at no additional cost to the District.

32  
33 **SC-6.04A.1.**

34  
35 Change reference "ENGINEER" to "OWNER and ENGINEER".

36  
37 **SC-6.05A.1.**

38  
39 Add the following after the first sentence:

40  
41 " "or-equal items" will be considered only after Award of Contract."

42  
43 **SC-6.08**

44  
45 Add a new subparagraph immediately after Paragraph 6.08A, which is to read as follows:

- 46  
47 "B. The Owner shall obtain the following permits and authorizations as needed:  
48 • Nebraska Department of Environmental Quality Construction Storm Water Notice of Intent  
49 (known as NPDES permit). Summary of permit contents is available on NDEQ website.  
50 • Papillion Creek Watershed Partnership grading Permit (OMA 20121019-1395-2).

51  
52 The Contractor shall obtain all other permits required for the project."

53  
54 **SC-6.12A.**

55  
56 Modify the last sentence of the General Conditions Paragraph 6.12 by adding the following after the word  
57 "items":

58  
59 "furnished under the Work of this Contract."  
60

1 **SC-6.16A.**

2  
3 Change reference "ENGINEER" in third sentence to "OWNER or ENGINEER".  
4 Change reference "ENGINEER" in fifth sentence to "OWNER or ENGINEER".

5  
6 **SC-6.19**

7  
8 Add a new paragraph immediately after Paragraph GC-6.19C.7. as follows:

9  
10 "D. The CONTRACTOR further warrants that all equipment, materials and/or supplies, not specified but  
11 furnished under the Contract to provide a functionally complete Project as required by GC  
12 Paragraph 3.01B., are fit for the purpose intended and shall perform in accordance with the  
13 requirements of the Contract. Contractor shall cause any Uniform Commercial Code implied  
14 warranties of goods incorporated into the Work to pass to the District by stipulations included in  
15 purchase orders used to procure goods."

16  
17 **SC-6.20**

18  
19 Modify General Conditions Paragraph 6.20A. by restoring the word "negligent" in the last sentence and by  
20 adding the following new sub-paragraph:

21  
22 "CONTRACTOR explicitly waives any right it has to immunity under applicable industrial insurance  
23 laws and agrees to indemnify, defend and hold ENGINEER, OWNER, their employees, officers,  
24 directors and board members harmless from any and all liability, losses, costs, expenses and fees  
25 arising out of claims or law suits brought by CONTRACTOR'S employees or any of its  
26 subcontractors' employees for bodily injuries or death sustained while performing services  
27 hereunder, except to the extent caused by the gross negligence or willful misconduct of ENGINEER  
28 or OWNER."

29  
30 **SC-9.03**

31  
32 Delete this Section in its entirety.

33  
34 **SC-9.05A.**

35  
36 Change reference "ENGINEER" to "OWNER or ENGINEER".

37  
38 **SC-9.07A.**

39  
40 Change reference "ENGINEER" to "OWNER or ENGINEER " in first, second, fourth and fifth sentences.

41  
42 Change reference "OWNER and CONTRACTOR" in sixth sentence to "CONTRACTOR".

43  
44 **SC-10.01A.1.a.**

45  
46 Modify the first sentence in the paragraph to read as follows:

47  
48 "a). When OWNER requests CONTRACTOR to present a proposal to accomplish a change in the  
49 Work, the request will be made in the form of a Change Proposal Request (CPR) prepared by  
50 OWNER or ENGINEER."

51  
52 **SC-10.01A.1.b.**

53  
54 Modify the paragraph to read as follows:

55  
56 "b). When the CONTRACTOR decides to propose changes to the Work, CONTRACTOR may initiate a  
57 CPR in the same form as provided in Paragraph 10.01A.1.a. and submit the CPR to OWNER for  
58 OWNER's and ENGINEER's review and recommendation."

59  
60 **SC-10.05A., B., C., D. and E.**

61  
62 Change reference "ENGINEER" to "OWNER and ENGINEER ".

1  
2 **SC-10.05G.**  
3

4 Add a new paragraph following Paragraph GC10.05F. to read as follows  
5

6 "G. *Claims for Consequential Damages:* The contractor and Owner waive Claims against each other for  
7 consequential damages arising out of or relating to this contract. This mutual waiver includes:

- 8 1. damages incurred by the Owner for rental expenses, for losses of use, income, profit,  
9 financing, business and reputation, and for loss of management or employee productivity or of  
10 the services if such persons; and  
11 2. damages incurred by the contractor for principal office expenses including the compensation of  
12 personnel stationed there, for losses if financing, business and reputation, and for loss of profit  
13 except anticipated profit arising directly from the Work.

14 This mutual waiver is applicable, without limitation, to all consequential damages due to either  
15 party's termination in accordance with Article 15. Nothing contained in this subparagraph *shall* be  
16 deemed to preclude an award of liquidated damages, when applicable, in accordance with the  
17 requirements of the Contract Documents.  
18

19 **SC-11.03**  
20

21 Delete this Section in its entirety.  
22

23 **SC-12.03**  
24

25 Add a new paragraph after Paragraph GC-12.03A. which is to read as follows:  
26

- 27 "1. Time extensions will not be granted for rain, wind, flood, or other natural phenomena of normal  
28 intensity for the locality where Work is performed. For purpose of determining extent of delay  
29 attributable to unusual weather phenomena, a determination shall be made by comparing the  
30 weather for a minimum continuous period of at least one-fourth (1/4) of the Contract Time involved  
31 with the average of the preceding 5-year climatic range during the same time interval based on  
32 U.S. Weather Bureau statistics for the locality where the Work is performed."  
33

34 **SC-13-03A.**  
35

36 Change reference "ENGINEER" to "OWNER and ENGINEER".  
37

38 **SC-13.03C.**  
39

40 Change reference "ENGINEER" in last sentence to "OWNER and ENGINEER".  
41

42 **SC-13.03E.**  
43

44 Change reference "ENGINEER" to "OWNER and ENGINEER".  
45

46 **SC-13.03F.**  
47

48 Change reference "ENGINEER" to "OWNER and ENGINEER".  
49

50 **SC-13.04A. and B.**  
51

52 Change reference "ENGINEER" to "OWNER and ENGINEER".  
53

54 **SC-13.06A.**  
55

56 Change reference "ENGINEER" to "OWNER and ENGINEER".  
57

58 **SC-13.08A.**  
59

60 Change reference "ENGINEER" to "OWNER and ENGINEER".  
61

1 **SC-13.09A.**

2  
3 Change reference "ENGINEER" to "OWNER and ENGINEER".

4  
5 **SC-14.01A.**

6  
7 Change reference "ENGINEER" to "OWNER and ENGINEER".

8  
9 **SC-14.02**

10 Delete this Section in its entirety and replace it with the following:

11  
12  
13 "14.02 *Progress Payments*

14  
15 A. *The District shall make payments as follows:*

16 **1. Partial payment while Work is in progress.** On or about the end of each month,  
17 the Contractor shall make an estimate of the total Work completed. Work completed shall mean  
18 Work completed in place or materials delivered to and properly stored at the Work site. The  
19 Contractor shall deliver to the District, a breakdown of the estimate. The Contractor shall prepare,  
20 sign, notarize and deliver to the District A.I.A. forms G702 and G703, or equivalent, or the District's  
21 *Certificate Covering Estimate on Contract Work*. After the District approves each estimate, the  
22 District shall pay to the Contractor, within 10 days, the amounts provided for in the Agreement for  
23 the estimate less the amount of all previous payments. If the District shall fail to make an estimate  
24 or payment within the time stated above, such failure shall not be held to violate the Contract.

25 **2. Payment withheld.** The District may withhold payment or, based on subsequently  
26 discovered information, nullify the whole or part of any estimate of payment to the extent necessary  
27 to protect itself from loss from:

- 28 a. Defective workmanship or materials not remedied.  
29 b. Claims filed or reasonable evidence indicating probable filing of claims.  
30 c. Failure of the CONTRACTOR to make proper payments to Subcontractors or for  
31 materials or labor.  
32 d. Any other failure to comply with the Contract Documents."  
33

34 When the above grounds are removed, the District shall make the payments withheld due to them.

35  
36 **SC-14.06A.**

37  
38 Modify first sentence in the paragraph to read as follows:

39  
40 "A. Upon written notice from CONTRACTOR that the entire Work or an agreed portion thereof is  
41 complete, OWNER and ENGINEER will promptly make a final inspection with CONTRACTOR and  
42 will notify CONTRACTOR in writing of all particulars in which this inspection reveals that the Work  
43 is incomplete or defective."  
44

45 **SC-14.07**

46  
47 Delete this Section in its entirety and replace it with the following:

48  
49 "14.07 *Final Payment*

50  
51 A. **Correction of Work Before Final Payment.** The Contractor shall promptly remove from the  
52 Work site all work and materials condemned by the District as failing to meet the requirements of  
53 the Contract Documents, whether incorporated into the Work or not. The Contractor shall promptly  
54 replace and re-execute the Work and shall pay the expense of replacing or repairing the work of  
55 other Contractors or Subcontractors destroyed or damaged by such removal, replacement or re-  
56 execution.  
57

1 If the Contractor does not remove condemned work and materials within 10 days after written  
2 notice, the District may remove them and may store the materials at the Contractor's expense. If  
3 the Contractor does not pay the expense of such removal and storage within 30 days thereafter, the  
4 District may, upon 10 days written notice, sell the materials at auction or at private sale and shall  
5 pay to the Contractor the net proceeds after deduction all expenses that should have been borne by  
6 the Contractor.

7  
8 **B. Affidavit That All Bills Have Been Paid.** Upon completion of the Work and prior to final  
9 payment, the Contractor shall file an affidavit with the District stating that all workers employed on  
10 the Work and the suppliers of all supplies and materials used in the Work have been paid in full.  
11 The affidavit shall also state that the Contractor has paid the cost of damage to all utilities that may  
12 have occurred in conjunction with the Work.

13  
14 **C. Unemployment Compensation and Final Payment.** The Contractor shall pay to the  
15 Unemployment Compensation Fund of the State of Nebraska unemployment contributions and  
16 interest due under the provisions of Neb. Stat. Sections 48-601 through 48-671, as amended, on  
17 wages paid to individuals employed in the performance of the Contract.

18  
19 Before the District pays the final three percent (3%) of the Contract amount, the Contractor shall  
20 submit to the District a written clearance from the Commissioner of Labor certifying that all  
21 payments then due for contributions or interest relating to the Contract have been made by the  
22 Contractor or Subcontractors to the Unemployment Compensation Fund.

23  
24 **D. Final Statement.** Prior to final payment, the Contractor shall submit a final statement to the  
25 District showing the total Contract amount and all previous payments made.

26  
27 **E. Final Payment.** When the Work is completed and the District has accepted all tests, the  
28 District shall prepare a final estimate and forward it to the Contractor with the necessary forms for  
29 processing as previously described. Final payment shall be made within 30 days after final  
30 acceptance of the Work, subject to the provision of Paragraphs A., B., C. and D. above and  
31 approval of the District's Board of Directors. Final payment made and accepted shall constitute a  
32 waiver of District claims, other than claims remaining unsettled, arising from faulty work or materials  
33 appearing after final payment, and of Contractor claims against OWNER and ENGINEER, other  
34 than claims remaining unsettled.”

35  
36 **SC-15.04A.**

37  
38 Delete Paragraph 15.04A. as modified and substitute the following:

39  
40 “A. If, through no act or fault of CONTRACTOR, the Work is suspended for more than 90 consecutive  
41 days by OWNER or under an order of court or other public authority, or OWNER fails for 30 days to  
42 pay CONTRACTOR any sum finally determined to be due, then CONTRACTOR may, upon seven  
43 days written notice to OWNER, and provided OWNER does not remedy such suspension or failure  
44 within that time, terminate the Contract and recover from OWNER payment on the same terms as  
45 provided in paragraph 15.03. In lieu of terminating the Contract and without prejudice to any other  
46 right or remedy, if OWNER has failed for 30 days to pay CONTRACTOR any sum finally  
47 determined to be due, CONTRACTOR may, seven days after written notice to OWNER, stop the  
48 Work until payment is made of all such amounts due CONTRACTOR, including interest thereon.  
49 The provisions of this paragraph 15.04 are not intended to preclude CONTRACTOR from making a  
50 Claim under paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for  
51 expenses or damage directly attributable to CONTRACTOR's stopping the Work as permitted by  
52 this paragraph.”

53  
**END OF SECTION**





**DIVISION 01**  
**GENERAL REQUIREMENTS**





1 2014/09/05

2

3

**SECTION 01060**  
**SPECIAL CONDITIONS**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6 A. Section Includes:

- 7 1. Administrative and procedural requirements for:
- 8 a. Preconstruction Conference.
  - 9 b. Contractor's Superintendent's Field Office.
  - 10 c. Drawings and Contract Documents for Contractor use.
  - 11 d. Testing and Special Inspections.
  - 12 e. Schedule of Values.
  - 13 f. Order of Construction and Construction Schedule.
  - 14 g. Construction Sequence Constraints.
  - 15 h. Project meetings.
  - 16 i. Special considerations related to adjacent properties and facilities.

17 B. Related Specification Sections include but are not necessarily limited to:

- 18 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 19 2. Division 01 - General Requirements.

20 **1.2 PRECONSTRUCTION CONFERENCE**

21 A. A preconstruction conference shall be held at Florence Water Treatment Plant after award of  
22 Contract.

- 23 1. Engineer will notify the Contractor as to the date and time of the conference two (2) weeks in  
24 advance of the proposed date.
- 25 2. Contractor's Project Manager and Project Superintendent and Contractor's Subcontractor  
26 Representatives shall attend.

27 **1.3 CONTRACTOR'S SUPERINTENDENT'S FIELD OFFICE**

28 A. Establish at site of Project.

29 B. Equipment: Telephone, telecopy, mailing address, and sanitary facilities.

30 C. Assure attendance at this office during the normal working day.

31 D. At this office, maintain complete field file of Shop Drawings, posted Contract Drawings and  
32 Specifications, and other files of field operations including provisions for maintaining "As  
33 Recorded Drawings."

34 E. Remove field office from site upon acceptance of the entire work by the Owner.

35 **1.4 DRAWINGS AND CONTRACT DOCUMENTS FOR CONTRACTOR USE**

36 A. Refer to General Conditions.

37 B. Contractor shall pick up all "no-charge" documents within 10 days from date of Notice to Proceed.

38 C. Additional documents after "no-charge" documents will be furnished to Contractor at cost.

39 **1.5 TESTING AND SPECIAL INSPECTIONS**

40 A. Payment for Soil, Concrete and Other Testing:

41 1. Soils and concrete testing:

- 42 a. The Owner will pay for "Passing" soils and "Passing" concrete tests on the Project.
- 43 b. Costs of corrective action, costs of "Failing" soils and concrete tests, and cost of testing  
44 associated with establishment of mix design are the sole responsibility of the Contractor.
- 45 c. See Section 01452.

- 1 B. Product Production Testing:
- 2 1. This testing category addresses all factory and fabrication plant testing required to certify that
- 3 materials meet Contract Document requirements.
- 4 2. Examples of this category of testing include steel mill tests, concrete block certification,
- 5 establishment of mix designs, etc.
- 6 3. Documentation requirements may include definition of factory test procedures, testing
- 7 reports, certificates or other forms as applicable.
- 8 4. Costs associated with all phases of securing satisfactory product production testing
- 9 information required by the Contract Documents are the full responsibility of the Contractor.
- 10 C. Field Testing:
- 11 1. Strength/condition of materials testing:
- 12 a. This testing category addresses all testing required to verify strength of materials or
- 13 conditions of subgrade or fireproofing during construction.
- 14 b. Examples of this subcategory of testing include soil density testing, concrete testing,
- 15 grout and mortar testing, structural steel, weld testing and sprayed fire resistant
- 16 materials testing.
- 17 c. Owner will hire independent testing lab(s) for this testing.
- 18 d. Costs associated with first time tests will be paid for by the Owner.
- 19 1) Costs of corrective action and costs of retesting are the sole responsibility of the
- 20 Contractor.
- 21 e. See Section 01452.
- 22 2. Non-strength related testing:
- 23 a. This subcategory addresses non-strength related testing such as HVAC balancing,
- 24 piping pressure testing, di-electric testing, etc.
- 25 b. Documentation requirements may include definition of test procedures, testing reports,
- 26 certificates or other forms as applicable.
- 27 c. Contractor shall hire an independent testing lab(s) for these tests.
- 28 1) Some applications of testing (such as pipe pressure testing) may be done using the
- 29 Contractor's forces with prior approval from Owner.
- 30 d. Costs associated with all phases of securing required satisfactory test information
- 31 required by the Contract Documents are the full responsibility of the Contractor.
- 32 D. Special Inspections:
- 33 1. This category addresses special inspections required by code to verify that materials are
- 34 properly constructed.
- 35 2. See Section 01452.
- 36 3. Work requiring special inspections will be discussed at the pre-construction meeting.
- 37 4. Contractor shall provide timely access to construction to allow special inspections and shall
- 38 provide a schedule of work every two (2) weeks to coordinate with the Owner such that
- 39 special inspectors may be made available as required.
- 40 5. Contractor shall provide necessary means (such as a hydraulic lift) to allow special
- 41 inspection to take place.

## 42 1.6 SCHEDULE OF VALUES

- 43 A. Where a Contract is awarded on a lump sum basis, the Contractor shall file with the Engineer a
- 44 balanced price segregation of the lump sum bid for each PCS and further into items similar to the
- 45 various subdivisions of the general and detailed specifications, the sum of which shall equal the
- 46 lump sum bid.
- 47 1. The cost of various materials shall be furnished upon request of the Engineer, and such data
- 48 will then be used as a basis for making progress estimates.
- 49 2. Breakdown costs, itemized by Project Classified System (PCS), Specification Section and
- 50 trade, and distribute cost to individual applicable units and structures.
- 51 3. Where structures, units, equipment or other components are identified by a specific series or,
- 52 identification number, utilize said designation throughout cost breakdown.
- 53 4. Provide detailed breakdown for individual yard piping or conduit runs and identify
- 54 approximate quantities involved to satisfaction of the Engineer.
- 55 5. Provide separate breakdown for change order items requested.
- 56 6. Provide an additional breakdown sheet, equivalent to EJCDC Document C620, Page 3 of 3,
- 57 showing the tabulation format for stored materials.
- 58 7. Submit this sheet each month with Contractor's pay request breakdown.

- 1           8. The detail and format of cost breakdown and stored materials tabulation sheet shall be fully  
2 approved by Engineer.
- 3           B. A reasonable allocation of the Contract Price to the component parts of the Work will be approved  
4 if component parts of the Work have values assigned to them that are well-balanced with respect to  
5 relative values for similar work established by published estimating guides.
- 6           1. Unless otherwise agreed to at the Preconstruction Conference, Means Estimator Guide or  
7 other similar nationally recognized estimating guide shall be used for resolving differences  
8 between Engineer's and Contractor's opinions of allocation of values.
- 9           2. Consent of Surety: If Contractor and Engineer cannot mutually agree on a Schedule of  
10 Values, Engineer will approve a Schedule of Values approved by the Surety providing the  
11 Performance Bond.
- 12           C. Schedule of Values shall be agreed upon prior to first Application for Payment.

13 **1.7 ORDER OF CONSTRUCTION AND CONSTRUCTION SCHEDULE**

- 14           A. Construction operations will be scheduled to allow the Owner uninterrupted operation of existing  
15 adjacent facilities except as noted in 1.8 of this Section.
- 16           B. Within 10 days after award of Contract, submit for approval a critical path type baseline schedule.
- 17           1. Account for schedule of Subcontracts.
- 18           2. Include proper sequence of construction, various crafts, purchasing time, Shop Drawing  
19 approval, material delivery, equipment fabrication, start-up, demonstration, and similar time  
20 consuming factors.
- 21           3. Show on schedule as a minimum, earliest starting, earliest completion, latest starting, latest  
22 finish, and free and total float for each task or item.
- 23           4. Schedule shall be based upon the PCS substantial completion defined in this Section.
- 24           5. Schedule shall include key shutdowns, tie-ins to existing systems, removal of existing  
25 systems or other key dates requiring coordination with the District.
- 26           C. Evaluate schedule no less than monthly.
- 27           1. Update, correct, and rerun schedule and submit to Owner and Engineer in triplicate with pay  
28 application to show rescheduling necessary to reflect true job conditions.
- 29           2. When shortening of various time intervals is necessary to correct for behind schedule  
30 conditions, indicate actions to implement to accomplish work in shorter duration.
- 31           3. Information shall be submitted to Owner and Engineer in writing with revised schedule.
- 32           D. If Contractor does not take necessary action to accomplish work according to schedule,  
33 Contractor may be ordered by Owner in writing to take necessary and timely action to improve  
34 work progress.
- 35           1. Owner may require increased work forces, extra equipment, extra shifts or other action as  
36 necessary.
- 37           2. Should Contractor refuse or neglect to take such action authorized, under provisions of this  
38 contract, Owner may take necessary actions including, but not necessarily limited to,  
39 withholding of payment and termination of Contract.
- 40           E. Construction scheduling requirements shall be as follows.
- 41           1. Demolition work shall be accomplished as shown on the Drawings with input from the Owner.
- 42           a. The Contractor shall not demolish any structure, facility, or system without the Owner's  
43 prior approval.
- 44           b. Contractor shall be mindful that the existing facilities will remain in operation throughout  
45 construction.
- 46           2. Pavement, roads, driveways, sidewalks, and other surfaces shall be restored to temporary  
47 driving conditions as soon as possible.
- 48           a. Final pavement, road, driveway and/or sidewalk replacement shall be completed prior to  
49 substantial completion.
- 50           3. Installation of valves, interior exposed piping, supports, and other structures shall be  
51 installed, labeled and operational prior to the substantial completion and/or hydrostatic  
52 testing.
- 53           4. Miscellaneous landscaping, seeding, or other miscellaneous activities may take place after  
54 substantial completion, but prior to final completion.
- 55           5. Other miscellaneous Work on this project not identified above shall be completed with the  
56 Contract Time allotted.

- 1 F. See Article 1.8 and Section 01601 for additional sequencing constraints.
- 2 G. See Section 01650 for requirements of substantial completion.
- 3 H. See Article 2 of the General Conditions for additional requirements for the Project Schedule.

4 **1.8 CONSTRUCTION SEQUENCE CONSTRAINTS**

- 5 A. See Section 01650 for description of Project Classified Systems (PCS's).
- 6 B. See Section 01601 for additional requirements for maintaining facility operations and project  
7 conditions.
- 8 C. It shall be the Contractor's responsibility to dewater and isolate the Work such that MUD may  
9 maintain operations of the plant. Only single isolation from ongoing plant operations and the  
10 distribution system is available. In addition, MUD will not guarantee the operation and water  
11 tightness of existing valves, gate structures, stop logs, etc. that may be used to isolate the  
12 Contractor's Work. The Contractor shall be responsible for providing any additional means of  
13 isolation and dewatering as needed to complete the Work at no additional cost.
- 14 D. PCS 1 shall consist of the work associated with the north and center gallery sections of the filter  
15 plant, both upper and lower areas, the roof area, interior of influent channel, and bounded by Grid  
16 Lines A to G in the East-West direction and 1-9 in the North-South direction. In addition, PCS 1  
17 shall include the installation of temporary and permanent chemical injection tie-ins to the 54 IN  
18 by-pass line feeding the north half of the filter plant. Chemicals to be rerouted are chlorine  
19 solution, ammonia, fluoride, polymer and sample line. Existing 16 IN filter air scour piping  
20 crossing beneath the filter influent flume shall remain in service throughout PCS 1. PCS 1 shall  
21 be completed, fully operational, and brought to substantial completion prior to September 1, 2015  
22 and prior to commencing work on PCS 2.
- 23 E. The north section of the filter plant, filters 13 through 24, will be removed from service and the  
24 filters drained during the period November 18, 2014 to September 1, 2015 to allow work for PCS  
25 1.
- 26 F. A plant shutdown may be required to initiate the installation of the stop logs to isolate the north  
27 portion of the filter plant for PCS 1 work. The plant shutdown will be a single event with a  
28 maximum duration of 1 day.
- 29 G. PCS 2 shall consist of the work associated with the south section of the filter plant, both upper  
30 and lower areas, the roof area, the chemical building addition, and bounded by Grid Lines BTO G  
31 in the East-West direction and South of Grid Line 9 including the new chemical addition. Existing  
32 16 IN filter air scour piping crossing beneath the filter influent flume shall remain in service until  
33 the installation of the filter air scour loops is complete at both ends of the lower level pipe gallery.  
34 PCS 2 shall be completed, fully operational, and brought to substantial completion prior to July 1,  
35 2016. Excavation for chemical building addition shall not commence until the influent channel  
36 from Basin 1 to the south filters is drained.
- 37 H. The south section of the filter plant, filters 1 through 12, will be removed from service and the  
38 filters drained during the period September 1, 2015 to July 1, 2016 to allow work for PCS 2.
- 39 I. PCS 3 shall consist of all other work not in PCS 1 and PCS 2. PCS 3 shall commence on  
40 November 18, 2014 and shall be completed, fully operational, and brought to substantial  
41 completion prior to July 1, 2016. Modifications and tie ins to the chemical feed systems, electrical  
42 systems and Instrumentation systems shall be coordinated and scheduled with the District in  
43 order to maintain operation of the water treatment facility.

44 **1.9 PROJECT MEETINGS**

- 45 A. Construction Meetings:
  - 46 1. The Engineer will conduct construction meetings involving:
    - 47 a. Contractor's project manager.
    - 48 b. Contractor's project superintendent.
    - 49 c. Owner's designated representative(s).
    - 50 d. Engineer's designated representative(s).
    - 51 e. Contractor's subcontractors as appropriate to the Work in progress.
    - 52 f. Owner's Construction Quality Control Consultant.
  - 53 2. Meetings will be conducted every 2 weeks, or more frequently as required by Owner.

- 1 3. The Owner will take meeting minutes and submit copies of meeting minutes to participants
- 2 and designated recipients identified at the Preconstruction Conference.
- 3 a. Corrections, additions or deletions to the minutes shall be noted and addressed at the
- 4 following meeting.
- 5 4. The Owner will schedule meetings for most convenient time frame.
- 6 5. The Owner will have available at each meeting full chronological files of all previous meeting
- 7 minutes.
- 8 6. As a minimum the Contractor shall have available at each meeting the following information:
- 9 a. Up-to-date Record Drawings.
- 10 b. Updated running total of unit price add/deduct quantities listed on the Bid Form.
- 11 B. Pre-Installation Conferences:
- 12 1. Coordinate and schedule with Resident Project Representative and Engineer for each
- 13 material, product or system specified.
- 14 a. Conferences to be held prior to initiating installation, but not more than two (2) weeks
- 15 before scheduled initiation of installation.
- 16 b. Conferences may be combined if installation schedule of multiple components occurs
- 17 within the same two (2) week interval.
- 18 c. Review manufacturer's recommendations and Contract Documents Specification
- 19 Sections.
- 20 2. Contractor's Superintendent and individual who will actually act as foreman of the installation
- 21 crew (installer), if other than the Superintendent, shall attend.

22 **1.10 SPECIAL CONSIDERATIONS RELATED TO ADJACENT PROPERTIES AND FACILITIES**

- 23 A. Contractor shall be responsible for negotiations of any waivers or alternate arrangements
- 24 required to enable transportation of materials to the site.
- 25 B. Maintain conditions of entrance roads and access roads around site such that access is not
- 26 hindered as the result of construction related deterioration.
- 27 1. Provide daily sweeping of hard-surface roadways to remove soils tracked onto roadway.
- 28 2. Maintain roads such that rutting and ponding of water does not occur.
- 29 3. Restore roads to existing conditions or better at completion of Contract.
- 30 4. Entrance to project site is from Pershing Drive.
- 31 C. Contractor shall be subject to the Districts Policy on Background checks and drug testing as
- 32 presented in Section 00100, Paragraph 27.
- 33 D. Access to the site is secure. Contractor shall coordinate initial access with MUD. Contractor is
- 34 responsible for following site access rules noted in Contract Drawings and Division 00.
- 35 E. Normal working hours for access to the site shall be between the hours of 7:30 a.m. and 4:00
- 36 p.m., Monday through Friday, unless otherwise allowed by the District.

37 **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

38 **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

39 **END OF SECTION**

40





1 2014/09/08

2

## SECTION 01340

3

### SUBMITTALS

#### 4 PART 1 - GENERAL

##### 5 1.1 SUMMARY

- 6 A. Section Includes:
- 7 1. Mechanics and administration of the submittal process for:
- 8 a. Shop Drawings.
- 9 b. Samples.
- 10 c. Informational submittals.
- 11 2. General content requirements for Shop Drawings.
- 12 B. Related Specification Sections include but are not necessarily limited to:
- 13 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 14 2. Division 01 - General Requirements.
- 15 3. Operations and Maintenance Manual submittal requirements are specified in Specification
- 16 Section 01342.
- 17 4. Specification Sections in Division 02 through Division 16 identifying required submittals.

##### 18 1.2 DEFINITIONS

- 19 A. Shop Drawings:
- 20 1. See General Conditions.
- 21 2. Product data and samples are Shop Drawing information.
- 22 3. Initial and Revised Construction Baseline Schedules.
- 23 4. Schedule of Values.
- 24 B. Informational Submittals:
- 25 1. Submittals other than Shop Drawings and samples required by the Contract Documents that
- 26 do not require approval.
- 27 2. Representative types of informational submittal items include but are not limited to:
- 28 a. Construction Record Schedules (progress schedules).
- 29 b. HVAC test and balance reports.
- 30 c. Installed equipment and systems performance test reports.
- 31 d. Manufacturer's installation certification letters.
- 32 e. Instrumentation and control commissioning reports.
- 33 f. Warranties.
- 34 g. Service agreements.
- 35 h. Construction photographs.
- 36 i. Survey data.
- 37 j. Health and safety plans.
- 38 k. Work plans.
- 39 l. Delegated designs per performance specification requirements
- 40 3. For-Information-Only submittals upon which the Engineer is not expected to conduct review
- 41 or take responsive action may be so identified in the Contract Documents.

##### 42 1.3 SUBMITTAL SCHEDULE

- 43 A. Schedule of Shop Drawings:
- 44 1. Submitted and approved within 20 days of receipt of Notice to Proceed.
- 45 2. Account for multiple transmittals under any Specification Section where partial submittals will
- 46 be transmitted.
- 47 3. Submittal and approval prior to 50 percent completion.
- 48 B. Informational Submittals:
- 49 1. Reports and installation certifications submitted within five (5) working days of conducting
- 50 testing or examination.

1 C. The submittal schedule shall include the following columns as a minimum:  
2

Submittal Section	Submittal Description	Planned Submittal Date	Submittal Need Date	Actual Submittal Date	Actual Return Date	Disposition
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3

4 **1.4 PREPARATION OF SUBMITTALS**

5 A. Legibility:

- 6 1. All submittals and all pages of all copies of a submittal shall be completely legible.  
7 2. Submittals which, in the Engineer's sole opinion, are illegible will be returned without review.

8 B. Shop Drawings and Samples:

- 9 1. Scope of any submittal and letter of transmittal:  
10 a. Limited to one (1) Specification Section.  
11 b. Do not submit under any Specification Section entitled (in part) "Basic Requirements"  
12 unless the product or material submitted is specified, in total, in a "Basic Requirements"  
13 Specification Section.  
14 2. Numbering letter of transmittal:  
15 a. Use the Specification Section number followed by a series number ("-xx" and beginning  
16 with "01"); increase the series number sequentially with each additional transmittal for  
17 that Specification Section.  
18 3. Describing transmittal contents:  
19 a. Provide listing of each component or item in submittal capable of receiving an  
20 independent review action.  
21 b. Identify for each item:  
22 1) Manufacturer and Manufacturer's Drawing or data number.  
23 2) Contract Document tag number(s).  
24 3) Contract Drawing Section or detail number if appropriate.  
25 4) Specification Section Article/Paragraph number if appropriate.  
26 5) Unique page numbers for each page of each separate item.  
27 c. When submitting "or-equal" items that are not the products of named manufacturers,  
28 include the words "or-equal" in the item description.  
29 4. Contractor certification of review and approval:  
30 a. Contractor's review and approval certification stamp shall be applied either to the letter  
31 of transmittal or a separate sheet preceding each independent item in the submittal.  
32 1) Stamp may be either a wet ink stamp or electronically embedded.  
33 2) Clearly identify the person who reviewed the submittal and the date it was reviewed.  
34 3) Shop Drawing submittal stamp shall read "(Contractor's Name) has satisfied  
35 Contractor's obligations under the Contract Documents with respect to Contractor's  
36 review and approval as stipulated in the General Conditions."  
37 or  
38 b. Contractor shall execute Exhibit AA, Contractor's Submittal Certification form, to indicate  
39 Contractor has reviewed and approved the submittal contents.  
40 1) Clearly identify the person who reviewed the submittal and the date it was  
41 reviewed."  
42 c. Submittals containing multiple independent items shall be prepared with each item listed  
43 on the letter of transmittal or on an index sheet for all items listing the discrete page  
44 numbers for each page of each item, which shall be stamped with the Contractor's  
45 review and approval stamp.  
46 1) Each independent item shall have a cover sheet with the transmittal number and  
47 item number recorded.  
48 a) Provide clear space of 3 IN SQ for Engineer stamping.  
49 2) Individual pages or sheets of independent items shall be numbered in a manner that  
50 permits the entire contents of a particular item to be readily recognized and  
51 associated with Contractor's certification.  
52 5. Resubmittals:  
53 a. Number with original Specification Section and series number with a suffix letter starting  
54 with "A" on a (new) duplicate transmittal form.

- 1 b. Do not increase the scope of any prior transmittal.
- 2 c. Account for all components of prior transmittal.
- 3 1) If items in prior transmittal received "A" or "B" Action code, list them and indicate "A"
- 4 or "B" as appropriate.
- 5 a) Do not include submittal information for items listed with prior "A" or "B" Action
- 6 in resubmittal.
- 7 2) Indicate "Outstanding-To Be Resubmitted at a Later Date" for any prior "C" or "D"
- 8 Action item not included in resubmittal.
- 9 a) Obtain Engineer's approval to exclude items.
- 10 6. Contractor shall not use red color for marks on transmittals.
- 11 a. Duplicate all marks on all copies transmitted, and ensure marks are photocopy
- 12 reproducible.
- 13 b. Engineer will use red marks or enclose marks in a cloud.
- 14 7. Transmittal contents:
- 15 a. Coordinate and identify Shop Drawing contents so that all items can be easily verified by
- 16 the Engineer.
- 17 b. Provide submittal information or marks defining specific equipment or materials utilized
- 18 on the Project.
- 19 1) Generalized product information, not clearly defining specific equipment or materials
- 20 to be provided, will be rejected.
- 21 c. Identify equipment or material project application, tag number, Drawing detail reference,
- 22 weight, and other Project specific information.
- 23 d. Provide sufficient information together with technical cuts and technical data to allow an
- 24 evaluation to be made to determine that the item submitted is in compliance with the
- 25 Contract Documents.
- 26 e. Do not modify the manufacturer's documentation or data except as specified herein.
- 27 f. Submit items such as equipment brochures, cuts of fixtures, product data sheets or
- 28 catalog sheets on 8-1/2 x 11 IN pages.
- 29 1) Indicate exact item or model and all options proposed.
- 30 g. When a Shop Drawing submittal is called for in any Specification Section, include as
- 31 appropriate, scaled details, sizes, dimensions, performance characteristics, capacities,
- 32 test data, anchoring details, installation instructions, storage and handling instructions,
- 33 color charts, layout Drawings, rough-in diagrams, wiring diagrams, controls, weights and
- 34 other pertinent data in addition to information specifically stipulated in the Specification
- 35 Section.
- 36 1) Arrange data and performance information in format similar to that provided in
- 37 Contract Documents.
- 38 2) Provide, at minimum, the detail specified in the Contract Documents.
- 39 h. If proposed equipment or materials deviate from the Contract Drawings or Specifications
- 40 in any way, clearly note the deviation and justify the said deviation in detail in a separate
- 41 letter immediately following transmittal sheet.
- 42 8. Samples:
- 43 a. Identification:
- 44 1) Identify sample as to transmittal number, manufacturer, item, use, type, project
- 45 designation, tag number, Specification Section or Drawing detail reference, color,
- 46 range, texture, finish and other pertinent data.
- 47 2) If identifying information cannot be marked directly on sample without defacing or
- 48 adversely altering samples, provide a durable tag with identifying information
- 49 securely attached to the sample.
- 50 b. Include application specific brochures, and installation instructions.
- 51 c. Provide Contractor's review and approval certification stamp or Contractor's Submittal
- 52 Certification form as indication of Contractor's checking and verification of dimensions
- 53 and coordination with interrelated work.
- 54 d. Resubmit revised samples of rejected items.
- 55 C. Informational Submittals:
- 56 1. Prepare in the format and detail specified in Specification requiring the informational
- 57 submittal.

1 **1.5 TRANSMITTAL OF SUBMITTALS**

- 2 A. Shop Drawings and Samples:  
3 1. Transmit all submittals to:

4  
5 HDR  
6 8404 Indian Hills Drive  
7 Omaha, NE 68114-4098  
8 Attn: Scott Anderson

- 9  
10 2. Utilize two (2) copies of attached Exhibit A to transmit all Shop Drawings and samples.  
11 3. All submittals must be from Contractor.  
12 a. Submittals will not be received from or returned to subcontractors.

- 13 B. Informational Submittals:

- 14 1. Transmit under Contractor's standard letter of transmittal or letterhead.  
15 2. Submit in triplicate or as specified in individual Specification Section.  
16 3. Transmit to:

17 HDR  
18 8404 Indian Hills Drive  
19 Omaha, NE 68114-4098  
20 Attn: Keith Froscheiser

- 21 4. Provide copy of letter of transmittal without attachments to Owner's Resident Project  
22 Representative.  
23 a. Exception for concrete, soils compaction and pressure test reports.  
24 1) Transmit one (1) copy of test reports to Resident Project Engineer.  
25 2) Transmit one (1) copy of test reports to location and individual indicated above for  
26 other informational submittals.

- 27 C. Electronic Transmission of Submittals:

- 28 1. Transmittals shall be made electronically.  
29 a. Use HDR's Project Tracker Collaboration System (PTCS).  
30 b. Protocols and processes will be determined at the Pre-Construction Conference.  
31 2. Scan all transmittals into Adobe Acrobat Portable Document Format (PDF), latest version,  
32 with printing enabled.  
33 a. Do not password protect or lock the PDF document.  
34 b. Rotate sheets that are normally viewed in landscape mode so that when the PDF file is  
35 opened the sheet is in the appropriate position for viewing.  
36 3. Required signatures shall be applied prior to scanning for transmittal.

37 **1.6 ENGINEER'S REVIEW ACTION**

- 38 A. Shop Drawings and Samples:

- 39 1. Items within transmittals will be reviewed for overall design intent and will receive one (1) of  
40 the following actions:  
41 a. A - FURNISH AS SUBMITTED.  
42 b. B - FURNISH AS NOTED (BY ENGINEER).  
43 c. C - REVISE AND RESUBMIT.  
44 d. D - REJECTED.  
45 e. E - ENGINEER'S REVIEW NOT REQUIRED.  
46 2. Submittals received will be initially reviewed to ascertain inclusion of Contractor's approval  
47 stamp.  
48 a. Submittals not stamped by the Contractor or stamped with a stamp containing language  
49 other than that specified herein will not be reviewed for technical content and will be  
50 returned without any action.  
51 3. In relying on the representation on the Contractor's review and approval stamp, Owner and  
Engineer reserve the right to review and process poorly organized and poorly described  
submittals as follows:  
a. Submittals transmitted with a description identifying a single item and found to contain  
multiple independent items:  
1) Review and approval will be limited to the single item described on the transmittal  
letter.

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- 2) Other items identified in the submittal will:
    - a) Not be logged as received by the Engineer.
    - b) Be removed from the submittal package and returned without review and comment to the Contractor for coordination, description and stamping.
    - c) Be submitted by the Contractor as a new series number, not as a re-submittal number.
  - b. Engineer, at Engineer's discretion, may revise the transmittal letter item list and descriptions, and conduct review.
    - 1) Unless Contractor notifies Engineer in writing that the Engineer's revision of the transmittal letter item list and descriptions was in error, Contractor's review and approval stamp will be deemed to have applied to the entire contents of the submittal package.
  - 4. Submittals returned with Action "A" or "B" are considered ready for fabrication and installation.
    - a. If for any reason a submittal that has an "A" or "B" Action is resubmitted, it must be accompanied by a letter defining the changes that have been made and the reason for the resubmittal.
    - b. Destroy or conspicuously mark "SUPERSEDED" all documents having previously received "A" or "B" Action that are superseded by a resubmittal.
  - 5. Submittals with Action "A" or "B" combined with Action "C" (Revise and Resubmit) or "D" (Rejected) will be individually analyzed giving consideration as follows:
    - a. The portion of the submittal given "C" or "D" will not be distributed (unless previously agreed to otherwise at the Preconstruction Conference).
      - 1) One (1) copy or the one (1) transparency of the "C" or "D" Drawings will be marked up and returned to the Contractor.
        - a) Correct and resubmit items so marked.
      - b. Items marked "A" or "B" will be fully distributed.
    - c. If a portion of the items or system proposed are acceptable, however, the major part of the individual Drawings or documents are incomplete or require revision, the entire submittal may be given "C" or "D" Action.
      - 1) This is at the sole discretion of the Engineer.
      - 2) In this case, some Drawings may contain relatively few or no comments or the statement, "Resubmit to maintain a complete package."
      - 3) Distribution to the Owner and field will not be made (unless previously agreed to otherwise).
  - 6. Failure to include any specific information specified under the submittal paragraphs of the Specifications will result in the submittal being returned to the Contractor with "C" or "D" Action.
  - 7. Calculations required in individual Specification Sections will be received for information purposes only, as evidence calculations have been performed by individuals meeting specified qualifications, and will be returned stamped "E. Engineer's Review Not Required" to acknowledge receipt.
  - 8. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.
  - 9. Transmittals of submittals which the Engineer considers as "Not Required" submittal information, which is supplemental to but not essential to prior submitted information, or items of information in a transmittal which have been reviewed and received "A" or "B" action in a prior submittal, will be returned with action "E. Engineer's Review Not Required."
  - 10. Samples may be retained for comparison purposes.
    - a. Remove samples when directed.
    - b. Include in bid all costs of furnishing and removing samples.
  - 11. Approved samples submitted or constructed, constitute criteria for judging completed work.
    - a. Finished work or items not equal to samples will be rejected.

- 1 **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**
- 2 **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**



EXHIBIT A

# Shop Drawing Transmittal

No. \_\_\_\_\_ - \_\_\_\_\_  
 (Spec Section) (Series)

Project Name:		Date Received:	
Project Owner:		Checked By:	
Contractor: HDR Engineering, Inc.		Log Page:	
Address:		HDR No.:	
		Spec Section:	
		Drawing/Detail No.:	
Attn:		Attn:	1st. Sub
			ReSub.
Date Transmitted:		Previous Transmittal Date:	
Item No.	No. Copies	Description	Manufacturer
			Mfr/Vendor Dwg or Data No.
			Action Taken*
Remarks:			

\* The Action designated above is in accordance with the following legend:

<p>A - Furnish as Submitted</p> <p>B - Furnish as Noted</p> <p>C - Revise and Submit</p> <ol style="list-style-type: none"> <li>1. Not enough information for review.</li> <li>2. No reproducibles submitted.</li> <li>3. Copies illegible.</li> <li>4. Not enough copies submitted.</li> <li>5. Wrong sequence number.</li> <li>6. Wrong resubmittal number.</li> <li>7. Wrong spec. section.</li> <li>8. Wrong form used.</li> <li>9. See comments.</li> </ol> <p>D - Rejected</p>	<p>E - Engineer's review not required</p> <ol style="list-style-type: none"> <li>1. Submittal not required.</li> <li>2. Supplemental Information. Submittal retained for informational purposes only.</li> <li>3. Information reviewed and approved on prior submittal.</li> <li>4. See comments.</li> <li>5. Delegated Design - Submittal received as requested by the Contract Documents. The Engineer did not review the engineering or technical content of the submittal.</li> </ol> <p>Engineer's review and approval is limited to determine whether items covered by this submittal will, after installation or incorporation in the Work, conform in general to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole. Any deviation from plans or specifications not depicted in the submittal or included but not clearly noted by the Contractor may not have been reviewed. Review by the Engineer shall not serve to relieve the Contractor of the contractual responsibility for any error or deviation from contract requirements.</p>
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Comments:

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By	Date

Distribution: Contractor | | File | | Field | | Owner | | Other | |

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# Contractor's Submittal Certification

Shop Drawing Transmittal No.: \_\_\_\_\_

Contract/Project Name: \_\_\_\_\_

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

has

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

This Submittal **does not** contain any variations from the requirements of the Contract Documents.

This Submittal **does** contain variations from the requirements of the Contract Documents. A separate description of said variations and a justification for them is provided in an attachment hereto identified as:

"Shop Drawing Transmittal No. \_\_\_\_\_ Variation and Justification Documentation"

Insert picture file or electronic signature of Authorized Representative

\_\_\_\_\_  
Authorized Representative

\_\_\_\_\_  
Date

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Revision Log

## END OF SECTION



**SECTION 01342**  
**OPERATION AND MAINTENANCE MANUALS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Administration of the submittal process for Operation and Maintenance Manuals.

2. Content requirements for Operation and Maintenance Manuals.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

2. Division 01 - General Requirements.

3. General submittal requirements are specified in Specification Section 01340 - Submittals.

4. Sections in Division 02 through Division 16 identifying required Operation and Maintenance

Manual submittals.

**1.2 DEFINITIONS**

A. Equipment Operation and Maintenance Manuals:

1. Contain the technical information required for proper installation, operation and maintenance of process, electrical and mechanical equipment and systems.

B. Building Materials and Finishes Operation and Maintenance Manuals:

1. Contain the information required for proper installation and maintenance of building materials and finishes.

**1.3 SUBMITTALS**

A. List of all the Operation and Maintenance Manuals required by the Contract as identified in Division 02 through Division 16.

B. Operation and Maintenance Manuals:

1. Draft and final electronic copies.

2. Final paper copies: Two (2).

**1.4 SUBMITTAL SCHEDULE**

A. List of Required Operation and Maintenance Manuals:

1. Submit list with Specification Section number and title within 90 days after Notice to Proceed.

B. Draft Operation and Maintenance Manuals:

1. Submit approvable draft manuals in electronic format (PDF) within 30 days following approval of the respective Shop Drawing.

a. Include placeholders or fly sheet pages where information is not final or is missing from the draft manual.

2. All Draft Operation and Maintenance Manuals shall be received by no later than 50 percent project completion.

C. Final Operation and Maintenance Manuals:

1. Final approval of Operation and Maintenance Manuals in electronic format (PDF) must be obtained 45 days prior to equipment start-up.

2. Provide paper copies and CD-ROMs of approved final Operation and Maintenance Manuals

in electronic format (PDF), a minimum of 30 days prior to equipment start-up.

3. Issue addenda to Final Approved Operation and Maintenance Manual to include:

a. Equipment data that requires collection after start-up, for example but not limited to HVAC balancing reports, electrical switchgear, automatic transfer switch and circuit breaker settings.

b. Equipment field testing data.

c. Equipment start-up reports.

1 **1.5 PREPARATION OF SUBMITTALS**

2 A. General:

- 3 1. All pages of the Operation and Maintenance Manual submittal shall be legible.  
4 a. Submittals which, in the Engineer's sole opinion, are illegible will be rejected without  
5 review.  
6 2. Identify each equipment item in a manner consistent with names and identification numbers  
7 used in the Contract Documents, not the manufacturer's catalog numbers.  
8 3. Neatly type any data not furnished in printed form.  
9 4. Operation and Maintenance Manuals are provided for Owner's use, to be reproduced and  
10 distributed as training and reference materials within Owner's organization.  
11 a. This requirement is:  
12 1) Applicable to both paper copy and electronic files.  
13 2) Applicable to materials containing copyright notice as well as those with no  
14 copyright notice.  
15 5. Notify supplier and/or manufacturer of the intended use of Operations and Maintenance  
16 Manuals provided under the Contract.

17 B. Operation and Maintenance Manual Format and Delivery:

- 18 1. Draft electronic submittals:  
19 a. Provide manual in Adobe Acrobat Portable Document Format (PDF), latest version.  
20 b. Create one (1) PDF file for each equipment Operation and Maintenance Manual.  
21 c. Do not password protect or lock the PDF document.  
22 d. Drawings or other graphics must be converted to PDF file format from the original  
23 drawing file format and made part of the PDF document.  
24 e. Scanning of drawings is to be used only where actual file conversion is not possible and  
25 drawings must be scanned at a resolution of 300 dpi or greater.  
26 f. Rotate sheets that are normally viewed in landscape mode so that when the PDF file is  
27 opened the sheet is in the appropriate position for viewing.  
28 g. Create bookmarks in the bookmarks panel for the Operation and Maintenance Manual  
29 cover, the Table of Contents and each major section of the Table of Contents.  
30 h. Using Adobe Acrobat Standard or Adobe Acrobat Professional, set the PDF document  
31 properties, initial view as follows:  
32 1) Select File → Properties → Initial View.  
33 2) Select the Navigation tab: Bookmarks Panel and Page.  
34 3) Select the Page layout: Single Page.  
35 4) Select the Magnification: Fit Page.  
36 5) Select Open to page: 1.  
37 6) Set the file to open to the cover page of the manual with bookmarks to the left, and  
38 the first bookmark linked to the cover page.  
39 i. Set the PDF file "Fast Web View" option to open the first several pages of the document  
40 while the rest of the document continues to load.  
41 1) To do this:  
42 a) Select Edit → Preferences → Documents → Save Settings.  
43 b) Check the Save As optimizes for Fast Web View box.  
44 j. PDF file naming convention:  
45 1) Use the Specification Section number, the manufacturer's name and the equipment  
46 description, separated by underscores.  
47 2) Example: 11083\_Sanitaire\_Coarse\_Bubble\_Diffusers.pdf.  
48 3) Do not put spaces in the file name.  
49 2. Final electronic submittals:  
50 a. Submit two (2) copies in PDF file format on two (2) CD-ROM discs (one (1) copy per  
51 CD-ROM), each secured in a jewel case.  
52 b. CD-ROM Labeling:  
53 1) Provide the following printed labeling on all CD-ROM discs:  
54 a) Project name.  
55 b) Specification Section.  
56 c) Equipment names and summary of tag(s) covered.  
57 d) Manufacturer name.  
58 e) Date (month, year).

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- c. CD-ROM Jewel Case Holder:
    - 1) Insert jewel cases containing labeled CD-ROM discs in three-ring binder holder (C-Line Products, www.c-lineproducts.com stock number CLI-61968 or equivalent) at the front of each final paper copy.
  - 3. Final paper copy submittals:
    - a. Quantity: Provide two (2) copies.
    - b. Paper: 8.5 x 11 IN or 11 x 17 IN bright white, 20 pound paper with standard three-hole punching.
    - c. 3-Ring Binder:
      - 1) Provide D-ring binder with clear vinyl sleeves (i.e. view binder) on front and spine.
      - 2) Insert binder title sheet with the following information under the front and spine sleeves:
        - a) Project name.
        - b) Specification Section.
        - c) Equipment names and summary of tag(s) covered.
        - d) Manufacturer name.
        - e) Date (month, year).
      - 3) Provide plastic sheet lifters prior to first page and following last page.
    - d. Drawings:
      - 1) Provide all drawings at 11 x 17 IN size, triple folded and three-hole punched for insertion into manual.
      - 2) Where reduction is not practical to ensure readability, fold larger Drawings separately and place in three-hole punched vinyl envelopes inserted into the binder.
      - 3) Identify vinyl envelopes with Drawing numbers.
    - e. Use plastic coated dividers to tab each Section of each manual in accordance with the Table of Contents.
- C. Equipment Operation and Maintenance Manual Content:
1. Provide a cover page as the first page of each manual with the following information:
    - a. Manufacturer(s) Name and Contact Information.
    - b. Vendor's Name and Contact Information.
    - c. Date (month, year).
    - d. Project Owner and Project Name.
    - e. Specification Section.
    - f. Project Equipment Tag Numbers.
    - g. Model Numbers.
    - h. Engineer's Name.
    - i. Contractor's Name.
  2. Provide a Table of Contents for each manual.
  3. Provide Equipment Record sheets as follows:
    - a. Printed copies of the Equipment Record (Exhibits B1, B2 and B3), as the first tab following the Table of Contents.
    - b. Exhibits B1-B3 are available as Fillable PDF Form documents from the Engineer.
    - c. Each section of the Equipment Record must be completed in detail; simply referencing the related equipment Operation and Maintenance Manual sections for nameplate, maintenance, spare parts or lubricant information is not acceptable.
    - d. For equipment involving separate components (for example, a motor and gearbox), a fully completed Equipment Record is required for each component.
    - e. Submittals that do not include the Equipment Record(s) will be rejected without further content review.
  4. Provide a printed copy of the Manufacturer's Field Services report as required by Specification Section 01650 following the Equipment Record sheets.
  5. Provide the following detailed information, as applicable:
    - a. Use equipment tag numbers from the Contract Documents to identify equipment and system components.
    - b. Equipment function, normal and limiting operating characteristics.
    - c. Instructions for assembly, disassembly, installation, alignment, adjustment, and inspection.
    - d. Operating instructions for start-up, normal operation, control, shutdown, and emergency conditions.
    - e. Lubrication and maintenance instructions.
    - f. Troubleshooting guide.

- 1 g. Mark each sheet to clearly identify specific products and component parts and data
- 2 applicable to the installation for the Project; delete or cross out information that does not
- 3 specifically apply to the Project.
- 4 h. Parts lists:
- 5 1) A parts list and identification number of each component part of the equipment.
- 6 2) Exploded view or plan and section views of the equipment with a detailed parts
- 7 callout matching the parts list.
- 8 3) A list of recommended spare parts.
- 9 4) List of spare parts provided as specified in the associated Specification Section.
- 10 5) A list of any special storage precautions which may be required for all spare parts.
- 11 i. General arrangement, cross-section, and assembly Drawings.
- 12 j. Electrical diagrams, including elementary diagrams, wiring diagrams, connection
- 13 diagrams, and interconnection diagrams.
- 14 k. Test data and performance curves.
- 15 l. As-constructed fabrication or layout Drawings and wiring diagrams.
- 16 m. Copy of the equipment manufacturer's warranty meeting the requirements of the
- 17 Contract.
- 18 n. Copy of any service contracts provided for the specific piece of equipment as part of the
- 19 Contract.
- 20 6. Additional information as required in the associated equipment or system Specification
- 21 Section.

- 22 D. Building Materials and Finishes Operation and Maintenance Manual Content:
- 23 1. Building products, applied materials and finishes:
- 24 a. Include product data, with catalog number, size, composition and color and texture
- 25 designations.
- 26 b. Provide information for ordering custom manufactured products.
- 27 2. Necessary precautions:
- 28 a. Include product MSDS for each approved product.
- 29 b. Include any precautionary application and storage guidelines.
- 30 3. Instructions for care and maintenance:
- 31 a. Include manufacturer's recommendations for cleaning agents and methods, precautions
- 32 against detrimental agents and methods and recommended schedule for cleaning and
- 33 maintenance.
- 34 4. Moisture protection and weather exposed products:
- 35 a. Include product data listing, applicable reference standards, chemical composition, and
- 36 details of installation.
- 37 b. Provide recommendations for inspections, maintenance and repair.
- 38 5. Additional requirements as specified in individual product Specifications.

### 39 1.6 TRANSMITTAL OF SUBMITTALS

- 40 A. Operation and Maintenance Manuals.
- 41 1. Transmit all submittals to:
- 42 a. The address specified in Specification Section 01340 - SUBMITTALS.
- 43 2. Transmittal form: Use Operation and Maintenance Manual Transmittal, Exhibit A.
- 44 3. Transmittal numbering:
- 45 a. Number each submittal with the Specification Section number followed by a series
- 46 number beginning with "-01" and increasing sequentially with each additional transmittal,
- 47 followed by "-OM" (for example: 11061-01-OM).
- 48 4. Submit draft and final Operation and Maintenance Manual in electronic format (PDF) to
- 49 Engineer, until manual is approved.
- 50 B. Expedited Return Delivery:
- 51 1. Include prepaid express envelope or air bill in submittal transmittal package for any
- 52 submittals Contractor expects or requires express return mail.
- 53 2. Inclusion of prepaid express envelope or air bill does not obligate Engineer to conduct
- 54 expedited review of submittal.

### 55 1.7 ENGINEER'S REVIEW ACTION

- 56 A. Draft Electronic (PDF) Submittals:
- 57 1. Engineer will review and indicate one of the following review actions:
- 58 a. A – ACCEPTABLE.

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- b. B - FURNISH AS NOTED.
- c. C - REVISE AND RESUBMIT.
- d. D – REJECTED.
- 2. Submittals marked as Acceptable or Furnish as Noted will be retained; however, the transmittal form will be returned with a request for the final paper and electronic documents to be submitted.
- 3. Copies of submittals marked as Revise and Resubmit or Rejected will be returned with the transmittal form marked to indicate deficient areas.
- 4. Resubmit until approved.

B. Final Paper Copy Submittals:

- 1. Engineer will review and indicate one (1) of the following review actions:
  - a. A – ACCEPTABLE.
  - b. D – REJECTED.
- 2. Submittals marked as Acceptable will be retained with the transmittal form returned as noted.
- 3. Submittals marked as Rejected will be returned with the transmittal form marked to indicate deficient areas.
- 4. Resubmit until approved.

**PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

**PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

**END OF SECTION**





EXHIBIT A **Operation and Maintenance Manual Transmittal** \_\_\_\_\_ - \_\_\_\_\_ - OM (Spec Section) (Series)

Project Name: \_\_\_\_\_ Date Received: \_\_\_\_\_

Project Owner: \_\_\_\_\_ Checked By: \_\_\_\_\_

Contractor: \_\_\_\_\_ Owner: \_\_\_\_\_ Log Page: \_\_\_\_\_

Address: \_\_\_\_\_ Address: \_\_\_\_\_ HDR No.: \_\_\_\_\_

Attn: \_\_\_\_\_ Attn: \_\_\_\_\_

\_\_\_\_\_ 1st. Sub. \_\_\_\_\_ ReSub. \_\_\_\_\_

Date Transmitted: \_\_\_\_\_ Previous Transmittal Date: \_\_\_\_\_

No. Copies	Description of Item	Manufacturer	Dwg. or Data No.	Action Taken*

Remarks: \_\_\_\_\_

To: \_\_\_\_\_ From: *HDR Engineering, Inc.*

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

- \* The Action designated above is in accordance with the following legend:
- A - Acceptable
  - B - Furnish as Noted
  - C - Revise and Resubmit
  - D - Rejected

Comments: \_\_\_\_\_

Distribution: Contractor | | File | | By | | Field | | Owner | | Date | | Other | |

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**Equipment Data and Spare Parts Summary**

Project Name	Specification Section:
Equipment Name	Year Installed:

Project Equipment Tag No(s).

Equipment Manufacturer

Address

Fax

Web Site

E-mail

Project/Order No.

Phone

Local Vendor/Service Center

Address

Fax

Web Site

E-mail

Phone

MECHANICAL NAMEPLATE DATA				
Equip.				Serial No.
Make				Model No.
ID No.	Frame No.	HP	RPM	Cap.
Size	TDH	Imp. Sz.	CFM	PSI
Other:				

ELECTRICAL NAMEPLATE DATA								
Equip.					Serial No.			
Make					Model No.			
ID No.	Frame No.	HP	V.	Amp.	HZ	PH	RPM	SF
Duty	Code	Ins. Cl.	Type	NEMA	C Amb.	Temp. Rise	Rating	
Other:								

SPARE PARTS PROVIDED PER CONTRACT		
Part No.	Part Name	Quantity

RECOMMENDED SPARE PARTS		
Part No.	Part Name	Quantity

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# Equipment Record

## Recommended Maintenance Summary

Equipment Description	Project Equip. Tag No(s).
-----------------------	---------------------------

RECOMMENDED BREAK-IN MAINTENANCE (FIRST OIL CHANGES, ETC.)	INITIAL COMPLETION * FOLLOWING START-UP							
	D	W	M	Q	S	A	RT	Hours

RECOMMENDED PREVENTIVE MAINTENANCE	PM TASK INTERVAL *							
	D	W	M	Q	S	A	RT	Hours

\* D = Daily    W = Weekly    M = Monthly    Q = Quarterly    S = Semiannual    A = Annual    Hours = Run Time I

(Jun 1990; Revised Oct 2001, Revised Nov 2007)  
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**Lubrication Summary**

Equipment Description	Project Equip. Tag No(s).
-----------------------	---------------------------

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

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**SECTION 01452**  
**SPECIAL INSPECTIONS AND TESTING PROGRAM**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Contractor responsibilities for special inspection and testing.

2. Special Inspection program and reporting requirements.

3. Attachment A to this Specification Section includes the Statement of Special Inspections.

4. Attachment B to this Specification Section includes Special Inspector qualifications, reporting requirements, and material specific inspections and tests.

a. This information is for the Contractor reference only and is not part of the Contract Documents.

b. It is included to assist the Contractor in understanding the Owner-provided Services so that those services may be factored into the Contractor's pricing and schedule.

c. The Service Provider(s) responsible for the Owner-provided Services will be selected after Contract award.

B. Purpose:

1. This Document was developed to address the requirements of the 2006 International Building Code (IBC), section 1704.1, including:

a. One or more special inspectors will be hired by the Owner or the Owner's Agent to provide inspections during constructions on the types of work listed under Section 1704.

2. A Statement of Special Inspections will be submitted to the Building Code Official as a condition for permit issuance. This statement is included as Attachment A to this Specification. Attachment B includes a complete list of materials and work requiring special inspections, the inspections to be performed and a list of the minimum qualifications of the individuals, approved agencies or firms intended to be retained for conducting such inspections.

C. Related Specification Sections include but are not necessarily limited to:

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

2. Division 01 - General Requirements.

**1.2 DEFINITIONS**

A. Special Inspector: Representative of the Owner approved inspection agency designated for that portion of the work.

B. Testing Agency: Agency which is responsible for the materials testing requirements of the project including but not limited to concrete cylinder breaks, soils testing, and masonry materials testing.

C. Statement of Special Inspections: Document provided to the Building Code Official outlining special inspections and tests to be done on the project and frequency of required test.

D. Soils Engineer: For the purposes of Special Inspection "Soils Engineer" and "Special Inspector" shall be interchangeable as pertains to the Division 2 specifications listed below.

E. NICET: National Institute for Certification in Engineering Technologies.

**1.3 CONTRACTOR'S RESPONSIBILITIES**

A. Contractor shall cooperate with testing agency personnel, special inspector, and agents of the Building Code Official and provide access to the work.

1. Providing access to the work shall include all labor and facilities to perform inspections and tests as listed in the specifications for the duration of the inspections or tests involved.

2. Contractor shall provide means to obtain and handle samples taken on site.

B. Attend a pre-construction meeting to coordinate and clarify inspection and testing procedures, requirements.

- 1 C. Contractor shall notify special inspector and/or testing agency of work to be inspected/tested  
2 minimum of 24 HR prior.
- 3 D. Work for which special inspections are required shall remain accessible and exposed for the  
4 purposes of special inspections until completion of required special inspections.
- 5 E. Any portion of work that is not in conformance shall be corrected and re-inspected. Such portions  
6 of the work shall not be covered or concealed until authorized by Owner or Owner's  
7 Representative.
- 8 F. Work to be inspected should be complete at time of inspector's arrival on-site.
- 9 G. Payment for special inspection services will be in accordance with the following:  
10 1. After Contractor notification, inspector arrives at site and performs inspection within the  
11 timeframe defined in Item 3 below.  
12 a. Inspection reveals work is satisfactory.  
13 b. Owner pays all costs associated with this inspection.  
14 2. After Contractor notification, inspector arrives at site and performs inspection within the  
15 timeframe defined in Item 3 below.  
16 a. Inspection reveals work is deficient.  
17 b. Contractor corrects deficiencies within timeframe defined in Item 3) below.  
18 c. Work is re-inspected and work is satisfactory.  
19 d. Owner pays all costs associated with this inspection.  
20 3. After Contractor notification, inspector arrives at site and work is not ready for inspection  
21 when inspector arrives.  
22 a. Inspector will remain on-site for a maximum of 2 HRS awaiting the completion of the  
23 work.  
24 b. If work is not ready for inspection at the end of this period, inspector will be dismissed  
25 until Contractor requests re-inspection.  
26 c. All costs associated with this inspection trip will be charged to the Contractor.  
27 4. After Contractor notification, inspector arrives at site and performs inspection within the  
28 timeframe defined above.  
29 a. Inspection reveals work is deficient.  
30 b. Contractor attempts to correct deficiencies within 2 HR timeframe and calls for re-  
31 inspection.  
32 c. Work is re-inspected and found to still be deficient.  
33 d. Inspector will be dismissed.  
34 e. All costs associated with this inspection trip will be charged to the Contractor.  
35 5. Owner will pay for "passing" soils on the Project. Costs of corrective actions and cost of  
36 retest of failed test areas are the sole responsibility of the Contractor. For additional specific  
37 payment requirements for soils see the respective Division 2 Section.  
38 6. For additional specific payment requirements for concrete see Specification Section 03350.
- 39 H. Special Inspection is intended to be an independent quality assurance. Special Inspections shall  
40 not relieve the Contractor of any quality assurance, quality control, workmanship, or warranty  
41 responsibilities. Contractor's own personnel shall review all work to be inspected for  
42 conformance with Contract Documents prior to calling for inspection.

#### 43 1.4 REPORTING DUTIES AND AUTHORITY

- 44 A. A pre-construction meeting to coordinate and clarify inspection, testing, and procedural  
45 requirements will be held per Section 01060.  
46 1. The meeting is to be attended by:  
47 a. Owner.  
48 b. Engineer.  
49 c. Building Code Official or Inspector if desired.  
50 d. Testing Agency and Special Inspectors.  
51 e. General Contractor.  
52 f. Appropriate Sub-contractor(s).
- 53 B. Special Inspector shall report all deficient work to the Contractor as soon as possible.  
54 1. Deficient work that has been covered up or concealed prior to re-inspection shall be reported  
55 to the Engineer and the Building Code Official.



1 C. Special Inspector does not have authority to stop work or modify the requirements of the Contract  
2 Documents.

3 **PART 2 - PRODUCTS- (NOT APPLICABLE TO THIS SECTION)**

4 **PART 3 - EXECUTION- (NOT APPLICABLE TO THIS SECTION)**

5 **END OF SECTION**

6



# Attachment A

## Statement of Special Inspections

Statement Date: 9/08/2014

Project Name: Florence Water Treatment Plant – Phase II Filter Plant Improvements

Project Address: 2710 Grebe St, Omaha, NE 68112

Owner: Metropolitan Utilities District

Registered Design Professional in Responsible Charge (DPRC): Brian Charles Hoagland, S.E.

This Statement of Special Inspections (Statement) is submitted as a condition for permit issuance in accordance with the Special Inspection requirements of the Building Code. Bi-weekly Special Inspection reports will be submitted to the DPRC and the Building Official. Discovered discrepancies will be brought to the immediate attention of the Contractor for correction. If the discrepancies are not corrected, the discrepancies will be brought to the attention of the DPRC and the Building Official. Only documents that are prepared and signed or sealed by the Special Inspectors (SI) are valid.

The SI is responsible for verifying all information on each document prior to signing or sealing and directly forwarding it to the DPRC and Building Official. The SI is responsible for verifying all inspectors under his supervision maintain current certifications during the course of the project, as failure to maintain current certifications may result in a voided document. At the conclusion of each individual Special Inspection type, the SI will complete a Final Report.

The Special Inspection program outlined in Specification Section 01452 and attachments, does not relieve the Contractor or any other entity of any contractual duties, including quality control, quality assurance, or safety. The Contractor is solely responsible for construction means, methods, and job site safety. Failure to adhere to the SI program as outlined herein may result in a stop work notice being issued by the Building Official.

A detailed explanation of the requirements for Special Inspections and Testing can be found in specification section 01452 of the Project Manual in conjunction with the Technical Specifications for each material.

Respectfully submitted,  
The Design Professional in Responsible Charge,

Brian Charles Hoagland  
Type or Print Name

Nebraska License # E-14788  
Expires December 31, 2015



\_\_\_\_\_  
Signature

9/08/2014

\_\_\_\_\_  
Date



2 **SECTION 01452B - ATTACHMENT B**  
3 **SPECIAL INSPECTIONS, INSPECTOR QUALIFICATIONS AND REPORTING**  
4 **REQUIREMENTS**

5 **PART 1 - GENERAL**

6 **1.1 SUMMARY**

- 7 A. Related Specification Sections include but are not necessarily limited to:
- 8 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 9 2. Division 01 - General Requirements.
- 10 3. Section 02200 –Earthwork.
- 11 4. Section 02221 – Trenching, Backfilling and Compacting for Utilities.
- 12 5. Section 02502 - Concrete Pavement, Curb and Sidewalk.
- 13 6. Section 03350 – Testing.
- 14 7. Section 03431 - Precast and Prestressed Concrete.
- 15 8. Section 04220 - Concrete Masonry.
- 16 9. Section 05505 - Metal Fabrications.

17 **1.2 QUALIFICATIONS**

- 18 A. Qualifications stated here are the minimum recommended by the Engineer. If the Building Code
- 19 Official has more stringent qualifications, the more stringent qualifications will take precedence.
- 20 B. All special inspections to be done under the direction of a Professional Engineer registered in the
- 21 State of Nebraska.
- 22 C. Soil, concrete, masonry, mortar, grout, steel and aluminum related testing.
- 23 1. The Testing Agency shall have a minimum of 10 years experience in the testing of these
- 24 materials.
- 25 2. The Testing Agency’s technician(s) conducting this testing:
- 26 a. Shall have a minimum of five (5) years experience in the testing of soil, concrete, mortar,
- 27 grout, steel and aluminum as appropriate.
- 28 3. Concrete related work:
- 29 a. International Code Council certification for Reinforced Concrete and American Concrete
- 30 Institute Concrete Field Testing Technician – Grade 1.
- 31 D. Special Structural Inspections:
- 32 1. Professional Engineers, licensed in the State of Nebraska, may perform special inspections
- 33 in accordance with their license qualifications.
- 34 2. Other individuals, working under the direct supervision of a licensed engineer and meeting
- 35 the following qualifications, may perform special inspections.
- 36 3. Soils related work:
- 37 a. NICET Level II Certification in geotechnical engineering technology/construction; or
- 38 b. Registered Geologist; or
- 39 c. Engineer Intern under the direct supervision of a Licensed Professional Engineer.
- 40 4. Concrete related work:
- 41 a. International Code Council certification for Reinforced Concrete Special Inspector or
- 42 American Concrete Institute Concrete Construction Special Inspector.
- 43 b. Alternatively, may be an Engineer Intern under the direct supervision of a Licensed
- 44 Professional Engineer.
- 45 5. Precast concrete erection related work:
- 46 a. Engineer Intern under the direct supervision of a Licensed Professional Engineer.
- 47 6. Precast concrete erection welding:
- 48 1) American Welding Society as a Certified Welding Inspector; or
- 49 2) International Code Council Structural Steel and Welding Certification and American
- 50 Welding Society Qualified and one (1) year of related experience; or
- 51 3) NDT Level II or II Certificate (for non-destructive testing only).
- 52 7. Masonry related work:
- 53 a. Shall be certified by the International Code Council or American Concrete Institute for
- 54 structural masonry and one (1) year of related experience.

- b. Alternatively, may by an Engineer Intern with a minimum of two (2) years appropriate training.
8. Steel and aluminum related work:
  - a. Frame and material verification (IBC Table 1704.3, Items 3 and 6):
  - b. Welding:
    - 1) American Welding Society as a Certified Welding Inspector; or
    - 2) International Code Council Structural Steel and Welding Certification and American Welding Society Qualified and one (1) year of related experience; or
    - 3) NDT Level II or II Certificate (for non-destructive testing only).
  - c. High strength bolting:
    - 1) International Code Council Structural Steel and Welding Certification and one (1) year related experience.
    - 2) Alternatively, may be an Engineer Intern with appropriate training.
9. Other equivalent certifications will not be acceptable unless approved by the Engineer.

### 1.3 REPORTING DUTIES AND AUTHORITY

- A. Reporting requirements for special inspector per IBC 2006 for Building System Related Work.
  1. Comply with requirements of IBC Section 1704.1.2.
  2. Provide written documentation of all inspections and testing.
    - a. Include exact location of work.
    - b. If testing of specimens is included, include detailed information on storage and curing of specimens prior to testing.
  3. Furnish inspection and test reports to the Contractor, the Engineer's Project Manager and the Owner's on-site representative.
    - a. Indicate that work inspected was done in conformance with approved construction documents.
    - b. Immediately report any discrepancies to the Contractor for correction.
    - c. If the discrepancies are not corrected in a timely fashion, notify the Engineer and Owner's on-site representative.
  4. Issue an electronic report summarizing all inspections, corrective action notifications and resolution of discrepancies and non-conforming work every two (2) weeks (14 calendar days).
    - a. Copy will be available to:
      - 1) Engineer's Project Manager.
      - 2) Owner.
      - 3) The Building Code Official.
      - 4) General Contractor.
    - b. At the end of the Project, compile all test reports and summaries into a single PDF and submit to the Engineer, Owner and Building Code Official.
- B. Special Inspector shall report all deficient work to the Contractor as soon as possible.
  1. Deficient work that has been covered up or concealed prior to re-inspection shall be reported to the Engineer and the Building Code Official.
- C. Special Inspector does not have authority to stop work or modify the requirements of the Contract Documents.

### 1.4 MATERIAL SPECIFIC SPECIAL INSPECTIONS AND TESTS

- A. Material specific requirements for special inspection and testing are listed in the technical specifications listed below. Special inspection and testing requirements will be located in each appropriate technical specification under "SOURCE QUALITY CONTROL", "FIELD QUALITY CONTROL" and/or "QUALITY ASSURANCE" as appropriate for each material.

### 1.5 SOILS

- A. Special Inspection/testing will be provided per IBC Section 1704.7 and Table 1704.7 as required to determine that the site has been prepared in accordance with the approved soils report, and to verify the allowable soil bearing pressure, materials, compaction densities, trenching and backfill and conformance to the project Specifications.
- B. Inspection/testing requirements are listed separately in Specification Division 2 and are indicated as the work to be done by the Soils Engineer, Testing Agency, or Special Inspections and Testing Provider.

1 **1.6 CONCRETE**

2 A. Special Inspection and testing will be provided per IBC 2006 Table 1704.4. Inspection is required  
3 for material verification, reinforcing steel, embedded bolts, mechanical splices, concrete tests,  
4 welding of reinforcing, concrete placement and curing, and waterstop placement.

5 B. Inspection and testing requirements are listed separately in Specification Section 03350 and are  
6 indicated as the work to be done by the Special Inspector or Testing Agency.

7 **1.7 PRECAST CONCRETE**

8 A. Special Inspection and testing will be provided per IBC 2006 Table 1704.4 Item 9. Inspection and  
9 testing is required for connection embed number and placement, connection welding, and proper  
10 panel detailing prior to placement.

11 B. Inspection requirements are listed separately in Specification Section 03431 and are indicated as  
12 the work to be done by the Special Inspector.

13 **1.8 MASONRY**

14 A. Special Inspection and testing will be provided per IBC 2006 Table 1704.5.1 (Level 1). Inspection  
15 is required for material tests and verification, reinforcing steel, embedded bolts and anchorage,  
16 grout placement, and welding of reinforcing.

17 B. Inspection/testing requirements are listed separately in Specification Section 04220 and are  
18 indicated as the work to be done by the Special Inspector.

19 **1.9 STEEL, STAINLESS STEEL, AND ALUMINUM**

20 A. Special Inspection will be provided for structural steel and aluminum per IBC 2006 Section  
21 1704.2, 1704.3 and Table 1704.3. Inspection is required for material verification, high-strength  
22 bolting, welding and other work noted on the Contract Documents.

23 B. Inspection/testing requirements are listed separately in Section 05505 and are indicated as the  
24 work to be done by the Special Inspector. Inspection requirements listed are applicable to  
25 aluminum, stainless steel, and structural steel.

26 **PART 2 - PRODUCTS- (NOT APPLICABLE TO THIS SECTION)**

27 **PART 3 - EXECUTION- (NOT APPLICABLE TO THIS SECTION)**

28 **END OF SECTION**





1 2014/09/08

2

## SECTION 01560

3

### ENVIRONMENTAL PROTECTION AND SPECIAL CONTROLS

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

###### A. Section Includes:

7

1. Minimizing the pollution of air, water, or land; control of noise, the disposal of solid waste materials, and protection of deposits of historical or archaeological interest.

8

9

2. Dust control.

10

###### B. Related Specification Sections include but are not necessarily limited to:

11

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

12

2. Division 01 - General Requirements.

13

##### 1.2 SUBMITTALS

14

###### A. Shop Drawings:

15

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

16

17

2. Prior to the start of any construction activities submit:

18

- a. A detailed proposal of all methods of control and preventive measures to be utilized for environmental protection.

19

- b. A drawing of the work area, haul routes, storage areas, access routes and current land conditions including trees and vegetation.

20

- c. A construction phasing schedule showing planned installation of erosion and sediment control measures.

21

- d. A copy of the NPDES permit authorizing Dewatering Discharges. A copy of the approved pollution prevention plan.

22

23

24

25

26

- e. Dust control plan.

27

#### PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

28

#### PART 3 - EXECUTION

29

##### 3.1 INSTALLATION

30

- A. Employ and utilize environmental protection methods, obtain all necessary permits, and fully observe all local, state, and federal regulations.

31

32

###### B. Land Protection:

33

1. Except for any work or storage area and access routes specifically assigned for the use of the Contractor, the land areas outside the limits of construction shall be preserved in their present condition.

34

- a. Contractor shall confine his construction activities to areas defined for work within the Contract Documents.

35

36

37

38

2. Manage and control all borrow areas, work or storage areas, access routes and embankments to prevent sediment from entering nearby water or land adjacent to the work site.

39

40

41

3. Restore all disturbed areas including borrow and haul areas and establish permanent type of locally adaptable vegetative cover.

42

43

4. Unless earthwork is immediately paved or surfaced, protect all side slopes and backslopes immediately upon completion of final grading.

44

45

46

5. Plan and execute earthwork in a manner to minimize duration of exposure of unprotected soils.

- 1                   6. Except for areas designated by the Contract Documents to be cleared and grubbed, the  
2 Contractor shall not deface, injure or destroy trees and vegetation, nor remove, cut, or  
3 disturb them without approval of the Engineer.  
4                   a. Any damage caused by the Contractor's equipment or operations shall be restored as  
5 nearly as possible to its original condition at the Contractor's expense.
- 6                   C. Surface Water Protection:  
7                   1. All permitting in Specification Section for construction storm water discharges will be  
8 obtained by the Engineer.  
9                   2. Storm Water Pollution Prevention Plan (SWPPP) will be prepared by the Engineer.  
10                  3. Utilize, as necessary, erosion control methods to protect side and backslopes, minimize and  
11 the discharge of sediment to the surface water leaving the construction site as soon as rough  
12 grading is complete.  
13                  a. These controls shall be maintained until the site is ready for final grading and  
14 landscaping or until they are no longer warranted and concurrence is received from the  
15 Engineer.  
16                  b. Physically retard the rate and volume of run-on and runoff by:  
17                    1) Implementing structural practices such as diversion swales, terraces, straw bales,  
18 silt fences, berms, storm drain inlet protection, rock outlet protection, sediment  
19 traps and temporary basins.  
20                    2) Implementing vegetative practices such as temporary seeding, permanent seeding,  
21 mulching, sod stabilization, vegetative buffers, hydroseeding, anchored erosion  
22 control blankets, sodding, vegetated swales or a combination of these methods.  
23                    3) Providing Construction sites with graveled or rock access entrance and exit  
24 drives and parking areas to reduce the tracking of sediment onto public or private  
25 roads.  
26                    4) Discharges from the construction site shall not contain pollutants at concentrations  
27 that produce objectionable films, colors, turbidity, deposits or noxious odors in the  
28 receiving stream or waterway.
- 29                  D. Solid Waste Disposal:  
30                  1. Collect solid waste on a daily basis.  
31                  2. Provide disposal of degradable solid waste to an approved solid waste disposal site.  
32                  3. Provide disposal of nondegradable solid waste to an approved solid waste disposal site or in  
33 an alternate manner approved by Engineer and regulatory agencies.  
34                  4. No building materials wastes or unused building materials shall be buried, dumped, or  
35 disposed of on the site.  
36                  5. Disposal shall be at no additional cost to Owner.
- 37                  E. Fuel and Chemical Handling:  
38                  1. Store and dispose of chemical wastes in a manner approved by regulatory agencies.  
39                  2. Take special measures to prevent chemicals, fuels, oils, greases, herbicides, and  
40 insecticides from entering drainage ways.  
41                  3. Do not allow water used in onsite material processing, concrete curing, cleanup, and other  
42 waste waters to enter a drainage way(s) or stream.  
43                  4. The Contractor shall provide containment around fueling and chemical storage areas to  
44 ensure that spills in these areas do not reach waters of the state.
- 45                  F. Control of Dust:  
46                  1. The control of dust shall mean that no construction activity shall take place without applying  
47 all such reasonable measures as may be required to prevent particulate matter from  
48 becoming airborne so that it remains visible beyond the limits of construction.  
49                    a. Reasonable measures may include paving, frequent road cleaning, planting vegetative  
50 groundcover, application of water or application of chemical dust suppressants.  
51                    b. The use of chemical agents such as calcium chloride must be approved by the State of  
52 Nebraska (NDOR) and the District.  
53                  2. Utilize methods and practices of construction to eliminate dust in full observance of agency  
54 regulations.  
55                  3. The Engineer will determine the effectiveness of the dust control program and may request  
56 the Contractor to provide additional measures, at no additional cost to Owner.

- 1           4. The Contractor shall be responsible for providing dust enclosure and ventilation to prevent
- 2           dust from entering the filters in the Filter Plant, the filter gallery piping, or otherwise effecting
- 3           the water quality in the plant. Prior to commencing work in the Filter Plant the Contractor
- 4           shall submit a dust control plan for review and approval.
  
- 5           G. Burning:
- 6           1. Do not burn material on the site.
- 7           2. If the Contractor elects to dispose of waste materials by burning, make arrangements for an
- 8           off-site burning area and conform to all agency regulations.
  
- 9           H. Control of Noise:
- 10          1. Control noise by fitting equipment with appropriate mufflers.
  
- 11          I. Completion of Work:
- 12          1. Upon completion of work, leave area in a clean, natural looking condition.
- 13          2. Ensure all signs of temporary construction and activities incidental to construction of required
- 14          permanent work are removed.
  
- 15          J. Dewatering:
- 16          1. Apply for and obtain a Dewatering Discharges from Construction Sites Permit from the
- 17          Nebraska Department of Environmental Quality.
  
- 18          K. Historical Protection:
- 19          1. If during the course of construction, evidence of deposits of historical or archaeological
- 20          interests is found, cease work affecting find and notify Engineer.
- 21           a. Do not disturb deposits until written notice from Engineer is given to proceed.
- 22          2. The Contractor will be compensated for lost time or changes in construction to avoid the find
- 23          based upon normal change order procedures.

**END OF SECTION**

24  
25



1 2014/05/28

2

## SECTION 01600

3

### PRODUCT DELIVERY, STORAGE, AND HANDLING

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

###### A. Section Includes:

7

1. Scheduling of product delivery.

8

2. Packaging of products for delivery.

9

3. Protection of products against damage from:

10

a. Handling.

11

b. Exposure to elements or harsh environments.

12

###### B. Related Specification Sections include but are not necessarily limited to:

13

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

14

2. Division 01 - General Requirements.

15

###### C. Payment:

16

1. No payment will be made to Contractor for equipment or materials not properly stored and insured or without approved Shop Drawings.

17

18

a. Previous payments for items will be deducted from subsequent progress estimate(s) if proper storage procedures are not observed.

19

20

##### 1.2 DELIVERY

21

A. Scheduling: Schedule delivery of products or equipment as required to allow timely installation and to avoid prolonged storage.

22

23

B. Packaging: Deliver products or equipment in manufacturer's original unbroken cartons or other containers designed and constructed to protect the contents from physical or environmental damage.

24

25

26

C. Identification: Clearly and fully mark and identify as to manufacturer, item, and installation location.

27

28

D. Protection and Handling: Provide manufacturer's instructions for storage and handling.

29

#### PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

30

#### PART 3 - EXECUTION

31

##### 3.1 PROTECTION, STORAGE AND HANDLING

32

###### A. Manufacturer's Instruction:

33

1. Protect all products or equipment in accordance with manufacturer's written directions.

34

a. Store products or equipment in location to avoid physical damage to items while in storage.

35

36

b. Handle products or equipment in accordance with manufacturer's recommendations and instructions.

37

38

2. Protect equipment from exposure to elements and keep thoroughly dry.

39

3. When space heaters are provided in equipment, connect and operate heaters during storage until equipment is placed in service.

40

1 **3.2 STORAGE FACILITIES**

- 2 A. Temporary Storage Facility:
- 3 1. Provide a weatherproof temporary storage facility specifically for the purpose of providing for
- 4 protection of products and equipment.
- 5 a. Size storage facility to accommodate anticipated storage items.
- 6 2. Equip storage facility with lockable doors and lighting, and provide electrical service for
- 7 equipment space heaters and heating or ventilation as necessary to provide storage
- 8 environments acceptable to specified manufacturers.
- 9 3. Provide methods of storage of products and equipment off the ground.
- 10 4. Provide storage facility prior to delivery of materials to be stored on-site.
- 11 a. Locate storage facility on-site where shown on the Drawings or in location approved by
- 12 Engineer.
- 13 b. Remove storage facility from site prior to startup and demonstration period.

14 **3.3 FIELD QUALITY CONTROL**

- 15 A. Inspect Deliveries:
- 16 1. Inspect all products or equipment delivered to the site prior to unloading.
- 17 a. Reject all products or equipment that are damaged, used, or in any other way
- 18 unsatisfactory for use on Project.
- 19 B. Monitor Storage Area: Monitor storage area to ensure suitable temperature and moisture
- 20 conditions are maintained as required by manufacturer or as appropriate for particular items.

21 **END OF SECTION**

1 2014/09/05

2 **SECTION 01601**  
3 **JOB CONDITIONS**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes: Job conditions.
- 7 B. Related Sections include but are not necessarily limited to:
- 8 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 9 2. Division 1 - General Requirements.

10 **1.2 PROJECT CONDITIONS**

- 11 A. Prior to installation of material, equipment and other work, verify with subcontractors, material or  
12 equipment manufacturers, and installers that the substrate or surface to which those materials  
13 attach is acceptable for installation of those materials or equipment (Substrate is defined as  
14 building surfaces to which materials or equipment is attached to i.e., floors, walls, ceilings, etc.).
- 15 B. Correct unacceptable substrate until acceptable for installation of equipment or materials.
- 16 C. Contractor shall not store materials in any way that prevents access to fire personnel and their  
17 equipment.
- 18 D. Construction is located in areas near existing operations and equipment buildings and their  
19 associated features. Contractor shall be responsible for protecting all existing buildings,  
20 improvements, and utilities during construction. If damage occurs, the Contractor will be  
21 responsible for any repairs necessary and the costs associated with completing repairs.
- 22 E. Contractor will likely encounter areas of saturation or perched water outside of groundwater limits  
23 indicated in the Geotechnical Report. These areas of saturation or perched water are likely due  
24 to leaks from existing basins and channels on-site. Any dewatering activities shall be done  
25 according to the Specifications in their respective Section at no additional cost to Owner.
- 26 F. Contractor may encounter rubble, concrete and other debris in the area of the Filter Building and  
27 Basin 7 excavation and the new filter chemical addition excavation. Contractor is responsible for  
28 removal and proper disposal off-site of the materials at no additional cost to Owner.
- 29 G. Dimensions and Elevations shown in the Drawings are based upon the best information available.  
30 Contractor shall verify existing conditions prior to fabrication or installation.
- 31 1. Floor elevations of the Filter Plant shown in the Drawings shall be considered nominal  
32 elevations. Contractor shall provide supplemental survey elevations as required.

33 **1.3 MAINTAINING FACILITY OPERATIONS:**

- 34 A. Facility is currently operating. Ensure construction activities do not interfere with Owner's  
35 operation of facility. Contractor and their work shall in no way interfere with any regular MUD  
36 operations or deliveries on-site.
- 37 B. The Engineer and District shall have authority to review, approve and modify the Contractor's  
38 schedule in order to protect the operation of existing facilities during construction.
- 39 C. The District must be provided two weeks written notice prior to any scheduled shutdowns of  
40 equipment or treatment basins. All shutdown notices shall be submitted by the General  
41 Contractor's Superintendent, not the various subcontractors.

- 1 D. All work requiring interface with the existing facilities and operations of the Florence Water  
2 Treatment Plant must be scheduled with the District to allow the District to maintain uninterrupted  
3 operation of existing facilities.
- 4 1. The Contractor is prohibited from operating any of the District's existing equipment, valves,  
5 gates or other plant components at any time. The Contractor shall inform the District on any  
6 such required actions and District staff shall conduct them. The District shall be provided  
7 48 HRS written notice.
- 8 2. The Contractor shall provide a minimum of 48 HRS written notice to any tie-ins to existing  
9 plant pipelines, channels or electrical, security or controls systems or any other interface  
10 activities with the exception of those listed in Paragraph 1.3C of this Section.
- 11 E. At no time shall Contractor modify operation of the existing facilities or start construction  
12 modifications of existing facilities without approval of District except in and emergency to prevent  
13 or minimize damage.
- 14 F. The District's representative(s) authorized to provided approvals stated above shall be identified  
15 at the Preconstruction meeting.
- 16 G. Two (2) planned facility shut-downs are permitted during the completion of the Work as described  
17 in Section 01060. See Section 01060 for duration and timing of the permissible plant shut downs:
- 18 1. During the plant shutdowns all facilities, processes and treatment components upstream of  
19 and including the filter-to-waste process may remain in operation at MUD's direction to allow  
20 the water to be discharged to the Missouri River as filter to waste. The Contractor's work  
21 shall not interfere with these operations.
- 22 2. Only single isolation from ongoing plant operations and distribution systems will be available.  
23 MUD can not guarantee that the valves, structures, gates, stoplogs, etc. that may used to  
24 isolate the Contractor's Work are fully operational and water tight. The Contractor shall  
25 provide any additional means of isolation and dewatering required to complete Work at no  
26 additional cost.
- 27 H. Control emissions of gases or particulates resulting from application of adhesives, paints or  
28 coatings, or produced by welding, grinding, abrasive blasting or other activities.
- 29 1. During the PCS 1 construction period the south half of the filter plant, (filters 1 through 12),  
30 will remain in operation as well as the lower level backwash pumps, valves, blowers and air  
31 compressors.
- 32 a. At the upper level operating floor, provide a clean access corridor and enclosure from  
33 the control room to the south half of the filter plant during PCS 1, complete with  
34 temporary access door that seals out dust and air from migration into the operating  
35 portion of the filter plant and into the control room.
- 36 b. Provide sealed openings with doors to all access openings from the upper level floor to  
37 the lower level floor.
- 38 2. During the PCS 2 construction period the north half of the filter plant, (filters 13 through 24),  
39 will remain in operation as well as the lower level backwash pumps, valves, blowers and air  
40 compressors.
- 41 a. At the upper level operating floor, maintain temporary access doors that seal out dust  
42 and air from migration into the operating portion of the filter plant and into the control  
43 room.
- 44 b. Provide sealed openings with doors to all access openings from the upper level floor to  
45 the lower level floor.
- 46 3. Provide temporary partition walls, drapes or other screening methods to isolate areas under  
47 construction from other areas of operation adjacent to construction areas.
- 48 4. Provide temporary ventilation of construction area:
- 49 a. Exhaust air to outdoor discharge.
- 50 b. Locate exhaust air discharge at an elevation sufficient to prevent personnel contact with  
51 exhaust air.
- 52 c. Locate exhaust air discharge to avoid short-circuiting with existing supply air intakes.
- 53 I. See Section 01060 for additional construction sequencing constraints.



1 **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)**

2 **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SECTION)**

3 **END OF SECTION**

4



**SECTION 01640**  
**PRODUCT SUBSTITUTIONS**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
  - 7 1. The procedure for requesting the approval of substitution of a product that is not equivalent
  - 8 to a product which is specified by descriptive or performance criteria or defined by reference
  - 9 to one or more of the following:
    - 10 a. Name of manufacturer.
    - 11 b. Name of vendor.
    - 12 c. Trade name.
    - 13 d. Catalog number.
  - 14 2. Substitutions are not "or-equals."
  - 15 3. This Specification Section does not address substitutions for major equipment.
    - 16 a. See "INSTRUCTIONS TO BIDDERS."
- 17 B. Related Specification Sections include but are not necessarily limited to:
  - 18 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
  - 19 2. Division 01 - General Requirements.
- 20 C. Request for Substitution - General:
  - 21 1. Base all bids on materials, equipment, and procedures specified.
  - 22 2. Certain types of equipment and kinds of material are described in specifications by means of
  - 23 references to names of manufacturers and vendors, trade names, or catalog numbers.
    - 24 a. When this method of specifying is used, it is not intended to exclude from consideration
    - 25 other products bearing other manufacturer's or vendor's names, trade names, or catalog
    - 26 numbers, provided said products are "or-equals," as determined by Engineer.
  - 27 3. Other types of equipment and kinds of material may be acceptable substitutions under the
  - 28 following conditions:
    - 29 a. Or-equals are unavailable due to strike, discontinued production of products meeting
    - 30 specified requirements, or other factors beyond control of Contractor; or,
    - 31 b. Contractor proposes a cost and/or time reduction incentive to the Owner.

32 **1.2 QUALITY ASSURANCE**

- 33 A. In making request for substitution or in using an approved product, Contractor represents
- 34 Contractor:
  - 35 1. Has investigated proposed product, and has determined that it is adequate or superior in all
  - 36 respects to that specified, and that it will perform function for which it is intended.
  - 37 2. Will provide same guarantee for substitute item as for product specified.
  - 38 3. Will coordinate installation of accepted substitution into Work, to include building
  - 39 modifications if necessary, making such changes as may be required for Work to be
  - 40 complete in all respects.
  - 41 4. Waives all claims for additional costs related to substitution which subsequently arise.

42 **1.3 DEFINITIONS**

- 43 A. Product: Manufactured material or equipment.

44 **1.4 PROCEDURE FOR REQUESTING SUBSTITUTION**

- 45 A. Substitution shall be considered only:
  - 46 1. After Award of Contract.
  - 47 2. Under the conditions stated herein.
- 48 B. Written request through Contractor only.

- 1 C. Transmittal Mechanics:
- 2 1. Follow the transmittal mechanics prescribed for Shop Drawings in Specification Section
- 3 01340.
- 4 2. Product substitution will be treated in a manner similar to "deviations," as described in
- 5 Specification Section 01340.
- 6 3. List the letter describing the deviation and justifications on the transmittal form in the space
- 7 provided under the column with the heading DESCRIPTION.
- 8 a. Include in the transmittal letter, either directly or as a clearly marked attachment, the
- 9 items listed in Paragraph D below.

- 10 D. Transmittal Contents:
- 11 1. Product identification:
- 12 a. Manufacturer's name.
- 13 b. Telephone number and representative contact name.
- 14 c. Specification Section or Drawing reference of originally specified product, including
- 15 discrete name or tag number assigned to original product in the Contract Documents.
- 16 2. Manufacturer's literature clearly marked to show compliance of proposed product with
- 17 Contract Documents.
- 18 3. Itemized comparison of original and proposed product addressing product characteristics
- 19 including but not necessarily limited to:
- 20 a. Size.
- 21 b. Composition or materials of construction.
- 22 c. Weight.
- 23 d. Electrical or mechanical requirements.
- 24 4. Product experience:
- 25 a. Location of past projects utilizing product.
- 26 b. Name and telephone number of persons associated with referenced projects
- 27 knowledgeable concerning proposed product.
- 28 c. Available field data and reports associated with proposed product.
- 29 5. Data relating to changes in construction schedule.
- 30 6. Data relating to changes in cost.
- 31 7. Samples:
- 32 a. At request of Engineer.
- 33 b. Full size if requested by Engineer.
- 34 c. Held until substantial completion.
- 35 d. Engineer not responsible for loss or damage to samples.

36 **1.5 APPROVAL OR REJECTION**

- 37 A. Written approval or rejection of substitution given by the Engineer.
- 38 B. Engineer reserves the right to require proposed product to comply with color and pattern of
- 39 specified product if necessary to secure design intent.
- 40 C. In the event the substitution is approved, the resulting cost and/or time reduction will be
- 41 documented by Change Order in accordance with the General Conditions.
- 42 D. Substitution will be rejected if:
- 43 1. Submittal is not through the Contractor with his stamp of approval.
- 44 2. Request is not made in accordance with this Specification Section.
- 45 3. In the Engineer's opinion, acceptance will require substantial revision of the original design.
- 46 4. In the Engineer's opinion, substitution will not perform adequately the function consistent with
- 47 the design intent.
- 48 E. Contractor shall reimburse Owner for the cost of Engineer's evaluation whether or not substitution
- 49 is approved.

1 **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

2 **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

3 **END OF SECTION**

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**SECTION 01650**  
**SYSTEM START-UP**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
- 7 1. Procedures and actions, required of the Contractor, which are necessary to achieve and
- 8 demonstrate Substantial Completion.
- 9 2. Requirements for Substantial Completion Submittals.
- 10 B. Related Sections include but are not necessarily limited to:
- 11 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 12 2. Division 01 - General Requirements.
- 13 3. Section 11005 - Equipment: Basic Requirements.
- 14 4. Section 13440 - Instrumentation for Process Control: Basic Requirements.

15 **1.2 DEFINITIONS**

- 16 A. Project Classified System (PCS): A defined part of the Project, consisting of an arrangement of
- 17 items, such as equipment, structures, components, piping, wiring, materials, or incidentals, so
- 18 related or connected to form an identifiable, unified, functional, operational, safe, and
- 19 independent system.
- 20 B. Pre-Demonstration Period: The period of time, of unspecified duration after initial construction
- 21 and installation activities during which Contractor, with assistance from manufacturer's
- 22 representatives, performs in the following sequence:
- 23 1. Finishing type construction work to ensure the Project or each PCS has reached a state of
- 24 Substantial Completion.
- 25 2. Equipment start-up.
- 26 3. Personnel training.
- 27 C. Demonstration Period: A period of time, of specified duration, following the Pre-Demonstration
- 28 Period, during which the Contractor initiates process flow through the facility Project Classified
- 29 System and starts up and operates the Project Classified System , without exceeding specified
- 30 downtime limitations, to prove the functional integrity of the mechanical and electrical equipment
- 31 and components and the control interfaces of the respective equipment and components
- 32 comprising the Project Classified System as evidence of Substantial Completion.
- 33 D. Substantial Completion: See Division 0, General Conditions.

34 **1.3 SUBMITTALS**

- 35 A. See Specification Section 01340 for requirements for the mechanics and administration of the
- 36 submittal process.
- 37 B. Submit in the chronological order listed below prior to the completion of the Pre-Demonstration
- 38 Period.
- 39 1. Master operation and maintenance training schedule:
- 40 a. Submit 30 days (minimum) prior to first training session for Owner's personnel.
- 41 b. Schedule to include:
- 42 1) Target date and time for Owner witnessing of each system initial start-up.
- 43 2) Target date and time for Operation and Maintenance training for each system, both
- 44 field and classroom.
- 45 3) Target date for initiation of Demonstration Period.
- 46 c. Submit for review and approval by Owner.
- 47 d. Include holidays observed by Owner.

- 1 e. Attend a schedule planning and coordination meeting 90 calendar days prior to first
- 2 anticipated training session.
- 3 1) Provide a status report and schedule-to-complete for requirements prerequisite to
- 4 manufacturer's training.
- 5 2) Identify initial target dates for individual manufacturer's training sessions.
- 6 f. Owner reserves the right to insist on a minimum seven (7) days' notice of rescheduled
- 7 training session not conducted on master schedule target date for any reason.
- 8 g. Schedule to be resubmitted until approved.
- 9 2. Substantial Completion Submittal:
- 10 a. File Contractor's Notice of Substantial Completion and Request for Inspection.
- 11 b. Approved Operation and Maintenance manuals received by Engineer minimum one (1)
- 12 week prior to scheduled training.
- 13 c. Written request for Owner to witness each system pre-demonstration start-up.
- 14 1) Request to be received by Owner minimum one (1) week before scheduled training
- 15 of Owner's personnel on that system.
- 16 d. Equipment installation and pre-demonstration start-up certifications.
- 17 e. Letter verifying completion of all pre-demonstration start-up activities including receipt of
- 18 all specified items from manufacturers or suppliers as final item prior to initiation of
- 19 Demonstration Period.

20 **1.4 SEQUENCING AND SCHEDULING**

- 21 A. The purpose of this Section is to establish sequencing and scheduling of major work components,
- 22 but does not necessarily include all work. Project Classified Systems (PCS) established as
- 23 follows.
- 24 B. PCS 1: North Filter and Center Gallery Improvements:
- 25 1. Isolation of the north half of filter influent channel at center operations level stop log location
- 26 to allow south half of filter plant to remain in operation. Isolation of the north half of filter
- 27 backwash supply channel at lower level stop log location to allow south half of filter plant to
- 28 remain in operation.
- 29 2. Constructing temporary dust capture and containment structures for isolating the PCS 1 from
- 30 the operating portion of the facility, upper operations level.
- 31 3. Cleaning, surface preparation, concrete repairs and coating Interior of influent channel and
- 32 installing new stop log frames.
- 33 4. Cleaning, surface preparation, concrete patching, repairs, and refurbishing of curbs, stop log
- 34 hatches, roof beams, girders, columns, ceilings and floors. Filter walkway modifications and
- 35 sealed plates for openings at filters from operating floor to lower level. Coating interior areas
- 36 at operations level, columns, beams, ceilings, floors and walls.
- 37 5. Refurbished guard rails at designated locations.
- 38 6. New exterior metal insulated wall panels, doors, windows and louvers.
- 39 7. New fin tube radiators and piping, operations level, and unit heaters and designated piping in
- 40 lower level. Refurbishing roof drain piping and insulation. Modifications to plumbing system.
- 41 8. Miscellaneous piping additions and insulation.
- 42 9. Refurbishing and modifying stairways and openings at operations level, lower level and east
- 43 and west exterior access to the building.
- 44 10. Constructing temporary dust capture and containment structures for isolating the PCS 1 from
- 45 the operating portion of the facility, lower level.
- 46 11. Isolation of various process water and chemical systems, electrical systems, security
- 47 systems and instrumentation systems from the operating portion of the facility to allow south
- 48 half of filter plant to remain in operation, lower level.
- 49 12. Demolition of selected piping systems, brackets, beams, hangers, pipe supports and conduit,
- 50 at operations level and lower level areas.
- 51 13. Removal and salvage of selected electrical and instrumentation equipment, meters, and
- 52 components, at operations level and lower level. Upgrades to instrumentation and control
- 53 system, flow and turbidity signals, control valve position limit switches, and instrument signal
- 54 routing.
- 55 14. Cleaning, surface preparation, concrete repairs and coating exterior of influent channel and
- 56 filter walls, lower level.
- 57 15. Cleaning, surface preparation, and coating of filter piping, valves and process small bore
- 58 piping systems.



- 1 16. Removal and replacement of all filter control valves and actuators, refurbishing to automate
- 2 filter to waste system. Change filter-to-waste valves to modulating to use percent open to
- 3 approximate flow through valve. Refurbish all pipe supports.
- 4 17. Removal and replacement of various process valves, filter influent drain valves, air supply
- 5 filter units, small bore piping and control components.
- 6 18. Refurbishing floor slopes at pipe gallery for improved drainage. Repairing filter to waste
- 7 drain openings in pipe gallery floor and repairing floor at backwash water supply floor
- 8 penetrations.
- 9 19. Replacement of switchboard, ATS, and Air Scour Blower starters into Electrical Room F11.
- 10 20. Replacement, refurbishing and new electrical panel boards, disconnects, transformers,
- 11 wireways, pull-boxes, disconnect switches and other electrical devices. New panelboards,
- 12 power circuits, and control wiring for valve actuator upgrades.
- 13 21. Replacement of power, control, communication, and security conduits in the lower level with
- 14 cable tray and new conduit. Replacement of power, control, communication, and security
- 15 cables and conductors.
- 16 22. Removal and replacement of light fixtures to accommodate rehabilitation of ceilings at the
- 17 lower level.
- 18 23. Removal and replacement of light fixtures to accommodate rehabilitation of ceilings at the
- 19 operating floor level.
- 20 24. Removal and replacement of conduit and conductors for security, power and lightning
- 21 protection at wall panels to facilitate wall panel removals and installation.
- 22 25. Relocation of conduits and receptacles on columns at operations level and lower level.
- 23 26. Re-route fiber optic cables entering the building from the south to enter the building on the
- 24 west side, and demolish handhole and duct bank at the south end of building to allow for
- 25 construction of the new chemical building in PCS 2.
- 26 27. Temporary power requirements for sequencing during construction.
- 27 28. Install temporary and permanent chemical injection ty ins to the 54 IN by-pass line feeding
- 28 the north half of the filter plant. Chemicals to be rerouted are chlorine solution, ammonia,
- 29 fluoride, polymer and sample line.
- 30 29. And all incidentals necessary for complete system.
- 31 C. PCS 2: South Filter Improvements:
- 32 1. Constructing improved egress from south end of pipe gallery.
- 33 2. Construction of new chemical addition.
- 34 3. Constructing repairs to brick and concrete foundation wall at south end of lower level pipe
- 35 gallery and influent channel.
- 36 4. Relocating and refurbishing fluoride feed system, fluoride transfer pumping system, polymer
- 37 feed system and polyphosphate feed system including removal of old tanks and replacement
- 38 with new tanks.
- 39 5. Isolation of the south half of filter influent channel at center operations level stop log location
- 40 to allow north half of filter plant to remain in operation. Isolation of the south half of filter
- 41 backwash supply channel at lower level stop log location to allow north half of filter plant to
- 42 remain in operation. The district will reroute water from Basin 1 to the north half of the filter
- 43 plant thru the existing 54 IN by-pass line to provide flow to the north half of the filter plant.
- 44 6. Constructing temporary dust capture and containment structures for isolating the PCS 2 from
- 45 the operating portion of the facility, upper operations level.
- 46 7. Cleaning, surface preparation, concrete repairs and coating Interior of influent channel and
- 47 installing new stop log frames.
- 48 8. Cleaning, surface preparation, concrete patching, repairs, and refurbishing of curbs, stop log
- 49 hatches, roof beams, girders, columns, ceilings and floors. Filter walkway modifications and
- 50 sealed plates for openings at filters from operating floor to lower level. Coating interior areas
- 51 at operations level, columns, beams, ceilings, floors and walls.
- 52 9. Refurbished guard rails at designated locations.
- 53 10. New exterior metal insulated wall panels, doors, windows and louvers.
- 54 11. New fin tube radiators and piping, operations level and unit heaters and designated piping in
- 55 lower level. Refurbishing roof drain piping and insulation. Modifications to plumbing system.
- 56 12. Miscellaneous piping additions and insulation.
- 57 13. Refurbishing and modifying stairways and openings at operations level, lower level.
- 58 14. Constructing temporary dust capture and containment structures for isolating the PCS 2 from
- 59 the operating portion of the facility, lower level.

15. Isolation of various process water and chemical systems, electrical systems, security systems and instrumentation systems from the operating portion of the facility to allow north half of filter plant to remain in operation, lower level.
  16. Demolition of selected piping systems, brackets, beams, hangers, pipe supports and conduit, at operations level and lower level areas.
  17. Removal and salvage of selected electrical and instrumentation equipment, meters, and components, at operations level and lower level. Upgrades to instrumentation and control system, flow and turbidity signals, control valve position limit switches, and instrument signal routing.
  18. Cleaning, surface preparation, concrete repairs and coating exterior of influent channel and filter walls, lower level.
  19. Cleaning, surface preparation, and coating of filter piping, valves and process small bore piping systems
  20. Removal and replacement of all filter control valves and actuators, refurbishing to automate filter to waste system. Change filter-to-waste valves to modulating to use percent open to approximate flow through valve. Refurbish all pipe supports.
  21. Removal and replacement of various process valves, filter influent drain valves, air supply filter units, small bore piping and control components.
  22. Refurbishing floor slopes at pipe gallery for improved drainage. Repairing filter to waste drain openings in pipe gallery floor and repairing floor at backwash water supply floor penetrations.
  23. Replacement, refurbishing and new electrical panel boards, disconnects, transformers, wireways, pull-boxes, disconnect switches and other electrical devices. New panelboards, power circuits, and control wiring for valve actuator upgrades.
  24. Replacement of power, control, communication, and security conduits in the lower level with cable tray and new conduit. Replacement of power, control, communication, and security cables and conductors.
  25. Removal and replacement of light fixtures to accommodate rehabilitation of ceilings at the lower level.
  26. Removal and replacement of light fixtures to accommodate rehabilitation of ceilings at the operating floor level.
  27. Removal and replacement of conduit and conductors for security, power and lightning protection at wall panels to facilitate wall panel removals and installation.
  28. Relocation of conduits and receptacles on columns at operations level and lower level.
  29. Temporary power requirements for sequencing during construction.
  30. And all incidentals necessary for complete system.
- D. PCS 3: All other work not in PCS 1 and PCS 2, including but not limited to the following:
1. New dehumidification system for lower level area and operations level control room. HVAC system modifications, and control upgrades.
  2. Sanitary sewer modifications.
  3. New improved access to roof area.
  4. Surface preparation and painting exterior work.
  5. New fluoride chemical system transfer pump station and underground piping.
  6. New chemical containment casing, chemical feed piping and connection to Basin 7 influent structure.
  7. New entrance vestibule of west side of the Filter Building.
  8. Renovation of the Storage Building located between the Filter Building and Basin 7.
- E. Phased Construction:
1. See Section 01060 and Section 01601 for requirements.
  2. See Section 00500 for completion dates of each PCS.
- F. Schedule of Events:
1. See Section 01060 and Section 01601 for requirements.
  2. See Section 00500 for completion dates of each PCS.

54 **1.5 COST OF START-UP**

- 55 A. Contractor to pay all costs associated with System start-up.

56 **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

1 **PART 3 - EXECUTION**

2 **3.1 GENERAL**

- 3 A. Facility Start-up Divided into Two Periods:
- 4 1. Pre-Demonstration Period including:
- 5 a. Completion of construction work to bring Project to a state of Substantial Completion.
- 6 b. Start-up of Equipment.
- 7 c. Training of Personnel.
- 8 d. Completion of the filing of all required submittals.
- 9 e. Filing of Contractor's Notice of Substantial Completion and Request for Inspection.
- 10 2. Demonstration Period including:
- 11 a. Demonstration of functional integrity of facility or PCS.

12 **3.2 PRE-DEMONSTRATION PERIOD**

- 13 A. Completion of Construction Work:
- 14 1. Complete the work to bring the PCS to a state of substantial completion.
- 15 B. Pressure Testing: See Section 15060.
- 16 C. Cleaning: See Section 01710 and Section 15060.
- 17 D. Disinfection of Facilities: See Section 15060 and Section 01733.
- 18 E. Equipment Start-up:
- 19 1. Requirements for individual items of equipment are included in Division 02 through Division
- 20 16 Specification Sections.
- 21 2. Prepare the equipment so it will operate properly and safely and be ready to demonstrate
- 22 functional integrity during the Demonstration Period.
- 23 3. Perform Equipment Start-up to extent possible without introducing product flow.
- 24 a. Test tanks, pumping and similar equipment and piping requiring a fluid, using clean
- 25 water supplied at Contractor's expense.
- 26 b. Dispose of water used for Equipment Start-up.
- 27 4. Introduce product flow to complete Equipment Start-up for the following equipment:
- 28 a. All Filters for each PCS.
- 29 b. All Chemical systems.
- 30 5. Procedures include but are not necessarily limited to the following:
- 31 a. Test or check and correct deficiencies of:
- 32 1) Power, control, and monitoring circuits for continuity prior to connection to power
- 33 source.
- 34 2) Voltage of all circuits.
- 35 3) Phase sequence.
- 36 4) Cleanliness of connecting piping systems.
- 37 5) Alignment of connected machinery.
- 38 6) Vacuum and pressure of all closed systems.
- 39 7) Lubrication.
- 40 8) Valve orientation and position status for manual operating mode.
- 41 9) Tankage for integrity using clean water
- 42 10) Pumping equipment using clean water.
- 43 11) Instrumentation and control signal generation, transmission, reception, and
- 44 response.
- 45 a) See Specification Section 13440.
- 46 12) Tagging and identification systems.
- 47 13) All equipment: Proper connections, alignment, calibration and adjustment.
- 48 b. Calibrate all safety equipment.
- 49 c. Manually rotate or move moving parts to assure freedom of movement.
- 50 d. "Bump" start electric motors to verify proper rotation.
- 51 e. Perform other tests, checks, and activities required to make the equipment ready for
- 52 Demonstration Period.
- 53 f. Documentation:
- 54 1) Prepare a log showing each equipment item subject to this paragraph and listing
- 55 what is to be accomplished during Equipment Start-up.

- 1                       2) Provide a place for the Contractor to record date and person accomplishing  
 2                             required work.  
 3                       3) Submit completed document before requesting inspection for Substantial  
 4                             Completion certification.  
 5                   6. Obtain certifications, without restrictions or qualifications, and deliver to Engineer:  
 6                   a. Manufacturer's equipment installation check letters (sometimes referred to as  
 7                   Manufacturer's Field Services report).  
 8                   b. Instrumentation Supplier's Instrumentation Installation Certificate.
- 9           F. Personnel Training:  
 10           1. See individual equipment specification sections.  
 11           2. Conduct all personnel training after completion of Equipment Start-up for the equipment for  
 12           which training is being conducted.  
 13           a. Personnel training on individual equipment or systems will not be considered completed  
 14           unless:  
 15                1) All pre-training deliverables are received and approved before commencement of  
 16                training on the individual equipment or system.  
 17                2) No system malfunctions occur during training.  
 18                3) All provisions of field and classroom training Specifications are met.  
 19           b. Training not in compliance with the above will be performed again in its entirety by the  
 20           manufacturer at no additional cost to Owner.
- 21           3. Field and classroom training requirements:  
 22           a. Hold classroom training on-site.  
 23           b. Notify each manufacturer specified for on-site training that the Owner reserves the right  
 24           to video record any or all training sessions.  
 25                1) Organize each training session in a format compatible with video recording.  
 26           c. Training instructor qualification: Factory trained and familiar with giving both classroom  
 27           and "hands-on" instructions.  
 28           d. Training instructors:  
 29                1) Be at classes on time.  
 30                2) Session beginning and ending times to be coordinated with the Owner and  
 31                indicated on the master schedule.  
 32                3) Normal time lengths for class periods can vary, but brief rest breaks should be  
 33                scheduled and taken.  
 34           e. Organize training sessions into maintenance verses operation topics and identify on  
 35           schedule.  
 36           f. Plan for minimum class attendance of 10 people at each session and provide sufficient  
 37           classroom materials, samples, and handouts for those in attendance.  
 38           g. Instructors to have a typed agenda and well prepared instructional material.  
 39                1) The use of visual aids, e.g., films, pictures, and slides is recommended for use  
 40                during the classroom training programs.  
 41                2) Deliver agendas to the Engineer a minimum of seven 7 days prior to the classroom  
 42                training.  
 43                3) Provide equipment required for presentation of films, slides, and other visual aids.  
 44           h. In the on-site training sessions, cover the information required in the Operation and  
 45           Maintenance Manuals submitted according to Specification Section 01340 and the  
 46           following areas as applicable to PCS's.  
 47                1) Operation of equipment.  
 48                2) Lubrication of equipment.  
 49                3) Maintenance and repair of equipment.  
 50                4) Troubleshooting of equipment.  
 51                5) Preventive maintenance procedures.  
 52                6) Adjustments to equipment.  
 53                7) Inventory of spare parts.  
 54                8) Optimizing equipment performance.  
 55                9) Capabilities.  
 56                10) Operational safety.  
 57                11) Emergency situation response.  
 58                12) Takedown procedures (disassembly and assembly).  
 59           i. Address above Paragraphs 1), 2), 8), 9), 10), and 11) in the operation sessions. Address  
 60           above Paragraphs 3), 4), 5), 6), 7), and 12) in the maintenance sessions.

- 1                   j. Maintain a log of classroom training provided including: Instructors, topics, dates, time,  
2                   and attendance.
- 3           G. Complete the filing of all required submittals:
- 4           1. Shop Drawings.
- 5           2. Operation and Maintenance Manuals.
- 6           3. Training material.
- 7           H. Filing of Contractor's Notice of Substantial Completion and Request for Inspection of Project or  
8           PCS:
- 9           1. File the notice when the following have been completed:
- 10          a. Construction work (brought to state of Substantial Completion).
- 11          b. Equipment Start-up.
- 12          c. Personnel Training.
- 13          d. Submittal of required documents.
- 14          2. Engineer will review required submittals for completeness within 5 calendar days of  
15          Contractor's notice. If complete, Engineer will complete inspection of the Work, within 10  
16          calendar days of Contractor's notice.
- 17          3. Engineer will inform Contractor in writing of the status of the Work reviewed, within 14  
18          calendar days of Contractor's notice.
- 19          a. Work determined not meeting state of Substantial Completion:
- 20            1) Contractor: Correct deficiencies noted or submit plan of action for correction within  
21            5 days of Engineer's determination.
- 22            2) Engineer: Re-inspect work within 5 days of Contractor's notice of correction of  
23            deficiencies.
- 24            3) Re-inspection costs incurred by Engineer will be billed to Owner who will deduct  
25            them from final payment due Contractor.
- 26          b. Work determined to be in state of tentative Substantial Completion: Engineer to prepare  
27          tentative "Engineer's Certificate of Substantial Completion."
- 28          c. Engineer's Certificate of Substantial Completion:
- 29            1) Certificate tentatively issued subject to successful Demonstration of functional  
30            integrity.
- 31            2) Issued for Project as a whole or for one or more PCS.
- 32            3) Issued subject to completion or correction of items cited in the certificate (punch  
33            list).
- 34            4) Issued with responsibilities of Owner and Contractor cited.
- 35            5) Executed by Engineer.
- 36            6) Accepted by Owner.
- 37            7) Accepted by Contractor.
- 38          d. Upon successful completion of Demonstration Period, Engineer will endorse certificate  
39          attesting to the successful demonstration, and citing the hour and date of ending the  
40          successful Demonstration Period of functional integrity as the effective date of  
41          Substantial Completion.

### 42   **3.3 DEMONSTRATION PERIOD**

- 43    A. General:
- 44    1. Demonstrate the functional integrity of the mechanical, electrical, and control interfaces of  
45    the respective equipment and components comprising the PCS as evidence of Substantial  
46    Completion.
- 47    2. Duration of Demonstration Period: 120 consecutive hours.
- 48    3. If, during the Demonstration Period, the aggregate amount of time used for repair, alteration,  
49    or unscheduled adjustments to any equipment or systems that renders the affected  
50    equipment or system inoperative exceed 10 percent of the Demonstration Period, the  
51    demonstration of functional integrity will be deemed to have failed.
- 52    a. In the event of failure, a new Demonstration Period will recommence after correction of  
53    the cause of failure.
- 54    b. The new Demonstration Period shall have the same requirements and duration as the  
55    Demonstration Period previously conducted.
- 56    4. Conduct the demonstration of functional integrity under full operational conditions.
- 57    5. Owner will provide operational personnel to provide process decisions affecting plant  
58    performance.
- 59    a. Owner's assistance will be available only for process decisions.

- 1                   b. Contractor will perform all other functions including but not limited to equipment  
2                   operation and maintenance until successful completion of the Demonstration Period.  
3                   6. Owner reserves the right to simulate operational variables, equipment failures, routine  
4                   maintenance scenarios, etc., to verify the functional integrity of automatic and manual  
5                   backup systems and alternate operating modes  
6                   7. Demonstration by PCS:  
7                   a. Contractor may demonstrate by PCS.  
8                   8. Time of beginning and ending any Demonstration Period shall be agreed upon by Contractor,  
9                   Owner, and Engineer in advance of initiating Demonstration Period.  
10                  9. Throughout the Demonstration Period, provide knowledgeable personnel to answer Owner's  
11                  questions, provide final field instruction on select systems and to respond to any system  
12                  problems or failures which may occur.  
13                  10. Provide all labor, supervision, utilities, chemicals, maintenance, equipment, vehicles or any  
14                  other item necessary to operate and demonstrate all systems being demonstrated.

15

**END OF SECTION**

1 2014/09/08

2

## SECTION 01710

3

### CLEANING

#### 4 PART 1 - GENERAL

##### 5 1.1 SUMMARY

- 6 A. Section Includes:
- 7 1. Intermediate and final cleaning of Work not including special cleaning of closed systems
- 8 specified elsewhere.
- 9 B. Related Specification Sections include but are not necessarily limited to:
- 10 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 11 2. Division 01 - General Requirements.

##### 12 1.2 STORAGE AND HANDLING

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

##### 15 1.3 SCHEDULING

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

#### 18 PART 2 - PRODUCTS

##### 19 2.1 MATERIALS

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

#### 24 PART 3 - EXECUTION

##### 25 3.1 CLEANING - GENERAL

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

1 I. Do not burn on-site.

2 **3.2 INTERIOR CLEANING**

3 A. See Section 01560 for Dust Control Requirements.

4 B. Cleaning During Construction:

- 5 1. Keep work areas clean so as not to hinder health, safety or convenience of personnel in
- 6 existing facility operations.
- 7 2. At maximum weekly intervals, dispose of waste materials, debris, and rubbish.
- 8 3. Control dust in work areas of existing facilities. The contractor shall provide any dust control
- 9 measures to prevent impacts to water production and water quality. See Section 01560 for
- 10 additional requirements.
- 11 4. Provide protection to existing electrical and mechanical equipment as required to eliminate
- 12 detrimental effects due to construction.
- 13 5. Check weekly air handling unit filters in existing units having construction activities.
- 14 6. a. Replace filters as necessary.
- 15 7. At maximum weekly intervals, check interior of existing electric panels and vacuum if dust
- 16 accumulation has occurred.
- 17 8. At maximum weekly intervals, sweep all floors, including platforms, walkways, piping gallery
- 18 and floors, remove and dispose of all debris.
- 19 a. Use dust suppressant sweeping compound in areas open to areas of existing facility
- 20 operations.
- 21 9. Vacuum clean interior areas when ready to receive finish painting.
- 22 a. Continue vacuum cleaning on an as-needed basis, until substantial completion.
- 23 10. Vacuum clean interior areas when ready to receive finish painting.
- 24 a. Continue vacuum cleaning on an as-needed basis, until substantial completion.
- 25 11. Frequency of cleaning shall be increased as determined by the District as required to
- 26 maintain operation of the facility. Additional cleaning will be at no additional cost to the
- 27 Owner.

28 C. Final Cleaning:

- 29 1. Complete immediately prior to Demonstration Period.
- 30 2. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign
- 31 materials from sight-exposed surfaces.
- 32 3. Ventilating systems:
- 33 a. Clean permanent filters and replace disposable filters if units were operated during
- 34 construction.
- 35 b. Clean ducts, blowers and coils if units were operated without filters during construction.
- 36 4. Wipe all lighting fixture reflectors, lenses, lamps and trims clean.
- 37 5. Ventilating systems.
- 38 6. Replace all burned out lamps.
- 39 7. Broom clean process area floors.
- 40 8. Mop office and control room floors.
- 41 9. In Filter Plant, Contractor shall provide cleaning necessary to remove all dust and debris in
- 42 filter plant including that generated during work or existing work. The Owner will request
- 43 additional cleaning by the Contractor at no additional cost to maintain the required
- 44 environment for water treatment.

45 **3.3 EXTERIOR (SITE) CLEANING**

46 A. See Section 01560 for Dust Control Requirements.

47 B. Cleaning During Construction:

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



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

5 **3.4 FIELD QUALITY CONTROL**

- 6 A. Immediately prior to Demonstration Period, conduct an inspection with Engineer to verify
- 7 condition of all work areas.

8 **END OF SECTION**

9



1 2014/09/08

2

## SECTION 01733

3

### CLEANING AND DISINFECTION OF FACILITIES

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

A. Section Includes:

7

1. Requirements for cleaning and disinfection of Pipelines, Storage and Treatment Facilities.

8

B. Related Sections include but are not necessarily limited to:

9

1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

10

2. Division 1 - General Requirements.

11

3. Section 11005 - Equipment: Basic Requirements.

12

4. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.

13

##### 1.2 QUALITY ASSURANCE

14

A. Referenced Standards:

15

1. American National Standards Institute (ANSI)/American Water Works Association (AWWA):

16

- a. B100, Filtering Material.

17

- b. B300, Hypochlorites.

18

- c. B301, Liquid Chlorine.

19

- d. C651, Disinfection Water Mains.

20

- e. C652, Disinfection of Water Storage Facilities.

21

- f. C653, Disinfection of Water Treatment Plants.

22

2. American National Standards Institute (ANSI)/National Sanitation Foundation (NSF):

23

- a. 60, Drinking Water Treatment Chemicals-Health Effects

24

- b. 61, Drinking Water System Components-Health Effects.

25

3. American Public Health Association (APHA)/American Water Works Association

26

- (AWWA)/Water Environment Federation (WEF):

27

- a. Standard Methods for the Examination of Water and Wastewater.

28

4. Nebraska Department of Health and Human Services:

29

- a. Title 179, Public Water Supply Systems.

30

B. Qualifications:

31

1. Provide qualified person to supervise use of liquid chlorine as defined in PART 2.

32

##### 1.3 SUBMITTALS

33

A. See Section 01340.

34

B. Shop Drawings:

35

1. Product technical data including:

36

- a. Acknowledgement that products submitted meet requirements of standards referenced.

37

- b. Product data for disinfectants to be used.

38

C. Miscellaneous Submittals:

39

1. Qualifications of Contractor's supervising personnel for use of liquid chlorine.

40

2. Disinfection Plan

41

- a. Accompany Contractor's Pre-Demonstration Startup Plan as required in Section 01650.

42

- b. Include the following:

43

- 1) Schedule for activities.

44

- 2) Procedure and plan for cleaning and flushing system.

45

- 3) Procedure and plan for disinfection and verification testing.

46

- 4) Proposed locations where samples are to be taken.

47

- 5) Proposed sampling intervals.

48

- 6) Schedule of samples to be tested by Owner.

49

- 7) Type of disinfecting solution and method of preparation.

50

- 8) Method of disposal of highly chlorinated water.

1 c. Certified bacteriological verification test results.

2 **1.4 SEQUENCING AND SCHEDULING**

3 A. See Section 01650 for requirements regarding sequencing of disinfection work with Facility  
4 Demonstration.

5 B. Commence disinfection after completion of the following:

- 6 1. Completion and acceptance of internal coatings systems.  
7 2. Hydrostatic and pneumatic testing, pressure testing, leak testing, functional and performance  
8 testing and acceptance of pipelines, pumping systems, structures, and equipment.

9 **PART 2 - PRODUCTS**

10 **2.1 MATERIALS**

11 A. Water for Disinfection:

- 12 1. Clean, uncontaminated, and meeting the requirements outlined in Section 01650 for  
13 management of water during start-up and demonstration.

14 B. Equipment:

- 15 1. Furnish chemicals and equipment, such as pumps and hoses, to accomplish disinfection.  
16 2. Provide protection as required by AWWA for cross-connection to previously disinfected  
17 sources.

18 C. Disinfectants:

- 19 1. Liquid chlorine:  
20 a. Conforming to requirements of ANSI/AWWA B301.  
21 b. Certified for potable water application per ANSI/NSF 60 or ANSI/NSF 61 as applicable.  
22 c. May be used only if following conditions are met:  
23 1) Used in combination with appropriate gas-flow chlorination equipment to provide  
24 controlled high-concentration solution feed to the water to be chlorinated.  
25 2) Used under direct supervision of a person familiar and experienced with the  
26 physiological, chemical and physical properties of liquid chlorine and who is trained  
27 and equipped to handle emergency situations that may arise.  
28 a) Owner must approve qualifications of supervising person designated by  
29 Contractor.  
30 3) When appropriate safety practices are observed to protect working personnel and  
31 the public.  
32 2. Sodium hypochlorite:  
33 a. Conforming to requirements of ANSI/AWWA B300.  
34 b. Certified for potable water application per ANSI/NSF 60 or ANSI/NSF 61 as applicable.  
35 3. Calcium hypochlorite:  
36 a. Conforming to requirements of ANSI/AWWA B300.  
37 b. Certified for potable water application per ANSI/NSF 60 or ANSI/NSF 61 as applicable.  
38 c. Sequestered calcium hypochlorite intended for swimming pool disinfection may not be  
39 used.

40 **PART 3 - EXECUTION**

41 **3.1 GENERAL**

42 A. All facilities covered by this Section shall be protected, cleaned, and flushed in accordance with  
43 the requirements herein. The specific facilities to be disinfected are also listed herein.

44 B. Protection During Construction Period:

- 45 1. Observe Preventive and Corrective Measures During Construction as defined in  
46 ANSI/AWWA C651.  
47 2. Keep pipe clean and dry during storage and installation.  
48 3. Provide water tight caps, plugs or other suitable water tight enclosure devices to protect  
49 contamination of potable water systems during valve replacements, new connections or  
50 piping removals and replacement.

- 1 4. Protect pipe during wet-trench installation and provide protection from flooding or storm
- 2 events.
- 3 5. In the event of contamination, clean and swab pipe in accordance with ANSI/AWWA C651.
- 4 C. Disinfection procedures shall conform to ANSI/AWWA, Nebraska Department of Health and
- 5 Human Services Regulations, and this Specification.
- 6 1. Disinfect surfaces of materials that will contact finished water, both during and following
- 7 construction, using one of the methods specified in this Section.
- 8 2. Take care to avoid recontamination following disinfection.
- 9 3. Allow freshwater and disinfectant solution to flow into pipe or vessel at a measured rate so
- 10 that chlorinated water is mixed and at a consistent concentration meeting or exceeding the
- 11 required solution strength.
- 12 4. Do not place concentrated commercial disinfectant in pipeline or other facilities to be
- 13 disinfected before it is filled with water.
- 14 D. Facilities to be Disinfected:
- 15 1. All equipment and pipelines that are or will be in contact with process water shall be cleaned
- 16 and flushed in accordance with this Section.
- 17 2. Items to be disinfected include, but are not limited to:
- 18 a. All potable water piping including:
- 19 1) FW - Finished Water.
- 20 2) SVW - Service Water.
- 21 3) BW - Backwash Supply Water.
- 22 4) PWC- Potable Water Cold.
- 23 5) Plumbing.
- 24 b. All water treatment process units including the following:
- 25 1) Backwash Supply Channel.
- 26 2) Existing filter effluent channel at valve replacement locations associated with
- 27 proposed construction.
- 28 3) Chemical piping connections to Basin 7 influent structure.
- 29 4) Filters, troughs, inlet channels and downstream channels, piping and valves.
- 30 c. All pumps, valves and appurtenances.

31 **3.2 PREPARATION**

- 32 A. Cleaning and Flushing for all Facilities:
- 33 1. Thoroughly clean and flush piping systems including supply, source and any appurtenant
- 34 devices before performing disinfection.
- 35 2. Cleaning agents used shall not contain hazardous substances or deleterious compounds that
- 36 would cause a violation of water quality standards or cause health effects is subsequently
- 37 introduced into the water supply during any disinfection or filling operations.
- 38 3. Clean piping in accordance with requirements of Section 15060.
- 39 B. Cleaning and Flushing of Piping and In-line Equipment:
- 40 1. Flush all foreign matter from pipe in accordance with ANSI/AWWA C651.
- 41 2. Provide hoses, temporary connections, ditches, and other conduits are necessary to dispose
- 42 of flushing water without damage to adjacent structures or terrain.
- 43 3. Use water suitable for disinfection.
- 44 4. Flush service connections and hydrants. Flush distribution lines prior to flushing hydrants
- 45 and service connections.
- 46 5. Operate valves during flushing process at least twice during each flush.
- 47 C. Cleaning of Basin 7 Influent Structure:
- 48 1. Remove all materials not part of the operating facilities including temporary works, tools, and
- 49 debris.
- 50 2. Clean and flush.
- 51 3. Remove all fouled water, dirt, paint chips, sediment, or foreign material by rinsing,
- 52 vacuuming, or other removal techniques.
- 53 4. Thoroughly clean walls, floors, and attached structures with high-pressure water jet and by
- 54 sweeping, scrubbing, or other similar means.
- 55 5. Cleaning shall:
- 56 a. Remove all deposits of foreign nature.
- 57 b. Remove biological growths.
- 58 c. Clean the slopes, walls, tops, and bottom.

- 1 d. Avoid damage to the structure.
- 2 e. Remove and avoid pollution or oil deposits by workers and equipment.

3 **3.3 DISINFECTION**

- 4 A. Piping and In-Line Equipment:
  - 5 1. Applies to piping and inline equipment such as pumps and valves that are not covered under
  - 6 other disinfection provisions.
  - 7 2. Disinfect in accordance with ANSI/AWWA C651.
  - 8 3. Utilize any of the three disinfection procedures.
    - 9 a. Tablet Method.
    - 10 b. Continuous Feed Method.
    - 11 c. Slug Method.
  - 12 4. Provide signage and tagging at all outlets from the piping being disinfected to prevent
  - 13 discharge of highly chlorinated water.
  - 14 5. After applicable retention period, flush piping at a velocity of not less than 2.5 feet per
  - 15 second.
    - 16 a. Flush water shall be potable water of domestic water quality.
- 17 B. Basin 7 influent structure:
  - 18 1. Disinfect in accordance with ANSI/AWWA C652.
  - 19 2. Utilize one of the following disinfection procedures from ANSI/AWWA C652:
    - 20 a. Method 1.
    - 21 b. Method 2.
    - 22 c. Method 3.
  - 23 3. Parts of structures, such as ceilings or overflows that cannot be immersed, shall be spray or
  - 24 brush disinfected.
  - 25 4. Provide signage and tagging at all outlets from the tank being disinfected to prevent
  - 26 discharge of highly chlorinated water.
  - 27 5. After applicable retention period, flush tank or reservoir with potable water of domestic water
  - 28 quality to remove heavily chlorinated water.
- 29 C. Filters:
  - 30 1. Disinfect the following components.
    - 31 a. Filter inlet gullet.
    - 32 b. Wetted portion of filter structure.
    - 33 c. Dry portion of side walls of structure.
    - 34 d. Piping as required under other provisions in this Section.
  - 35 2. Complete disinfection after initial backwashing.
  - 36 3. Disinfect in accordance with ANSI/AWWA C653.
  - 37 4. Utilize one of the two disinfection procedures outlined in ANSI/AWWA C653.
    - 38 a. Disinfection Procedure.
    - 39 b. Alternate Disinfection Procedure.
  - 40 5. Provide signage and tagging at all outlets from areas being disinfected to prevent discharge
  - 41 of highly chlorinated water.
  - 42 6. After applicable retention period and testing of residual, filter to waste or backwash filters to
  - 43 remove heavily chlorinated water.
    - 44 a. Backwash water shall be potable water with a free chlorine residual of at least 0.5
    - 45 milligrams per liter.

46 **3.4 DISPOSAL OF FLUSHING AND DISINFECTION WATER**

- 47 A. Disposal of flushing and disinfection water is the responsibility of the Contractor.
- 48 B. Dispose of flushing water in accordance with and as defined in Section 01650.
- 49 C. Heavily chlorinated water must be dechlorinated in accordance with ANSI/AWWA C651,
- 50 ANSI/AWWA C652, and ANSI/AWWA C653 prior to release.
  - 51 1. See appendix of ANSI/AWWA standards for additional information.

52 **3.5 VERIFICATION TESTING**

- 53 A. Upon completion of flushing, provide verification in the form of bacteriological sampling meeting
- 54 the requirements of applicable ANSI/AWWA standard.

- 1 B. Collection of Samples:  
2 1. Contractor shall collect samples where directed by the Owner and deliver to Owner for  
3 laboratory analysis.  
4 2. Coordinate activities to allow samples to be taken in accordance with this Section.  
5 3. Provide valves at sampling points.  
6 4. Provide access to sampling points.
- 7 C. Testing Equipment:  
8 1. Clean containers, equipment, and connections used in sampling to make sure they are free  
9 of contamination.  
10 2. Obtain laboratory sampling bottles with instructions for handling from Owner.
- 11 D. Chlorine Sampling and Analysis:  
12 1. Collect samples in accordance with applicable ANSI/AWWA standard.  
13 2. Samples of disinfecting solution:  
14 a. One sample per batch of disinfecting solution mixed and injected into pipe or vessel.  
15 b. If mixed solution not used, sample structure or pipe being disinfected during or  
16 immediately after filling.  
17 3. Free chlorine residual samples:  
18 a. As required to establish concentrations at the beginning and end of retention period.  
19 4. Sampling locations and intervals:  
20 a. Sampling points shall be representative and accepted by Owner.  
21 5. Laboratory analysis to be performed by Owner. Samples will be analyzed for disinfectant  
22 residual concentration.  
23 6. If chlorine concentration testing results in disinfection concentrations not meeting the  
24 required standard, disinfecting procedures and verification testing shall be repeated until  
25 specified limits are met.
- 26 E. Bacteriological Sampling and Analysis:  
27 1. Collect samples in accordance with applicable ANSI/AWWA standard.  
28 2. Sampling locations and intervals:  
29 a. In accordance with applicable ANSI/AWWA Standard.  
30 b. Sampling points shall be representative and accepted by Owner.  
31 c. If ANSI/AWWA Standard is not applicable or does not fully describe sampling procedure,  
32 utilize the following minimum requirements:  
33 1) A minimum of two (2) samples on two (2) consecutive days from each separable  
34 structure and each individual section of pipeline.  
35 3. Laboratory analysis to be performed by Owner. Samples will be analyzed for disinfectant  
36 residual and coliform concentrations using methods as described in the latest edition of  
37 Standard Methods for Examination of Water and Wastewater.  
38 4. If verification testing results in bacterially positive samples or disinfection concentrations not  
39 meeting the required standard, disinfecting procedures and verification testing shall be  
40 repeated until specified limits are met.
- 41 F. Documentation:  
42 1. Secure from Owner's laboratory and submit certified bacteriological reports on samples  
43 taken from system. Certify that sampling and testing procedures/results are in full  
44 compliance with ANSI/AWWA standards and Nebraska Department of Health & Human  
45 Services regulations.

46  
47

**END OF SECTION**





1 2014/09/15

2

## SECTION 01800

3

### OPENINGS AND PENETRATIONS IN CONSTRUCTION

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

###### A. Section Includes:

7

1. Methods of installing and sealing openings and penetrations in construction.

8

###### B. Related Specification Sections include but are not necessarily limited to:

9

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

10

2. Division 01 - General Requirements.

11

3. Section 05505 - Miscellaneous Metals.

12

4. Section 07541 - PVC Roof Membrane - Fully Adhered.

13

5. Section 07600 - Flashing and Sheet Metal.

14

6. Section 07900 - Joint Sealants.

15

7. Section 09910 - Architectural Coatings.

16

##### 1.2 QUALITY ASSURANCE

17

###### A. Referenced Standards:

18

1. American Concrete Institute (ACI):

19

- a. 318, Building Code Requirements for Structural Concrete.

20

2. ASTM International (ASTM):

21

- a. A36, Standard Specification for Carbon Structural Steel.

22

- b. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

23

3. National Fire Protection Association (NFPA):

24

- a. 70, National Electrical Code (NEC):

25

- 1) Article 501, Class 1 Locations.

26

- b. 90A, Standard for Installation of Air Conditioning and Ventilating Systems.

27

4. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

28

- ###### B. Obtain prior approval from Engineer when any opening larger than 100 SQ IN must be made in existing or newly completed construction.

29

30

31

##### 1.3 DEFINITIONS

32

- ###### A. Hazardous Areas: Areas shown in the Contract Documents as having Class I or Class II area classifications.

33

34

- ###### B. Washdown Areas: Areas having floor drains or hose bibs.

35

##### 1.4 SUBMITTALS

36

###### A. Shop Drawings:

37

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

38

2. For each structure provide dimensioned or scaled (minimum 1/8 IN = 1 FT) plan view drawings containing the following information:

39

- a. Vertical and horizontal location of all required openings and penetrations.

40

- b. Size of all openings and penetrations.

41

- c. Opening type.

42

- d. Seal type.

43

44

3. Manufacturer's installation instructions for standard manufactured products.

45

1 **1.5 SITE CONDITIONS**

- 2 A. For purposes of this Project, Contractor will likely encounter areas of saturation or perched water  
3 outside of ground water limits indicated in the Geotechnical Report. Areas of saturation or  
4 perched water are likely due to leaks from existing basins and channels.

5 **PART 2 - PRODUCTS**

6 **2.1 MATERIALS**

- 7 A. Pipe Sleeves: Steel, ASTM A53, Schedule 40, galvanized.
- 8 B. Pipe Sleeves Penetrating into Corrosive or Washdown Areas: Stainless steel, 1/4 IN minimum  
9 thickness.
- 10 C. Backing Rod and Sealant: See Specification Section 07900.
- 11 D. Modular Mechanical Seals:  
12 1. Acceptable manufacturers:  
13 a. Link-Seal.  
14 2. 304 stainless steel bolts, nuts and washers.
- 15 E. Sheet Metal Sleeves: Steel, ASTM A36, 12 GA.
- 16 F. Commercial Wall Castings:  
17 1. For unclassified areas both sides of penetration:  
18 a. Ductile iron, class equal to connecting piping system.  
19 2. For wet/corrosive areas either side of penetration:  
20 a. Stainless steel, 304L.

21 **PART 3 - EXECUTION**

22 **3.1 INSTALLATION AND APPLICATION**

- 23 A. Perform HVAC penetrations in accordance with NFPA 90A.
- 24 B. Perform electrical penetrations in accordance with NFPA 70, Article 501.
- 25 C. Install sleeves and castings in accordance with ACI 318, Chapter #6.
- 26 D. When mechanical or electrical work cannot be installed as structure is being erected, provide and  
27 arrange for building-in of boxes, sleeves, insets, fixtures or devices necessary to permit  
28 installation later.  
29 1. Lay out chases, holes or other openings which must be provided in masonry, concrete or  
30 other work.
- 31 E. Where pipes, conduits or ducts pass through floors in washdown areas, install sleeves with top  
32 3 IN above finish floors.  
33 1. In non-washdown areas, install sleeves with ends flush with finished surfaces.
- 34 F. Size sleeves, blockouts and cutouts which will receive sealant seal such that free area to receive  
35 sealant is minimized and seal integrity may be obtained.
- 36 G. For insulated piping and ducts, size sleeves, blockouts and cutouts large enough to  
37 accommodate full thickness of insulation.
- 38 H. Do not cut into or core drill any beams, joists, or columns.
- 39 I. Do not install sleeves in beams, joists, or columns.
- 40 J. Do not install recesses in beams, joists, columns, or slabs.
- 41 K. Field Cutting and Coring:  
42 1. Saw or core drill with non-impact type equipment.  
43 2. Mark opening and drill small 3/4 IN or less holes through structure following opening outline.

- 1 3. Sawcut opening outline on both surfaces.
- 2 a. Knock out within sawcuts using impact type equipment.
- 3 b. Do not chip or spall face of surface to remain intact.
- 4 c. Do not allow any overcut with saw kerf.
- 5 L. Precast-Prestressed Concrete Construction:
- 6 1. Cast openings and sleeves into units.
- 7 2. Cast openings larger than 6 IN in diameter or 6 IN maximum dimension in units at time of
- 8 manufacture.
- 9 3. Cast openings smaller than 6 IN in diameter or 6 IN maximum dimensions in flanges of units
- 10 at time of manufacture or field cut.
- 11 4. Do not field cut or core drill thru prestressed-precast concrete construction without first
- 12 locating prestressing strands and receiving written verification from the manufacturer that the
- 13 holes may be cut.
- 14 M. Where alterations are necessary or where new and old work joins, restore adjacent surfaces to
- 15 their condition existing prior to start of work.
- 16 N. Provide waterstop plate/anchor flange for piping, ducts, castings and sleeves cast-in-place in
- 17 concrete.
- 18 1. For fabricated units, weld plate to sleeve, pipe, or ductwork.
- 19 2. For commercial castings, cast water stop/anchor with wall pipe.
- 20 3. Plate is to be same thickness as sleeve, pipe, casting or ductwork.
- 21 4. For fabricated units, diameter of plate or flange to be 4 IN larger than outside diameter of
- 22 sleeve, pipe or ductwork.
- 23 5. For commercial castings, waterstop/anchor size to be manufacturer standard.
- 24 6. Provide continuous around entire circumference of sleeve, pipe, or ductwork.
- 25 O. Where area is blocked out to receive sheet metal sleeve at later date:
- 26 1. If blockout size is sufficient to allow placement, utilize dowels for interface of initially placed
- 27 concrete and sleeve encasement concrete which is placed later.
- 28 a. Size blockout based on sleeve size required plus 4 to 6 IN each side of sleeve for
- 29 concrete encasement.
- 30 b. Provide #4 dowels at 12 IN spacing along each side of blockout with minimum of two (2)
- 31 dowels required per side.
- 32 2. If blockout size is not sufficient to allow placement of dowels, provide keyway along all sides
- 33 of blockout.
- 34 a. Size blockout based on sleeve size required plus 2 to 4 IN each side of sleeve for
- 35 concrete encasement.
- 36 P. For interior wall applications where backer rod and sealant are specified, provide backer rod and
- 37 sealant at each side of wall.
- 38 Q. Use full depth expanding foam sealant for seal applications where single or multiple pipes,
- 39 conduits, etc., pass through a single sleeve.
- 40 R. Do not make duct or conduit penetrations below high water levels when entering or leaving
- 41 tankage, wet wells, or other water holding structures.
- 42 S. Modular Mechanical Seals:
- 43 1. Utilize one (1) seal for concrete thickness less than 8 IN and two (2) seals for concrete, 8 IN
- 44 thick or greater.
- 45 2. Utilize two (2) seals for piping 16 IN diameter and larger if concrete thickness permits.
- 46 3. Install seals such that bolt heads are located on the most accessible side of the penetration.
- 47 T. Backer Rod and Sealant:
- 48 1. Install in accordance with Specification Section 07900.
- 49 2. Provide backer rod and sealant for modular mechanical seal applications.
- 50 a. Apply on top side of slab penetrations and on interior, dry side wall penetrations.
- 51 U. Roof Penetrations:
- 52 1. Flash all roof penetrations in accordance with Roofing Manufacturer's recommended details.
- 53 a. See Specification Section 07541.

1 **3.2 SCHEDULES**

- 2 A. General Schedule of Penetrations through Floors, Roofs, Foundation Base Slabs, Foundation  
3 Walls, Foundation Footings, Partitions and Walls for Ductwork, Piping, and Conduit:
- 4 1. Provide the following opening and penetration types:
- 5 a. Type A - Block out 2 IN larger than outside dimensions of duct, pipe, or conduits.
  - 6 b. Type B - Saw cut or line-drill opening. Place new concrete with integrally cast sheet  
7 metal or pipe sleeve.
  - 8 c. Type C - Fabricated sheet metal sleeve or pipe sleeve cast-in-place. Provide pipe  
9 sleeve with water ring for wet and/or washdown areas.
  - 10 d. Type D - Commercial type casting or fabrication.
  - 11 e. Type E - Saw cut or line-drill opening. Place new concrete with integrally cast pipe, duct  
12 or conduit spools.
  - 13 f. Type F - Integrally cast pipe, duct or conduit.
  - 14 g. Type G - Saw cut or line-drill and remove area 1 IN larger than outside dimensions of  
15 duct, pipe or conduit.
  - 16 h. Type H - Core drill.
  - 17 i. Type I - Block out area. At later date, place new concrete with integrally cast sheet  
18 metal or pipe sleeve.
- 19 2. Provide seals of material and method described as follows.
- 20 a. Category 1 - Modular Mechanical Seal.
  - 21 b. Category 2 - Roof curb and flashing according to SMACNA specifications unless  
22 otherwise noted on Drawings. Refer to Specification Section 07600 and roofing  
23 Specification Sections for additional requirements.
  - 24 c. Category 3 - 12 GA sheet metal drip sleeve set in bed of silicon sealant with backing rod  
25 and sealant used in sleeve annulus.
  - 26 d. Category 4 - Backer rod and sealant.
  - 27 e. Category 5 - Full depth compressible sealant with escutcheons on both sides of  
28 opening.
  - 29 f. Category 6 - Full depth compressible sealant and flanges on both sides of opening.  
30 Flanges constructed of same material as duct, fastened to duct and minimum 1/2 IN  
31 larger than opening.
  - 32 g. Category 7 - Full depth compressible sealant and finish sealant or full depth expanding  
33 foam sealant depending on application.
- 34 3. Furnish openings and sealing materials through new floors, roofs, partitions and walls in  
35 accordance with Schedule A, Openings and Penetrations for New Construction.
- 36 4. Furnish openings and sealing materials through existing floors, roofs, partitions and walls in  
37 accordance with Schedule B, Openings and Penetrations for Existing Construction.  
38

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**SCHEDULE A. OPENINGS AND PENETRATIONS SCHEDULE  
FOR NEW CONSTRUCTION**

APPLICATIONS	DUCTS		PIPING		CONDUIT	
	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY
Through floors with bottom side a hazardous location	C F I	7 Not Req 7	F I <sup>(1)</sup>	Not Req 7	C F	7 Not Req
Through floors on grade above water table	C F I	4 Not Req 4	C F I <sup>(1)</sup>	7 Not Req 7	C F I <sup>(1)</sup>	4 Not Req 7
Through slab on grade below water table	F	Not Req	F	Not Req	F	Not Req
Through floors in washdown areas	C I	4 4	C H <sup>(2)</sup> I <sup>(1)</sup>	4 3 4	F H <sup>(2)</sup> I <sup>(1)</sup>	Not Req 3 7
Through walls where one side is a hazardous area	C F I	7 Not Req 7	F I <sup>(1)</sup>	Not Req 7	C F	7 Not Req
Through wall from tankage or wet well (below high water level) to dry well or dry area	F	Not Req	F	Not Req	F	Not Req
Through exterior wall above grade	A B C	6 6 6	A D H <sup>(2)</sup>	5 Not Req 5	C H <sup>(2)</sup>	5 4
Roof penetrations	A	2	A	2	A	2
Through interior walls and slabs not covered by the above applications	A C	4 4	A C	4 4	A C F	4 4 Not Req

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**SCHEDULE B. OPENINGS AND PENETRATIONS SCHEDULE  
FOR EXISTING CONSTRUCTION**

APPLICATIONS	DUCTS		PIPING		CONDUIT	
	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY
Through slab on grade below water table	E	Not Req	E	Not Req	E	Not Req
Through floors in washdown areas	G	3	G H <sup>(2)</sup>	3 3	G H <sup>(2)</sup>	3 3
Through wall from tankage or wet well (above high water level) to dry well or dry area	B E	7 Not Req	E H <sup>(2)</sup>	Not Req 1	B <sup>(1)(3)</sup> E H <sup>(2)</sup>	7 Not Req 7
Through wall from tankage or wet well (below high water level) to dry well or dry area	E	Not Req	E	Not Req	E	Not Req
Through exterior wall above grade	G	6	G <sup>(1)(3)</sup> H <sup>(2)</sup>	5 5	G <sup>(1)(3)</sup> H <sup>(2)</sup>	5 7
Roof penetrations	G	2	G <sup>(1)(3)</sup> H <sup>(2)</sup>	2	G	2
Through interior walls and slabs not covered by the above applications	G	4	G <sup>(1)(3)</sup> H <sup>(2)</sup>	4 4	G <sup>(1)(3)</sup> H <sup>(2)</sup>	4 4

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6  
7

- (1) Multiple piping 3 IN and smaller or multiple conduits.
- (2) Single pipe 3 IN and smaller or single conduit.
- (3) Single pipe or conduit larger than 3 IN.

8

**END OF SECTION**



# DIVISION 02

SITE WORK







1 2014/09/10

2

## SECTION 02072

3

### DEMOLITION, CUTTING AND PATCHING

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

###### A. Section Includes:

7

1. Demolition, cutting and patching of existing construction where shown on Drawings, as required to accommodate new work shown or as specified.

8

9

###### B. Related Specification Sections include but are not necessarily limited to:

10

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

11

2. Division 01 - General Requirements.

12

3. Section 03308 – Concrete, Materials and Proportioning.

13

4. Section 03348 - Concrete Finishing and Repair of Surface Defects.

14

5. Section 09960 - High Performance Industrial Coatings.

15

##### 1.2 QUALITY ASSURANCE

16

###### A. Qualifications:

17

1. Structural Concrete Repair Contractor:

18

- a. Contractor responsible for the portions of the concrete repair and restoration and meeting the minimum qualifications as defined in Section 03348.

19

20

##### 1.3 SUBMITTALS

21

###### A. Shop Drawings:

22

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

23

2. Indicate manufacturer and type of:

24

- a. Proposed nonshrink grout.

25

- b. Bonding agent.

26

- c. Epoxy patch material.

27

- d. Proposed materials and methods to be used for matching and repairing existing construction.

28

29

30

##### 1.4 DELIVERY, STORAGE, AND HANDLING

31

###### A. General:

32

1. Salvage items, designated for Owner's salvage, as a functional unit.

33

2. Clean, list and tag for storage.

34

3. Protect from damage and deliver to location designated.

35

4. Salvage each item with auxiliary or associated equipment required for operation.

36

##### 1.5 PROJECT CONDITIONS

37

- A. Perform preliminary investigations as required to ascertain extent of work.

38

##### 1.6 SEQUENCING AND SCHEDULING

39

- A. Coordinate and reschedule work as required to preclude interference with other operations.

40

#### PART 2 - PRODUCTS

41

##### 2.1 ACCEPTABLE MANUFACTURERS

42

- A. Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable:

43

1. Nonshrink grout: See Section 03308.

44

- 1           2. Bonding agent: See Section 03348.
- 2           3. Epoxy patch:
- 3           a. Depth of patch:
- 4               1) Greater than 3/4 IN: Five Star MP Epoxy Patch.
- 5               2) Between 1/8 IN and 3/4 IN: Five Star Fluid Epoxy.
- 6           B. Submit request for substitution in accordance with Specification Section 01640.

7   **2.2 MATERIALS**

- 8           A. Temporary Partitions:
- 9               1. Plywood: 1/2 IN minimum for interior or exterior use.
- 10              2. Paneling: 1/4 IN minimum for interior use.

11   **PART 3 - EXECUTION**

12   **3.1 PREPARATION**

- 13           A. Provide temporary partitions as required in public areas and as directed for isolation of the plant
- 14               PCS construction sequence.
- 15               1. Construct partitions of braced plywood in exterior areas.
- 16               2. Adequately braced paneling may be used in interior areas.
- 17           B. Provide covered passageways where necessary to ensure safe passage of persons in , near or
- 18               through the areas of work.
- 19           C. Provide substantial barricades and safety lights as required.
- 20           D. Provide temporary dustproof partitions where indicated or necessary.
- 21               1. Prevent infiltration of dust into occupied areas.
- 22           E. Provide temporary weather protection as necessary.

23   **3.2 INSTALLATION**

- 24           A. Cutting and Removal:
- 25               1. Remove existing work indicated to be removed, or as necessary for installation of new work.
- 26               2. Neatly cut and remove materials, and prepare all openings to receive new work.
- 27               3. Remove masonry or concrete in small sections.
- 28           B. Modification of Existing Concrete:
- 29               1. Where indicated, remove existing concrete and finish remaining surfaces as specified in
- 30                   Specification Section 03348.
- 31                   a. Protect remaining concrete from damage.
- 32                   b. Make openings by sawing through the existing concrete.
- 33                   c. Break out concrete after initial saw cuts in the event concrete thickness prevents cutting
- 34                       through.
- 35                   d. Make openings by drilling holes around perimeter of opening and then chipping out the
- 36                       concrete where sawing is not possible.
- 37                       1) Holes shall be sufficient in number to prevent damage to remaining concrete.
- 38               2. Oversize required openings in existing concrete 1 IN on all sides and build back to required
- 39                   opening size by means of nonshrink grout bonded to the existing concrete.
- 40               3. Where oversized openings cannot be made, remove the concrete to the required opening
- 41                   size and cut back exposed reinforcing 1 IN from face of concrete and fill resulting holes with
- 42                       nonshrink grout.
- 43           C. Removal of Existing Anchor Bolts or Other Protruding Elements:
- 44               1. Remove all protruding elements.
- 45               2. Remove to a depth of 1/4 IN from finished surface.
- 46               3. Fill void with epoxy patch.
- 47           D. Removal of Existing Exposed Corroded Ferrous Metals In Concrete:
- 48               1. Remove all corroded reinforcing steel bar supports, chairs or pieces of reinforcing steel that
- 49                   is exposed to view.
- 50               2. Fill void with epoxy patch.

- 1 E. Matching and Patching:
- 2 1. Walls, ceilings, floors or partitions:
- 3 a. Repair abutting walls, ceilings, floors or partitions disturbed by removal.
- 4 b. Match and patch existing construction disturbed during installation of new work.
- 5 2. Methods and materials:
- 6 a. Similar in appearance, and equal in quality to adjacent areas for areas or surfaces being
- 7 repaired.
- 8 b. Subject to review of Owner.
- 9 3. Reinforcing steel that is cut and exposed:
- 10 a. Remove to a depth of 1/4 IN.
- 11 b. Fill void with epoxy patch.
- 12 F. Salvaged Items:
- 13 1. Thoroughly dry and clean all metal surfaces.
- 14 2. Prime all bare metal in accordance with Specification Section 09960.
- 15 3. Clean and lubricate motors and other moving parts.
- 16 4. Brace motors attached to flexible mountings until reinstallation.
- 17 5. Dispose of items or materials not designated for Owner's salvage or reuse.
- 18 a. Promptly remove from site.
- 19 6. Do not store or sell Contractor salvaged items or materials on-site.
- 20 7. Carefully remove items to be salvaged and reused or to be delivered to Owner's storage.
- 21 a. Store and protect items indicated on Drawings or those which have been marked by
- 22 Owner to be salvaged or to be reused in Work.
- 23 b. Replace any item damaged through carelessness in removal, storage, or handling with
- 24 new items of same type.
- 25 c. Do not reuse materials or equipment not specifically indicated or specified to be reused.
- 26 8. Preparation of equipment for storage:
- 27 a. Identify each component with markings or tags to show its position in the assembly and
- 28 the assembly of which it belongs.
- 29 b. Place small parts of wooden boxes and clearly mark contents on the outside.
- 30 c. Remove oil from oil-lubricated bearings and gear boxes and replace with storage oil.
- 31 d. Grease grease-lubricated bearings.
- 32 e. Replace any breather plug with solid plug.
- 33 f. Megger test motor windings: Attach report of the test results to the unit and furnish one
- 34 (1) copy to the Engineer.
- 35 g. Attach unit to suitable crate bottom.
- 36 h. Enclose unit in polyethylene film and seal all seams and the film to the base of the unit
- 37 with tape.
- 38 i. Construct crate of wooden slats around top and sides of unit.
- 39 j. Attach permanent instruction tag to outside of crate stating "This unit has been prepared
- 40 for storage--replace oil, vent plugs, and lubricant in accordance with manufacturer's
- 41 instructions before start-up."
- 42 G. Clean Up: Transport debris and legally dispose of off-site.

### 43 3.3 SCHEDULE

- 44 A. Items to be Salvaged to Owner: Identified on Demolition Sheets within the Contract Drawings.
- 45 B. Filter Building (Operating Floor):
- 46 1. All exposed existing concrete top of floor slabs, walkways, beams, columns, curbs, walls,
- 47 from the top of operating floor elevation to the underside of the roof structure.
- 48 a. Remove all existing anchor bolts or other protruding elements.
- 49 b. Remove all existing exposed corroded ferrous metals
- 50 c. Other items as shown in the Contract Drawings.
- 51 d. Coordinate patching with specified coatings, toppings or overlays to ensure
- 52 compatibility.
- 53 C. Filter Building (Underside of Operating Floor):
- 54 1. All exposed existing concrete on the underside of walkway beams and slabs over the filters
- 55 and underside of the filter influent conduit slab.
- 56 a. Does not include the exposed underside of the operating floor slab in the pipe gallery.
- 57 b. Remove all existing anchor bolts or other protruding elements.
- 58 c. Remove all existing exposed corroded ferrous metals.

- 1 d. Other items as shown in the Contract Drawings.
- 2 e. Coordinate patching with specified coatings, toppings or overlays to ensure
- 3 compatibility.
- 4 D. Filter Building (Pipe Gallery):
- 5 1. All exposed existing concrete below the bottom of the operating floor slab to the top of the
- 6 filter gallery floor slab including, but not limited to the exterior face of the filter influent conduit
- 7 walls, underside of the filter influent conduit slab, exterior face of the filters, columns, struts
- 8 and top of the pipe gallery floor slab.
- 9 a. Remove all existing anchor bolts or other protruding elements.
- 10 b. Remove all existing exposed corroded ferrous metals.
- 11 c. Other items as shown in the Contract Drawings.
- 12 d. Coordinate patching with specified coatings, toppings or overlays to ensure
- 13 compatibility.
- 14 E. Other areas as shown in the Contract Drawings.

15

**END OF SECTION**

1 2014/07/08

2

## SECTION 02073

3

### MATERIAL REMOVAL AND MANAGEMENT

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

###### A. Section Includes:

7

1. Removal of select materials.

8

2. Relocation of select materials.

9

3. Salvage of select materials.

10

4. Disposal of select materials.

11

5. Reuse of select materials.

12

6. Abatement of select materials.

13

###### B. Related Sections include but are not necessarily limited to:

14

1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

15

2. Division 1 - General Requirements.

16

3. Section 13283 – Lead-Based Paint Abatement.

17

##### 1.2 DEFINITIONS

18

###### A. Material:

19

1. Shall mean equipment, electrical components, wire, cable, consoles, mechanical equipment and components, valves, piping, brackets, railings, items, and other appurtenances designated for removal.

20

21

22

###### B. Remove:

23

1. The partial or complete removal and proper material management implemented for the materials designated for removal.

24

25

2. When the term "Remove," is used in the Specifications or on the Drawings, it shall grant the Contractor the following options for material management, as stipulated further in this Specification:

26

27

28

a. "Relocate" selected materials of the work to a different location designated in the Specifications or on the Drawings.

29

30

b. "Salvage" selected materials of the work and turn over to the Owner at an area designated on-site by the Owner.

31

32

c. "Dispose" of selected materials of the work to an off-site facility properly licensed for disposal, reuse or recycling at Contractor's sole discretion and expense.

33

34

d. "Reuse" selected materials of the work and reinstall in the same location.

35

36

e. "Abatement" of selected materials of the work to an off-site facility properly licensed for disposal, reuse or recycling at Contractor's sole discretion and expense.

37

###### C. Protect: Action or activities required to ensure the integrity of structures and components

38

adjacent to removals is not adversely affected by materials removal, salvage, reuse, or relocation activities such that they will remain undamaged and functional in subsequent construction.

39

40

###### D. Remove and Relocate:

41

1. The careful and complete removal of designated materials.

42

2. When the terms "Remove and Relocate", are used in the Specifications or on the Drawings, they shall obligate the Contractor's best efforts to reclaim material in an undamaged manner and carefully store the material at a location designated by the Owner until final installation.

43

44

a. Material which is damaged during construction and in the Owner or Engineer judgment does not permit relocation may be disposed at a properly licensed landfill, recycling or disposal facility at Contractor's sole discretion and expense.

45

46

47

48

###### E. Remove and Salvage:

49

1. The careful and complete removal of designated materials.

- 1                   2. When the terms "Remove and Salvage", are used in the Specifications or on the Drawings,  
2 they shall obligate the Contractor's best efforts to reclaim material in an undamaged manner  
3 and carefully transport the materials to a location on site designated by the Owner.  
4                   a. Material which is damaged during construction and in the Owner or Engineer judgment  
5 does not permit salvage may be disposed at a properly licensed landfill, recycling or  
6 disposal facility at Contractor's sole discretion and expense.
- 7                   F. Remove and Dispose:  
8                   1. The careful and complete removal of designated materials.  
9                   2. When the terms "Remove and Dispose", are used in the Specifications or on the Drawings,  
10 they shall obligate the Contractor's best efforts to remove, collect, handle and transport  
11 materials off-site to a properly licensed landfill, recycling or disposal facility at Contractor's  
12 sole discretion and expense.
- 13                   G. Remove and Reuse:  
14                   1. The careful and complete removal of designated materials.  
15                   2. When the terms "Remove and Reuse", are used in the Specifications or on the Drawings,  
16 they shall obligate the Contractor's best efforts to reclaim material in an undamaged manner  
17 and carefully store the material at a location designated by the Owner until final installation  
18                   a. Damaged material which in the Owner or Engineer judgment does not permit salvage or  
19 reuse may be disposed at a properly licensed landfill, recycling or disposal facility at  
20 Contractor's sole discretion and expense.
- 21                   H. Remove and Abate:  
22                   1. The careful and complete removal of items coated with lead-based paint and designated for  
23 removal from the site and handled as environmentally regulated materials which require  
24 special management controls for either disposal or recycling.  
25                   2. Lead-based paint shall not be removed from the items while on-site.
- 26                   I. The terms defined above shall convey the same intent whether used in the form of nouns, verbs  
27 or various tenses.

## 28 **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

## 29 **PART 3 - EXECUTION**

### 30 **3.1 REMOVE AND RELOCATE OR REUSE**

- 31                   A. Materials undamaged prior to removal and subsequent relocation or reuse:  
32                   1. Contractor shall verify functional integrity of materials designated for "remove and relocate"  
33 or "remove and reuse" prior to removal.  
34                   2. If removal represents a risk for damage or in-place material is deemed damaged and  
35 unusable, Contractor shall notify Engineer and Owner to obtain concurrence that relocation  
36 or reuse may not be viable without loss of integrity.  
37                   3. If functional integrity of materials scheduled for "remove and relocate" or "remove and reuse"  
38 are subsequently damaged and rendered inoperable, Contractor shall replace materials at  
39 Contractor's cost.  
40                   4. Materials removed as a part of relocation or reuse, which is functionally usable or reusable  
41 shall be removed in a manner that will prevent damage.  
42                   5. Conduct a detailed pre-removal and post-relocation inspection with the Owner and Engineer  
43 to verify the condition of items designated for remove and relocate or reuse, and agree upon  
44 the conditions prior to removal and after relocation.

### 45 **3.2 REMOVE AND SALVAGE**

- 46                   A. Undamaged prior to removal or as a result of removal action and subsequent reuse:  
47                   1. Contractor shall verify functional integrity of materials designated for "remove and salvage"  
48 prior to removal.  
49                   2. Conduct a detailed pre-removal and post-salvage inspection with the Owner and Engineer to  
50 verify the condition of items designated for salvage, and agree upon the conditions prior to  
51 removal and salvage.

- 1 3. Notify and coordinate with the Owner the intended date and time for removal of salvaged
- 2 items.
- 3 4. Salvage items in an as found condition.
- 4 5. Salvage each item with auxiliary or associated components required for operation.
- 5 6. If removal represents a risk for damage or in-place material is deemed damaged, Contractor
- 6 shall notify Engineer and Owner to obtain concurrence that salvage may not be viable
- 7 without loss of integrity.
- 8 7. If functional integrity of materials scheduled for "remove and salvage" are subsequently
- 9 damaged, Contractor shall replace materials at Contractor's cost.
- 10 8. Protect salvaged items from damage and deliver to storage area designated by the Owner.

11 **3.3 REMOVE AND DISPOSE**

- 12 A. General:
- 13 1. Materials removed for disposal shall be disposed of off-site in accordance with applicable
  - 14 laws and regulations.
  - 15 2. Materials removed for disposal shall be removed in a manner that will prevent damage to
  - 16 existing structures or adjacent equipment.
  - 17 3. Provide containers or trailers to neatly organize and manage materials while temporarily on-
  - 18 site.
  - 19 4. Promptly remove materials from site. Do not store or sell material or equipment on site.

20 **3.4 REMOVE AND ABATE**

- 21 A. General:
- 22 1. Items or materials designated for remove and abate shall be managed or disposed of off-site
  - 23 in accordance with applicable laws and regulations.
  - 24 2. Do not remove lead-based paint from items designated for removal.
  - 25 3. Protect items from damage and releasing lead-based paint into the environment.

26 **END OF SECTION**

27





1 2014/08/07

2

## SECTION 02110

3

### SITE CLEARING

#### 4 PART 1 - GENERAL

##### 5 1.1 SUMMARY

6

A. Section Includes: Site clearing, tree protection, stripping topsoil and demolition.

7

B. Related Specification Sections include but are not necessarily limited to:

8

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

9

2. Division 01 - General Requirements.

10

3. Section 02200 - Earthwork.

11

4. Section 02260 - Topsoiling and Finished Grading.

12

5. Section 02270 - Soil Erosion and Sediment Control.

13

#### PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

14

#### PART 3 - EXECUTION

15

##### 3.1 PREPARATION

16

A. Protect existing vegetation to remain against damage.

17

1. Provide temporary protection as required.

18

B. Replace vegetation damaged by construction operations.

19

##### 3.2 SITE CLEARING

20

A. Topsoil Removal:

21

1. Strip topsoil to depths encountered.

22

a. Remove heavy growths of grass before stripping.

23

b. Separate from underlying subsoil or objectionable material.

24

2. Stockpile topsoil where directed by Owner's Construction Representative.

25

a. Construct storage piles to freely drain surface water.

26

b. Cover storage piles to prevent erosion.

27

B. Pavement Removal:

28

1. Remove concrete pavement, asphalt pavement, and concrete sidewalk as indicated on the Drawings. Saw cut and remove concrete pavement and sidewalk to the nearest joint.

29

30

2. Remove rock surfacing.

31

C. Disposal of Waste Materials: Remove all waste materials from site.

32

##### 3.3 ACCEPTANCE

33

A. Upon completion of the site clearing, obtain Engineer's acceptance of the extent of clearing,

34

depth of stripping and rough grade.

35

**END OF SECTION**

36



1 2014/09/08

2

## SECTION 02200

3

### EARTHWORK

#### 4 PART 1 - GENERAL

##### 5 1.1 SUMMARY

6 A. Section Includes: Earthwork.

7 B. Related Specification Sections include but are not necessarily limited to:

- 8 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.  
9 2. Division 01 - General Requirements.  
10 3. Section 07190 - Under Slab Vapor Retarder.

##### 11 1.2 QUALITY ASSURANCE

12 A. Referenced Standards:

- 13 1. ASTM International (ASTM):  
14 a. C33, Standard Specification for Concrete Aggregates.  
15 b. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using  
16 Standard Effort (12,400 ft-lbf/ft<sup>3</sup>).  
17 c. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using  
18 Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m)).  
19 d. D3786, Standard Test Method for Bursting Strength of Textile Fabrics--Diaphragm  
20 Bursting Strength Tester Method.  
21 e. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils  
22 Using a Vibratory Table.  
23 f. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and  
24 Calculation of Relative Density.  
25 g. D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

##### 26 1.3 SUBMITTALS

27 A. Shop Drawings:

- 28 1. See Specification Section 01340 for requirements for the mechanics and administration of  
29 the submittal process.  
30 2. Scaled layout Drawings and materials of construction for earth retaining systems.  
31 3. Product technical data including:  
32 a. Acknowledgement that products submitted meet requirements of standards referenced.  
33 b. Manufacturer's installation instructions.  
34 4. Certifications.

#### 35 PART 2 - PRODUCTS

##### 36 2.1 MATERIALS

37 A. Fill, Structural Fill and Backfill:

- 38 1. Selected material approved by Soils Engineer from site excavation or from off site borrow.  
39 2. All fill, structural fill and backfill material shall consist of approved materials free of organic  
40 matter and debris.  
41 3. Approved materials are those soils classified by ASTM D2487 as CL, ML, and SC (liquid limit  
42 less than 45 when determined in accordance with the wet preparation procedures outlined in  
43 ASTM D4318).

44 B. Granular Fill Under Building Floor Slabs-On-Grade: Clean, crushed, nonporous rock, crushed or  
45 uncrushed gravel complying with ASTM C33 gradation size No. 67, 3/4 IN to No. 4.

46 C. Granular Fill: Free draining granular fill, NDOR 47B.

- 1 D. Flowable Fill: See Specification Section 03308.
- 2 E. Geotextile Filter Fabric:
- 3 1. Nonwoven type.
- 4 2. Equivalent opening size: 50-100 (U.S. Standard Sieve).
- 5 3. Permeability coefficient (cm/second): 0.07 minimum, 0.30 maximum.
- 6 4. Grab strength: 90 LBS minimum in either direction in accordance with ASTM D4632
- 7 requirements.
- 8 5. Mullen burst strength: 125 psi minimum in accordance with ASTM D3786 requirements.
- 9 F. Vapor Barrier: Refer to Specification Section 07190.

10 **PART 3 - EXECUTION**

11 **3.1 PROTECTION**

- 12 A. Protect existing surface and subsurface features on-site and adjacent to site as follows:
- 13 1. Provide barricades, coverings, or other types of protection necessary to prevent damage to
- 14 existing items indicated to remain in place.
- 15 2. Protect and maintain bench marks, monuments or other established reference points and
- 16 property corners.
- 17 a. If disturbed or destroyed, replace at own expense to full satisfaction of Owner and
- 18 controlling agency.
- 19 3. Verify location of utilities.
- 20 a. Omission or inclusion of utility items does not constitute nonexistence or definite
- 21 location.
- 22 b. Secure and examine local utility records for location data.
- 23 c. Take necessary precautions to protect existing utilities from damage due to any
- 24 construction activity.
- 25 d. Repair damages to utility items at own expense.
- 26 e. In case of damage, notify Engineer at once so required protective measures may be
- 27 taken.
- 28 4. Maintain free of damage, existing sidewalks, structures, and pavement, not indicated to be
- 29 removed.
- 30 a. Any item known or unknown or not properly located that is inadvertently damaged shall
- 31 be repaired to original condition.
- 32 b. All repairs to be made and paid for by Contractor.
- 33 5. Provide full access to public and private premises, fire hydrants, street crossings, sidewalks
- 34 and other points as designated by Owner to prevent serious interruption of travel.
- 35 6. Maintain stockpiles and excavations in such a manner to prevent inconvenience or damage
- 36 to structures on-site or on adjoining property.
- 37 7. Avoid surcharge or excavation procedures which can result in heaving, caving, or slides.
- 38 B. Salvageable Items: Carefully remove items to be salvaged, and store on Owner's premises
- 39 unless otherwise directed.
- 40 C. Dispose of waste materials, legally, off site.
- 41 1. Burning, as a means of waste disposal, is not permitted.

42 **3.2 SITE EXCAVATION AND GRADING**

- 43 A. The work includes all operations in connection with excavation, borrow, construction of fills and
- 44 embankments, rough grading, and disposal of excess materials in connection with the
- 45 preparation of the site(s) for construction of the proposed facilities.
- 46 B. Excavation and Grading:
- 47 1. Perform as required by the Contract Drawings.
- 48 2. Contract Drawings may indicate both existing grade and finished grade required for
- 49 construction of Project.
- 50 a. Stake all units, structures, piping, roads, parking areas and walks and establish their
- 51 elevations.
- 52 b. Perform other layout work required.
- 53 c. Replace property corner markers to original location if disturbed or destroyed.

- 1 3. Preparation of ground surface for embankments or fills:
  - 2 a. Before fill is started, scarify to a minimum depth of 6 IN in all proposed embankment and
  - 3 fill areas.
  - 4 b. Where ground surface is steeper than one vertical to four horizontal, plow surface in a
  - 5 manner to bench and break up surface so that fill material will bind with existing surface.
  - 6 4. Protection of finish grade:
    - 7 a. During construction, shape and drain embankment and excavations.
    - 8 b. Maintain ditches and drains to provide drainage at all times.
    - 9 c. Protect graded areas against action of elements prior to acceptance of work.
    - 10 d. Reestablish grade where settlement or erosion occurs.
- 11 C. Borrow:
  - 12 1. Provide necessary amount of approved fill compacted to density equal to that indicated in
  - 13 this Specification.
  - 14 2. Include cost of all borrow material in original proposal.
  - 15 3. Fill material to be approved by Soils Engineer prior to placement.
- 16 D. Construct embankments and fills as required by the Contract Drawings:
  - 17 1. Construct embankments and fills at locations and to lines of grade indicated.
    - 18 a. Completed fill shall correspond to shape of typical cross section or contour indicated
    - 19 regardless of method used to show shape, size, and extent of line and grade of
    - 20 completed work.
    - 21 2. Provide approved fill material which is free from roots, organic matter, trash, frozen material,
    - 22 and stones having maximum dimension greater than 6 IN.
      - 23 a. Ensure that stones larger than 4 IN are not placed in upper 6 IN of fill or embankment.
      - 24 b. Do not place material in layers greater than 8 IN loose thickness.
      - 25 c. Place layers horizontally and compact each layer prior to placing additional fill.
    - 26 3. Compact by sheepsfoot, pneumatic rollers, vibrators, or by other equipment as required to
    - 27 obtain specified density.
      - 28 a. Control moisture for each layer necessary to meet requirements of compaction.

### 29 3.3 FIELD QUALITY CONTROL

- 30 A. Do not include in bid price the cost of inspection services indicated herein as being performed by
- 31 the Soils Engineer.
- 32 B. Moisture density relations, to be established by the Soils Engineer required for all materials to be
- 33 compacted.
- 34 C. Extent of compaction testing will be as necessary to assure compliance with specifications.
- 35 D. Give minimum of 24 HR advance notice to Soils Engineer when ready for compaction or
- 36 subgrade testing and inspection.
- 37 E. Should any compaction density test or subgrade inspection fail to meet specification
- 38 requirements, perform corrective work as necessary.
- 39 F. Pay for all costs associated with corrective work and retesting resulting from failing compaction
- 40 density tests.

### 41 3.4 COMPACTION DENSITY REQUIREMENTS

- 42 A. Obtain approval from Soils Engineer with regard to suitability of soils and acceptable subgrade
- 43 prior to subsequent operations.
- 44 B. Provide dewatering system necessary to successfully complete compaction and construction
- 45 requirements.
- 46 C. Remove frozen, loose, wet, or soft material and replace with approved material as directed by
- 47 Soils Engineer.
- 48 D. Stabilize subgrade with well graded granular materials as directed by Soils Engineer.
- 49 E. Moisture content of compacted cohesive material shall be within -2/+3 percent of optimum as
- 50 established per ASTM D698.

- F. Assure by results of testing that compaction densities comply with the following requirements:
1. Sitework:

LOCATION	COMPACTION DENSITY
Under Paved Areas, Sidewalks and Piping:	
Cohesive soils	95 percent per ASTM D698
Cohesionless soils	70 percent relative density per ASTM D4253 and ASTM D4254
Unpaved Areas:	
Cohesive soils	92 percent of ASTM D698
Cohesionless soils	70 percent relative density per ASTM D4253 and ASTM D4254

2. Structures:

LOCATION	COMPACTION DENSITY
Inside of structures under foundations, under equipment support pads, under slabs-on-grade and scarified existing subgrade under fill material	95 percent per ASTM D1557
Outside structures next to walls, piers, columns and any other structure exterior member	90 percent per ASTM D1557

3. Specific areas:

LOCATION	COMPACTION DENSITY
Outside structures under equipment support foundations	95 percent per ASTM D1557
Under void	85 percent per ASTM D1557
Granular fill under base slabs with pressure relief valves, and under building floor slabs-on-grade	75 percent relative density per ASTM D4253 and ASTM D4254

### 3.5 EXCAVATION, FILLING, AND BACKFILLING FOR STRUCTURES

#### A. General:

1. In general, work includes, but is not necessarily limited to, excavation for structures and retaining walls, removal of underground obstructions and undesirable material, backfilling, filling, and fill, backfill, and subgrade compaction.
2. Obtain fill and backfill material necessary to produce grades required.
  - a. Materials and source to be approved by Soils Engineer.
  - b. Excavated material approved by Soils Engineer may also be used for fill and backfill.
3. In this Specification Section, the word "foundations" includes footings, base slabs, foundation walls, mat foundations, grade beams, piers and any other support placed directly on soil.
4. In the paragraphs of this Specification Section, the word "soil" also includes any type of rock subgrade that may be present at or below existing subgrade levels.

#### B. Excavation Requirements for Structures:

1. General:
  - a. Do not commence excavation for foundations for structures until Soils Engineer approves:
    - 1) The removal of topsoil and other unsuitable and undesirable material from existing subgrade.

- 1                   2) Density and moisture content of site area compacted fill material meets  
2                   requirements of specifications.  
3                   3) Site surcharge or mass fill material can be removed from entire construction site or  
4                   portion thereof.  
5                   4) Surcharge or mass fill material has been removed from construction area or  
6                   portions thereof.  
7                   b. Engineer grants approval to begin excavations.  
8                   2. Dimensions:  
9                   a. Excavate to elevations and dimensions indicated or specified.  
10                  b. Allow additional space as required for construction operations and inspection of  
11                  foundations.  
12                  3. Removal of obstructions and undesirable materials in excavation includes, but is not  
13                  necessarily limited to, removal of old foundations, existing construction, unsuitable subgrade  
14                  soils, expansive type soils, and any other materials which may be concealed beneath  
15                  present grade, as required to execute work indicated on Contract Drawings.  
16                  a. If undesirable material and obstructions are encountered during excavation, remove  
17                  material and replace as directed by Soils Engineer.  
18                  4. Level off bottoms of excavations to receive foundations, floor slabs, equipment support pads,  
19                  or compacted fill.  
20                  a. Remove loose materials and bring excavations into approved condition to receive  
21                  concrete or fill material.  
22                  b. Where compacted fill material must be placed to bring subgrade elevation up to  
23                  underside of construction, scarify existing subgrade upon which fill material is to be  
24                  placed to a depth of 6 IN and then compact to density stated in this Specification Section  
25                  before fill material can be placed thereon.  
26                  c. Do not carry excavations lower than shown for foundations except as directed by Soils  
27                  Engineer or Engineer.  
28                  d. If any part of excavations is carried below required depth without authorization, maintain  
29                  excavation and start foundation from excavated level with concrete of same strength as  
30                  required for superimposed foundation, and no extra compensation will be made to  
31                  Contractor therefore.  
32                  5. Make excavations large enough for working space, forms, dampproofing, waterproofing, and  
33                  inspection.  
34                  6. Notify Soils Engineer and Engineer as soon as excavation is completed in order that  
35                  subgrades may be inspected.  
36                  a. Do not commence further construction until subgrade under compacted fill material,  
37                  under foundations, under floor slabs-on-grade, under equipment support pads, and  
38                  under retaining wall footings has been inspected and approved by the Soils Engineer as  
39                  being free of undesirable material, being of compaction density required by this  
40                  specification, and being capable of supporting the allowable foundation design bearing  
41                  pressures and superimposed foundation, fill, and building loads to be placed thereon.  
42                  b. Soils Engineer shall be given the opportunity to inspect subgrade below fill material both  
43                  prior to and after subgrade compaction.  
44                  c. Place fill material, foundations, retaining wall footings, floor slabs-on-grade, and  
45                  equipment support pads as soon as weather conditions permit after excavation is  
46                  completed, inspected, and approved and after forms and reinforcing are inspected and  
47                  approved.  
48                  d. Before concrete or fill material is placed, protect approved subgrade from becoming  
49                  loose, wet, frozen, or soft due to weather, construction operations, or other reasons.  
50                  7. Dewatering:  
51                  a. Where groundwater is or is expected to be encountered during excavation, install a  
52                  dewatering system to prevent softening and disturbance of subgrade below foundations  
53                  and fill material, to allow foundations and fill material to be placed in the dry, and to  
54                  maintain a stable excavation side slope.  
55                  b. Groundwater shall be maintained at least 3 FT below the bottom of any excavation.  
56                  c. Review soils investigation before beginning excavation and determine where  
57                  groundwater is likely to be encountered during excavation.  
58                  d. Employ dewatering specialist for selecting and operating dewatering system.  
59                  e. Keep dewatering system in operation until dead load of structure exceeds possible  
60                  buoyant uplift force on structure.

- 1 f. Dispose of groundwater to an area which will not interfere with construction operations  
2 or damage existing construction.  
3 1) Install groundwater monitoring wells as necessary.
- 4 g. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might  
5 weaken the subgrade.
- 6 8. Subgrade stabilization:
- 7 a. If subgrade under foundations, fill material, floor slabs-on-grade, or equipment support  
8 pads is in a frozen, loose, wet, or soft condition before construction is placed thereon,  
9 remove frozen, loose, wet, or soft material and replace with approved compacted  
10 material as directed by Soils Engineer.
- 11 b. Provide compaction density of replacement material as stated in this Specification  
12 Section.
- 13 c. Loose, wet, or soft materials, when approved by Soils Engineer, may be stabilized by a  
14 compacted working mat of well graded crushed stone.
- 15 d. Compact stone mat thoroughly into subgrade to avoid future migration of fines into the  
16 stone voids.
- 17 e. Remove and replace frozen materials as directed by Soils Engineer.
- 18 f. Method of stabilization shall be performed as directed by Soils Engineer.
- 19 g. Do not place further construction on the repaired subgrades, until the subgrades have  
20 been approved by the Soils Engineer.
- 21 9. Do not place floor slabs-on-grade including equipment support pads until subgrade below  
22 has been approved, piping has been tested and approved, reinforcement placement has  
23 been approved, and Contractor receives approval to commence slab construction.
- 24 a. Do not place building floor slabs-on-grade including equipment support pads when  
25 temperature of air surrounding the slab and pads is or is expected to be below 40 DegF  
26 before structure is completed and heated to a temperature of at least 50 DegF.
- 27 10. Protection of structures:
- 28 a. Prevent new and existing structures from becoming damaged due to construction  
29 operations or other reasons.
- 30 b. Prevent subgrade under new and existing foundations from becoming wet and  
31 undermined during construction due to presence of surface or subsurface water or due  
32 to construction operations.
- 33 11. Earth retention system:
- 34 a. Shore, sheet pile, slope, or brace excavations as required to prevent them from  
35 collapsing.
- 36 b. Remove shoring as backfilling progresses but only when banks are stable and safe from  
37 caving or collapse.
- 38 c. See Drawings for specific location of required earth retention system adjacent to the  
39 existing Filter Building.
- 40 1) Sheet pile, steel plate or other means of retaining earth as shown in the Drawings.
- 41 2) System shall be designed by the Contractor to withstand the superimposed  
42 pressures of the empty filter basin as shown in the Drawings.
- 43 3) System shall be designed as a leave-in-place shoring system that is also used as a  
44 concrete form for the below-grade foundation walls as shown in the Drawings.
- 45 d. The design of the earth retention systems is the responsibility of the Contractor.
- 46 12. Drainage:
- 47 a. Control grading around structures so that ground is pitched to prevent water from  
48 running into excavated areas or damaging structures.
- 49 b. Maintain excavations where foundations, floor slabs, equipment support pads or fill  
50 material are to be placed free of water.
- 51 c. Provide pumping required to keep excavated spaces clear of water during construction.
- 52 d. Should any water be encountered in the excavation, notify Engineer and Soils Engineer.
- 53 e. Provide free discharge of water by trenches, pumps, wells, well points, or other means  
54 as necessary and drain to point of disposal that will not damage existing or new  
55 construction or interfere with construction operations.
- 56 13. Frost protection:
- 57 a. Do not place foundations, slabs-on-grade, equipment support pads, or fill material on  
58 frozen ground.
- 59 b. When freezing temperatures may be expected, do not excavate to full depth indicated,  
60 unless foundations, floor slabs, equipment support pads, or fill material can be placed  
61 immediately after excavation has been completed and approved.
- 62 c. Protect excavation from frost if placing of concrete or fill is delayed.



- 1 d. Where a concrete slab is a base slab-on-grade located under and within a structure that  
2 will not be heated, protect subgrade under the slab from becoming frozen until final  
3 acceptance of the Project by the Owner.  
4 e. Protect subgrade under foundations of a structure from becoming frozen until structure  
5 is completed and heated to a temperature of at least 50 DegF.
- 6 C. Fill and Backfill Inside of Structure and Below Foundations, Base Slabs, Floor Slabs, Equipment  
7 Support Pads and Piping:  
8 1. General:  
9 a. Subgrade to receive fill or backfill shall be free of undesirable material as determined by  
10 Soils Engineer and scarified to a depth of 6 IN and compacted to density specified  
11 herein.  
12 b. Surface may be stepped by at not more than 12 IN per step or may be sloped at not  
13 more than 2 percent.  
14 c. Do not place any fill or backfill material until subgrade under fill or backfill has been  
15 inspected and approved by Soils Engineer as being free of undesirable material and  
16 compacted to specified density.  
17 2. Obtain approval of fill and backfill material and source from Soils Engineer prior to placing  
18 the material.  
19 3. Granular fill under floor slabs-on-grade: Place all floor slabs-on-grade on a minimum of 6 IN  
20 of granular fill unless otherwise indicated.  
21 4. Vapor barrier: Install a continuous vapor barrier under floor slabs-on-grade as required by  
22 Specification Section 07190 and shown on Contract Drawings.  
23 5. Fill and backfill placement:  
24 a. Prior to placing fill and backfill material, optimum moisture and maximum density  
25 properties for proposed material shall be obtained from Soils Engineer.  
26 b. Place fill and backfill material in thin lifts as necessary to obtain required compaction  
27 density.  
28 c. Compact material by means of equipment of sufficient size and proper type to obtain  
29 specified density.  
30 d. Use hand operated equipment for filling and backfilling next to walls.  
31 e. Do not place fill and backfill when the temperature is less than 40 DegF and when  
32 subgrade to receive fill and backfill material is frozen, wet, loose, or soft.  
33 f. Use vibratory equipment to compact granular material; do not use water.  
34 6. Where fill material is required below foundations, place fill material, conforming to the  
35 required density and moisture content, outside the exterior limits of foundations located  
36 around perimeter of structure the following horizontal distance whichever is greater:  
37 a. As required to provide fill material to indicated finished grade.  
38 b. 5 FT.  
39 c. Distance equal to depth of compacted fill below bottom of foundations.  
40 d. As directed by Soils Engineer.
- 41 D. Filling and Backfilling Outside of Structures.  
42 1. This paragraph of this Specification applies to fill and backfill placed outside of structures  
43 above bottom level of both foundations and piping but not under paving.  
44 2. Provide material as approved by Soils Engineer for filling and backfilling outside of  
45 structures.  
46 3. Fill and backfill placement:  
47 a. Prior to placing fill and backfill material, obtain optimum moisture and maximum density  
48 properties for proposed material from Soils Engineer.  
49 b. Place fill and backfill material in thin lifts as necessary to obtain required compaction  
50 density.  
51 c. Compact material with equipment of proper type and size to obtain density specified.  
52 d. Use only hand operated equipment for filling and backfilling next to walls and retaining  
53 walls.  
54 e. Do not place fill or backfill material when temperature is less than 40 DegF and when  
55 subgrade to receive material is frozen, wet, loose, or soft.  
56 f. Use vibratory equipment for compacting granular material; do not use water.  
57 4. Backfilling against walls:  
58 a. Do not backfill around any part of structures until each part has reached specified 28-  
59 day compressive strength and backfill material has been approved.

- 1 b. Do not start backfilling until concrete forms have been removed, trash removed from  
2 excavations, pointing of masonry work, concrete finishing, dampproofing and  
3 waterproofing have been completed.
- 4 c. Do not place fills against walls until floor slabs at top, bottom, and at intermediate levels  
5 of walls are in place and have reached 28-day required compressive strength to prevent  
6 wall movement.
- 7 d. Bring backfill and fill up uniformly around the structures and individual walls, piers, or  
8 columns.
- 9 E. Backfilling Outside of Structures Under Piping or Paving:
- 10 1. When backfilling outside of structures requires placing backfill material under piping or  
11 paving, the material shall be placed from bottom of excavation to underside of piping or  
12 paving at the density required for fill under piping or paving as indicated in this Specification  
13 Section.
- 14 2. This compacted material shall extend transversely to the centerline of piping or paving a  
15 horizontal distance each side of the exterior edges of piping or paving equal to the depth of  
16 backfill measured from bottom of excavation to underside of piping or paving.
- 17 3. Provide special compacted bedding or compacted subgrade material under piping or paving  
18 as required by other Specification Sections for the Project.

19 **3.6 SPECIAL REQUIREMENTS**

- 20 A. Erosion Control:
- 21 1. Conduct work to minimize erosion of site.
- 22 2. Construct stilling areas to settle and detain eroded material.
- 23 3. Remove eroded material washed off site.
- 24 4. Clean streets daily of any spillage of dirt, rocks or debris from equipment entering or leaving  
25 site.

26 **END OF SECTION**

1 2014/09/10

2

## SECTION 02221

3

### TRENCHING, BACKFILLING, AND COMPACTING FOR UTILITIES

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

###### A. Section Includes:

7

1. Excavation, trenching, backfilling and compacting for all underground utilities.

8

###### B. Related Specification Sections include but are not necessarily limited to:

9

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

10

2. Division 01 - General Requirements.

11

3. Section 02200 - Earthwork.

12

4. Section 02515 - Precast Concrete Manhole Structures.

13

5. Section 03311 - Concrete Mixing, Placing, Jointing, and Curing.

14

6. Division 16 - Electrical.

15

##### 1.2 QUALITY ASSURANCE

16

###### A. Referenced Standards:

17

1. ASTM International (ASTM):

18

- a. C33, Standard Specification for Concrete Aggregates.

19

- b. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).

20

- c. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

21

- d. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

22

23

24

25

- ###### B. Qualifications: Hire an independent soils laboratory to conduct in-place moisture-density tests for backfilling to assure that all work complies with this Specification Section.

26

27

##### 1.3 DEFINITIONS

28

- ###### A. Excavation: All excavation will be defined as unclassified.

29

##### 1.4 SUBMITTALS

30

###### A. Shop Drawings:

31

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

32

2. Product technical data including:

33

- a. Acknowledgement that products submitted meet requirements of standards referenced.

34

- b. Manufacturer's installation instructions.

35

3. Submit respective pipe or conduit manufacturer's data regarding bedding methods of installation and general recommendations.

36

37

38

4. Submit sieve analysis reports on all granular materials.

39

###### B. Informational Submittals:

40

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

41

2. Trench shield (trench box) certification if employed:

42

- a. Specific to Project conditions.

43

- b. Re-certified if members become distressed.

44

- c. Certification by registered professional structural engineer, registered in the state where the Project is located.

45

46

47

- d. Engineer is not responsible to, and will not, review and approve.

1 **1.5 PROJECT CONDITIONS**

- 2 A. Avoid overloading or surcharge a sufficient distance back from edge of excavation to prevent
- 3 slides or caving.
- 4 1. Maintain and trim excavated materials in such manner to be as little inconvenience as
- 5 possible to public and adjoining property owners.
- 6 B. Provide full access to public and private premises and fire hydrants, at street crossings, sidewalks
- 7 and other points as designated by Owner to prevent serious interruption of travel.
- 8 C. Protect and maintain bench marks, monuments or other established points and reference points
- 9 and if disturbed or destroyed, replace items to full satisfaction of Owner and controlling agency.
- 10 D. Verify location of existing underground utilities.
- 11 E. See Section 01601 for additional conditions.

12 **PART 2 - PRODUCTS**

13 **2.1 MATERIALS**

- 14 A. Backfill Material:
- 15 1. As approved by Soils Engineer.
- 16 a. Site excavated material free of rock cobbles, roots, sod or other organic matter, and
- 17 frozen material.
- 18 b. Fills shall be compacted to a minimum of 92 percent of the materials maximum dry
- 19 density in unpaved areas and 95 percent in areas under pavements or structures as
- 20 determined by ASTM D698.
- 21 c. Moisture content at time of placement: -2 to +3 percent of optimum moisture content as
- 22 specified in accordance with ASTM D698.
- 23 B. Subgrade Stabilization Materials: Provide subgrade stabilization material consisting of well
- 24 graded granular material approved by Soils Engineer.
- 25 C. Bedding Materials:
- 26 1. As approved by the Soils Engineer.
- 27 2. Granular bedding materials:
- 28 a. Aggregate bedding material shall consist of recycled PCC, crushed limestone, quartzite,
- 29 or dolomite meeting the requirements for Class 1S coarse aggregate as defined in
- 30 ASTM C33. See gradation below:
- 31

Sieve Size	3/4 IN	3/8 IN	No. 4	No. 10	No. 200
Percent Passing by Weight	100	45-75	20-60	5-25	<8

- 32
- 33 3. Flowable fill:
- 34 a. Description: Flowable fill shall be a mixture of cement, fly ash, fine sand, water, and air
- 35 having a consistency which will flow under a very low head.
- 36 b. Material characteristics:
- 37 1) The approximate quantities of each component per cubic yard of mixed material
- 38 shall be as follows:
- 39 a) Cement (Type I or II): 50 LBS.
- 40 b) Fly ash: 200 LBS.
- 41 c) Fine sand: 2,700 LBS.
- 42 d) Water: 420 LBS.
- 43 e) Air content: 10 percent.
- 44 2) Actual quantities shall be adjusted to provide a yield of 1 CY with the materials
- 45 used.
- 46 3) Approximate compressive strength should be 85 to 175 psi.
- 47 4) Fine sand shall be an evenly graded material having not less than 95 percent
- 48 passing the No. 4 sieve and not more than 5 percent passing the No. 200 sieve.
- 49 5) Mixing and handling of the material shall be in accordance with Specification
- 50 Section 03311.

1 **PART 3 - EXECUTION**

2 **3.1 GENERAL**

3 A. Remove and dispose of unsuitable materials per Specification Section 02200.

4 **3.2 EXCAVATION**

5 A. Unclassified Excavation: Remove rock excavation, clay, silt, gravel, hard pan, loose shale, and  
6 loose stone as directed by Soils Engineer.

7 B. Excavation for Appurtenances:

- 8 1. 12 IN (minimum) clear distance between outer surface and embankment.
- 9 2. See Specification Section 02200 for applicable requirements.
- 10 3. See Specification Section 02515 for applicable requirements.

11 C. Groundwater Dewatering:

- 12 1. Where groundwater is, or is expected to be, encountered during excavation, install a  
13 dewatering system to prevent softening and disturbance of subgrade to allow subgrade  
14 stabilization, pipe, bedding and backfill material to be placed in the dry, and to maintain a  
15 stable trench wall or side slope.
- 16 2. See Specification Section 02200, Paragraph 3.7.B.7 for additional conditions.
- 17 3. Cost of groundwater dewatering shall be incidental to work and at no additional cost to  
18 Owner.

19 D. Trench Excavation:

- 20 1. Excavate trenches by open cut method to depth shown on Drawings and necessary to  
21 accommodate work.
  - 22 a. Support existing utility lines and yard piping where proposed work crosses at a lower  
23 elevation.
    - 24 1) Stabilize excavation to prevent undermining of existing utility and yard piping.
- 25 2. Open trench outside buildings, units, and structures:
  - 26 a. No more than the distance between two manholes, structures, units, or 300 LF,  
27 whichever is less.
  - 28 b. Field adjust limitations as weather conditions dictate.
- 29 3. There is a potential for debris or unsuitable materials existing across the site.
  - 30 a. In areas where debris or unsuitable backfill material is encountered in the trench and to  
31 a depth of 12 IN below the trench base as shown on the pipe bedding details in the  
32 Drawings, the Contractor shall remove the material and properly dispose of it at a  
33 licensed landfill facility at no additional cost to the Owner.
  - 34 b. The trench width in these locations shall be a minimum of 18 IN beyond the outside  
35 diameter of the pipe or conduit on each side of the pipe or conduit.
- 36 4. Trenching within buildings, units, or structures:
  - 37 a. No more than 100 LF at any one time.
- 38 5. Any trench or portion of trench, which is opened and remains idle for seven (7) calendar  
39 days, or longer, as determined by the Owner, may be directed to be immediately refilled,  
40 without completion of work, at no additional cost to Owner.
  - 41 a. Said trench may not be reopened until Owner is satisfied that work associated with  
42 trench will be prosecuted with dispatch.
- 43 6. Observe following trenching criteria:
  - 44 a. Trench size:
    - 45 1) Excavate width to accommodate free working space.
    - 46 2) Maximum trench width at top of pipe or conduit may not exceed outside diameter of  
47 utility service by more than the following dimensions:

OVERALL DIAMETER OF	
UTILITY SERVICE	EXCESS DIMENSION
33 IN and less	18 IN
more than 33 IN	24 IN

- 49
- 50 3) Cut trench walls vertically from bottom of trench to 1 FT above top of pipe, conduit,  
51 or utility service.

- 1 4) Keep trenches free of surface water runoff.
- 2 a) Include cost in Bid.
- 3 b) No separate payment for surface water runoff pumping will be made.
- 4 5) In common trench, maintain a minimum 1 FT-6 IN clearance between pipes.
- 5 E. Trenching for Electrical Installations:
- 6 1. Observe the preceding Trench Excavation paragraph in PART 3 of this Specification Section.
- 7 2. Modify for electrical installations as follows:
- 8 a. Open no more than 600 LF of trench in exterior locations for trenches more than 12 IN
- 9 but not more than 30 IN wide.
- 10 b. Any length of trench may be opened in exterior locations for trenches which are 12 IN
- 11 wide or less.
- 12 c. Do not over excavate trench.
- 13 d. Cut trenches for electrical runs with minimum 30 IN cover, unless otherwise specified or
- 14 shown on Drawings.
- 15 e. See Division 16 for additional requirements.
- 16 F. Flowable Fill:
- 17 1. Flowable fill shall be:
- 18 a. Discharged from a mixer by any means acceptable to the Owner's Construction
- 19 Representative into the area to be filled.
- 20 b. Placed in 4 FT maximum lifts to the elevations indicated.
- 21 1) Allow 12 HR set-up time before placing next lift or as approved by the Engineer.
- 22 2) Contractor shall place flowable fill lifts in such a manner as to prevent flotation of the
- 23 pipe.
- 24 2. Flowable fill shall not be placed on frozen ground.
- 25 3. Subgrade on which flowable fill is placed shall be free of disturbed or softened material and
- 26 water.
- 27 4. Conform to appropriate requirements of Specification Section 02200.
- 28 5. Flowable fill batching, mixing, and placing may be started if weather conditions are favorable,
- 29 and the air temperature is 35 DegF and rising.
- 30 6. At the time of placement, flowable fill must have a temperature of at least 40 DegF.
- 31 7. Mixing and placing shall stop when the air temperature is 38 DegF or less and falling.
- 32 8. Each filling stage shall be as continuous an operation as is practicable.
- 33 9. Contractor shall prevent traffic contact with flowable fill for at least 24 HRS after placement or
- 34 until flowable fill is hard enough to prevent rutting by construction equipment.
- 35 10. Flowable fill shall not be placed until water has been controlled or groundwater level has
- 36 been lowered in conformance with the requirements of the preceding Groundwater
- 37 Dewatering paragraph in PART 3 of this Specification Section.

38 **3.3 PREPARATION OF FOUNDATION FOR PIPE LAYING**

- 39 A. Over-Excavation:
- 40 1. Backfill and compact to 95 percent of maximum dry density per ASTM D698.
- 41 2. Backfill with granular bedding material as option.
- 42 B. Subgrade Stabilization:
- 43 1. Stabilize the subgrade when directed by the Soils Engineer/Owner's Construction
- 44 Representative.
- 45 2. Observe the following requirements when unstable trench bottom materials are encountered.
- 46 a. Notify Owner's Construction Representative when unstable materials are encountered.
- 47 1) Define by drawing station locations and limits.
- 48 b. Remove unstable trench bottom caused by Contractor failure to dewater, rainfall, or
- 49 Contractor operations.
- 50 1) Replace with subgrade stabilization with no additional compensation.

51 **3.4 BACKFILLING METHODS**

- 52 A. Do not backfill until tests to be performed on system show system is in full compliance to
- 53 specified requirements.
- 54 B. Common Trench Backfill:
- 55 1. Perform in accordance with the following:
- 56 a. Place backfill in lift thicknesses capable of being compacted to densities specified.

- 1                    b. Observe specific manufacturer's recommendations regarding backfilling and
- 2                    compaction.
- 3                    c. Avoid displacing joints and appurtenances or causing any horizontal or vertical
- 4                    misalignment, separation, or distortion.
- 5                    C. Water flushing for consolidation is not permitted.
- 6                    D. Backfilling for Electrical Installations:
- 7                    1. Observe the preceding Carefully Compacted Backfill paragraph or Common Trench Backfill
- 8                    paragraph in PART 3 of this Specification Section or when approved by the Engineer.
- 9                    2. Modify for electrical installation as follows:
- 10                    a. Observe notes and details on electrical drawings for fill in immediate vicinity of direct
- 11                    burial cables.

12                    **3.5 COMPACTION**

- 13                    A. General:
- 14                    1. Place and assure bedding, backfill, and fill materials achieve an equal or higher degree of
- 15                    compaction than undisturbed materials adjacent to the work.
- 16                    2. In no case shall degree of compaction below minimum compactions specified be accepted.
- 17                    B. Compaction Requirements:
- 18                    1. Unless noted otherwise on Drawings or more stringently by other Specification Sections,
- 19                    comply with following minimum trench compaction criteria.
- 20                    a. Bedding material:
- 21

LOCATION	SOIL TYPE	COMPACTION DENSITY
All locations	Cohesionless soils	70 percent relative density by ASTM D4253 and ASTM D4254

- 22                    b. Common trench backfill:
- 23
- 24

LOCATION	SOIL TYPE	COMPACTION DENSITY
Under pavements, sidewalks and structures	Cohesive soils	95 percent of maximum dry density by ASTM D698
	Cohesionless soils	70 percent of relative density by ASTM D4253 and ASTM D4254
Unpaved areas	Cohesive soils	92 percent of maximum dry density by ATM D698
	Cohesionless soils	70 percent of relative density by ASTM D4253 and ASTM D4254

25

26                    **3.6 FIELD QUALITY CONTROL**

- 27                    A. Testing:
- 28                    1. Perform a minimum of one in-place moisture density test between each appurtenance
- 29                    (manhole, bend, etc.).
- 30                    2. Perform tests through recognized testing laboratory approved by Owner.
- 31                    3. Costs of "Passing" tests paid by Owner.
- 32                    4. Perform additional tests as directed until compaction meets or exceeds requirements.
- 33                    5. Cost associated with "Failing" tests shall be paid by Contractor.
- 34                    6. Reference to Engineer in this Specification Section will imply Soils Engineer when employed
- 35                    by Owner and directed by Engineer to undertake necessary inspections as approvals as
- 36                    necessary.
- 37                    7. Assure Owner has immediate access for testing of all soils related work.
- 38                    8. Ensure excavations are safe for testing personnel.

39                    **END OF SECTIO**

40

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134-225510-006

MUD Florence Water Treatment Plant  
Phase II Filter Plant Improvements -  
TRENCHING, BACKFILLING, AND COMPACTING FOR UTILITIES  
02221 - 6



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**SECTION 02260**  
**TOPSOILING AND FINISHED GRADING**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes: Topsoiling and finished grading.
- 7 B. Related Specification Sections include but are not necessarily limited to:
- 8 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 9 2. Division 01 - General Requirements.
- 10 3. Section 02110 - Site Clearing.
- 11 4. Section 02200 - Earthwork.
- 12 5. Section 02270 - Soil Erosion and Sediment Control.
- 13 6. Section 02930 - Sodding.
- 14 C. Location of Work: All areas within limits of grading and all areas outside limits of grading which
- 15 are disturbed in the course of the work.

16 **1.2 QUALITY ASSURANCE**

- 17 A. Soil Conditioning Area:
- 18 1. General Contractor to coordinate pre-construction conference with grading sub-contractors,
- 19 Owner's Construction Representative, and Owner.
- 20 a. Contractor to make request with 48 HRS notice prior to needing testing.
- 21 2. Owner shall hire an independent soils laboratory to verify soil mixture.
- 22 3. Owner's Construction Representative to verify correct limits of soil mixture after placement.

23 **1.3 SUBMITTALS**

- 24 A. Shop Drawings:
- 25 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 26 the submittal process.
- 27 2. Project Data:
- 28 a. Verification of soil mixture for Soil Conditioning Area.
- 29 3. Drawing verifying the in-place limits of the Soil Conditioning Area.

30 **1.4 SITE CONDITIONS**

- 31 A. Verify amount of topsoil stockpiled and determine amount of additional topsoil, if necessary to
- 32 complete work.

33 **PART 2 - PRODUCTS**

34 **2.1 MATERIALS**

- 35 A. Topsoil:
- 36 1. Original surface soil typical of the area.
- 37 2. Existing topsoil stockpiled under Specification Section 02110.
- 38 3. Capable of supporting native plant growth.
- 39 4. Reasonably free of subsoil, clay, weeds, roots, and stones larger than 1 IN.
- 40 B. Compost to be used for soil conditioning:
- 41 1. Locally obtained and well rotted compost:
- 42 a. 100 percent of material must pass a 1/2 IN screen.
- 43 b. pH between 6 and 8.
- 44 c. Dry bulk density between 40 and 50 LBS/CU FT.
- 45 d. Manufactured inert material less than 1 percent by weight.

- 1 e. Organic matter content between 35 percent and 65 percent.
- 2 f. Soluble salt content shall be less than 6.0 mmhos/cm.
- 3 g. Maturity should be greater than 80 percent.
- 4 h. Stability shall be 7 or less.
- 5 i. Carbon/nitrogen ratio shall be less than 25:1.
- 6 j. Free of viable weed seeds.
- 7 k. Stable with regard to oxygen consumption and carbon dioxide generation.

8 **2.2 TOLERANCES**

- 9 A. Finish Grading Tolerance: 0.1 FT plus/minus from required elevations.

10 **PART 3 - EXECUTION**

11 **3.1 PREPARATION**

- 12 A. Correct, adjust and/or repair rough graded areas.
  - 13 1. Cut off mounds and ridges.
  - 14 2. Fill gullies and depressions.
  - 15 3. Perform other necessary repairs.
  - 16 4. Bring all sub-grades to specified contours, even and properly compacted.
- 17 B. Loosen surface to depth of 2 IN, minimum.
- 18 C. Remove all stones and debris over 2 IN in any dimension.

19 **3.2 ROUGH GRADE REVIEW**

- 20 A. Reviewed by Engineer in Specification Section 02110.

21 **3.3 PLACING TOPSOIL**

- 22 A. Do not place when subgrade is wet or frozen enough to cause clodding.
- 23 B. Spread to compacted depth of 4 IN for all areas to be sodded.
- 24 C. If topsoil stockpiled is less than amount required for work, furnish additional topsoil at no cost to  
25 Owner.
- 26 D. Provide finished surface free of stones, sticks, or other material 1 IN or more in any dimension.
- 27 E. Provide finished surface smooth and true to required grades.
- 28 F. Restore stockpile area to condition of rest of finished work.
- 29 G. In the Soil Conditioning Area, evenly till in a 3 IN layer of compost into the top 6 IN of topsoil and  
30 subsoil.
  - 31 1. Minimize heavy equipment compaction in this area.
  - 32 2. Firm soil using one pass of a 50 LB roller in this area to help ensure successful plant  
33 establishment.

34 **3.4 ACCEPTANCE**

- 35 A. Upon completion of topsoiling, obtain Engineer's acceptance of grade and surface.
- 36 B. Make test holes where directed to verify proper placement of amended soil in Soil Conditioning  
37 Area.

38 **END OF SECTION**

1 2014/09/05

2

## SECTION 02270

3

### SOIL EROSION AND SEDIMENT CONTROL

#### 4 PART 1 - GENERAL

##### 5 1.1 SUMMARY

6

A. Section Includes: Soil erosion and sediment control.

7

B. Related Specification Sections include but are not necessarily limited to:

8

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

9

2. Division 01 - General Requirements.

10

##### 1.2 QUALITY ASSURANCE

11

A. Referenced Standards:

12

1. City of Omaha Regional Stormwater Design Manual.

13

2. City of Omaha Standard Specifications for Public Works Construction, 2014 Edition.

14

#### PART 2 - PRODUCTS

15

##### 2.1 MATERIALS

16

A. Silt Fence: City of Omaha, Standard Specifications for Public Works Construction, 2014 Edition, Section 101.02(B)(C).

17

18

B. Wattles:

19

1. Netting: Open weave, degradable netting. Nominal diameter of 9 IN or as specified.

20

2. Fill material: Straw, wood excelsior, coir, or other natural materials approved by the Engineer.

21

22

3. Stakes: 1 IN x 1 IN (minimum) wooded stakes, or stakes of equivalent strength.

23

#### PART 3 - EXECUTION

24

##### 3.1 PREPARATION

25

A. The Contractor shall contain all sediment within the limits of construction.

26

1. If any sediment leaves the site, the Contractor is responsible for all cleanup, restoration, and repairs on neighboring property, as required to satisfy the Engineer, Owner, and City.

27

28

B. Geotextile Fabric and Silt Fence:

29

1. Silt fence shall be constructed and installed as detailed on the Plans before any work begins.

30

2. Silt fence shall be in accordance with the requirements of Section 9.5.5 of the City of Omaha Regional Stormwater Design Manual.

31

32

3. Silt fences are to remain in operating condition throughout grading operations.

33

C. Wattles Installation:

34

1. Construct a shallow trench, 2 to 4 IN deep, matching the width and contour of the wattle.

35

2. Install wattle along contour of slope.

36

3. Turn ends of wattle uphill to prevent water from flowing around the ends.

37

4. Place and compact excavated soil against the wattle, on the uphill side.

38

5. Drive stakes through the center of the wattle, into the ground at a maximum spacing of 4 FT along the length of the wattle, and as needed to secure the wattle and prevent movement.

39

40

6. Abut ends of adjacent wattles tightly.

41

D. Removal: Remove the wattle upon completion of the Project, and after final stabilization is achieved.

42

43

1. Completely remove the wattle netting, filler material, and stakes.



1 2014/08/12

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## SECTION 02502

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### CONCRETE PAVEMENT, CURB AND SIDEWALK

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

###### A. Section Includes:

7

1. Concrete pavement, curb, sidewalk, and steps.

8

###### B. Related Specification Sections include but are not necessarily limited to:

9

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

10

2. Division 01 - General Requirements.

11

3. Section 03308 - Concrete, Materials and Proportioning.

12

4. Section 03311 - Concrete Mixing, Placing, Jointing, and Curing.

13

5. Section 03350 - Testing.

14

##### 1.2 QUALITY ASSURANCE

15

###### A. Referenced Standards:

16

1. American Association of State Highway and Transportation Officials (AASHTO):

17

- a. M153, Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction (ASTM D1752).

18

- b. M171, Sheet Materials for Curing Concrete (ASTM C1271).

19

- c. M182, Burlap Cloth Made from Jute or Kenaf.

20

- d. M213, Preformed Expansion Joint Fillers for Concrete Paving and Structural

21

- Construction (Nonextruding and Resilient Bituminous Types) (ASTM D1751).

22

2. American Concrete Institute (ACI):

23

- a. 305R, Hot Weather Concreting.

24

- b. 306R, Cold Weather Concreting.

25

3. ASTM International (ASTM):

26

- a. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

27

- b. C33, Standard Specification for Concrete Aggregates.

28

- c. C150, Standard Specification for Portland Cement.

29

- d. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

30

- e. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup>).

31

- f. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

32

- g. D1752, Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

33

- h. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils

34

- Using a Vibratory Table.

35

- i. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

36

4. Federal Specification (FS):

37

- a. SS-S-1614, Sealants, Joint, Jet-Fuel-Resistant, Hot-Applied for Portland Cement and Tar Concrete Pavements.

38

- b. TT-S 00227 E, Sealing Compound: Elastomeric Type, Multi-Component (for Calking, Sealing, and Glazing in Buildings and Other Structures).

39

5. City of Omaha Standard Specifications for Public Works Construction, 2014 Edition.

40

41

42

43

44

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46

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48

49

##### 1.3 SUBMITTALS

50

###### A. Shop Drawings:

51

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

52

- 1 2. Product technical data including:
- 2 a. Acknowledgement that products submitted meet requirements of standards referenced.
- 3 3. Mix design in accordance with Specification Section 03308 and Specification Section 03350.
- 4 4. Qualifications of concrete installer.
- 5 5. Test reports:
- 6 a. Concrete cylinder test results from field quality control.
- 7 B. Samples:
- 8 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 9 the submittal process.
- 10 2. Samples of fabricated jointing materials and devices.

## 11 PART 2 - PRODUCTS

### 12 2.1 MATERIALS

- 13 A. Portland Cement: ASTM C150, Type I or II.
- 14 B. Aggregates:
- 15 1. ASTM C33, gradation size #67, 3/4 IN to #4.
- 16 2. Clean, crushed gravel.
- 17 C. Water: Potable quality.
- 18 D. Admixtures: Comply with Specification Section 03308.
- 19 E. Reinforcing Bars: ASTM A615, Grade 60.
- 20 F. Preformed Joint Filler:
- 21 1. Nonextruding cork, self-expanding cork, sponge rubber or cork rubber.
- 22 2. AASHTO M153 or AASHTO M213.
- 23 G. Hot-Poured Joint Sealing Material:
- 24 1. FS SS-S-1614.
- 25 H. Sidewalk Joint Sealant:
- 26 1. Two (2) compound polyurethane.
- 27 2. Class A, Type 1.
- 28 3. Self-leveling.
- 29 4. Nontracking.
- 30 5. FS TT-S 00227 E(3).
- 31 I. Membrane Curing Compound: ASTM C309.
- 32 J. Cover Materials for Curing:
- 33 1. Burlap:
- 34 a. AASHTO M182.
- 35 b. Minimum Class 2, 8 OZ material (1 YD x 42 IN).
- 36 2. Polyethylene film, AASHTO M171.
- 37 K. Forms:
- 38 1. Steel or wood.
- 39 2. Size and strength to resist movement during concrete placement and able to retain horizontal
- 40 and vertical alignment.
- 41 3. Free of distortion and defects.
- 42 4. Full depth.
- 43 5. Metal side forms:
- 44 a. Minimum 7/32 IN thick.
- 45 b. Depth equal to edge thickness of concrete.
- 46 c. Flat or rounded top minimum 1-3/4 IN wide.
- 47 d. Base 8 IN wide or equal to height, whichever is less.
- 48 e. Maximum deflection 1/8 IN under center load of 1,700 LBS.
- 49 f. Use flexible spring steel forms or laminated boards to form radius bends.

- 1 L. Aggregate Subbase:
- 2 1. City of Omaha Standard Specifications for Public Works Construction, 2014 Edition -
- 3 Section 300.02.
- 4 M. Aggregate Surface Course:
- 5 1. City of Omaha Standard Specifications for Public Works Construction, 2014 Edition -
- 6 Section 300.02.

7 **2.2 MIXES**

- 8 A. Mix design to provide 4,000 psi 28-day compressive strength, 1-1/2 IN plus 1 IN slump, 6 percent
- 9 air.
- 10 B. Comply with Specification Section 03308 and Specification Section 03311.

11 **PART 3 - EXECUTION**

12 **3.1 PREPARATION**

- 13 A. Subgrade Preparation:
- 14 1. Prepare using methods, procedures, and equipment necessary to attain required compaction
- 15 densities, elevation and section.
- 16 2. Scarify and recompact top 6 IN of fills and embankments which will be under paved areas.
- 17 3. Remove soft or spongy areas.
- 18 4. Replace with aggregate subbase material.
- 19 5. Compact to the following densities:
- 20 a. Cohesive soils: 95 percent per ASTM D698.
- 21 b. Noncohesive soils: 75 percent relative per ASTM D4253 and ASTM D4254.
- 22 6. Assure moisture content is within limits prescribed to achieve required compaction density.
- 23 7. Following compaction, trim and roll to exact cross section.
- 24 a. Check with approved grading template.
- 25 8. Perform density tests on subgrade to determine that subgrade complies with the
- 26 specification.
- 27 B. Aggregate Subbase Course:
- 28 1. Place material in not more than 6 IN thick layers.
- 29 2. Spread, shape, and compact all material deposited on the subgrade during the same day.
- 30 3. Compact to 75 percent relative per ASTM D4253 and ASTM D4254.
- 31 C. Loose and Foreign Material: Remove loose and foreign material immediately before application
- 32 of paving.

33 **3.2 INSTALLATION**

- 34 A. Concrete Production: Comply with Specification Section 03311.
- 35 B. Forms:
- 36 1. Form support:
- 37 a. Compact soil foundation and cut to grade to support forms and superimposed machine
- 38 loads.
- 39 b. Use bearing stakes driven flush with bottom of form to supplement support as
- 40 necessary.
- 41 c. Do not use earth pedestals.
- 42 2. Staking forms:
- 43 a. Joint forms neatly and tightly.
- 44 b. Stake and pin securely with at least three (3) pins for each 10 FT section.
- 45 3. Clean and oil forms prior to placement of concrete.
- 46 4. Set forms sufficiently in advance of work (minimum of 2 HRS) to permit proper inspection.
- 47 5. Previously finished concrete pavement, curb or sidewalk contiguous with new work may
- 48 serve as side form when specifically approved.
- 49 C. Reinforcing:
- 50 1. Locate longitudinal edge bars between 3 and 6 IN from edge of slab.
- 51 2. Lap mats one (1) full space.

- 1 3. Tie end transverse member of upper mat securely to prevent curving.
- 2 4. Lap nonwelded bars 12 IN minimum.
- 3 5. Support:
- 4 a. Place bars and heavy mats securely on chairs at called-for height.
- 5 D. Joints:
- 6 1. Hold joint location and alignment to within +1/4 IN.
- 7 2. Finish concrete surface adjacent to previously placed slab to within +1/8 IN, with tooled
- 8 radius of 1/4 IN.
- 9 3. Metal keyway joints:
- 10 a. Form by installing metal joint strip left in place.
- 11 b. Stake and support like side form.
- 12 c. Provide dowels or tie bars.
- 13 4. Weakened plane joints:
- 14 a. Tooled joints:
- 15 1) Form groove in freshly placed concrete with tooling device.
- 16 2) Groove dimensions shall be 3/8 IN at surface and 1/4 IN at root.
- 17 b. Sawed joints:
- 18 1) Saw 1/4 IN groove in green concrete.
- 19 2) Commence sawing as soon as concrete is hard enough to withstand operation
- 20 without chipping, spalling or tearing, regardless of nighttime or weather.
- 21 3) Thoroughly wet surface to protect membrane cure and recoat afterward.
- 22 4) Complete saw cutting before shrinkage stresses cause cracking.
- 23 c. Locate at intervals shown on the Drawings.
- 24 d. Provide preformed joint filler at all junctions with curb, sidewalk, or other structures.
- 25 5. Install construction joints at end of day's work or wherever concreting must be interrupted for
- 26 30 minutes or more.
- 27 6. Thoroughly clean and fill joints with joint sealing material as specified.
- 28 7. Fill joints without overflowing onto pavement surface.
- 29 8. Upper surface of filled joint to be flush to 1/8 IN below finish surface.
- 30 E. Place Concrete:
- 31 1. Comply with Specification Section 03311.
- 32 F. Cold and Hot Weather Concreting:
- 33 1. Cold weather:
- 34 a. Cease concrete placing when descending air temperature in shade falls below 40 DegF.
- 35 b. Do not resume until ambient temperature rises to minimum 40 DegF.
- 36 c. If placing below 40 DegF is authorized by Engineer, maintain temperature of mix
- 37 between 60 and 80 DegF.
- 38 d. Heat aggregates or water or both.
- 39 e. Water temperature may not exceed 175 DegF.
- 40 f. Aggregate temperature may not exceed 150 DegF.
- 41 g. Remove and replace frost damaged concrete.
- 42 h. Salt or other antifreeze is not permitted.
- 43 i. Comply with ACI 306R.
- 44 2. Hot weather:
- 45 a. Cease concrete placing when plastic mix temperature cannot be maintained under 90
- 46 DegF.
- 47 b. Aggregates or water or both may be cooled.
- 48 c. Cool water with crushed ice.
- 49 d. Cool aggregates by evaporation of water spray.
- 50 e. Never batch cement hotter than 160 DegF.
- 51 f. Comply with ACI 305R.
- 52 G. Finishing:
- 53 1. As soon as placed, strike off and screed to crown and cross section, slightly above grade, so
- 54 that consolidation and finishing will bring to final Drawing elevations.
- 55 2. Maintain uniform ridge full width with first pass of first screed.
- 56 3. Pavement and similar surfaces:
- 57 a. Float by longitudinally reciprocating float, passing gradually from edge to edge.
- 58 b. Assure successive advances do not exceed half the length of the float.
- 59 c. Test level of slab with minimum 10 FT straightedge.



- 1 d. Fill depressions with fresh material, consolidate and refinish.
- 2 e. Cut down high areas and retest.
- 3 f. Belt surface with two-ply canvas belt, using transverse strokes while advancing along
- 4 center line.
- 5 g. Provide final finish by full width burlap or carpet drag, drawn longitudinally.
- 6 h. Keep drag clean to avoid build up and consequent scarring.
- 7 i. Tool pavement edges with suitable edger.
- 8 j. Retest with straightedge and if pavement shows deviation of more than 1/8 IN in 10 FT,
- 9 remove and replace.
- 10 4. Curb and similar surfaces:
- 11 a. Bring curb to grade by running straightedge over steel templates with sawing motion.
- 12 b. Float surface with a wood float to draw cement to surface.
- 13 c. Broom finish after floating.
- 14 d. Tool edges with suitable edger.
- 15 e. Upon removal of forms, fill honeycombed or unevenly filled sections immediately with
- 16 cement mortar.
- 17 f. Assure that expansion joints are cleared of concrete.
- 18 5. Sidewalk and similar surfaces:
- 19 a. Test with 6 FT straightedges equipped with long handles and operated from off the
- 20 sidewalk.
- 21 b. Draw excess water and laitance off from surface.
- 22 c. Float finish so as to leave no disfiguring marks but to produce a uniform granular or
- 23 sandy texture.
- 24 d. Broom finish after floating.
- 25 e. Tool pavement edges with suitable edger.
- 26 f. Provide exposed aggregate surfaces in areas indicated on the Drawings.
- 27 g. Provide method such as abrasive blasting, bush hammering, or surface retarder
- 28 acceptable to the Engineer.
- 29 H. Curing:
- 30 1. Apply membrane curing compound complying with ASTM C309, and in accordance with
- 31 manufacturer's directions but at a minimum rate of 200 SF per gallon.
- 32 2. Apply curing compound within 4 HRS after finishing or as soon as surface moisture has
- 33 dissipated.
- 34 3. Cure for minimum of seven (7) days.
- 35 4. When average daily temperature is below 50 DegF, provide insulative protection of 12 IN
- 36 minimum thickness loose dry straw, or equivalent, for 10 days.
- 37 I. Protection of Concrete:
- 38 1. Protect concrete surfaces and appurtenances from traffic for minimum of 14 days.
- 39 2. Erect and maintain warning signs, lights, watchmen to direct traffic.
- 40 3. Repair or replace parts of concrete surfaces damaged by traffic, or other causes, occurring
- 41 prior to final acceptance.
- 42 4. Protect concrete pavement against public traffic, construction traffic and traffic caused by
- 43 employees and agents.
- 44 5. No equipment shall be driven or moved across concrete surfaces unless such equipment is
- 45 rubber-tired and only if concrete is designed for and capable of sustaining loads to be
- 46 imposed by the equipment.
- 47 6. Do not drive over new or existing concrete with tracked vehicles and equipment.
- 48 J. Opening to Traffic:
- 49 1. After 14 days, pavement may, at Owner's discretion, be opened to traffic if job cured test
- 50 cylinders have attained a compressive strength of 3,000 LBS per square inch when tested in
- 51 accordance with ASTM standard methods.
- 52 2. Prior to opening to traffic, clean and refill joints as required with the specified filler material.
- 53 K. Clean Up:
- 54 1. Assure clean up work is completed within two (2) weeks after pavement has been opened to
- 55 traffic.
- 56 2. No new work will begin until clean up work has been completed, or is maintained within two
- 57 (2) weeks after pavement has been opened to traffic.

- 1 L. Pavement Patching:
- 2 1. Comply with material and density requirements as mentioned elsewhere in this Specification
- 3 except provide minimum 6 IN aggregate immediately below the patch.
- 4 2. Place pavement patch providing a thickened edge.
- 5 3. Assure that patch in plane of "cold" joint has a thickness 6 IN greater than that of the existing
- 6 pavement.
- 7 4. Extend patch under existing pavement for a distance of 6 IN minimum.
- 8 5. Fill void under existing pavement with concrete.
- 9 6. Undercut existing pavement 6 IN all around patch and to a depth of 6 IN.
- 10 7. Prior to placing patch, sawcut edge of existing concrete to 1/4 depth and remove to provide a
- 11 vertical face for a straight and true joint.
- 12 M. Aggregate Surface Course: Install according to City of Omaha Standard Specifications for Public
- 13 Works Construction, 2014 Edition - Section 300.03.

14 **3.3 FIELD QUALITY CONTROL**

- 15 A. Provide test cylinders in accordance with Specification Section 03350 for each 50 CY of concrete
- 16 placed.

17 **END OF SECTION**

1 2014/08/04

2

## SECTION 02515

3

### PRECAST CONCRETE MANHOLE STRUCTURES

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

###### A. Section Includes:

7

1. Precast concrete manhole structures and appurtenant items.

8

- a. Chemical piping manholes and appurtenances.

9

###### B. Related Specification Sections include but are not necessarily limited to:

10

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

11

2. Division 01 - General Requirements.

12

3. Section 02221 - Trenching, Backfilling, and Compacting for Utilities.

13

4. Section 03208 - Reinforcement.

14

5. Section 03308 - Concrete Materials and Proportioning.

15

6. Section 09960 - High Performance Industrial Coatings.

16

##### 1.2 QUALITY ASSURANCE

17

###### A. Referenced Standards:

18

1. ASTM International (ASTM):

19

- a. A48, Standard Specification for Gray Iron Castings.

20

- b. C150, Standard Specification for Portland Cement.

21

- c. C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.

22

- d. D1227, Standard Specification for Emulsified Asphalt Used as a Protective Coating for

23

Roofing.

24

- e. D4022, Standard Specification for Coal Tar Roof Cement, Asbestos Containing.

25

##### 1.3 SUBMITTALS

26

###### A. Shop Drawings:

27

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

28

2. Product technical data including:

29

- a. Acknowledgement that products submitted meet requirements of standards referenced.

30

- b. Manufacturer's installation instructions.

31

3. Fabrication and/or layout drawings:

32

- a. Include detailed diagrams of manholes showing typical components and dimensions, reinforcements and other details.

33

- b. Itemize, on separate schedule, sectional breakdown of each manhole structure with all components and refer to drawing identification number or notation.

34

35

- c. Indicate knockout elevations for all piping entering each manhole.

36

37

38

##### 1.4 PROJECT CONDITIONS

39

###### A. Contractor will likely encounter areas of saturation or perched water outside of ground water limits

40

indicated in the Geotechnical Report. Areas of saturation or perched water are likely due to leaks

41

from existing basins and channels.

42

#### PART 2 - PRODUCTS

43

##### 2.1 ACCEPTABLE MANUFACTURERS

44

###### A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

45

1. Manhole rings, covers and frames:

46

- a. Neenah Foundry.

47

- b. Deeter Foundry.

- 1 c. Or equal.
- 2 2. Black mastic joint compound:
- 3 a. Kalktite 340.
- 4 b. Tufflex.
- 5 c. Plastico.
- 6 3. Premolded joint compound:
- 7 a. Ram Nec.
- 8 b. Kent Seal.
- 9 c. Or equal.
- 10 4. Emulsified fibrated asphalt compound:
- 11 a. Sonneborn Hydrocide 700B Semi-Mastic.
- 12 b. Or equal.
- 13 B. Submit request for substitution in accordance with Specification Section 01640.

14 **2.2 CHEMICAL PIPING MANHOLE STRUCTURE COMPONENTS**

- 15 A. Manhole Components:
- 16 1. Reinforcement: ASTM C478.
- 17 2. Minimum wall thickness: 5 IN.
- 18 3. Minimum base thickness: 12 IN.
- 19 4. Provide the following components for each manhole structure:
- 20 a. Base (precast) with integral bottom section or (cast-in-place).
- 21 b. Precast barrel section(s).
- 22 c. Precast eccentric transition section where indicated on Drawings.
- 23 d. Precast adjuster ring(s).
- 24 e. Precast flat top where indicated on Drawings.
- 25 5. Unless dimensioned or specifically noted on Drawings, provide manhole section with
- 26 minimum 48 IN inside dimensions.
- 27 B. Nonpressure Type Frames and Cover:
- 28 1. Cast iron frame and covers: ASTM A48, Class 35 (minimum).
- 29 2. Use only cast iron of best quality, free from imperfections and blow holes.
- 30 3. Furnish frame and cover of heavy-duty construction a minimum total weight of 450 LBS.
- 31 4. Machine all horizontal surfaces.
- 32 5. Furnish unit with solid nonventilated lid with concealed pickholes.
- 33 6. Ensure minimum clear opening of 24 IN DIA.
- 34 C. Special Coatings and Joint Treatment:
- 35 1. Joints of precast sections:
- 36 a. Black mastic compound: ASTM D4022.
- 37 2. Vertical wall surfaces:
- 38 a. Emulsified fibrated asphalt compound meeting ASTM D1227 Type I for all exterior
- 39 vertical wall surfaces.
- 40 D. Manhole Concrete:
- 41 1. Provide all manholes constructed with Portland ASTM C150, Type I or II cement with a
- 42 tricalcium aluminate content not to exceed 8 percent.
- 43 2. Mix aggregate shall be a minimum of 50 percent crushed limestone.
- 44 3. Provide 3000 psi nonshrink grout.

45 **PART 3 - EXECUTION**

46 **3.1 MANHOLE CONSTRUCTION**

- 47 A. General:
- 48 1. Construct cast-in-place concrete base slabs.
- 49 B. Build each manhole to dimensions shown on plans and at such elevation that pipe sections built
- 50 into wall of manhole will be true extensions of line of pipe.
- 51 C. For all horizontal mating surfaces between concrete and concrete or concrete and metal, above
- 52 established high groundwater elevation shown trowel apply to clean surface black mastic joint
- 53 compound to a minimum wet thickness of 1/4 IN immediately prior to mating the surfaces.

- 1 D. For horizontal joints that fall below established high groundwater elevation shown, install a  
2 resilient O-ring type gasket or pre-molded joint compound.
- 3 E. Seal all pipe penetrations in manhole.  
4 1. Form pipe openings smooth and well shaped.  
5 2. After installation, seal cracks with, non shrink grout.  
6 3. After grout cures, wire brush smooth and apply two coats emulsified fibrated asphalt  
7 compound to minimum wet thickness of 1/8 IN to ensure complete seal.
- 8 F. Set and adjust frame and cover final 6 IN (minimum) to 18 IN (maximum) to match finished  
9 pavement or finished grade elevation using precast adjuster rings.

10  
11

**END OF SECTION**



1 2014/08/15

2 **SECTION 02930**  
3 **SEEDING AND SODDING**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes: Seeding, sodding and soil preparation.
- 7 B. Related Specification Sections include but are not necessarily limited to:
- 8 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 9 2. Division 01 - General Requirements.
- 10 3. Section 02260 - Topsoiling and Finished Grading.

11 **1.2 SEQUENCING AND SCHEDULING**

- 12 A. Installation Schedule:
- 13 1. Show schedule of when sod is anticipated to be installed.
- 14 2. Indicate schedule in relation to schedule for finish grading and topsoiling.
- 15 3. Indicate anticipated dates Engineer will be required to review installation for final acceptance.

16 **1.3 SUBMITTALS**

- 17 A. Shop Drawings:
- 18 1. See Section 01340 for requirements for the mechanics and administration of the submittal
- 19 process.
- 20 2. Product technical data including:
- 21 a. Signed copies of vendor's statement for seed mixture required, stating botanical and
- 22 common name, place of origin, strain, percentage of purity, percentage of germination,
- 23 and amount of Pure Live Seed (PLS) per bag.
- 24 3. Certification that each container of seed delivered will be labeled in accordance with Federal
- 25 and State Seed Laws and equals or exceeds Specification requirements.

26 **1.4 DELIVERY, STORAGE, AND HANDLING**

- 27 A. Furnish seed in sealed standard containers labeled with producer's name and seed analysis.
- 28 1. Remove from the site seed which has become wet, moldy, or otherwise damaged in transit.

29 **1.5 SEQUENCING AND SCHEDULING**

- 30 A. Installation Schedule:
- 31 1. Show schedule of when seeded areas are anticipated to be planted.
- 32 2. Indicate planting schedules in relation to schedule for finish grading and topsoiling.
- 33 3. Indicate anticipated dates Owner's Construction Representative will be required to review
- 34 installation for initial acceptance and final acceptance.
- 35 B. Pre-installation Meeting:
- 36 1. Meet with Owner's Construction Representative and other parties as necessary to discuss
- 37 schedule and methods, unless otherwise indicated by Owner's Construction Representative.

38 **PART 2 - PRODUCTS**

39 **2.1 MATERIALS**

- 40 A. Seed Quality:
- 41 1. Fresh, clean, new-crop seed labeled in accordance with USDA Rules and Regulations under
- 42 the Federal Seed Act in effect on date of bidding.
- 43 2. Provide seed of species, proportions, and minimum percentages of purity, germination and
- 44 maximum percentage of weed seed as specified.

1 3. Approval of all seed for use shall be based on the accumulative total of PLS specified for  
2 each phase of work.

3 B. Seed Mixture:  
4

BOTANICAL AND COMMON NAME	PERCENT BY WEIGHT (PLS)	MINIMUM PERCENT GERMINATION	MINIMUM PERCENT PURITY
Kentucky Bluegrass (Poa pratensis)	60	85	95
Fescue, Tall, KY 31 (Festura arundiancea 'KY 31')	30	85	98
Ryegrass, Perennial (Lolium perenne)	10	90	95

5

6 C. Mulch:

7 1. For seeded areas:

8 a. Clean, seed-free, threshed straw of oats, wheat, barley, rye, beans, peanuts, or other  
9 locally available mulch material which does not contain an excessive quantity of matured  
10 seeds of noxious weeds or other species that will grow or be detrimental to seeding, or  
11 provide a menace to surrounding land.

12 b. Do not use material which is fresh or excessively brittle, or which is decomposed and will  
13 smother or retard growth of grass.

14 D. Sod:

15 1. Viable, dense, strongly rooted, not less than two (2) years old.

16 2. 60 percent Kentucky Bluegrass, 30 percent Fescue, and 10 percent other grasses.

17 3. Free of weeds and undesirable native grasses.

18 4. Strips 12 to 18 IN wide.

19 5. Mow prior to stripping from field.

20 6. Cut so 3/4 IN of soil is firmly attached to roots.

21 7. Not frozen or dormant.

22 E. Water:

23 1. Water free from substances harmful to sod growth.

24 2. Provide water from source approved prior to use.

## 25 PART 3 - EXECUTION

### 26 3.1 SOIL PREPARATION

27 A. General:

28 1. Limit preparation to areas which will be planted soon after.

29 2. Provide facilities to protect and safeguard all persons on or about premises.

30 B. Preparation for Seeding:

31 1. Loosen surface to minimum depth of 4 IN.

32 2. Remove stones over 1 IN in any dimension and sticks, roots, rubbish, and other extraneous  
33 matter.

34 3. Correct any surface irregularities in order to prevent pocket or low areas which will allow  
35 water to stand.

36 4. Remove stones or other substances from surface which will interfere with turf development  
37 or subsequent mowing operations.



- 1 C. Preparation for Sodding:
- 2 1. Loosen surface to minimum depth of 4 IN.
- 3 2. Remove stones over 1 IN in any dimension and sticks, roots, rubbish, and other extraneous
- 4 matter.
- 5 3. Correct any surface irregularities in order to prevent pocket or low areas which will allow
- 6 water to stand.
- 7 4. Remove stones or other substances from surface which will interfere with turf development
- 8 or subsequent mowing operations.
- 9 5. Grade lawn areas to a smooth, even surface with a loose, uniformly fine texture.
- 10 a. Roll and rake, remove ridges and fill depressions, as required to meet finish grades.
- 11 b. Limit fine grading to areas which can be planted soon after preparation.

12 **3.2 INSTALLATION**

- 13 A. Seeding:
- 14 1. Do not use seed which is wet, moldy, or otherwise damaged.
- 15 2. Perform seeding work from April 20 to May 15 for spring planting, and August 1 to
- 16 September 15 for fall planting, unless otherwise approved by Engineer.
- 17 3. Employ satisfactory methods of sowing using mechanical power-driven drills or seeders,
- 18 mechanical hand seeders, or other approved equipment.
- 19 4. Distribute seed evenly over entire area at rate of application not less than 4 LBS (PLS) of
- 20 seed per 1,000 SF, 50 percent sown in one direction, remainder at right angles to first
- 21 sowing.
- 22 5. Stop work when work extends beyond most favorable planting season for species
- 23 designated, or when satisfactory results cannot be obtained because of drought, high winds
- 24 excessive moisture, or other factors.
- 25 a. Resume work only when favorable conditions develop.
- 26 6. Lightly rake seed into soil followed by light rolling or cultipacking.
- 27 7. Immediately protect seeded areas against erosion by mulching.
- 28 a. Spread mulch in continuous blanket using 1-1/2 tons per acre to a depth of 4 or
- 29 5 straws.
- 30 8. Protect seeded areas against traffic or other use by erecting barricades and placing warning
- 31 signs.

- 32 B. Sodding:
- 33 1. Notify Engineer of source and location of sod at least 30 days prior to sodding operation, to
- 34 permit inspection.
- 35 a. Submit species and percentages of purity and state botanical and common names.
- 36 2. Sod areas as designated and disturbed lawn areas which were sodded or established prior
- 37 to construction.
- 38 3. Perform sodding only during climatic or weather conditions conducive to successful results.
- 39 a. Lay within 24 HRS of stripping.
- 40 b. Do not use dormant or frozen sod.
- 41 c. Sodding may be accomplished at all seasonal periods providing adequate provisions for
- 42 sod protection are taken to ensure fitness and survival.
- 43 d. Do not place sod when temperature is below 32 DegF.
- 44 e. Do not place frozen or dried out sod.
- 45 f. Do not sod on frozen or dried out soil.
- 46 4. Lay sod to form a solid mass with tightly fitted joints.
- 47 a. Butt ends and edges; do not overlap.
- 48 b. Stagger joints.
- 49 c. Tamp or roll lightly to ensure full contact with subgrade.
- 50 d. Work sifted soil into minor cracks, avoid smothering adjacent grass.

51 **3.3 MAINTENANCE AND REPLACEMENT**

- 52 A. General:
- 53 1. Begin maintenance of seeded and sodded areas immediately after each portion is planted
- 54 and continue until final acceptance.
- 55 2. Provide hoses, and watering equipment as required to convey water from water sources and
- 56 to keep planted areas uniformly moist as required for proper growth.

- 1
  - 2
  - 3
  - 4
  - 5
  - 6
3. Protection of new materials:
    - a. Provide barricade types of protection necessary to prevent damage to existing improvements indicated to remain.
    - b. Repair and pay for all damaged items.
  4. Replace unacceptable materials with materials and methods identical to the original specifications unless otherwise approved by the Engineer.

7

**END OF SECTION**



**DIVISION 03**  
CONCRETE





1 2014/09/08

2 **SECTION 03108**  
3 **FORMWORK**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes: Formwork requirements for concrete construction.
- 7 B. Related Specification Sections include but are not necessarily limited to:
- 8 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 9 2. Division 01 - General Requirements.
- 10 3. Section 03311 - Concrete Mixing, Placing, Jointing, and Curing.

11 **1.2 QUALITY ASSURANCE**

- 12 A. Referenced Standards:
- 13 1. American Concrete Institute (ACI):
- 14 a. 116R, Cement and Concrete Terminology.
- 15 b. 347, Guide to Formwork for Concrete.
- 16 2. Building Code:
- 17 a. International Code Council (ICC):
- 18 1) International Building Code and associated standards, 2006 Edition including all
- 19 City of Omaha amendments, referred to herein as Building Code.
- 20 B. Qualifications:
- 21 1. Formwork, shoring and reshoring to be designed by a professional civil or structural engineer
- 22 currently registered in the state of Nebraska and having a minimum of three (3) years
- 23 experience in this type of design work.
- 24 a. Above qualifications apply to slabs and beams not cast on the ground, wall and column
- 25 pours over 15 FT high.
- 26 C. Miscellaneous:
- 27 1. Design and engineering of formwork, shoring and reshoring as well as its construction is the
- 28 responsibility of the Contractor.
- 29 2. Design requirements:
- 30 a. Design formwork for loads, lateral pressures and allowable stresses outlined in ACI 347
- 31 and for design considerations, wind loads, allowable stresses and other applicable
- 32 requirements of the controlling local Building Code.
- 33 1) Where conflicts occur between the above two (2) standards, the more stringent
- 34 requirements shall govern.
- 35 b. Design formwork to limit maximum deflection of form facing materials reflected in
- 36 concrete surfaces exposed to view to 1/240 of span between structural members.
- 37 3. For slabs and beams not cast on the ground, develop a procedure and schedule for removal
- 38 of shores and installation of reshores and for calculating the loads transferred to the structure
- 39 during this process.
- 40 a. Perform structural calculations as required to prove that all portions of the structure in
- 41 combination with remaining forming and shoring system has sufficient strength to safely
- 42 support its own weight plus the loads placed thereon.
- 43 b. When developing procedure, schedule and structural calculations, consider the following
- 44 at each stage of construction:
- 45 1) The structural system that exists.
- 46 2) Effects of all loads during construction.
- 47 3) Strength of concrete.
- 48 4) The influence of deformations of the structure and shoring system on the
- 49 distribution of dead loads and construction loads.
- 50 5) The strength and spacing of shores or shoring systems used, as well as the method
- 51 of shoring, bracing, shore removal, and reshoring including the minimum time
- 52 intervals between the various operations.

- 1                                   6) Any other loading or condition that affects the safety or serviceability of the structure  
2                                   during construction.

3   **1.3 DEFINITIONS**

- 4           A. Words and terms used in these Specifications are defined in ACI 116R.

5   **1.4 SUBMITTALS**

- 6           A. Shop Drawings:  
7                1. See Specification Section 01340 for the requirements for the mechanics and administration  
8                of the submittal process.  
9                2. Product technical data including:  
10               a. Acknowledgement that products submitted meet requirements of standards referenced.  
11               b. Manufacturer's installation instructions.  
12               c. Manufacturer and type of proposed form materials.  
13               d. Manufacturer and type of proposed form ties.  
14               e. Manufacturer and type of proposed form coating material.  
15               f. Manufacturer and type of void forms including compressive strength.  
16               g. Manufacturer and type of stay-in-place forms.

17   **PART 2 - PRODUCTS**

18   **2.1 ACCEPTABLE MANUFACTURERS**

- 19           A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:  
20                1. Void forms:  
21                a. SureVoid Products, Inc.  
22                b. Deslauriers, Inc.  
23                2. Stay-in-place forms:  
24                a. Alabama Metal Industries Corporation (AMICO).  
25           B. Submit request for substitution in accordance with Specification Section 01640.

26   **2.2 MATERIALS**

- 27           A. Forms for Surfaces Exposed to View:  
28                1. Wood forms:  
29                a. New 5/8 or 3/4 IN 5-ply structural plywood of concrete form grade.  
30                b. Built-in-place or prefabricated type panel.  
31                c. 4 x 8 FT sheets for built-in-place type except where smaller pieces will cover entire area.  
32                d. When approved, plywood may be reused.  
33                2. Metal forms:  
34                a. Metal forms excluding aluminum may be used.  
35                b. Forms to be tight to prevent leakage, free of rust and straight without dents to provide  
36                members of uniform thickness.  
37           B. Forms for Surfaces Not Exposed to View:  
38                1. Wood or metal sufficiently tight to prevent leakage.  
39                a. Stay-in-place forms where shown in the Drawings.  
40                2. Do not use aluminum forms.

41   **2.3 ACCESSORIES**

- 42           A. Form Ties:  
43                1. Commercially fabricated for use in form construction.  
44                a. Do not use wire ties.  
45                2. Constructed so that ends or end fasteners can be removed without causing spalling at  
46                surfaces of the concrete.  
47                3. 3/4 IN minimum diameter cones on both ends.  
48                4. Embedded portion of ties to be not less than 1-1/2 IN from face of concrete after ends have  
49                been removed.

- 1 5. Provide ties with built-in waterstops in all walls that will be in contact with process liquid
- 2 during plant operation or are permanently buried below grade on one side only.
- 3 a. Through-wall ties that are designed to be entirely removed are not allowed in all walls
- 4 that will be in contact with process liquid during plant operation.
- 5 B. Void Forms:
- 6 1. Continuous void forms.
- 7 2. Specially designed and manufactured for the purpose of creating a void area directly under
- 8 concrete members which will allow a space for soil vertical upward movement.
- 9 3. Able to support the weight of concrete and construction loads to be placed thereon with no
- 10 decrease in required void form depth.
- 11 4. Constructed from double faced corrugated cardboard or fiberboard which is wax impregnated
- 12 and laminated with moisture-resistant adhesive.
- 13 5. Capable of resisting moisture with no loss of load carrying strength or change in depth or
- 14 configuration.
- 15 C. Stay-In-Place Forms:
- 16 1. Ribbed expanded metal leave-in-place concrete forms commercially fabricated to provide an
- 17 intentionally rougher surface.
- 18 2. Hot-dipped galvanized.
- 19 3. Alabama Metal Industries Corporation "Stay-Form."

## 20 **PART 3 - EXECUTION**

### 21 **3.1 PREPARATION**

- 22 A. Form Surface Treatment:
- 23 1. Before placing of either reinforcing steel or concrete, cover surfaces of forms with an
- 24 approved coating material that will effectively prevent absorption of moisture and prevent
- 25 bond with concrete, will not stain concrete or prevent bonding of future finishes.
- 26 a. A field applied form release agent or sealer of approved type or a factory applied non-
- 27 absorptive liner may be used.
- 28 2. Do not allow excess form coating material to stand in puddles in forms nor in contact with
- 29 hardened concrete against which fresh concrete is to be placed.
- 30 B. Provide temporary openings at base of column and wall forms and at other points where
- 31 necessary to facilitate cleaning and observation immediately before concrete is placed, and to
- 32 limit height of free fall of concrete to prevent aggregate segregation.
- 33 1. Temporary openings to limit height of free fall of concrete shall be spaced no more than 8 FT
- 34 apart.
- 35 C. Clean surfaces of forms, reinforcing steel and other embedded materials of any accumulated
- 36 mortar or grout from previous concreting and of all other foreign material before concrete is
- 37 placed.

### 38 **3.2 ERECTION**

- 39 A. Install products in accordance with manufacturer's instructions.
- 40 B. Tolerances:
- 41 1. Variation from plumb:
- 42 a. In lines and surfaces of columns, piers, walls, and in risers.
- 43 1) Maximum in any 10 FT of height: 1/4 IN.
- 44 2) Maximum for entire height: 1/2 IN.
- 45 b. For exposed corner columns, control-joint grooves, and other exposed to view lines:
- 46 1) Maximum in any 20 FT length: 1/4 IN.
- 47 2) Maximum for entire length: 1/2 IN.
- 48 2. Variation from level or from grades specified:
- 49 a. In slab soffits, ceilings, beam soffits and in arises, measured before removal of
- 50 supporting shores.
- 51 1) Maximum in any 10 FT of length: 1/4 IN.
- 52 2) Maximum in any bay or in any 20 FT length: 3/8 IN.
- 53 3) Maximum for entire length: 3/4 IN.

- 1                    b. In exposed lintels, sills, parapets, horizontal grooves, and other exposed to view lines:
- 2                        1) Maximum in any bay or in 20 FT length: 1/4 IN.
- 3                        2) Maximum for entire length: 1/2 IN.
- 4                    3. Variation of linear structure lines from established position in plan and related position of
- 5                        columns, walls, and partitions:
- 6                        a. Maximum in any bay: 1/2 IN.
- 7                        b. Maximum in any 20 FT of length: 1/2 IN.
- 8                        c. Maximum for entire length: 1 IN.
- 9                    4. Variation in sizes and location of sleeves, floor openings, and wall openings: Maximum of
- 10                        +1/2 IN.
- 11                    5. Variation in horizontal plan location of beam, column and wall centerlines from required
- 12                        location: Maximum of +1/2 IN.
- 13                    6. Variation in cross sectional dimensions of columns and beams and in thickness of slabs and
- 14                        walls: Maximum of -1/4 IN, +1/2 IN.
- 15                    7. Footings and foundations:
- 16                        a. Variations in concrete dimensions in plan: -1/2 IN, +2 IN.
- 17                        b. Misplacement or eccentricity:
- 18                            1) 2 percent of footing width in direction of misplacement but not more than 2 IN.
- 19                        c. Thickness:
- 20                            1) Decrease in specified thickness: 5 percent.
- 21                            2) Increase in specified thickness: No limit except that which may interfere with other
- 22                                    construction.
- 23                    8. Variation in steps:
- 24                        a. In a flight of stairs:
- 25                            1) Rise: +1/8 IN.
- 26                            2) Tread: +1/4 IN.
- 27                        b. In consecutive steps:
- 28                            1) Rise: +1/16 IN.
- 29                            2) Tread: +1/8 IN.
- 30                    9. Establish and maintain in an undisturbed condition and until final completion and acceptance
- 31                        of Project, sufficient control points and bench marks to be used for reference purposes to
- 32                        check tolerances.
- 33                    10. Regardless of tolerances listed allow no portion of structure to extend beyond legal boundary
- 34                        of Project.
- 35                    11. To maintain specified tolerances, camber formwork to compensate for anticipated deflections
- 36                        in formwork prior to hardening of concrete.
- 37                    C. Make forms sufficiently tight to prevent loss of mortar from concrete.
- 38                    D. Place 3/4 IN chamfer strips in exposed to view corners of forms to produce 3/4 IN wide beveled
- 39                        edges.
- 40                    E. At construction joints, overlap contact surface of form sheathing for flush surfaces exposed to
- 41                        view over hardened concrete in previous placement by at least 1 IN.
- 42                        1. Hold forms against hardened concrete to prevent offsets or loss of mortar at construction
- 43                        joint and to maintain a true surface.
- 44                        2. Where possible, locate juncture of built-in-place wood or metal forms at architectural lines,
- 45                        control joints or at construction joints.
- 46                    F. Construct wood forms for wall openings to facilitate loosening, if necessary, to counteract
- 47                        swelling.
- 48                    G. Anchor formwork to shores or other supporting surfaces or members so that movement of any
- 49                        part of formwork system is prevented during concrete placement.
- 50                    H. Provide runways for moving equipment with struts or legs, supported directly on formwork or
- 51                        structural member without resting on reinforcing steel.
- 52                    I. Provide positive means of adjustment (wedges or jacks) of shores and struts and take up all
- 53                        settlement during concrete placing operation.
- 54                        1. Securely brace forms against lateral deflection.
- 55                        2. Fasten wedges used for final adjustment of forms prior to concrete placement in position
- 56                        after final check.



- 1 J. Void Forms:  
2 1. After void forms are in place and before concrete is placed thereon, cover joints between  
3 abutting form sections and cover ends of forms to prevent intrusion of soil, concrete or any  
4 other materials.  
5 2. Install void forms in accordance with manufacturer's instructions.
- 6 K. Stay-In-Place Forms:  
7 1. Support stay-in-place forms as required to maintain the formwork in proper position.  
8 2. Hold the edge of stay-in-place forms back a minimum of 3 IN from all smooth formed  
9 concrete surfaces.  
10 3. Stay-in-place forms may be used where shown in the Drawings:  
11 a. Other locations approved by Engineer.

### 12 3.3 REMOVAL OF FORMS

- 13 A. No construction loads shall be supported on, nor any shoring removed from, any part of the  
14 structure under construction except when that portion of the structure in combination with  
15 remaining forming and shoring system has sufficient strength to safely support its weight and  
16 loads placed thereon.
- 17 B. When required for concrete curing in hot weather, required for repair of surface defects or when  
18 finishing is required at an early age, remove forms as soon as concrete has hardened sufficiently  
19 to resist damage from removal operations or lack of support.
- 20 C. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient  
21 stiffness to prevent sagging.  
22 1. Perform any needed repairs or treatment required on such sloping surfaces at once, followed  
23 by curing specified in Specification Section 03311.
- 24 D. Loosen wood forms for wall openings as soon as this can be accomplished without damage to  
25 concrete.
- 26 E. Formwork for columns, walls, sides of beams, and other parts not supporting weight of concrete  
27 may be removed as soon as concrete has hardened sufficiently to resist damage from removal.
- 28 F. Where no reshoring is planned, leave forms and shoring used to support weight of concrete in  
29 place until concrete has attained its specified 28 day compressive strength.  
30 1. Where a reshoring procedure is planned, supporting formwork may be removed when  
31 concrete has reached the concrete strength required by the formwork designer's structural  
32 calculations.
- 33 G. When shores and other vertical supports are so arranged that non-load-carrying form facing  
34 material may be removed without loosening or disturbing shores and supports, facing material  
35 may be removed when concrete has sufficiently hardened to resist damage from removal.

### 36 3.4 RESHORING

- 37 A. No construction loads shall be supported on, nor any shoring removed from, any part of the  
38 structure under construction except when that portion of the structure in combination with  
39 remaining forming and shoring system has sufficient strength to safely support its weight and  
40 loads placed thereon.
- 41 B. While reshoring is underway, no superimposed dead or live loads shall be permitted on the new  
42 construction.
- 43 C. During reshoring do not subject concrete in structural members to combined dead and  
44 construction loads in excess of loads that structural members can adequately support.
- 45 D. Place reshores as soon as practicable after stripping operations are complete but in no case later  
46 than end of working day on which stripping occurs.
- 47 E. Tighten reshores to carry their required loads without overstressing.
- 48 F. Shoring, reshoring and supporting formwork may be removed when concrete has reached the  
49 concrete strength required by the formwork designer's structural calculations.

- 1 G. For floors supporting shores under newly placed concrete leave original supporting shores in  
2 place or reshore.  
3 1. Reshoring system shall have a capacity sufficient to resist anticipated loads.  
4 2. Locate reshores directly under a shore position above.
- 5 H. In multi-story buildings, extend reshoring over a sufficient number of stories to distribute weight of  
6 newly placed concrete, forms, and construction live loads in such a manner that design  
7 superimposed loads of floors supporting shores are not exceeded.

8

**END OF SECTION**

1 2014/09/10

2

**SECTION 03208**  
**REINFORCEMENT**

3

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes: Reinforcing bar requirements for concrete construction.
- 7 B. Related Specification Sections include but are not necessarily limited to:
- 8 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 9 2. Division 01 - General Requirements.

10 **1.2 QUALITY ASSURANCE**

- 11 A. Referenced Standards:
- 12 1. American Concrete Institute (ACI):
- 13 a. SP 66, ACI Detailing Manual.
- 14 b. 318, Building Code Requirements for Structural Concrete.
- 15 2. ASTM International (ASTM):
- 16 a. A185, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
- 17 b. A497, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for
- 18 Concrete.
- 19 c. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete
- 20 Reinforcement.
- 21 d. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain
- 22 and Deformed, for Concrete.
- 23 3. Concrete Reinforcing Steel Institute (CRSI):
- 24 a. Manual of Standard Practice.

25 **1.3 SUBMITTALS**

- 26 A. Shop Drawings:
- 27 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 28 the submittal process.
- 29 2. Product technical data including:
- 30 a. Acknowledgement that products submitted meet requirements of standards referenced.
- 31 b. Manufacturer's installation instructions.
- 32 c. Mill certificates for all reinforcing.
- 33 d. Manufacturer and type of proprietary rebar mechanical splices.
- 34 e. Manufacturer and type of rebar adhesive anchor including installation instructions.
- 35 3. Rebar number, sizes, spacing, dimensions, configurations, locations, mark numbers, lap
- 36 splice lengths and locations, concrete cover and rebar supports.
- 37 4. Sufficient rebar details to permit installation of reinforcing.
- 38 5. Rebar details in accordance with ACI SP 66.
- 39 6. Locations where proprietary rebar mechanical splices are required or proposed for use.
- 40 7. Shop Drawings shall be in sufficient detail to permit installation of reinforcing without
- 41 reference to Contract Drawings.
- 42 a. Shop Drawings shall not be prepared by reproducing the plans and details indicated on
- 43 the Contract Drawings but shall consist of completely redrawn plans and details as
- 44 necessary to indicate complete fabrication and installation of all reinforcing steel.

45 **1.4 DELIVERY, STORAGE, AND HANDLING**

- 46 A. Support and store all reinforcing above ground.
- 47 B. Ship to jobsite with attached plastic or metal tags with permanent mark numbers which match the
- 48 Shop Drawing mark numbers.

1 **PART 2 - PRODUCTS**

2 **2.1 ACCEPTABLE MANUFACTURES**

- 3 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 4 1. Rebar adhesive anchors:
- 5 a. HIT-HY150 Max-SD (ICC-ED ESR-3013) System and HIT-RE-500 SD (ICC-ES-ESR-
- 6 2322) System Adhesive Anchors by Hilti.
- 7 b. EPCON G5 (ICC-ES-ESR-1137) Adhesive Anchoring System by ITW Ramset/Red
- 8 Head.
- 9 c. SET-XP (ICC-ES-ESR-2508) Adhesive Anchoring Systems by Simpson Strong Tie
- 10 Anchor Systems.
- 11 d. Or approved equal.
- 12 2. Rebar mechanical splices:
- 13 a. Lenton Rebar Splicing by Erico, Inc.
- 14 b. Richmond dowel bar splicer system by Richmond Screw and Anchor Co., Inc.
- 15 c. Bar-Grip Systems by Barsplice Products, Inc.
- 16 B. Submit request for substitution in accordance with Specification Section 01640.

17 **2.2 MATERIALS**

- 18 A. Reinforcing Bars: ASTM A615, grade 60, deformed.
- 19 B. Welded Wire Reinforcement: ASTM A185, ASTM A497 or ASTM A1064.
- 20 C. Smooth Dowel Bars: ASTM A615, grade 60 with metal end cap to allow longitudinal movement
- 21 equal to joint width plus 1 IN.
- 22 D. Proprietary Rebar Mechanical Splices: To develop in tension and compression a minimum of 125
- 23 percent of the yield strength of the rebars being spliced.
- 24 E. Rebar Adhesive Anchors:
- 25 1. Manufactured for the specific purpose of embedding and developing 125 percent of the yield
- 26 strength of rebars in hardened concrete.

27 **2.3 ACCESSORIES**

- 28 A. Metal Chairs, Runners, Bolsters, Spacers, Hangers, and Other Rebar Supports:
- 29 1. Plastic-coated tips in contact with forms.
- 30 2. Plastic coating meeting requirements of CRSI Manual of Standard Practice.
- 31 B. Protective plastic caps at mechanical splices.

32 **2.4 FABRICATION**

- 33 A. Tolerances:
- 34 1. Sheared lengths: +1 IN.
- 35 2. Overall dimensions of stirrups, ties and spirals: +1/2 IN.
- 36 3. All other bends: +0 IN, -1/2 IN.
- 37 B. Minimum diameter of bends measured on the inside of the rebar to be as indicated in ACI 318
- 38 Paragraph 7.2.
- 39 C. Ship rebars to jobsite with attached plastic or metal tags.
- 40 1. Place on each tag the mark number of the rebar corresponding to the mark number indicated
- 41 on the Shop Drawing.
- 42 2. Mark numbers on tags to be so placed that the numbers cannot be removed.

43 **PART 3 - EXECUTION**

44 **3.1 INSTALLATION**

- 45 A. Tolerances:
- 46 1. Rebar placement:
- 47 a. Clear distance to formed surfaces: +1/4 IN.
- 48 b. Minimum spacing between bars: -1/4 IN.

- 1 c. Top bars in slabs and beams:
- 2 1) Members 8 IN deep or less: +1/4 IN.
- 3 2) Members between 8 IN and 2 FT deep: -1/4 IN, +1/2 IN.
- 4 3) Members more than 2 FT deep: -1/4 IN, +1 IN.
- 5 d. Crosswise of members: Spaced evenly within +1 IN.
- 6 e. Lengthwise of members: +2 IN.
- 7 2. Minimum clear distances between rebars:
- 8 a. Beams, walls and slabs: Distance equal to rebar diameter or 1 IN, whichever is greater.
- 9 b. Columns: Distance equal to 1-1/2 times the rebar diameter or 1-1/2 IN, whichever is
- 10 greater.
- 11 c. Beam and slab rebars shall be threaded through the column vertical rebars without
- 12 displacing the column vertical rebars and still maintaining the clear distances required
- 13 for the beam and slab rebars.
- 14 B. Minimum concrete protective covering for reinforcement: As shown on Drawings.
- 15 C. Unless indicated otherwise on Drawings, provide splice lengths for reinforcing as follows:
- 16 1. For rebars: Class B splice meeting the requirements of ACI 318, Paragraph 12.15.
- 17 2. For welded wire reinforcement:
- 18 a. Splice lap length measured between outermost cross wires of each fabric sheet shall not
- 19 be less than one (1) spacing of cross wires plus 2 IN, nor less than 1.5 x development
- 20 length nor less than 6 IN.
- 21 b. Development length shall be as required for the yield strength of the welded wire
- 22 reinforcement in accordance with ACI 318, Paragraph 12.8.
- 23 3. Provide splices of reinforcing not specifically indicated or specified subject to approval of
- 24 Engineer.
- 25 a. Mechanical proprietary splice connectors may only be used when approved or indicated
- 26 on the Contract Drawings.
- 27 D. Placing Rebars:
- 28 1. Assure that reinforcement at time concrete is placed is free of mud, oil or other materials that
- 29 may affect or reduce bond.
- 30 2. Reinforcement with rust, mill scale or a combination of both will be accepted as being
- 31 satisfactory without cleaning or brushing provided dimensions and weights including heights
- 32 of deformations on a cleaned sample is not less than required by applicable ASTM
- 33 specification that governs for the rebar supplied.
- 34 3. Rebar support:
- 35 a. Uncoated rebar:
- 36 1) Support rebars and fasten together to prevent displacement by construction loads
- 37 or placing of concrete.
- 38 a) Locate and support reinforcement with bar supports to maintain minimum
- 39 concrete cover.
- 40 b) Set wire ties with ends directed into concrete, not toward exposed concrete
- 41 surfaces.
- 42 2) Rebar supported on ground:
- 43 a) Slab on grade and other members with only one mat of reinforcing:
- 44 (1) Provide metal bar supports with bottom plate.
- 45 (2) Do not use concrete blocks to support slab-on-grade reinforcing.
- 46 b) All other members: Provide supporting concrete blocks or metal bar supports
- 47 with bottom plate.
- 48 3) Rebar supported on formwork:
- 49 a) Concrete surfaces in contact with or over process liquid: 100 percent non-
- 50 metallic, non-corrosive chairs.
- 51 b) All other formed surfaces:
- 52 (1) Provide plastic-coated metal chairs, runners, bolsters, spacers, hangers
- 53 and other rebar support.
- 54 (2) Only tips in contact with the forms need to be plastic coated.
- 55 4. Support rebars over cardboard void forms by means of concrete supports which will not
- 56 puncture or damage the void forms during construction nor impair the strength of the
- 57 concrete members in any way.

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5. Where parallel horizontal reinforcement in beams is indicated to be placed in two or more layers, rebars in the upper layers shall be placed directly above rebars in the bottom layer with clear distance between layers to be 1 IN.
    - a. Place spacer rebars at 3 FT maximum centers to maintain the required 1 IN clear distance between layers.
  6. Extend reinforcement to within 2 IN of concrete perimeter edges.
    - a. If perimeter edge is formed by earth or stay-in-place forms, extend reinforcement to within 3 IN of the edge.
  7. To assure proper placement, furnish templates for all column vertical bars and dowels.
  8. Do not bend reinforcement after embedding in hardened concrete unless approved by Engineer.
    - a. Do not bend reinforcing by means of heat.
  9. Do not tack weld reinforcing.
  10. Embed rebars into hardened concrete utilizing adhesive anchor system specifically manufactured for such installation:
    - a. Drill hole in concrete with diameter and depth as required to develop 125 percent of the yield strength of the bar according to manufacturer's requirements.
    - b. Clean holes per manufacturer's recommendations.
    - c. Place adhesive in drilled hole.
    - d. Insert rebar into hole and adhesive in accordance with manufacturer's instructions.

21 **3.2 FIELD QUALITY CONTROL**

- 22 A. Reinforcement Congestion and Interferences:
  - 23 1. Notify Engineer whenever the specified clearances between rebars cannot be met.
  - 24 2. Do not place any concrete until the Engineer submits a solution to rebar congestion problem.
  - 25 3. Rebars may be moved as necessary to avoid interference with other reinforcing steel,  
26 conduits, or embedded items.
  - 27 4. If rebars are moved more than one bar diameter, obtain Engineer's approval of resulting  
28 arrangement of rebars.
  - 29 5. No cutting of rebars shall be done without written approval of Engineer.
- 30 B. See Section 01452 for the Special Inspection and Testing Program requirements.

31 **END OF SECTION**

1 2014/09/08

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## SECTION 03308

3

### CONCRETE, MATERIALS AND PROPORTIONING

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

###### A. Section Includes:

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1. Concrete materials, strengths and proportioning for concrete work.

8

2. Grouting:

9

a. Base plates for columns and equipment.

10

b. Patching cavities in concrete.

11

c. As specified and indicated in the Contract Document.

12

###### B. Related Specification Sections include but are not necessarily limited to:

13

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

14

2. Division 01 - General Requirements.

15

3. Section 03350 - Testing.

16

4. Section 03431 - Precast and Prestressed Concrete.

17

##### 1.2 QUALITY ASSURANCE

18

###### A. Referenced Standards:

19

1. American Concrete Institute (ACI):

20

a. 116R, Cement and Concrete Terminology.

21

b. 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.

22

c. 212.3R, Chemical Admixtures for Concrete.

23

d. 318, Building Code Requirements for Structural Concrete.

24

e. 350, Code Requirements for Environmental Engineering Concrete Structures.

25

2. ASTM International (ASTM):

26

a. C33, Standard Specification for Concrete Aggregates.

27

b. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

28

c. C94/C94M, Standard Specification for Ready-Mixed Concrete.

29

d. C150, Standard Specification for Portland Cement.

30

e. C157, Standard Test Method for Length Change of Hardened Hydraulic-Cement, Mortar, and Concrete.

31

f. C192, Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.

32

g. C260, Standard Specification for Air-Entraining Admixtures for Concrete.

33

h. C494, Standard Specification for Chemical Admixtures for Concrete.

34

i. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

35

3. Corps of Engineers (COE):

36

a. CRD-C621, Standard Specification for Packaged, Dry, Hydraulic-Cement Grout (NonShrink).

37

4. State of Nebraska Department of Roads (NDOR):

38

a. Standard Specification for Highway Construction.

39

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##### 1.3 DEFINITIONS

46

A. Words and terms used in these Specifications are defined in ACI 116R.

47

##### 1.4 SUBMITTALS

48

###### A. Shop Drawings:

49

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

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2. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's instructions.
    - c. Concrete mix designs as required by Specification Section 03350.
    - d. Manufacturer and type of proposed admixtures.
    - e. Manufacturer and type of proposed non-shrink grout and grout cure/seal compound.
  3. Certifications:
    - a. Certification of standard deviation value in psi for ready mix plant supplying the concrete.
    - b. Certification that the fly ash meets the quality requirements stated in this Specification Section, and fly ash supplier's certified test reports for each shipment of fly ash delivered to concrete supplier.
    - c. Certification that the class of coarse aggregate meets the requirements of ASTM C33 for type and location of concrete construction.
    - d. Certification of aggregate gradation.
  4. Test reports: Cement mill reports for all cement to be supplied.

## 1.5 DELIVERY, STORAGE AND HANDLING

- A. Storage of Materials:
  1. Store cement and pozzolan in weathertight buildings, bins, or silos which will exclude moisture and contaminants.
  2. Arrange aggregate stockpiles and use in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of like aggregates.
  3. Allow natural sand to drain until it has reached a relatively uniform moisture content before use.
  4. Store admixtures in such a manner as to avoid contamination, evaporation, or damage.
    - a. For those used in form of suspensions or non-stable solutions, provide agitating equipment to assure thorough distribution of ingredients.
    - b. Protect liquid admixtures from freezing and temperature changes which would adversely affect their characteristics and performance.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.
- B. Submit request for substitution in accordance with Specification Section 01640.

### 2.2 MATERIALS

- A. Cement:
  1. ASTM C150, Type I or II.
    - a. ASTM C595, Type 1P at Contractor's option.
  2. Cement type used shall correspond to that upon which selection of concrete proportions was based in the mix design.
- B. Fly Ash:
  1. ASTM C618, Class F.
  2. Non-staining.
  3. Suited to provide hardened concrete of uniform light gray color.
  4. Maximum loss on ignition: 4 percent.
  5. Compatible with other concrete ingredients and having no deleterious effects on the hardened concrete.
  6. Produced by source approved by the State Highway Department in the state where the Project is located for use in concrete for bridges.
  7. Cement and fly ash type used shall correspond to that upon which selection of concrete proportions was based in the mix design.
- C. Admixtures:
  1. Air entraining: ASTM C260.



- 1 2. Water reducing, retarding, and accelerating: Conform to ASTM C494, Types A through E,
- 2 and provisions of ACI 212.3R.
- 3 3. High range water reducers (superplasticizers): Conform to ASTM C494, Types F or G.
- 4 4. Admixtures to be chloride free.
- 5 a. Do not use calcium chloride.
- 6 5. Provide admixtures of same type, manufacturer and quantity as used in establishing required
- 7 concrete proportions in the mix design.
  
- 8 D. Water:
- 9 1. Potable.
- 10 2. Clean and free from deleterious substances.
- 11 3. Free of oils, acids and organic matter.
- 12 a. ASTM C1602 when used in conjunction with alternative ASTM C595 hydraulic blended
- 13 cement.
  
- 14 E. Aggregates for Normal Weight Concrete:
- 15 1. General:
- 16 a. Fine and coarse aggregates shall be regarded as separate ingredients.
- 17 b. Each size of coarse and fine aggregate shall conform to grading requirements of
- 18 indicated Specification.
- 19 c. Fine aggregate to be natural not manufactured.
- 20 2. Aggregates for Normal Weight Concrete:
- 21 a. 47B concrete per "Standard Specifications for Highway Construction" by NDOR.
- 22 1) Maximum size of coarse aggregate for concrete topping: 1/2 IN.
- 23 b. For manufacturing of precast and prestressed concrete, aggregates can also conform to
- 24 ASTM C33 with coarse aggregate size number 67 (maximum 3/4 IN).
  
- 25 F. Sand Cement Grout:
- 26 1. Approximately three (3) parts sand, one (1) part Portland cement, 6 ±1 percent entrained air
- 27 and water to produce a slump which allows grout to completely fill required areas and
- 28 surround adjacent reinforcing.
- 29 a. Provide sand in accordance with requirements for fine aggregate for concrete.
- 30 2. Minimum 28 day compressive strength: 3000 psi.
  
- 31 G. Non-shrink Grout:
- 32 1. Non-shrink, nonmetallic, noncorrosive, and non-staining.
- 33 2. Premixed with only water to be added in accordance with manufacturer's instructions at
- 34 jobsite.
- 35 3. Grout to produce a positive but controlled expansion.
- 36 a. Mass expansion shall not be created by gas liberation or by other means.
- 37 4. Minimum 28 day compressive strength: 6500 psi.
- 38 5. Acceptable manufacturers:
- 39 a. BASF Admixtures, Inc. "Masterflow, 713 Plus".
- 40 b. Euclid Chemical "NS Grout".
- 41 c. Sauereisen Cements "F-100 Level Fill Grout".
- 42 d. U.S. Grout "Five Star Grout".
- 43 e. Set Products, Inc. "Set Non-Shrink Grout".
- 44 f. The Upco Corp "Upcon".
- 45 g. L&M "Crystex".
- 46 h. Sika Corporation "Sika Grout 212".
- 47 6. In accordance with COE CRD-C621.
  
- 48 H. Epoxy Grout:
- 49 1. Three-component epoxy resin system:
- 50 a. Two (2) liquid epoxy components.
- 51 b. One (1) inert aggregate filler component.
- 52 2. Adhesive acceptable manufacturers:
- 53 a. BASF "Masterflow 648 CP".
- 54 b. Exxon Chemical Company "Escoweld 2505."
- 55 c. Sika "Sikadur Hi-Mod."
- 56 d. U.S. Grout "Five Start Epoxy Grout."
- 57 e. Euclid Chemical "E3-G."
- 58 3. Aggregate acceptable manufacturers:
- 59 a. BASF "Masterflow 648 CP".

- 1                    b. Exxon Chemical Company "Escoweld 2510."
- 2                    c. Sika aggregate.
- 3                    d. U.S. Grout aggregate.
- 4                    e. Euclid Chemical "Euclid aggregate."
- 5                    4. Aggregate manufacturer shall be the same as the adhesive manufacturer.
- 6                    5. The aggregate shall be compatible with the adhesive.
- 7                    6. Each component furnished in separate package for mixing at jobsite.

8    **2.3 MIXES**

9    A. General:

- 10                   1. Provide concrete capable of being placed without aggregate segregation and, when cured, of
- 11                       developing all properties specified.
- 12                   2. Ready-mixed concrete shall conform to ASTM C94/C94M.
- 13                   3. All concrete to be normal weight concrete weighing approximately 145 to 150 LBS per cubic
- 14                       foot at 28 days after placement.

15    B. Minimum 28 Day Compressive Strengths:

Normal weight concrete topping	4000 psi
Normal weight all other concrete	4500 psi
Normal weight precast concrete	5000 psi

17

18    C. Air Entrainment:

- 19                   1. Provide air entrainment in all concrete resulting in a total air content percent by volume as
- 20                       follows:
- 21                       a. 3/4 IN maximum aggregate size: 5 to 7 percent total air content.
- 22                       b. 1/2 IN maximum aggregate size: 5-1/2 to 8 percent total air content.
- 23                       c. Interior slabs and mats with power trowel finish: Maximum 3 percent total air content.

24    D. Slump:

- 25                   1. Walls and columns:
- 26                       a. 8 IN maximum, 4 IN minimum measured at the point of discharge into the concrete
- 27                           member.
- 28                       b. Slump shall be obtained by use of mid-range or high-range water reducer in accordance
- 29                           with ASTM C494.
- 30                   2. All other members: 4 IN maximum, 1 IN minimum measured at point of discharge into the
- 31                       concrete construction member.
- 32                   3. Concrete of lower than minimum slump may be used provided it can be properly placed and
- 33                       consolidated.
- 34                   4. Provide additional water or water reducing admixture at ready mix plant for concrete that is to
- 35                       be pumped to allow for slump loss due to pumping.
- 36                       a. Provide only enough additional water so that slump of concrete at discharge end of
- 37                           pump hose does not exceed maximum slump specified and the maximum specified
- 38                           water-cement ration is not exceeded.
- 39                   5. Slump may be adjusted in the field through the use of water reducers.
- 40                       a. Coordinate dosage and mixing requirements with concrete supplier.

41    E. Proportioning:

- 42                   1. General:
- 43                       a. Proportion ingredients to produce a mixture which will work readily into corners and
- 44                           angles of forms and around reinforcement by methods of placement and consolidation
- 45                           employed without permitting materials to segregate or excessive free water to collect on
- 46                           surface.
- 47                       b. Proportion ingredients to produce proper placability, durability, strength and other
- 48                           required properties.

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2. Normal weight concrete maximum water cement ratios:

SPECIFIED STRENGTH (PSI)	MAXIMUM WATER CEMENT RATIO BY WEIGHT
4000	0.45
4500	0.42
5000	0.45

\* If fly ash is proposed for use, the weight of fly ash plus weight of Portland cement shall equal these values.

3. Fly ash:
  - a. For cast-in-place concrete only, a maximum of 25 percent by weight of Portland cement content per cubic yard may be replaced with fly ash at a rate of 1 LB fly ash for 1 LB cement.
  - b. If fly ash is used, the water to fly ash plus cement ratio not to exceed the maximum water cement ratio specified in this Specification Section.
  - c. Concrete containing fly ash shall not be used in the construction of the precast concrete units specified in Specification Section 03431.
4. Water reducing, retarding, and accelerating admixtures:
  - a. Use in accordance with manufacturer's instructions.
  - b. Do not use unless required by these specifications or approved for use by Engineer.
5. High range water reducers (superplasticizers):
  - a. Use in accordance with manufacturer's instructions.
  - b. Do not use unless required by these Specifications or approved for use by Engineer.
6. Concrete mix proportioning methods for normal weight concrete:
  - a. Method 1:
    - 1) Used when combination of materials proposed is to be evaluated and proportions selected to be on a basis of trial mixes.
    - 2) Produce mixes having suitable proportions and consistencies based on ACI 211.1, using at least three (3) different water cement ratios or cement contents which will produce a range of compressive strengths encompassing the required average strength.
    - 3) Design trial mixes to produce a slump within 0.75 IN of maximum specified, and for air entrained concrete, air content within 0.5 percent specified.
    - 4) For each water cement ratio or cement content, make at least three (3) compression test cylinders for specified test age, and cure in accordance with ASTM C192.
      - a) Test for strength at 28 days in accordance with ASTM C39.
    - 5) From results of these tests, plot a curve showing relationship between water cement ratio or cement content and compressive strength.
    - 6) From this curve select water cement ratio or cement content to be used to produce required average strength.
    - 7) Use cement content and mixture proportions such that maximum water cement ratio is not exceeded when slump is maximum specified.
    - 8) Base field control on maintenance of proper cement content, slump, air content and water cement ratio.
    - 9) See paragraph hereafter for definition of required average strength.
  - b. Method 2:
    - 1) In lieu of trial mixes, field test records for concrete made with similar ingredients may be used.
    - 2) Use of proposed concrete mix proportions based on field test records subject to approval by Engineer based on information contained in field test records and demonstrated ability to provide the required average strength.
    - 3) Field test records to represent materials, proportions and conditions similar to those specified.
      - a) Changes in the materials, proportions and conditions within the test records shall have not been more restricted than those for the proposed concrete mix.
      - b) Field test records shall meet the requirements of ACI 318 Paragraph 5.3.1.

- 1                   4) Required concrete proportions may be established by interpolation between the  
2                   strengths and proportions of two (2) or more test records each of which meets the  
3                   requirements of this Specification Section.  
4                   7. Required average strength to exceed the specified 28 day compressive strength by the  
5                   amount determined or calculated in accordance with Paragraph 5.3 of ACI 318 using the  
6                   standard deviation of the proposed concrete production facility as described in Paragraphs  
7                   5.3.1 and 2 of ACI 318.

8                   F. Flowable Fill:

- 9                   1. Flowable fill shall be a mixture of cement, fly ash, fine sand, water and air having a  
10                   consistency which will flow under a very low head.  
11                   2. Approximate quantities of each component per cubic yard of mixed material:  
12                   a. Cement (Type I or II): 50 LBS.  
13                   b. Fly ash: 200 LBS.  
14                   c. Fine sand: 2,700 LBS.  
15                   d. Water (approximate): 420 LBS.  
16                   e. Air content (approximate): 10 percent.  
17                   3. Actual quantities shall be adjusted to provide a yield of 1 CY with the materials used.  
18                   4. Approximate compressive strength should be 85 to 175 psi.  
19                   5. Fine sand shall be an evenly graded material having not less than 95 percent passing the  
20                   No. 4 sieve and not more than 5 percent passing the No. 200 sieve.

21                   **2.4 SOURCE QUALITY CONTROL**

- 22                   A. To assure stockpiles are not contaminated or materials are segregated, perform any test for  
23                   determining conformance to requirements for cleanness and grading on samples secured from  
24                   aggregates at point of batching.  
25                   B. Do not use frozen or partially frozen aggregates.

26                   **PART 3 - EXECUTION**

27                   **3.1 FIELD QUALITY CONTROL**

- 28                   A. Perform concrete tests per Specification Section 03350.  
29                   1. Perform a strength test on all concrete to which water or superplasticizer, above the amount  
30                   stated in the approved concrete mix design, has been added.  
31                   a. Perform sampling after water or superplasticizer has been added and additional mixing  
32                   has been performed.  
33                   B. Perform strength test on any concrete to which water has been added at the jobsite.  
34                   C. See Section 01452 for the Special Inspection and Testing Program requirements.

35                   **END OF SECTION**

1 2014/09/08

2

## SECTION 03311

3

### CONCRETE MIXING, PLACING, JOINTING, AND CURING

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

A. Section Includes: Mixing, placing, jointing, and curing of concrete construction.

7

B. Related Specification Sections include but are not necessarily limited to:

8

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

9

2. Division 01 - General Requirements.

10

3. Section 03108 - Formwork.

11

4. Section 03208 - Reinforcement.

12

5. Section 03308 - Concrete, Materials and Proportioning.

13

6. Section 03348 - Concrete Finishing and Repair of Surface Defects.

14

7. Section 03350 - Testing.

15

8. Section 07190 - Under Slab Vapor Retarder.

16

9. Section 07900 - Joint Sealants.

17

##### 1.2 QUALITY ASSURANCE

18

A. Referenced Standards:

19

1. American Concrete Institute (ACI):

20

a. 116R, Cement and Concrete Terminology.

21

b. 304R, Guide for Measuring, Mixing, Transporting and Placing Concrete.

22

c. 304.2R, Placing Concrete by Pumping Methods.

23

d. 305R, Hot Weather Concreting.

24

e. 306R, Cold Weather Concreting.

25

f. 308R, Guide to Curing Concrete.

26

g. 309R, Guide for Consolidation of Concrete.

27

2. ASTM International (ASTM):

28

a. C94/C94M, Standard Specification for Ready-Mixed Concrete.

29

b. C156, Standard Test Method for Water Loss (from a Mortar Specimen) Through Liquid

30

Membrane-Forming Curing Compounds for Concrete.

31

c. C171, Standard Specification for Sheet Materials for Curing Concrete.

32

d. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing

33

Concrete.

34

e. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete

35

(Bituminous Type).

36

f. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded

37

Rubber.

38

g. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving

39

and Structural Construction (Nonextruding and Resilient Bituminous Types).

40

3. Corps of Engineers (COE):

41

a. CRD-C572, Specifications for Polyvinylchloride Waterstop.

42

4. National Ready Mixed Concrete Association (NRMCA):

43

a. Checklist for Certification of Ready Mixed Concrete Production Facilities.

44

5. NSF International (NSF).

45

B. Qualifications:

46

1. Ready Mixed Concrete Batch Plant: Certified by NRMCA.

47

##### 1.3 DEFINITIONS

48

A. Words and terms used in this Specification Section are defined in ACI 116R.

1 **1.4 SUBMITTALS**

- 2 A. Shop Drawings:
- 3 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 4 the submittal process.
- 5 2. Product technical data including:
- 6 a. Acknowledgement that products submitted meet requirements of standards referenced.
- 7 b. Manufacturer's installation instructions.
- 8 1) Procedure for adding high-range water reducer at the jobsite.
- 9 c. Scaled (minimum 1/8 IN/FT) Drawings showing proposed locations of construction joints
- 10 and joint keyway dimensions.
- 11 d. Manufacturers and types:
- 12 1) Joint fillers.
- 13 2) Curing agents.
- 14 3) Construction joint bonding adhesive.
- 15 4) Waterstops.
- 16 3. Certifications:
- 17 a. Ready mix concrete plant certification.
- 18 b. Waterstops: Products shipped meet or exceed the physical properties specified.
- 19 B. Informational Submittals:
- 20 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 21 the submittal process.
- 22 2. Copies of concrete delivery tickets.

23 **1.5 DELIVERY, STORAGE, AND HANDLING**

- 24 A. Delivery:
- 25 1. Concrete:
- 26 a. Prepare a delivery ticket for each load of ready mixed concrete.
- 27 b. Truck operator shall hand ticket to Contractor at the time of delivery.
- 28 c. Ticket to show:
- 29 1) Mix identification.
- 30 2) Quantity delivered.
- 31 3) Amount of material in each batch.
- 32 4) Outdoor temperature in the shade.
- 33 5) Time at which cement was added
- 34 6) Time of delivery.
- 35 7) Time of discharge.
- 36 8) Amount of water that may be added at the site without exceeding the specified
- 37 water-cement ratio.
- 38 9) Amount of water added at the site.

39 **PART 2 - PRODUCTS**

40 **2.1 ACCEPTABLE MANUFACTURERS**

- 41 A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable
- 42 Articles below are acceptable.
- 43 B. Submit request for substitution in accordance with Specification Section 01640.

44 **2.2 COMPONENTS**

- 45 A. Neoprene Expansion Joint Fillers:
- 46 1. Acceptable manufacturers:
- 47 a. Permaglaze.
- 48 b. Rubatex.
- 49 c. Williams Products.
- 50 2. Materials:
- 51 a. Closed cell neoprene.
- 52 b. ASTM D1056, Type 2, Class C.

- 1                   c. Compression deflection: As required to limit deflection to 25 percent of joint thickness  
2                   under pressure from concrete pour height.
- 3           B. Asphalt Expansion Joint Fillers:  
4           1. Acceptable manufacturers:  
5           a. J and P Petroleum Products.  
6           2. Materials: ASTM D994.
- 7           C. Fiber Expansion Joint Fillers:  
8           1. Materials: ASTM D1751.
- 9           D. Waterstops, PVC Type:  
10           1. Acceptable manufacturers:  
11           a. Greenstreak Plastic Products.  
12           b. Vinylex Corporation.  
13           2. Materials:  
14           a. Virgin polyvinyl chloride compound not containing any scrap or reclaimed materials or  
15           pigment.  
16           b. Standard: COE CRD-C572.  
17           3. In joints as indicated on Drawings:  
18           a. 4 IN wide by 3/16 IN thick bulb type waterstop.  
19           b. Greenstreak Plastic Products Style #701.  
20           4. Provide hog rings or grommets at maximum 12 IN OC along the length of the waterstop.  
21           5. Provide factory-made waterstop fabrications at all changes in direction, intersections and  
22           transitions, leaving only straight butt splices for the field.
- 23           E. Waterstops, Preformed Strip Type:  
24           1. Acceptable manufacturers:  
25           a. Hydrotite CJ by Greenstreak Plastics, Inc.  
26           b. Adeka Ultra Seal USA.  
27           2. Materials:  
28           a. Hydrophilic type waterstop manufactured solely for the purpose of preventing water from  
29           traveling through construction joints.  
30           b. Hydrotite type CJ-0725-3K.
- 31           F. Bonding Agent:  
32           1. Acceptable manufacturers:  
33           a. L&M Construction Chemicals, Inc.  
34           b. Sika.  
35           c. Euclid Chemical Co.  
36           2. Materials:  
37           a. Latex: ASTM C1059, Type II.  
38           b. Epoxy: ASTM C881, Type V.
- 39           G. Vapor Retarder: See Specification Section 07190.
- 40           H. Sand cement grout, non-shrink grout and epoxy grout: See Specification Section 03308.

## 41   **PART 3 - EXECUTION**

### 42   **3.1 PREPARATION**

- 43           A. General:  
44           1. Complete formwork.  
45           a. See Specification Section 03108.  
46           2. Remove earth, snow, ice, water, and other foreign materials from areas that will receive  
47           concrete.  
48           3. Secure reinforcement in place.  
49           a. See Specification Section 03208.  
50           4. Position expansion joint material, anchors and other embedded items.  
51           5. Obtain approval of reinforcement erection and placement prior to placing concrete.  
52           a. See Section 01452 for the Special Inspection and Testing Program requirements.

- 1 6. Do not place concrete during rain, sleet, or snow, unless adequate protection is provided and
- 2 approval is obtained.
- 3 a. Plan size of crews with due regard for effects of concrete temperature and atmospheric
- 4 conditions on rate of hardening of concrete as required to obtain good surfaces and
- 5 avoid unplanned cold joints.
- 6 b. Do not allow rainwater to increase mixing water nor to damage surface finish.
- 7 7. Prepare all construction joints for proper bond per the Construction Joints - Bonding
- 8 Paragraph in PART 3 of this Specification Section.
- 9 8. Remove hardened concrete and foreign materials from inner surfaces of conveying
- 10 equipment and formwork.
- 11 9. Provide slabs and beams of minimum indicated required depth when sloping structural
- 12 foundation base slabs and elevated slabs to drains.
- 13 a. For floor slabs on grade, slope top of subgrade to provide slab of required uniform
- 14 thickness.
- 15 B. Preparation of Subgrade for Slabs On Ground:
- 16 1. Subgrade drained and of adequate and uniform load-bearing nature.
- 17 2. Obtain approval of subgrade compaction density prior to placing slabs on ground.
- 18 3. Maintain subgrade at a temperature above 32 DegF before concrete placing begins for a
- 19 sufficient amount of time to remove frost.
- 20 4. Moisten subgrade to eliminate absorption.
- 21 a. Keep subgrade moist at time of concreting.
- 22 b. Allow no free-standing water on subgrade or soft or muddy spots when concrete is
- 23 placed.
- 24 C. Edge Forms and Screeds:
- 25 1. Set accurately to produce designated elevations and contours of finished surface.
- 26 2. Sufficiently strong to support vibrating screeds or roller pipe screeds, if required.
- 27 3. Use strike off templates, or approved vibrating type screeds, to align concrete surfaces to
- 28 contours of screed strips.

### 29 3.2 CONCRETE MIXING

- 30 A. General:
- 31 1. Provide all concrete from a central plant conforming to Checklist for Certification of Ready
- 32 Mixed Concrete Production Facilities of the NRMCA.
- 33 2. Batch, mix, and transport in accordance with ASTM C94/C94M.
- 34 B. Control of Admixtures:
- 35 1. Charge admixtures into mixer as solutions.
- 36 a. Measure by means of an approved mechanical dispensing device.
- 37 b. Liquid considered a part of mixing water.
- 38 c. Admixtures that cannot be added in solution may be weighed or measured by volume if
- 39 so recommended by manufacturer.
- 40 2. Add separately, when two or more admixtures are used in concrete, to avoid possible
- 41 interaction that might interfere with efficiency of either admixture, or adversely affect
- 42 concrete.
- 43 3. Complete addition of retarding admixtures within one minute after addition of water to cement
- 44 has been completed, or prior to beginning of last three quarters of required mixing, whichever
- 45 occurs first.
- 46 C. Tempering and Control of Mixing Water:
- 47 1. Mix concrete only in quantities for immediate use.
- 48 2. Discard concrete which has set.
- 49 3. Discharge concrete from ready mix trucks within time limit and drum revolutions stated in
- 50 ASTM C94/C94M.
- 51 4. Addition of water at the jobsite:
- 52 a. See Specification Section 03308 for specified water cement ratio and slump.
- 53 b. Do not exceed maximum specified water cement ratio or slump.
- 54 c. Incorporate water by additional mixing equal to at least half of total mixing required.
- 55 d. Perform strength test on any concrete to which water has been added at the jobsite.
- 56 1) See Specification Section 03350.



1 **3.3 PLACING OF CONCRETE**

2 A. General:

- 3 1. Comply with ACI 304R and ACI 304.2R.
- 4 2. Deposit concrete:
- 5 a. Continuously to avoid cold joints.
- 6 b. In layers of 12 to 18 IN.
- 7 3. Locate construction joints at locations approved by Engineer.
- 8 a. Plan size of crews with due regard for effects of concrete temperature and atmosphere
- 9 conditions to avoid unplanned cold joints.
- 10 4. Place concrete at such a rate that concrete, which is being integrated with fresh concrete, is
- 11 still workable.
- 12 5. Do not deposit concrete which has partially hardened or has been contaminated by foreign
- 13 materials.
- 14 6. Spreaders:
- 15 a. Temporary: Remove as soon as concrete placing renders their function unnecessary.
- 16 b. Embedded:
- 17 1) Obtain approval of Engineer.
- 18 2) Materials: Concrete or metal.
- 19 3) Ends of metal spreaders coated with plastic coating 2 IN from each end.
- 20 7. Deposit concrete as nearly as practicable in its final position to avoid segregation.
- 21 a. Maximum free fall: 4 FT.
- 22 b. Free fall exceeding 4 FT: Place concrete by means of hopper, elephant trunk or tremie
- 23 pipe extending down to within 4 FT of surface placed upon.
- 24 8. Perform the following operations before bleeding water has an opportunity to collect on
- 25 surface:
- 26 a. Spread.
- 27 b. Consolidate.
- 28 c. Straightedge.
- 29 d. Darby or bull float.
- 30 9. Deposit concrete on void forms by methods which will not crush or damage void forms in any
- 31 way.

32 B. Admixtures:

- 33 1. All admixtures to be introduced at the batch plant in accordance with manufacturer's
- 34 recommendations.

35 C. Cold Weather Concrete Placement:

- 36 1. Comply with ACI 306R.
- 37 2. Do not place concrete on substrates that are below 32 DegF or contain frozen material.
- 38 3. Maintain all materials, forms, reinforcement, subgrade and any other items which concrete
- 39 will come in contact with free of frost, ice or snow at time of concrete placement.
- 40 4. Temperature of concrete when discharged at site:
- 41

AIR TEMPERATURE DEGF	MINIMUM CONCRETE TEMPERATURE, DEGF FOR SECTIONS WITH LEAST DIMENSION LESS THAN 12 IN	MINIMUM CONCRETE TEMPERATURE, DEGF FOR SECTIONS WITH LEAST DIMENSION 12 IN OR GREATER
30 to 45	60	55
0 to 30	65	55
below 0	70	60

- 42
- 43 5. Heat subgrade, forms, and reinforcement so the temperature of the subgrade, forms, and
- 44 reinforcement will be between 45 and 70 DegF, when temperature of surrounding air is 40
- 45 DegF or below at time concrete is placed.
- 46 a. Remove all frost from subgrade, forms and reinforcement before concrete is placed.
- 47 6. Combine water with aggregate in mixer before cement is added, if water or aggregate is
- 48 heated above 90 DegF.
- 49 7. Do not mix cement with water or with mixtures of water and aggregate having a temperature
- 50 greater than 90 DegF.
- 51 8. Do not place slabs on ground if temperature is below 40 DegF or if temperature surrounding
- 52 the slab will be below 40 DegF before structure is enclosed and heated.

- 1 D. Hot Weather Concrete Placement:
- 2 1. Comply with ACI 305R.
- 3 2. Cool ingredients before mixing, or add flake ice or well crushed ice of a size that will melt
- 4 completely during mixing for all or part of mixing water if high temperature, low slump, flash
- 5 set, cold joints, or shrinkage cracks are encountered.
- 6 3. Temperature of concrete when placed:
- 7 a. Not to exceed 90 DegF.
- 8 b. Not so high as to cause:
- 9 1) Shrinkage cracks.
- 10 2) Difficulty in placement due to loss of slump.
- 11 3) Flash set.
- 12 4. Temperature of forms and reinforcing when placing concrete:
- 13 a. Not to exceed 90 DegF.
- 14 b. May be reduced by spraying with water to cool below 90 DegF.
- 15 1) Leave no standing water to contact concrete being placed.
- 16 E. Consolidating:
- 17 1. Consolidate in accordance with ACI 309R except as modified herein.
- 18 2. Consolidate by vibration so that concrete is thoroughly worked around reinforcement,
- 19 embedded items and into corners of forms.
- 20 a. Eliminate:
- 21 1) Air or stone pockets.
- 22 2) Honeycombing or pitting.
- 23 3) Planes of weakness.
- 24 3. Internal vibrators:
- 25 a. Minimum frequency of 8000 vibrations per minute.
- 26 b. Insert and withdraw at points approximately 18 IN apart.
- 27 1) Allow sufficient duration at each insertion to consolidate concrete but not sufficient
- 28 to cause segregation.
- 29 c. Use in:
- 30 1) Beams and girders of framed slabs.
- 31 2) Columns and walls.
- 32 d. Size of vibrators shall be in accordance with ACI 309R, Table 5.1.5.
- 33 4. Obtain consolidation of slabs with internal vibrators, vibrating screeds, roller pipe screeds, or
- 34 other approved means.
- 35 5. Do not use vibrators to transport concrete within forms.
- 36 6. Provide spare vibrators on jobsite during all concrete placing operations.
- 37 7. Bring a full surface of mortar against form by vibration supplemented if necessary by spading
- 38 to work coarse aggregate back from formed surface, where concrete is to have an as-cast
- 39 finish.
- 40 8. Use suitable form vibrators located just below top surface of concrete, where internal
- 41 vibrators cannot be used in areas of congested reinforcing.
- 42 9. Prevent construction equipment, construction operations, and personnel from introducing
- 43 vibrations into freshly placed concrete after the concrete has been placed and consolidated.
- 44 F. Handle concrete from mixer to place of final deposit by methods which will prevent segregation or
- 45 loss of ingredients and in a manner which will assure that required quality of concrete is
- 46 maintained.
- 47 1. Use truck mixers, agitators, and non-agitating units in accordance with ASTM C94/C94M.
- 48 2. Horizontal belt conveyors:
- 49 a. Mount at a slope which will not cause segregation or loss of ingredients.
- 50 b. Protect concrete against undue drying or rise in temperature.
- 51 c. Use an arrangement at discharge end to prevent segregation.
- 52 d. Do not allow mortar to adhere to return length of belt.
- 53 e. Discharge conveyor runs into equipment specially designed for spreading concrete.
- 54 3. Metal or metal lined chutes:
- 55 a. Slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal.
- 56 b. Chutes more than 20 FT long and chutes not meeting slope requirements may be used
- 57 provided they discharge into a hopper before distribution.
- 58 c. Provide end of each chute with a device to prevent segregation.
- 59 4. Pumping or pneumatic conveying equipment:
- 60 a. Designed for concrete application and having adequate pumping capacity.
- 61 b. Control pneumatic placement so segregation is avoided in discharged concrete.

- 1 c. Loss of slump in pumping or pneumatic conveying equipment shall not exceed 1-1/2 IN.
- 2 d. Do not convey concrete through pipe made of aluminum or aluminum alloy.
- 3 e. Provide pumping equipment without Y sections.

4 **3.4 JOINTS AND EMBEDDED ITEMS**

5 A. Construction Joints - General:

- 6 1. Locate joints as indicated on Contract Drawings or as shown on approved Shop Drawings.
- 7 a. Where construction joint spacing shown on Drawings exceeds the joint spacing
- 8 indicated in Paragraph B. below, submit proposed construction joint location in
- 9 conformance with this Specification Section.
- 10 2. Unplanned construction joints will not be allowed.
- 11 a. If concrete cannot be completely placed between planned construction joints, then it
- 12 must be removed.
- 13 3. In general, locate joints near middle of spans of slabs, beams and girders unless a beam
- 14 intersects a girder at this point, in which case, offset joint in girder a distance equal to twice
- 15 the width of the beam.
- 16 4. Locate joints in walls and columns at underside of floors, slabs, beams, or girders, and at
- 17 tops of foundations or floor slabs, unless shown otherwise.
- 18 a. At Contractor's option, beam pockets may be formed into concrete walls.
- 19 b. Size pockets to allow beam reinforcing to be placed as detailed on Drawings.
- 20 5. Place beams, girders, column capitals and drop panels at same time as slabs.
- 21 6. Make joints perpendicular to main reinforcement with all reinforcement continuous across
- 22 joints.
- 23 7. Provide roughened construction joints at all horizontal construction joints unless indicated
- 24 otherwise on Drawings.
- 25 a. Clean the previously hardened concrete interface and remove all laitance.
- 26 b. Intentionally roughen the interface to a full amplitude of 1/4 IN.
- 27 c. Provide recessed flat surface as required to install strip type waterstops.
- 28 8. Provide continuous keyways at all vertical construction joints unless shown otherwise in the
- 29 Drawings.
- 30 a. Construction joint keyways shall have the following dimensions, unless shown otherwise
- 31 on Drawings or directed otherwise by Engineer.
- 32 b. Construction joint keyways in walls:
- 33 1) Keyway width, not less than 1/3 and not more than 1/2 the wall thickness measured
- 34 perpendicular to wall faces.
- 35 2) Keyway depth to be not less than 1-1/2 IN.
- 36 3) Place keyway in wall center unless shown otherwise on Drawings.
- 37 c. Construction joint keyways in footings, foundations, base slabs, and structural or
- 38 elevated slabs:
- 39 1) Keyway height not less than 1/3 and not more than 1/2 the footing or slab thickness.
- 40 2) Keyway depth not less than 1-1/2 IN.
- 41 3) Keyway in footing or slab center unless shown otherwise on Drawings.
- 42 d. Construction joint keyways in beams:
- 43 1) Keyway height not less than 1/3 and not more than 1/2 the beam depth.
- 44 2) Keyway depth not less than 1-1/2 IN.
- 45 3) Keyway in beam center unless shown otherwise on Drawings.
- 46 9. Allow a minimum of 48 HRS before placement of adjoining concrete construction.

47 B. Construction Joints - Spacing:

- 48 1. General:
- 49 a. Wall vertical construction joints:
- 50 1) 60 FT maximum centers.
- 51 2) At wall intersections, 30 FT maximum from corner.
- 52 b. Wall horizontal construction joints: 20 to 25 FT centers.
- 53 c. Base slab, floor, and roof slab construction joints:
- 54 1) Placements to be approximately square and not to exceed 3500 SF.
- 55 2) Maximum side dimension of a slab pour to be less than:
- 56 a) Twice the length of the short side.
- 57 b) 80 FT.

- 1 C. Construction Joints - Bonding:
- 2 1. Obtain bond between concrete pours at construction joints by thoroughly cleaning and
- 3 removing all laitance from construction joints.
- 4 a. Before new concrete is placed, all construction joints shall be coated with cement grout,
- 5 or dampened.
- 6 2. Roughened construction joints:
- 7 a. Roughen the surface of the concrete to expose the aggregate uniformly
- 8 b. Remove laitance, loosened particles of aggregate or damaged concrete at the surface,
- 9 or at the Contractor's option, use an approved chemical retarder which delays but does
- 10 not prevent setting of the surface of the mortar in accordance with the manufacturer's
- 11 recommendations.
- 12 1) Retarded mortar shall be removed within 24 HRS after placing to produce a clean
- 13 exposed aggregate bonding surface.
- 14 c. Cover the hardened concrete of horizontal joints with a coat of cement grout of similar
- 15 proportions to the concrete, except substitute fine aggregate for coarse aggregate.
- 16 d. Place 1 IN layer of grout in bottoms of wall lifts immediately before placing concrete.
- 17 1) Vibrate grout and first layer of concrete simultaneously.
- 18 e. Place fresh concrete before the grout has attained its initial set.
- 19 3. Other keyed construction joints:
- 20 a. Thoroughly clean construction joints and remove all laitance.
- 21 b. Dampen the hardened concrete (but do not saturate) immediately prior to placing of
- 22 fresh concrete.
- 23 D. Locate control joints in slabs on grade as indicated on Drawings.
- 24 1. Time cutting properly with set of concrete, if saw cut joints are required or permitted.
- 25 a. Start cutting as soon as concrete has hardened sufficiently to prevent aggregates being
- 26 dislodged by saw.
- 27 b. Complete before shrinkage stresses become sufficient to produce cracking.
- 28 E. Expansion Joints:
- 29 1. Do not permit reinforcement or other embedded metal items bonded to concrete (except
- 30 smooth dowels bonded on only one side of joint) to extend continuously through an
- 31 expansion joint.
- 32 2. Use neoprene expansion joint fillers, unless noted otherwise on Drawings.
- 33 3. Seal expansion joints as shown on Drawings.
- 34 a. See Specification Section 07900 for requirements.
- 35 F. Waterstops:
- 36 1. Preformed strip type:
- 37 a. Install on smooth surface of hardened concrete by use of nails, adhesive or other means
- 38 as recommended by manufacturer to prevent movement of waterstop during placement
- 39 of concrete.
- 40 b. Waterstop to be continuous with splices in accordance with manufacturer's instructions.
- 41 c. Use in joints against existing concrete and where indicated on Drawings.
- 42 2. PVC type:
- 43 a. Position waterstop accurately in forms.
- 44 b. Secure waterstops in correct position using hog rings or grommets spaced along the
- 45 length of waterstop and tie wire to adjacent reinforcing.
- 46 c. Hold horizontal waterstops in place with continuous supports.
- 47 d. Install according to manufacturer's instructions.
- 48 1) Do not displace reinforcement from required location.
- 49 e. Waterstops to be continuous.
- 50 f. Splice ends with perpendicular butt splice using electrical splicing iron in accordance
- 51 with manufacturer's instructions.
- 52 g. Unless otherwise noted, use for all construction joints in new construction for all
- 53 structures indicated on Drawings.
- 54 G. Other Embedded Items:
- 55 1. Place sleeves, inserts, anchors, and embedded items required for adjoining work or for its
- 56 support, prior to initiating concreting.
- 57 2. Do not place electrical conduit, drains, or pipes in or thru concrete slabs, walls, columns,
- 58 foundations, beams or other structural members unless approved by Engineer.

- 1 H. Placing Embedded Items:
- 2 1. Position expansion joint material, waterstops, and other embedded items accurately.
- 3 2. Support against displacement.
- 4 3. Fill voids in sleeves, inserts and anchor slots temporarily with readily removable material to
- 5 prevent entry of concrete into voids.
- 6 4. Provide adequate means for anchoring waterstop in concrete.
- 7 a. Provide means to prevent waterstops in the forms from being folded over by the
- 8 concrete as it is placed.
- 9 b. Work concrete under the waterstops by hand, so as to avoid the formation of air and
- 10 rock pockets, when placing roof and floor slab concrete around waterstops.

11 **3.5 FINISHING**

- 12 A. See Specification Section 03348.
- 13 B. Coordinate mixing and placing with finishing.

14 **3.6 INSTALLATION OF GROUT**

- 15 A. Grout Schedule of Use:
- 16 1. Sand cement grout:
- 17 a. Fill keyways if precast HCU.
- 18 b. General use.
- 19 2. Non-shrinking non-metallic grout:
- 20 a. Filling form tie holes.
- 21 b. Under column and beam base plates.
- 22 c. Other uses indicated on the Drawings.
- 23 3. Epoxy grout: Uses indicated on the Drawings.
- 24 B. Grout Installation:
- 25 1. Sand cement grout:
- 26 a. Fill keyways between precast concrete hollow core slabs with sand cement grout.
- 27 b. Consolidate grout by rodding or by other means to assure complete filling of keyways.
- 28 c. Cure grout by one of methods specified.
- 29 2. Non-shrink non-metallic grout:
- 30 a. Clean concrete surface to receive grout.
- 31 b. Saturate concrete with water for 24 HRS prior to grouting.
- 32 c. Mix in a mechanical mixer.
- 33 d. Use no more water than necessary to produce flowable grout.
- 34 e. Place in accordance with manufacturer's instructions.
- 35 f. Provide under beam, column, and equipment base plates, in joints between precast
- 36 concrete filter slabs, and in other locations indicated on the Drawings.
- 37 g. Completely fill all spaces and cavities below the top of base plates.
- 38 h. Provide forms where base plates and bed plates do not confine grout.
- 39 i. Where exposed to view, finish grout edges smooth.
- 40 j. Except where a slope is indicated on the Drawings, finish edges flush at the base plate,
- 41 bed plate, member or piece of equipment.
- 42 k. Coat exposed edges of grout with cure or seal compound recommended by the grout
- 43 manufacturer.
- 44 3. Epoxy grout:
- 45 a. Mix and place in accordance with manufacturer's instructions.
- 46 b. Apply only to clean, dry, sound surface.
- 47 c. Obtain manufacturer's field technical assistance as required to assure proper placement.

48 **3.7 CURING AND PROTECTION**

- 49 A. Protect concrete from premature drying, excessively hot or cold temperatures, and mechanical
- 50 injury immediately after placement, and maintain with minimal moisture loss at relatively constant
- 51 temperature for period necessary for hydration of cement, hardening, and compressive strength
- 52 gain.
- 53 1. Follow recommendations of ACI 308 except as modified herein.
- 54 B. Apply one of the following curing procedures immediately after completion of placement and
- 55 finishing, for concrete surfaces not in contact with forms.
- 56 1. Ponding or continuous sprinkling.

- 1 2. Application of absorptive mats or fabric kept continuously wet.
- 2 3. Application of sand kept continuously wet.
- 3 4. Continuous application of steam (not exceeding 150 DegF) or mist spray.
- 4 5. Application of waterproof sheet materials, conforming to ASTM C171.
- 5 6. Application of other moisture retaining covering as approved.
- 6 7. Application of a curing compound conforming to ASTM C309.
  - 7 a. Apply curing compound in accordance with manufacturer's recommendations
  - 8 immediately after any water sheen which may develop after finishing has disappeared
  - 9 from concrete surface.
  - 10 b. Do not use on any surface against which additional concrete or other material is to be
  - 11 bonded unless it is proven that curing compound will not prevent bond.
  - 12 c. Where a vertical surface is cured with a curing compound, the vertical surface shall be
  - 13 covered with a minimum of two (2) coats of the curing compound.
    - 14 1) Apply the first coat of curing compound to a vertical surface immediately after form
    - 15 removal.
    - 16 2) The vertical concrete surface at the time of receiving the first coat shall be damp
    - 17 with no free water on the surface.
    - 18 3) Allow the preceding coat to completely dry prior to applying the next coat.
    - 19 4) A vertical surface: Any surface steeper than 1 vertical to 4 horizontal.
    - 20 d. Curing compounds used in water treatment plant construction shall be non-toxic and
    - 21 taste and odor free.
      - 22 1) Curing compound to be NSF approved and have a moisture loss of not more than
      - 23 0.62 kg/SQ meter per ASTM C156.
        - 24 a) Atlas Tech Products Atlas Quantum-Cure.
        - 25 2) Alternately, all tank surfaces shall be sand-blasted as required to remove non-NSF
        - 26 approved curing compound.
- 27 C. Curing Concrete In Contact with Forms:
  - 28 1. Minimize moisture loss from and temperature gain of concrete placed in forms exposed to
  - 29 heating by sun by keeping forms wet and cool until they can be safely removed.
  - 30 2. After form removal, cure concrete until end of time prescribed.
    - 31 a. Use one of methods listed above.
  - 32 3. Forms left in place shall not be used as a method of curing in hot weather.
  - 33 4. The term "hot weather," where used in these specifications, is defined in ACI 305R.
  - 34 5. In hot weather, remove forms from vertical surfaces as soon as concrete has gained
  - 35 sufficient strength so that the formwork is no longer required to support the concrete.
- 36 D. Continue curing for at least seven (7) days for all concrete except high early strength concrete for
- 37 which period shall be at least three (3) days.
  - 38 1. If one of curing procedures indicated above is used initially, it may be replaced by one of
  - 39 other procedures indicated any time after concrete is one (1) day old, provided concrete is
  - 40 not permitted to become surface dry during transition.
- 41 E. Cold Weather:
  - 42 1. Follow recommendations of ACI 306R.
  - 43 2. Maintain temperature of concrete between 50 and 70 DegF for required curing period, when
  - 44 outdoor temperature is 40 DegF, or less.
  - 45 3. Use heating, covering, insulating, or housing of the concrete work to maintain required
  - 46 temperature without injury due to concentration of heat.
  - 47 4. Do not use combustion heaters unless precautions are taken to prevent exposure of
  - 48 concrete to exhaust gases which contain carbon dioxide.
  - 49 5. Interior slabs in areas intended to be heated shall be adequately protected so that frost does
  - 50 not develop in the supporting subgrade.
- 51 F. Hot Weather:
  - 52 1. Follow recommendations of ACI 305R.
  - 53 2. Make provision for cooling forms, reinforcement and concrete, windbreaks, shading, fog
  - 54 spraying, sprinkling, ponding, or wet covering with a light colored material.
  - 55 3. Provide protective measures as quickly as concrete hardening and finishing operations will
  - 56 allow.
- 57 G. Rate of Temperature Change:
  - 58 1. Keep changes in temperature of air immediately adjacent to concrete as uniform as possible,
  - 59 during and immediately following curing period.







1 2014/09/10

2

## SECTION 03348

3

### CONCRETE FINISHING AND REPAIR OF SURFACE DEFECTS

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

###### A. Section Includes:

7

1. Concrete finishing.

8

2. Repair of surface defects in new concrete construction

9

3. Repair of surface and subsurface defects in existing concrete construction.

10

4. Cementitious concrete coating.

11

5. Polymer resurfacing mortar.

12

6. Concrete sealers.

13

###### B. Related Specification Sections include but are not necessarily limited to:

14

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

15

2. Division 01 - General Requirements.

16

3. Section 02072 – Demolition, Cutting and Patching.

17

4. Section 03108 - Formwork.

18

5. Section 03308 - Concrete, Materials and Proportioning.

19

6. Section 03311 - Concrete Mixing, Placing, Jointing and Curing.

20

7. Section 03601 – FRP Concrete Strengthening.

21

##### 1.2 QUALITY ASSURANCE

22

###### A. Referenced Standards:

23

1. American Concrete Institute (ACI):

24

a. 116R, Cement and Concrete Terminology.

25

b. 117, Specification for Tolerances for Concrete Construction and Materials.

26

c. 301, Specifications for Structural Concrete.

27

d. 303R, Guide to Cast-in-Place Architectural Concrete Practice.

28

e. 503.7, Specification for Crack Repair by Epoxy Injection.

29

2. ASTM International (ASTM):

30

a. C150, Standard Specification for Portland Cement.

31

b. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing

32

Concrete.

33

c. C881, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

34

d. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having

35

Special Properties for Curing and Sealing Concrete.

36

e. D4258, Standard Practice for Surface Cleaning Concrete for Coating.

37

f. D4259, Standard Practice for Abrading Concrete.

38

g. E1155, Standard Test Method for Determining  $F_F$  Floor Flatness and  $F_L$  Floor Levelness

39

Numbers.

40

3. International Concrete Repair Institute (ICRI).

41

4. National Science Foundation (NSF).

42

5. Sealant, Waterproofing and Restoration Institute (SWRI).

43

6. The Society for Protective Coatings/NACE International (SSPC/NACE):

44

a. SP 13/NACE No. 6, Surface Preparation of Concrete.

45

###### B. Qualifications:

46

1. Applicator of concrete sealers shall be factory trained and approved, in writing, by the

47

manufacturer to apply the product.

48

a. Applicator shall have a minimum of five (5) years experience successfully applying

49

materials specified.

50

2. Structural Concrete Repair Contractor:

51

a. Contractor shall have a minimum of two years active membership in good standing with

52

the International Concrete Repair Institute (ICRI).

- 1                   b. Contractor shall have a minimum of two years active membership in good standing with  
2                   the Sealant, Waterproofing and Restoration Institute (SWRI).  
3                   c. Contractor shall have a minimum of five (5) years current experience in the repair and  
4                   rehabilitation of concrete structures in facilities of similar size and environmental  
5                   exposures.
- 6           C. Mock-Ups:  
7           1. General:  
8           a. Mock-ups shall be independent of permanent construction.  
9           1) Mock-ups shall be readily accessible and identifiable during construction.  
10           b. Accepted mock-ups constitute minimum standard of quality for actual construction.  
11           1) Construct additional mock-ups as necessary until accepted by Engineer.  
12           c. Maintain mock-ups during construction.  
13           1) Remove when directed by Engineer.  
14           2. Construct mock-up for each type of wall finish specified for review and acceptance by  
15           Engineer.  
16           a. Mock-ups shall include:  
17           1) Minimum 4 x 4 FT area of each different wall finish specified.  
18           2) Sample of patched tie hole.

### 19   1.3   DEFINITIONS

- 20           A. Appurtenant Surfaces:  
21           1. Concrete columns, pipe supports, and equipment supports.  
22           2. Curbs, housekeeping pads and equipment pads,  
23           3. Overhead concrete slabs, landings, beams and girders.
- 24           B. Installer or Applicator:  
25           1. Installer or applicator is the person actually installing or applying the product in the field at the  
26           Project site.  
27           2. Installer and applicator are synonymous.
- 28           C. Structural Concrete Repair Contractor:  
29           1. Contractor or subcontractor meeting the minimum specified qualifications and is responsible  
30           for the structural repair or restoration of existing concrete surfaces in accordance with Article  
31           3.3 of this Specification.
- 32           D. Vertical Surface Defects:  
33           1. Any void in the face of the concrete deeper than 1/8 IN, such as:  
34           a. Tie holes.  
35           b. Air pockets (bug holes).  
36           c. Honeycombs.  
37           d. Rock holes.  
38           2. Scabbing:  
39           a. Scabbing is defect in which parts of the form face, including release agent, adhere to  
40           concrete.  
41           3. Foreign material embedded in or attached to the face of concrete  
42           4. Fins, ridges, lift joints or other protrusions.
- 43           E. Other words and terms used in this Specification Section are defined in ACI 116R.

### 44   1.4   SUBMITTALS

- 45           A. Shop Drawings:  
46           1. See Specification Section 01340 for requirements for the mechanics and administration of  
47           the submittal process.  
48           2. Product technical data including:  
49           a. Acknowledgement that products submitted meet requirements of standards referenced.  
50           b. Manufacturer's installation instructions.  
51           3. Certifications:  
52           a. Certification of aggregate gradation.  
53           b. Certification that the Structural Concrete Repair Contractor meets the specified  
54           qualifications and experience requirements.  
55           1) Include a list of projects completed in the past five (5) years that meet the specified  
56           experience.

- 1 B. Miscellaneous Submittals:  
2 1. See Specification Section 01340 for requirements for the mechanics and administration of  
3 the submittal process.

4 **1.5 DELIVERY, STORAGE, AND HANDLING**

- 5 A. Comply with manufacturer's recommendations and requirements for materials used.

6 **1.6 PROJECT CONDITIONS**

- 7 A. Environmental limitations:  
8 1. Comply with manufacturers written instructions for substrate temperature and moisture  
9 content, ambient temperature and humidity, ventilation, and other conditions affecting  
10 performance of concrete floor sealers and hardeners.

11 **PART 2 - PRODUCTS**

12 **2.1 ACCEPTABLE MANUFACTURERS**

- 13 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:  
14 1. Chemical floor sealers:  
15 a. Advanced Floor Products.  
16 b. Euclid Chemical Co.  
17 c. L&M Construction Chemicals, Inc.  
18 2. Bonding agents:  
19 a. Euclid Chemical Co.  
20 b. BASF Building Systems.  
21 c. L&M Construction Chemicals, Inc.  
22 3. Cementitious concrete coating:  
23 a. Aquafin International.  
24 b. BASF Building Systems.  
25 c. Euclid Chemical Co.  
26 4. Polymer resurfacing mortar:  
27 a. Euclid Chemical Co.  
28 b. BASF Building Systems.  
29 c. L&M Construction Chemicals, Inc.  
30 5. Polymer modified repair mortar:  
31 a. Euclid Chemical Co.  
32 b. BASF Building Systems.  
33 c. L&M Construction Chemicals, Inc.  
34 B. Submit request for substitution in accordance with Specification Section 01640.

35 **2.2 MATERIALS**

- 36 A. Chemical Floor Sealer (CS-1):  
37 1. Colorless low VOC water-based solution containing acrylic copolymers.  
38 a. ASTM C1315, Class B, minimum 30 percent solids.  
39 b. ASTM C309, Type 1.  
40 c. Non-yellowing UV resistant.  
41 2. L&M Construction Chemicals, Inc. Dress and Seal WB 30.  
42 B. Bonding Agent:  
43 1. For use only on concrete surfaces not receiving liquid water repellent coating:  
44 a. High solids acrylic latex base liquid for interior or exterior application as a bonding agent  
45 to improve adhesion and mechanical properties of concrete patching mortars.  
46 b. Euclid Chemical Co. "Flex-Con."  
47 c. BASF Admixtures, Inc. "Acryl-Set."  
48 d. L&M Construction Chemicals, Inc. "Everbond."  
49 e. Thoro System Products "Acryl 60."  
50 2. For use only on concrete surface receiving liquid water repellent:  
51 a. Non-acrylic base liquid for interior or exterior application as a bonding agent to improve  
52 adhesion and mechanical properties of concrete patching mortars.

- 1 C. Cement: ASTM C150, Type I or III Portland.
- 2 D. Aggregate:
- 3 1. Sand: Maximum size #30 mesh sieve.
- 4 2. For exposed aggregate finish surfaces: Same as surrounding wall.
- 5 E. Water: Potable.
- 6 F. Cementitious Concrete Coating:
- 7 1. Polymer modified Portland cement based coating for concrete and masonry.
- 8 a. Waterproof.
- 9 b. Resistant to both positive and negative hydrostatic pressure.
- 10 c. Breathable.
- 11 2. BASF "Masterseal 581 Thoroseal".
- 12 a. Color:
- 13 1) Interior surfaces: Standard gray.
- 14 b. Texture: Fine.
- 15 G. Non-shrink Grout: See Specification Section 03308 and Specification Section 03311.
- 16 H. Polymer Resurfacing Mortar:
- 17 1. Single component, polymer reinforced, high-strength, cement-based patching and
- 18 resurfacing mortar.
- 19 2. Minimum compressive strength in accordance with ASTM C109:
- 20 a. 3000 psi at 7 days.
- 21 b. 5000 psi at 28 days.
- 22 3. L&M "Duracrete" or approved equal.
- 23 I. Polymer Modified Repair Mortar:
- 24 1. Single component, polymer reinforced, high-strength, cement-based patching and repair
- 25 mortar with integral corrosion inhibitor.
- 26 2. Compatible with vertical and/or overhead applications as required.
- 27 3. Minimum compressive strength in accordance with ASTM C109:
- 28 a. 5000 PSI at 7 days.
- 29 J. Crack Injection Adhesive
- 30 1. Where injection adhesive may be in contact with process water the product must meet the
- 31 requirements of NSF for contact with drinking water.
- 32 2. Epoxy shall be in accordance with ASTM C881.
- 33 3. Polyurethane shall be a hydrophobic polyurethane grout.
- 34 a. SikaFix HH Hydrophilic Polyurethane or approved equal.

### 35 2.3 MIXES

- 36 A. Bonding Grout:
- 37 1. One (1) part cement to one (1) part aggregate.
- 38 2. Bonding agent and water in accordance with manufacturer's directions and the
- 39 PREPARATION Article in Part 3.
- 40 B. Patching Mortar:
- 41 1. One (1) part Portland cement to two and one-half (2-1/2) parts aggregate by damp loose
- 42 volume.
- 43 a. Blend white Portland cement and gray Portland cement as necessary to produce color
- 44 matching surrounding concrete.
- 45 2. Bonding agent and water in accordance with manufacturer's directions and the
- 46 PREPARATION Article in Part 3.
- 47 C. Finishing Grout:
- 48 1. One (1) part Portland cement to one and one-half (1-1/2) parts fine sand.
- 49 a. Blend white Portland cement and gray Portland cement as necessary to produce color
- 50 matching surrounding concrete.
- 51 2. Water:
- 52 a. Provide sufficient water to produce grout mixture with the consistency of thick paint.

1 **PART 3 - EXECUTION**

2 **3.1 PREPARATION**

- 3 A. For methods of curing, see Specification Section 03311.
- 4 B. Preparation of Bonding Grout Mixture:
- 5 1. Mix cement and aggregate.
- 6 2. Mix bonding agent and water together in separate container in accordance with
- 7 manufacturer's instructions.
- 8 3. Add bonding agent/water mixture to cement/aggregate mixture.
- 9 4. Mix to consistency of thick cream.
- 10 5. Bonding agent itself may be used as bonding grout if approved by manufacturer and
- 11 Engineer.
- 12 C. Preparation of Patching Mortar Mixture:
- 13 1. Mix cement and aggregate.
- 14 2. Mix bonding agent and water together in separate container in accordance with
- 15 manufacturer's instructions.
- 16 3. Add only enough bonding agent/water mixture to cement/aggregate mixture to allow handling
- 17 and placing.
- 18 4. Let stand with frequent manipulation with a trowel, until mix has reached stiffest consistency
- 19 to allow placement.
- 20 D. Surface Preparation:
- 21 1. Clean surfaces in accordance with ASTM D4258 to remove dust, dirt, form oil, grease, or
- 22 other contaminants prior to abrasive blasting, chipping, grinding or wire brushing.
- 23 2. Grind fins or protrusions in accordance with ASTM D4259.
- 24 3. Abrasive blast surfaces in accordance with ASTM D4259 and SSPC SP 13/NACE No. 6.
- 25 a. Remove laitance, blemishes, efflorescence or other surface defects as defined in the
- 26 Definitions article of this Specification Section.
- 27 b. Completely open defects down to sound concrete.
- 28 c. If additional chipping or wire brushing is necessary, make edges perpendicular to
- 29 surface or slightly undercut.
- 30 d. No featheredges will be permitted.
- 31 4. Rinse surface with clean water and allow surface water to evaporate prior to repairing
- 32 surface defects.

33 **3.2 REPAIR OF SURFACE DEFECTS FOR NEW CONSTRUCTION**

- 34 A. Fill tie holes and repair surface defects in accordance with ACI 301 and as specified herein.
- 35 B. Fill tie-holes flush with finished wall surface, using material indicated:
- 36 1. Below grade or otherwise not exposed to view: Non-shrink grout.
- 37 2. Exposed to view walls:
- 38 a. Walls indicated to receive Concrete Finish No. 2 or higher: Patching mortar mix.
- 39 C. Repair surface defects using patching mortar mix specified in the MIXES Article in PART 2 of this
- 40 Specification Section.
- 41 1. Do not use non-shrink grout to repair surface defects.
- 42 2. If required by bonding agent manufacturer, etch surfaces with a muriatic acid solution
- 43 followed by a thorough rinse with clean water.
- 44 a. Test concrete to determine pH level and continue flushing with clean water until surface
- 45 pH is within acceptable limits.
- 46 3. Dampen area to be patched and an area at least 6 IN wide surrounding it prior to application
- 47 of bonding grout.
- 48 4. Brush bonding grout into the surface after the surface water has evaporated.
- 49 5. Allow bonding grout to set for period of time required by bonding agent manufacturer before
- 50 applying premixed patching mortar.
- 51 6. Fill defects with patching mortar.
- 52 a. Match color of surrounding wall.
- 53 D. Consolidate grout or mortar into place and strike off so as to leave patch slightly higher than
- 54 surrounding surface.
- 55 1. Leave undisturbed for at least 60 minutes before finishing level with surrounding surface.

1                   2. Do not use metal tools in finishing a patch in a formed wall which will be exposed or coated  
2                   with other materials.

3                   E. Keep areas damp in accordance with grout manufacturer or bonding agent manufacturer's  
4                   directions.

5                   **3.3 REPAIR OF SURFACE AND SUBSURFACE DEFECTS FOR EXISTING CONSTRUCTION**

6                   A. Remove embedment's, protrusions and patch existing concrete surfaces as shown in Section  
7                   02072.

8                   B. Structural repair of existing concrete as shown in the Drawings and Specification Section 03601.

9                   C. Crack injection as shown in the Drawings and Article 3.4 of this Specification.

10                  **3.4 CRACK INJECTION**

11                 A. Crack injection shall conform to all requirements of ACI 503.7-07 except as modified below:

12                   1. Inject cracks with epoxy or polyurethane adhesives where shown in the Drawings.

13                   2. Prepare the crack by use of compressed air or water to remove dirt, dust, oils, etc. that will  
14                   prevent bonding of adhesive.

15                   3. Core testing as defined in ACI 503.7 is not required.

16                   4. Remove surface seals and ports when complete. Repair the surface in accordance with this  
17                   Specification.

18                  **3.5 INSTALLATION AND APPLICATION**

19                 A. Do not repair surface defects or apply wall or floor finishes when temperature is or is expected to  
20                   be below 50 DegF.

21                   1. If necessary, enclose and heat area to between 50 and 70 DegF during repair of surface  
22                   defects and curing of patching material.

23                   a. Use only clean fuel, indirect fired heating apparatus.

24                 B. Chemical Floor Sealer Application:

25                   1. General:

26                   a. Thoroughly clean floor prior to application.

27                   1) Ensure that any membrane-forming curing agent is completely removed.

28                   b. Apply to floor areas indicated on the Drawings in accordance with manufacturer's  
29                   recommendations.

30                   c. Do not apply sealer to floors scheduled to receive epoxy floor finish.

31                   2. Chemical Floor Sealer (CS-1):

32                   a. Dampen concrete and broom off all standing water.

33                   b. Apply two (2) uniform coats.

34                   1) Allow minimum 3-hours between coats.

35                 C. Polymer Resurfacing Mortar:

36                   1. Prepare the surface in accordance with Article 3.1.D and the manufacturer  
37                   recommendations.

38                   2. Install, cure and protect in accordance with the manufacturer instructions.

39                 D. Concrete Finishes for Vertical, Overhead and Appurtenant Surfaces:

40                   1. General:

41                   a. Give concrete surfaces finish as specified below after removal of formwork and repair of  
42                   surface defects.

43                   2. Finish #1 - As cast rough form finish:

44                   a. Selected forming materials are not required.

45                   b. Prepare surface in accordance with the PREPARATION Article in PART 3 of this  
46                   Specification Section and repair the following surface defects:

47                   1) Tie holes.

48                   2) Honeycombs deeper than 1/4 IN.

49                   3) Air pockets deeper than 1/4 IN.

50                   4) Rock holes deeper than 1/4 IN.

51                   c. Remove fins exceeding 1/4 IN in height.

52                   d. Use at unexposed surfaces such as foundations and backfilled surfaces of walls not to  
53                   be waterproofed.

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3. Finish #2 - As cast form finish:
    - a. Form facing material shall produce a smooth, hard, uniform texture.
      - 1) Use forms specified for surfaces exposed to view in accordance with Specification Section 03108.
    - b. Prepare surface in accordance with the PREPARATION Article in PART 3 of this Specification Section.
    - c. Repair surface defects in accordance with the REPAIR OF SURFACE DEFECTS Article in PART 3 of this Specification Section.
      - 1) Repair the following surface defects:
        - a) Tie holes.
        - b) Honeycombs deeper than 1/4 IN or larger than 1/4 IN DIA.
        - c) Air pockets deeper than 1/4 IN or larger than 1/4 IN DIA.
        - d) Rock holes deeper than 1/4 IN or larger than 1/4 IN DIA.
        - e) Scabbing.
    - d. Remove fins exceeding 1/8 IN in height.
    - e. Provide this finish for:
      - 1) Inside walls of pipe trenches, troughs and similar structures.
      - 2) Inside walls of fully enclosed basins or tanks.
      - 3) Inside walls of open-top basins, tanks, below the low-water level.
      - 4) Walls indicated to receive waterproofing.
      - 5) Underside of overhead slabs, beams or landings.
      - 6) Exposed surfaces not specified to receive another finish.
  4. Finish #3 - Grout rubbed finish:
    - a. Form facing material shall produce a smooth, hard, uniform texture.
      - 1) Use forms specified for surfaces exposed to view in accordance with Specification Section 03108.
      - 2) Comply with ACI 303R for formwork accuracy and form joint handling to prevent grout leakage.
    - b. Prepare surface in accordance with the PREPARATION Article in PART 3 of this Specification Section.
    - c. Repair surface defects in accordance with the REPAIR OF SURFACE DEFECTS Article in PART 3 of this Specification Section.
    - d. Begin finishing operations one (1) day after form removal.
    - e. Complete all finishing operations for a given area on the same day.
    - f. Wet surface and rub with carborundum brick to remove surface irregularities and provide a consistent texture.
    - g. Grout application:
      - 1) Wet surface to prevent absorption of water from grout.
      - 2) Apply grout uniformly over entire surface.
        - a) Completely fill bugholes, voids or other blemishes.
    - h. Immediately following application of grout, float the surface with a cork float, scouring the wall vigorously.
    - i. Finish wall with sponge rubber float.
      - 1) Remove all excess grout.
      - 2) Do not remove grout from holes or depressions.
    - j. Allow wall to dry thoroughly and then rub vigorously with burlap to completely remove any dried grout film.
    - k. Provide this finish for:
      - 1) Inside walls of open-top basins, tanks, above the low-water level.
      - 2) Interior walls, columns and appurtenant surfaces where indicated on Room Finish Schedule on the Drawings.
    - l. Construct mock-up per the Mock-Ups paragraph in the QUALITY ASSURANCE Article in PART 1 of this Specification Section.
  5. Finish #4 - Cementitious concrete coating:
    - a. Form facing material shall produce a smooth, hard, uniform texture.
      - 1) Use forms specified for surfaces exposed to view in accordance with Specification Section 03108.
      - 2) Comply with ACI 303R for formwork accuracy and form joint handling to prevent grout leakage.
    - b. Prepare surface in accordance with the PREPARATION Article in PART 3 of this Specification Section.

- 1 c. Repair surface defects in accordance with the REPAIR OF SURFACE DEFECTS Article  
2 in PART 3 of this Specification Section.  
3 d. Brush on decorative coating to entire surface.  
4 1) As a mixing liquid for the decorative coating, use bonding agent and water mixture  
5 as recommended by coating manufacturer.  
6 2) Apply two (2) coats at 2 LBS per square yard per coat.  
7 e. When second coat is set, float to a uniform texture with a sponge float.  
8 f. Provide this finish on all exposed to view:  
9 1) Interior walls, columns and similar vertical surfaces where indicated on Room Finish  
10 Schedule on the Drawings.  
11 g. Construct mock-up per the Mock-Ups paragraph in the QUALITY ASSURANCE Article  
12 in PART 1 of this Specification Section.
- 13 E. Related Unformed Surfaces (Except Slabs):  
14 1. Strike smooth and level tops of walls or buttresses, horizontal offsets, and similar unformed  
15 surfaces occurring adjacent to formed surfaces after concrete is placed.  
16 2. Float surface to a texture consistent with that of formed surfaces.  
17 a. If more than one (1) finish occurs immediately adjacent to unformed surface, provide  
18 surface with most stringent formed surface requirement.  
19 3. Continue treatment uniformly across unformed surfaces.
- 20 F. Concrete Finishes for Horizontal Slab Surfaces:  
21 1. General:  
22 a. Tamp concrete to force coarse aggregate down from surface.  
23 b. Screed with straightedge, eliminate high and low places, bring surface to required finish  
24 elevations; slope uniformly to drains.  
25 c. Dusting of surface with dry cement or sand during finishing processes not permitted.  
26 2. Unspecified slab finish:  
27 a. When type of finish is not indicated, use following finishes as applicable:  
28 1) Surfaces intended to receive bonded applied cementitious applications: Scratched  
29 finish.  
30 2) Surfaces intended to receive roofing: Floated finish.  
31 3) Floors: Troweled finish.  
32 4) Ramps: Broom or belt finish.  
33 5) Platforms, steps and landings not scheduled to receive another finish: Broom or  
34 belt finish.  
35 6) Exterior slabs, stoops, and approach slabs: Broom or belt finish.  
36 7) Sidewalks and site paving: See Division 2.  
37 8) All slabs to receive a floated finish before final finishing.  
38 3. Scratched slab finish: After concrete has been placed, consolidated, struck off, and leveled  
39 to a Class B tolerance, roughen surface with stiff brushes or rakes before final set.  
40 4. Floated finish:  
41 a. After concrete has been placed, consolidated, struck off, and leveled, do no further work  
42 until ready for floating.  
43 b. Begin floating when water sheen has disappeared and surface has stiffened sufficiently  
44 to permit operations.  
45 1) Use wood or cork float.  
46 c. During or after first floating, check planeness of entire surface with a 10 FT straightedge  
47 applied at not less than two (2) different angles.  
48 d. Cut down all high spots and fill all low spots to produce a surface with Class B tolerance  
49 throughout.  
50 e. Refloat slab immediately to a uniform texture.  
51 5. Troweled finish:  
52 a. Float finish surface to true, even plane.  
53 b. Power trowel, and finally hand trowel.  
54 c. First troweling after power troweling shall produce a smooth surface which is relatively  
55 free of defects, but which may still show some trowel marks.  
56 d. Perform additional troweling by hand after surface has hardened sufficiently.  
57 e. Final trowel when a ringing sound is produced as trowel is moved over surface.  
58 f. Thoroughly consolidate surface by hand troweling.  
59 g. Leave finished surface essentially free of trowel marks, uniform in texture and  
60 appearance and plane to a Class A tolerance.



- 1 h. On surfaces intended to support floor coverings, remove any defects that would show
- 2 through floor covering by grinding.
- 3 6. Broom or belt finish: Immediately after concrete has received a float finish as specified, give
- 4 it a transverse scored texture by drawing a broom or burlap belt across surface.
- 5 7. Underside of concrete slab finish:
- 6 a. Match finish as specified for adjacent vertical surfaces.
- 7 b. If more than one (1) finish occurs immediately adjacent to underside of slab surface,
- 8 provide surface with most stringent formed surface requirement.

9 **3.6 FIELD QUALITY CONTROL**

- 10 A. Horizontal Slab Tolerances:
- 11 1. Tolerances are to be enforced on new floor slab construction and are not applicable to floor
- 12 toppings being applied to existing construction.
- 13 2. Provide Floor Flatness ( $F_F$ ) and Floor Levelness ( $F_L$ ) in accordance with ACI 117.
- 14 a. Measure in accordance with ASTM E1155.
- 15 3. Slabs not indicated to be sloped:
- 16 a.  $F_F$ : Equal or greater than 35.
- 17 b.  $F_L$ : Equal or greater than 25.
- 18 4. Slabs indicated to receive polished concrete floor:
- 19 a.  $F_F$ : Equal or greater than 45.
- 20 b.  $F_L$ : Equal or greater than 35.
- 21 c. Refer to Room Finish Schedule on Drawings.
- 22 5. Slabs indicated to be sloped or curved:
- 23 a. Measure in accordance with ASTM E1486.
- 24 b. Provide slopes or curves as indicated on the Drawings.
- 25 B. Unacceptable finishes shall be replaced.
- 26 1. Where not exposed to view and when approved in writing by Engineer, defects may be
- 27 corrected provided strength is not adversely affected.
- 28 a. High spots to be removed by grinding and/or low spots filled with a patching compound
- 29 or other remedial measures to match adjacent surfaces.

30 **3.7 PROTECTION**

- 31 A. All horizontal slab surfaces receiving chemical floor sealer shall be kept free of traffic and loads
- 32 for minimum of 72 HRS following installation of sealer.

33 **END OF SECTION**

34



**SECTION 03350**  
**CONCRETE TESTING**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
  - 7 1. Contractor requirements for testing of concrete and grout.
  - 8 2. Definition of Owner provided testing.
  - 9 3. Acceptance criteria for concrete.
- 10 B. Related Specification Sections include but are not necessarily limited to:
  - 11 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
  - 12 2. Division 01 - General Requirements.
  - 13 3. Section 03208 - Reinforcement.
  - 14 4. Section 03308 - Concrete, Materials and Proportioning.

15 **1.2 RESPONSIBILITY AND PAYMENT**

- 16 A. Owner will hire an independent Testing Agency/Service Provider to perform the following testing and inspection and provide test results to the Engineer and Contractor.
  - 17 1. Testing and inspection of concrete and grout produced for incorporation into the work during
  - 18 the construction of the Project for compliance with the Contract Documents.
  - 19 2. Additional testing or retesting of materials occasioned by their failure, by test or inspection, to
  - 20 meet requirements of the Contract Documents.
  - 21 3. Strength testing on concrete required by the Engineer or Special Inspector when the water-
  - 22 cement ratio exceeds the water-cement ratio of the typical test cylinders.
  - 23 4. In-place testing of concrete as may be required by Engineer when strength of structure is
  - 24 considered potentially deficient.
  - 25 5. Other testing services needed or required by Contractor such as field curing of test
  - 26 specimens and testing of additional specimens for determining when forms, form shoring or
  - 27 reshoring may be removed.
  - 28 6. Owner will pay for services defined in Paragraph 1.2A.1.
  - 29 7. See Section 01452 for the Special Inspection and Testing Program requirements.
  - 30
- 31 B. Contractor shall hire a qualified testing agency to perform the following testing and provide test results to the Engineer.
  - 32 1. Testing of materials and mixes proposed by the Contractor for compliance with the Contract
  - 33 Documents and retesting in the event of changes.
  - 34 2. Additional testing and inspection required because of changes in materials or proportions
  - 35 requested by Contractor.
  - 36 3. Contractor shall pay for services defined in Paragraphs 1.2B.1. and 1.2B.2.
  - 37 4. Contractor shall reimburse Owner for testing services defined in Paragraphs 1.2A.2., 1.2A.3.,
  - 38 1.2A.4. and 1.2A.5.
  - 39 5. See Section 01452 for the Special Inspection and Testing Program requirements.
  - 40
- 41 C. Duties and Authorities of Testing Agency/Service Provider:
  - 42 1. Any Testing Agency/Service Provider or agencies and their representatives retained by
  - 43 Contractor or Owner for any reason are not authorized to revoke, alter, relax, enlarge, or
  - 44 release any requirement of Contract Documents, nor to reject, approve or accept any portion
  - 45 of the Work.
  - 46 2. Testing Agency/Service Provider shall inform the Contractor and Engineer regarding
  - 47 acceptability of or deficiencies in the work including materials furnished and work performed
  - 48 by Contractor that fails to fulfill requirements of the Contract Documents.
  - 49 3. Testing Agency to submit test reports and inspection reports to Engineer and Contractor
  - 50 immediately after they are performed.
    - 51 a. All test reports to include exact location in the work at which batch represented by a test
    - 52 was deposited.
    - 53 b. Reports of strength tests to include detailed information on storage and curing of
    - 54 specimens prior to testing.

- 1           4. Owner retains the responsibility for ultimate rejection or approval of any portion of the Work.

2   **1.3 QUALITY ASSURANCE**

3    A. Referenced Standards:

- 4      1. American Association of State Highway and Transportation Officials (AASHTO):  
5         a. T260, Standard Method of Test for Sampling and Testing for Chloride Ion in Concrete  
6             and Concrete Raw Materials.  
7      2. American Concrete Institute (ACI):  
8         a. 318, Building Code Requirements for Structural Concrete.  
9      3. ASTM International (ASTM):  
10        a. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.  
11        b. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete  
12            Specimens.  
13        c. C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams  
14            of Concrete.  
15        d. C138, Standard Test Method for Density (Unit Weight), Yield, and Air Content  
16            (Gravimetric) of Concrete.  
17        e. C143, Standard Test Method for Slump of Hydraulic-Cement Concrete.  
18        f. C172, Standard Practice for Sampling Freshly Mixed Concrete.  
19        g. C173, Standard Test Method for Air Content of Freshly Mixed Concrete by the  
20            Volumetric Method.  
21        h. C231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure  
22            Method.  
23        i. E329, Standard Specification for Agencies Engaged in Construction Inspection, Testing,  
24            or Special Inspection.  
25      4. National Bureau of Standards (NBS):  
26         a. Cement and Concrete Reference Laboratory (CCRL).

27    B. Qualifications:

- 28      1. Contractor's Testing Agency:  
29         a. Meeting requirements of ASTM E329.  
30         b. Provide evidence of recent inspection by CCRL of NBS, and correction of deficiencies  
31            noted.

32    C. Use of Testing Agency and approval by Engineer of proposed concrete mix design shall in no  
33    way relieve Contractor of responsibility to furnish materials and construction in full compliance  
34    with Contract Documents.

35   **1.4 DEFINITIONS**

- 36    A. Testing Agency/Service Provider: An independent professional testing/inspection firm or service  
37    hired by Contractor or by Owner to perform testing, inspection or analysis services as directed,  
38    and as provided in the Contract Documents.

39   **1.5 SUBMITTALS**

40    A. Shop Drawings:

- 41      1. See Specification Section 01340 for requirements for the mechanics and administration of  
42         the submittal process.  
43      2. Product technical data including:  
44         a. Concrete materials and concrete mix designs proposed for use.  
45            1) Include results of all testing performed to qualify materials and to establish mix  
46            designs.  
47            2) Place no concrete until approval of mix designs has been received in writing.  
48            3) Submittal for each concrete mix design to include:  
49                a) Sieve analysis and source of fine and coarse aggregates.  
50                b) Test for aggregate organic impurities.  
51                c) Proportioning of all materials.  
52                d) Type of cement with mill certificate for the cement.  
53                e) Brand, quantity and class of fly ash proposed for use along with other submittal  
54                data as required for fly ash by Specification Section 03308.  
55                f) Slump.  
56                g) Brand, type and quantity of air entrainment and any other proposed admixtures.

- 1 h) Total chloride ion content per cubic yard of concrete determined in accordance
- 2 with AASHTO T260.
- 3 i) 28-day compression test results and any other data required by Specification
- 4 Section 03308 to establish concrete mix design.
- 5 3. Certifications: Testing Agency qualifications.

## 6 PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)

## 7 PART 3 - EXECUTION

### 8 3.1 TESTING SERVICES TO BE PERFORMED BY OWNER

9 A. The following concrete testing will be performed by the Owner's Service Provider:

- 10 1. Concrete strength testing:
  - 11 a. Secure concrete samples in accordance with ASTM C172.
  - 12 1) Obtain each sample from a different batch of concrete on a random basis, avoiding
  - 13 selection of test batch other than by a number selected at random before
  - 14 commencement of concrete placement.
  - 15 b. For each strength test, mold and cure cylinders from each sample in accordance with
  - 16 ASTM C31.
  - 17 1) Record any deviations from requirements on test report.
  - 18 2) Cylinder size: Per ASTM C31.
  - 19 3) Quantity:
    - 20 a) 6 IN DIA by 12 IN high: Four (4) cylinders.
    - 21 b) 4 IN DIA by 8 IN high: Six (6) cylinders.
  - 22 c. Field cure one (1) cylinder for the seven (7) day test.
  - 23 1) Laboratory cure the remaining.
  - 24 d. Test cylinders in accordance with ASTM C39.
  - 25 1) 6 IN DIA cylinders:
    - 26 a) Test two (2) cylinders at 28 days for strength test result and one (1) at seven
    - 27 (7) days for information.
    - 28 b) Hold remaining cylinder in reserve.
  - 29 2) 4 IN DIA cylinders:
    - 30 a) Test three (3) cylinders at 28 days for strength test result and one (1) at seven
    - 31 (7) days for information.
    - 32 b) Hold remaining cylinders in reserve.
  - 33 e. Strength test result:
    - 34 1) Average of strengths of two (2) 6 IN DIA cylinders or three (3) 4 IN DIA cylinders
    - 35 from the same sample tested at 28 days.
    - 36 2) If one (1) cylinder in a test manifests evidence of improper sampling, molding,
    - 37 handling, curing, or testing, discard and test reserve cylinder; average strength of
    - 38 remaining cylinders shall be considered strength test result.
    - 39 3) Should all cylinders in a test show any of above defects, discard entire test.
  - 40 f. Frequency of tests:
    - 41 1) Concrete sand cement grout: One (1) strength test for each 4 HR period of grout
    - 42 placement or fraction thereof.
    - 43 2) Precast concrete, concrete topping, concrete fill and lean concrete: One (1)
    - 44 strength test for each 10 CY of each type of concrete or fraction thereof placed.
    - 45 3) All other concrete:
      - 46 a) One (1) strength test to be taken not less than once a day, nor less than once
      - 47 for each 60 CY or fraction thereof placed in any one (1) day.
      - 48 b) If total volume of concrete on Project is such that frequency of testing required
      - 49 in above paragraph will provide less than five (5) strength tests for each
      - 50 concrete mix, tests shall then be made from at least five (5) randomly selected
      - 51 batches or from each batch if fewer than five (5) batches are provided.
- 52 2. Slump testing:
  - 53 a. Determine slump of concrete sample for each strength test.
  - 54 1) Determine slump in accordance with ASTM C143.
  - 55 b. If consistency of concrete appears to vary, the Engineer shall be authorized to require a
  - 56 slump test for each concrete truck.
  - 57 1) This practice shall continue until the Engineer deems it no longer necessary.

- 1 3. Air content testing: Determine air content of concrete sample for each strength test in
- 2 accordance with either ASTM C231, ASTM C173, or ASTM C138.
- 3 4. Temperature testing: Determine temperature of concrete sample for each strength test.
- 4 5. In-place concrete testing (if required).

### 5 3.2 SAMPLING ASSISTANCE AND NOTIFICATION FOR OWNER

- 6 A. To facilitate testing and inspection, perform the following:
  - 7 1. Furnish any necessary labor to assist Testing Agency in obtaining and handling samples at
  - 8 site.
  - 9 2. Provide and maintain for sole use of Testing Agency adequate facilities for safe storage and
  - 10 proper curing of test specimens on site for first 24 HRS as required by ASTM C31.
  - 11 3. Take samples at point of placement.
- 12 B. Notify Owner and Owner's Testing Agency sufficiently in advance of operations (minimum of 24
- 13 HRS) to allow completion of quality tests for assignment of personnel and for scheduled
- 14 completion of quality tests.

### 15 3.3 ACCEPTANCE

- 16 A. Completed concrete work which meets applicable requirements will be accepted without
- 17 qualification.
- 18 B. Completed concrete work which fails to meet one or more requirements but which has been
- 19 repaired to bring it into compliance will be accepted without qualification.
- 20 C. Completed concrete work which fails to meet one or more requirements and which cannot be
- 21 brought into compliance may be accepted or rejected as provided in these Contract Documents.
  - 22 1. In this event, modifications may be required to assure that concrete work complies with
  - 23 requirements.
  - 24 2. Modifications, as directed by Engineer, to be made at no additional cost to Owner.
- 25 D. Dimensional Tolerances:
  - 26 1. Formed surfaces resulting in concrete outlines smaller than permitted by tolerances shall be
  - 27 considered potentially deficient in strength and subject to modifications required by Engineer.
  - 28 2. Formed surfaces resulting in concrete outlines larger than permitted by tolerances may be
  - 29 rejected and excess material subject to removal.
    - 30 a. If removal of excess material is permitted, accomplish in such a manner as to maintain
    - 31 strength of section and to meet all other applicable requirements of function and
    - 32 appearance.
  - 33 3. Concrete members cast in wrong location may be rejected if strength, appearance or
  - 34 function of structure is adversely affected or misplaced items interfere with other
  - 35 construction.
  - 36 4. Inaccurately formed concrete surfaces exceeding limits of tolerances and which are exposed
  - 37 to view, may be rejected.
    - 38 a. Repair or remove and replace if required.
  - 39 5. Finished slabs exceeding tolerances may be required to be repaired provided that strength or
  - 40 appearance is not adversely affected.
    - 41 a. High spots may be removed with a grinder, low spots filled with a patching compound, or
    - 42 other remedial measures performed as permitted or required.
- 43 E. Appearance:
  - 44 1. Concrete surfaces exposed to view with defects which, in opinion of Engineer, adversely
  - 45 affect appearance as required by specified finish shall be repaired by approved methods.
  - 46 2. Concrete not exposed to view is not subject to rejection for defective appearance unless, in
  - 47 the opinion of the Engineer, the defects impair the strength or function of the member.
- 48 F. High Water-Cement Ratio:
  - 49 1. Concrete with water in excess of the specified maximum water-cement ratio will be
  - 50 considered potentially deficient in durability.
  - 51 2. Remove and replace concrete with high water-cement ratio or make other corrections as
  - 52 directed by Engineer.

1 G. Strength of Structure:

- 2 1. Strength of structure in place will be considered potentially deficient if it fails to comply with  
3 any requirements which control strength of structure, including but not necessarily limited to  
4 following:
- 5 a. Low concrete strength:
- 6 1) Test results for standard molded and cured test cylinders to be evaluated separately  
7 for each mix design.
- 8 a) Such evaluation shall be valid only if tests have been conducted in accordance  
9 with specified quality standards.
- 10 b) For evaluation of potential strength and uniformity, each mix design shall be  
11 represented by at least three (3) strength tests.
- 12 c) A strength test shall be the average of two (2) 6 IN diameter cylinders or three  
13 (3) 4 IN diameter cylinders from the same sample tested at 28 days.
- 14 2) Acceptance:
- 15 a) Strength level of each specified compressive strength shall be considered  
16 satisfactory if both of the following requirements are met:
- 17 (1) Average of all sets of three (3) consecutive strength tests equal or exceed  
18 the required specified 28 day compressive strength.
- 19 (2) No individual strength test falls below the required specified 28 day  
20 compressive strength by more than 500 psi.
- 21 b. Reinforcing steel size, configuration, quantity, strength, position, or arrangement at  
22 variance with requirements in Specification Section 03208 or requirements of the  
23 Contract Drawings or approved Shop Drawings.
- 24 c. Concrete which differs from required dimensions or location in such a manner as to  
25 reduce strength.
- 26 d. Curing time and procedure not meeting requirements of this Specification Section.
- 27 e. Inadequate protection of concrete from extremes of temperature during early stages of  
28 hardening and strength development.
- 29 f. Mechanical injury, construction fires, accidents or premature removal of formwork likely  
30 to result in deficient strength.
- 31 g. Concrete defects such as voids, honeycomb, cold joints, spalling, cracking, etc., likely to  
32 result in deficient strength or durability.
- 33 2. Structural analysis and/or additional testing may be required when strength of structure is  
34 considered potentially deficient.
- 35 3. In-place testing of concrete may be required when strength of concrete in place is considered  
36 potentially deficient.
- 37 a. Testing by impact hammer, sonoscope, or other nondestructive device may be permitted  
38 by Engineer to determine relative strengths at various locations in the structure or for  
39 selecting areas to be cored.
- 40 1) Such tests shall not be used as a basis for acceptance or rejection.
- 41 b. Core tests:
- 42 1) Where required, test cores will be obtained in accordance with ASTM C42.
- 43 a) If concrete in structure will be dry under service conditions, air dry cores  
44 (temperature 60 to 80 DegF, relative humidity less than 60 percent) for seven  
45 (7) days before test then test dry.
- 46 b) If concrete in structure will be wet or subjected to high moisture atmosphere  
47 under service conditions, test cores after immersion in water for at least 40  
48 HRS and test wet.
- 49 c) Testing wet or dry to be determined by Engineer.
- 50 2) Three (3) representative cores may be taken from each member or area of concrete  
51 in place that is considered potentially deficient.
- 52 a) Location of cores shall be determined by Engineer so as least to impair  
53 strength of structure.
- 54 b) If, before testing, one (1) or more of cores shows evidence of having been  
55 damaged subsequent to or during removal from structure, damaged core shall  
56 be replaced.
- 57 3) Concrete in area represented by a core test will be considered adequate if average  
58 strength of three (3) cores is equal to at least 85 percent of specified strength and  
59 no single core is less than 75 percent of specified strength.
- 60 4) Fill core holes with nonshrink grout and finish to match surrounding surface when  
61 exposed in a finished area.

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4. If core tests are inconclusive or impractical to obtain or if structural analysis does not confirm safety of structure, load tests may be required and their results evaluated in accordance with ACI 318, Chapter 20.
  5. Correct or replace concrete work judged inadequate by structural analysis or by results of core tests or load tests with additional construction, as directed by Engineer, at Contractor's expense.
  6. Contractor to pay all costs incurred in providing additional testing and/or structural analysis required.

9

**END OF SECTION**



1 2014/09/10

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## SECTION 03431

3

### PRECAST AND PRESTRESSED CONCRETE

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

A. Section Includes: Precast and prestressed concrete.

7

B. Related Specification Sections include but are not necessarily limited to:

8

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

9

2. Division 01 - General Requirements.

10

3. Section 03208 - Reinforcement.

11

4. Section 03308 - Concrete, Materials and Proportioning.

12

5. Section 03350 - Testing.

13

6. Section 09960 - High Performance Industrial Coatings (HPIC).

14

##### 1.2 QUALITY ASSURANCE

15

A. Referenced Standards:

16

1. American Association of State Highway and Transportation Officials (AASHTO):

17

a. HB, Standard Specifications for Highway Bridges.

18

2. American Concrete Institute (ACI):

19

a. 211.2, Standard Practice for Selecting Proportions for Structural Lightweight Concrete.

20

b. 318, Building Code Requirements for Structural Concrete.

21

3. ASTM International (ASTM):

22

a. A36, Standard Specification for Carbon Structural Steel.

23

b. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.

24

c. A416, Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.

25

d. A496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.

26

e. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

27

f. C33, Standard Specification for Concrete Aggregates.

28

g. C150, Standard Specification for Portland Cement.

29

h. C330, Standard Specification for Lightweight Aggregates for Structural Concrete.

30

i. D2240, Standard Test Method for Rubber Property-Durometer Hardness.

31

j. E329, Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.

32

4. American Welding Society (AWS):

33

a. A5.1/A5.1M, Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.

34

b. A5.5/A5.5M, Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding.

35

c. D1.1, Structural Welding Code - Steel.

36

d. D1.4, Structural Welding Code - Reinforcing Steel.

37

5. Occupational Safety and Health Administration (OSHA).

38

6. Precast/Prestressed Concrete Institute (PCI):

39

a. MNL 116, Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.

40

b. MNL 120, Design Handbook - Precast and Prestressed Concrete.

41

7. State of Nebraska Department of Roads (NDOR):

42

a. Standard Specification for Highway Construction.

43

8. Building Code:

44

a. International Code Council (ICC):

45

1) International Building Code and associated standards, 2006 Edition including all amendments, referred to herein as Building Code.

46

B. Qualifications:

47

1. Provide precast and prestressed concrete units produced by an active member of PCI.

2. Provide units manufactured by plant which has regularly and continuously engaged in manufacture of units of same type as those required for a minimum of three (3) years.
3. Assure manufacturer's testing facilities meet requirements of ASTM E329.
4. Welding operators and processes to be qualified in accordance with:
  - a. AWS D1.1 for welding steel shapes and plates.
  - b. AWS D1.4 for welding reinforcing bars.
5. Welding operators to have passed qualification tests for type of welding required during the previous 12 months prior to commencement of welding.

### 1.3 SUBMITTALS

- A. Shop Drawings:
1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.
  2. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Sizes, types and manufacturer of bearing pads.
    - d. Hardware to be utilized to support suspended appurtenances.
  3. Shop Drawings and erection plans for precast units, their connections and supports showing:
    - a. Member size and location.
    - b. Size, configuration, location and quantity of reinforcing bars and prestressing strands.
    - c. Initial prestress forces.
    - d. Size and location of openings verified by Contractor.
    - e. Size, number, and locations of embedded metal items and connections.
    - f. Required concrete strengths.
    - g. Identification of each unit using same standard marking numbers as used to mark actual units.
  4. Calculations for members and connections designed by fabricator.
    - a. Calculations to be sealed by a professional Civil or Structural Engineer registered in the State in of Nebraska.
    - b. Perform calculations using the dead load of the members plus the superimposed uniform and concentrated loads shown on the Drawings and indicated in this Specification Section.
    - c. Indicate the following:
      - 1) Design for maximum moment, maximum shear and maximum torsion.
      - 2) Final top and bottom flexural stresses resulting from the stresses due to maximum moment and prestress force.
      - 3) Ultimate moment capacity.
      - 4) Final top and bottom flexural stresses, ultimate moment capacity, and ultimate shear capacity, if affected, for members with reduced cross sections due to openings or penetrations.
      - 5) When required on Drawings, a check for no tension in top and bottom of members due to prestress force and member dead load plus superimposed loads indicated on Drawings and in this Specification Section.
  5. Submit test results, when so required on Drawings, showing that embedded connection items will adequately support the indicated loads.
    - a. Connection items to have an ultimate load capacity of at least two (2) times the required indicated load.
  6. Concrete mix design(s) including submittal information defined Specification Section 03350.
  7. Copies of source quality control tests.
  8. Certification of manufacturer's testing facility qualifications.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Headed studs and deformed bar anchors:
    - a. Nelson Stud Welding Div., TRW, Inc.
    - b. KSM Division, Omark Industries.

- 1           2. Bearing pads: JVI, Inc.
- 2           B. Submit request for substitution in accordance with Specification Section 01640.
- 3   **2.2 MATERIALS**
- 4           A. Embedded Steel Plates and Shapes:
- 5           1. ASTM A36.
- 6           2. Galvanized: ASTM A123/A123M, minimum 2.0 OZ zinc per square foot of metal surface.
- 7           B. Bearing Pads:
- 8           1. Random, fiber-reinforced elastomeric pads.
- 9           2. Preformed, randomly oriented synthetic fibers set in elastomer.
- 10          3. Shore-A hardness: 70 to 90 per ASTM D2240.
- 11          4. Capable of supporting a compressive stress of 3000 psi with no cracking, splitting or
- 12          delaminating in the internal portions of the pad.
- 13          5. Masticord as manufactured by JVI, Inc.
- 14          C. Cement: Comply with ASTM C150, Type I or III.
- 15          D. Aggregates for Normal Weight Concrete:
- 16          1. Comply with aggregate requirements for 47B concrete per Standard Specifications for
- 17          Highway Construction by State of Nebraska Department of Roads or comply with ASTM C33
- 18          with coarse aggregate meeting the gradation for size number 67 as stated in ASTM C33.
- 19          2. Fine aggregates to be natural, not manufactured.
- 20          3. Provide aggregates approved for bridge construction by the State Highway Department in
- 21          the state where the Project is located or in the state where the units are manufactured.
- 22          E. Water:
- 23          1. Potable, clean.
- 24          2. Free of oils, acids, and organic matter.
- 25          F. Maximum total chloride ion content contributed from all ingredients of concrete including water,
- 26          aggregates, cement and admixtures measured as a weight percent of cement to not exceed 0.06
- 27          for prestressed concrete and 0.10 for all other precast concrete.
- 28          G. Prestressing Strands:
- 29          1. Either 250K or 270K high tensile strength uncoated seven (7) wire strand.
- 30          2. Manufacture and test strands in accordance with ASTM A416.
- 31          H. Reinforcing Steel and Welded Wire Reinforcement: See Specification Section 03208.
- 32          I. Headed Studs:
- 33          1. ASTM A108.
- 34          2. Minimum yield strength: 50,000 psi.
- 35          3. Minimum tensile strength: 60,000 psi.
- 36          J. Deformed Bar Anchors:
- 37          1. ASTM A496 or ASTM A1064.
- 38          2. Minimum tensile strength: 80,000 psi.
- 39          3. Minimum yield strength: 70,000 psi.
- 40          K. Electrodes:
- 41          1. E70 series conforming to AWS A5.1/A5.1M or AWS A5.5/A5.5M for welding steel shapes
- 42          and plates.
- 43          2. E90 series conforming to AWS A5.5/A5.5M for welding rebar.
- 44          L. Concrete sand cement grout in keyways between hollow core slabs.
- 45          1. See Specification Section 03308.

46   **2.3 DESIGN**

- 47          A. General Design Requirements:
- 48          1. Design units and connections in strict accordance with ACI 318 and the PCI MNL 120.
- 49          2. Design units for spans, dead load of members, dead and live loads indicated on the
- 50          Drawings with concentrated loads placed in their actual locations.
- 51              a. Verify weights and locations of concentrated loads.
- 52          3. Design units taking into account reduced cross section at openings and penetrations.

- 1           4. Provide all reinforcing in units as indicated.  
2           a. Where not indicated, design and provide all reinforcing and prestressing strands subject  
3           to approval of Engineer.

4   **2.4 MIXES**

- 5           A. See Specification Section 03308.  
6           B. Do not begin fabrication of units until concrete mix design(s) have been approved by Engineer.

7   **2.5 FABRICATION**

- 8           A. Do not fabricate units until Shop Drawings have been approved by Engineer and returned to  
9           Contractor and support locations have been field verified by Contractor.
- 10          B. Manufacture, quality, dimensional and erection tolerances of all units to be in accordance with  
11          both PCI MNL 116 and PCI MNL 120.
- 12          C. Cast all members in smooth rigid forms which will provide straight, true members of uniform  
13          thickness and uniform color and finish.
- 14          D. Use sand cement grout mixture to fill all air pockets and voids, and to repair chipped edges.
- 15          E. Finish all repairs to match adjacent surface texture and color.
- 16          F. Where units are to receive concrete topping, provide units having heavy broom finish on top  
17          surface for bond.  
18              1. Provide roughness of top surface to provide bond with topping and design for horizontal  
19              shear at topping and unit interface in accordance with requirements of ACI 318, Horizontal  
20              Shear Strength paragraph.
- 21          G. Solid planks used for walkways shall have a light broom finish on the top side for slip resistance.  
22          Broom finish shall be applied perpendicular to the span of the unit.
- 23          H. Incorporate embedded plates, angles, sleeves and flange welding strips into members at time of  
24          manufacture.  
25              1. Provide embedded items or grouted anchor sleeves as shown on the Drawings unless prior  
26              approval is received from Engineer to do otherwise.  
27              2. Space strips as shown on Drawings.  
28              3. Cast lifting handles into units at or near support points.  
29              a. Remove lifting handles after units are erected.
- 30          I. Cast openings larger than 6 IN SQ or 6 IN DIA in units at time of manufacture.  
31              1. Make smaller openings by neat cutting or neat drilling by trades requiring them.  
32              2. Coordinate sizes and locations of all openings before fabrication of units.
- 33          J. Make provisions for support of suspended ceilings, lighting fixtures, ducts, piping, conduits and  
34          other suspended work.  
35              1. When drilled expansion bolts or powder-driven fasteners are approved for use, coordinate  
36              prestress strand location with prestress concrete member supplier so that drilled expansion  
37              bolts or powder-driven fasteners do not hit or are drilled or driven into prestress strands.  
38              2. Install powder-driven fasteners by means of a low velocity powder-actuated tool complying  
39              with requirements of OSHA.  
40              a. Assure that the load to be supported by each in place drilled expansion bolt or powder-  
41              driven fastener does not exceed the maximum allowable load recommended by the bolt  
42              or fastener manufacturer for the concrete strength encountered and for the type, size  
43              and embedment length of expansion bolt or driven fastener installed.
- 44          K. Automatically weld headed studs and deformed bar anchors to members to provide full  
45          penetration weld between studs, bar anchors and members they are attached to.
- 46          L. Weld steel shapes and plates per AWS D1.1 and reinforcing steel per AWS D1.4.
- 47          M. Minimum concrete compressive strength at time of strand release: 3500 psi.
- 48          N. Mark each unit as indicated on the erection plans.  
49              1. Place mark on non-exposed-to-view surface.
- 50          O. Coat or finish ends of exposed prestressing strands to prevent rusting.

- 1 P. Fabricate the following types of precast and prestressed units (all units to be made with normal  
 2 weight concrete unless noted otherwise on Drawings):  
 3 1. Prestressed hollow core slabs of sizes indicated.  
 4 a. Weight of hollow core slabs not to exceed the following:  
 5

NORMAL WEIGHT CONCRETE	
DEPTH	
8 IN	90 psf*

- 6 \* Weight listed include 3" (50 psf) concrete topping.  
 7 2. Precast items shown on Drawings including but not limited to:  
 8 a. Lintels.  
 9 b. Splash blocks.

10 **2.6 SOURCE QUALITY CONTROL**

- 11 A. During production of precast concrete units, conduct strength tests of concrete placed in units as  
 12 required in Specification Section 03350 for concrete placed during fabrication.  
 13 1. Results of strength tests to be sent immediately to Engineer, Contractor and Owner.  
 14 2. Test reports to indicate units they represent.  
 15 B. When approved by Engineer, strength tests may be made by precast manufacturer after he has  
 16 submitted certification that his testing facilities meet the requirements of ASTM E329.

17 **PART 3 - EXECUTION**

18 **3.1 PREPARATION**

- 19 A. Verify acceptability and location of supports to receive units.  
 20 1. Check bearing surfaces to determine that they are level and uniform.  
 21 B. Verify compressive strengths of concrete and masonry supports.  
 22 1. Do not start erection of units until supports have reached their 28 day required compressive  
 23 strengths.

24 **3.2 INSTALLATION**

- 25 A. Sequence erection to provide a balance of loads across beams and columns.  
 26 B. Give consideration to possible lack of stability or capacity of partially completed frame or  
 27 structure.  
 28 C. Contractor to be responsible for guying, shoring, and bracing of frame, walls and individual  
 29 members as necessary to resist forces due to wind, erection, or any other source that may occur  
 30 before structure is completed.  
 31 D. Use only erection equipment adequate for placing units at lines and elevations indicated on  
 32 Drawings.  
 33 1. Do not damage units or existing construction during erection.  
 34 2. Erect units using lifting handles cast into the units.  
 35 E. Place hollow core slabs on continuous 1/4 IN thick bearing pad so that width equals bearing  
 36 length -1 IN.  
 37 F. After erection, verify that there is no direct contact between bottom of units and supporting  
 38 members.  
 39 1. Where direct contact occurs, install additional layers of bearing material to raise units off  
 40 supports.  
 41 G. Lintels:  
 42 1. Length of lintel bearing on supports to be as indicated on Drawings.  
 43 a. If not indicated, minimum length of lintel bearing to be 8 IN.  
 44 2. Fill masonry cells under lintel bearing with masonry grout and reinforce cells as indicated.  
 45 3. Provide minimum 3/8 IN thick full bed joint of masonry mortar between underside of lintel and  
 46 top surface of grouted masonry for complete lintel bearing length.

- 1 H. Weld steel shapes and plates per AWS D1.1 and reinforcing steel per AWS D1.4.  
2 I. Fill all keyways between hollow core slabs with concrete sand cement grout.  
3 1. See Specification Section 03308.  
4 J. After all precast units are erected and all precast unit connections have been made, coat all  
5 exposed surfaces of the connections with the same prime and finish paint as required on the  
6 adjacent precast concrete units.  
7 1. See Specification Section 09960.

8 **3.3 FIELD QUALITY CONTROL**

- 9 A. Causes for rejection of units include, but are not necessarily limited to the following:  
10 1. Cracked units.  
11 2. Chipped, broken, or spalled edges.  
12 3. Units not within allowable casting tolerances.  
13 4. Voids or air pockets which, in opinion of Engineer, are too numerous or too large.  
14 5. Non-uniform finish or appearance.  
15 6. Low concrete strength.  
16 7. Improperly placed embedded items and/or openings.  
17 8. Exposed wire mesh, reinforcing or prestressing strands.

18 **END OF SECTION**

**SECTION 03601**  
**FRP CONCRETE STRENGTHENING**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
- 7 1. Minimum design requirements for FRP System Concrete Strengthening design.
  - 8 2. Materials.
  - 9 3. Installation.
- 10 B. Related Specification Sections include but are not necessarily limited to:
- 11 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
  - 12 2. Division 1 - General Requirements.
  - 13 3. Section 03311 - Concrete Mixing, Placing, Jointing, and Curing.
  - 14 4. Section 03348 – Concrete Finishing and Repair of Surface Defects
  - 15 5. Section 09960 - High Performance Industrial Coatings (HPIC).

16 **1.2 QUALITY ASSURANCE**

- 17 A. Referenced Standards:
- 18 1. American National Standards Institute (ANSI):
  - 19 a. B40.100, Pressure Gauges and Gauge Attachments.
  - 20 2. American Concrete Institute (ACI):
  - 21 a. 116R, Cement and Concrete Terminology.
  - 22 b. 117, Specifications for Tolerances for Concrete Construction and Materials.
  - 23 c. 440.2R, Guide for the Design and Construction of Externally Bonded FRP Systems for
  - 24 Strengthening Concrete Structures.
  - 25 d. 546R, Concrete Repair Guide
  - 26 3. ASTM International (ASTM):
  - 27 a. D3039, Test Method for Tensile Properties of Polymer Matrix Composite Materials.
  - 28 b. D3418, Test Method for Transition Temperatures of Polymers by Differential Scanning
  - 29 Calorimetry.
  - 30 c. D4541, Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Tester.
  - 31 d. D5687, Guide for Preparation of Flat Composite Panels with Processing Guidelines for
  - 32 Specimen Preparation.
  - 33 e. D7522, Standard Test Method for Pull-Off Strength for FRP Bonded to Concrete
  - 34 Substrate.
  - 35 f. D7565, Standard Test Method for Determining Tensile Properties of Fiber Reinforced
  - 36 Polymer Matrix Composites Used for Strengthening Civil Structures.
  - 37 4. International Code Council (ICC):
  - 38 a. ICC AC125, Acceptance Criteria for Concrete and Reinforced and Unreinforced
  - 39 Masonry Strengthening Using Externally Bonded Fiber Reinforced Polymer (FRP)
  - 40 Composite Systems.
  - 41 b. ICC AC178, Interim Criteria for Inspection and Verification of Concrete and Reinforced
  - 42 and Unreinforced Masonry Strengthening Using Externally Bonded Fiber Reinforced
  - 43 (FRP) Composite Systems.
  - 44 5. International Concrete Repair Institute (ICRI):
  - 45 a. No. 03730, Guide for Surface Preparation for the Repair of Deteriorated Concrete
  - 46 Resulting from Reinforcing Steel Corrosion.
- 47 B. Qualifications:
- 48 1. FRP System Designer:
  - 49 a. Minimum five (5) years experience in design of the FRP System.
  - 50 b. Is responsible charge of engineering work to be done for FRP System design,
  - 51 construction, and testing.
  - 52 c. Registered Professional Civil or Structural Engineer in the State of Nebraska.
  - 53 2. Installer qualification:
  - 54 a. Installer must be approved in writing by FRP System Designer.

- 1                   b. Installer must have minimum of 5 years current experience in installation of similar  
2                   systems.
- 3           C. Witness Panels:
- 4           1. Construct minimum of five (5) witness panels to be tested to confirm FRP System properties.  
5           Designer to determine size of panels required for proper testing. Number of plies required  
6           shall be the same as the most required for any one element on the project.
- 7           2. Minimum of two witness panels shall be constructed before work on the FRP system begins.  
8           Minimum of two shall be constructed during work on the FRP system. One may be  
9           constructed after FRP system installation is complete.
- 10          3. Surface preparation and application of FRP system shall be the same as the surface  
11          preparation and FRP application for work indicated on Drawings.

### 12   **1.3 DEFINITIONS**

- 13          A. FRP System:
- 14           1. FRP System is the manufacturer's proprietary finished product including but not limited to  
15           FRP fiber, carbon fiber, resin, epoxy, and installation methods.
- 16          B. FRP System Designer: Engineer in responsible charge of engineering work related to the FRP  
17          system.
- 18          C. Installer or Applicator:
- 19           1. Installer or applicator is the person actually installing or applying the product in the field at the  
20           Project site.
- 21           2. Installer and applicator are synonymous.
- 22          D. Structural Repair Contractor: See Section 03348.
- 23          E. Resin: The mixed polymer component or matrix of the FRP.
- 24          F. Inspector:
- 25           1. Representative of the Designer hired by the Contractor to inspect installation of the FRP  
26           system.
- 27          G. Witness Panel:
- 28           1. A small FRP panel, manufactured on site under conditions similar to the actual construction.  
29           The panel will later be tested to determine mechanical and physical properties to confirm the  
30           expected properties of the FRP System. Witness panel shall not be installed on existing  
31           structure and shall remain at conclusion of project.

### 32   **1.4 SUBMITTALS**

- 33          A. Shop Drawings:
- 34           1. See Specification Section 01340 for requirements for the mechanics and administration of  
35           the submittal process.
- 36           2. Product technical data including:
- 37           a. Acknowledgement that products submitted meet requirements of standards referenced.
- 38           b. Designer's installation instructions including step by step requirements for surface  
39           preparation, installation, curing and quality control requirements.
- 40           c. ICC Reports for FRP system used in similar condition as required by this project.
- 41           d. Certification letter of manufacturer's materials QA/QC program and acceptance criteria.
- 42           e. Designer shall submit installation QA/QC plan to ensure installation of FRP System per  
43           Designer's instructions.
- 44           f. Contractor shall submit certification that the coating system specified in Section 09960 is  
45           compatible with the FRP System.
- 46           3. Fabrication and/or layout Drawings.
- 47           4. Layout of planned anchors to be drilled through the fiber reinforcing.
- 48           5. Fiber sizes, spacing, dimensions, configurations, locations, and lap splice lengths.
- 49           6. Sufficient details to permit installation of fiber reinforcing.
- 50           7. Shop Drawings shall be in sufficient detail to permit installation of fiber reinforcing without  
51           reference to Contract Drawings.
- 52           a. Shop Drawings shall not be prepared by reproducing the plans and details indicated on  
53           the Contract Drawings but shall consist of completely redrawn plans and details as  
54           necessary to indicate complete fabrication and installation of all fiber reinforcing.



- 1           8. Calculations for fiber reinforcing and attachment to concrete substrate.
- 2           a. Calculations to be sealed by a Professional Civil or Structural Engineer in the State of
- 3           Nebraska.
- 4           b. Submitted for information only.
- 5        B. Record of five (5) of Installer's past installations of similar FRP systems in a similar condition.
- 6        C. Certification letter from Designer stating that based on Designer's site specific inspections, FRP
- 7        System was installed per Designer instructions.
- 8        D. Field quality control test reports as defined in Article 3.3 of this Specification.

9        **1.5 DELIVERY, STORAGE, AND HANDLING**

- 10       A. Store materials in a protected area at a temperature between 40 DegF and 100 DegF.
- 11       B. Products shall be stored according to the manufacturer's requirements and shall avoid contact
- 12       with soil and moisture. Products shall be stored to avoid UV exposure.
- 13       C. Deliver epoxy materials in factory sealed containers with the manufacturer's labels intact and
- 14       legible with verification of date of manufacture and shelf life.

15       **PART 2 - PRODUCTS**

16       **2.1 ACCEPTABLE MANUFACTURERS**

- 17       A. Subject to compliance with the Contract Documents, the following FRP Systems are acceptable:
- 18       1. Fyfe/Fibrwrap.
- 19       2. QuakeWrap.
- 20       3. HJ3 Composite Technologies.
- 21       B. No like, equivalent or "or-equal" item is permitted.
- 22       C. Submit request for substitution in accordance with Specification Section 01640.

23       **2.2 PERFORMANCE AND DESIGN REQUIREMENTS**

- 24       A. General Design Requirements:
- 25       1. Design FRP System to provide required bending, shear and/or tensile strength to specific
- 26       elements as shown on the Contract Documents.
- 27       2. Design in accordance with ACI 440.2 R.
- 28       3. Design for in place condition of concrete including effects of corrosion and deterioration on
- 29       concrete substrate.
- 30       a. If surface preparation requirements in excess of those specified are required to achieve
- 31       capacities listed, clearly state required surface preparation in installation instructions.
- 32       4. Design for potential corrosion/degradation of FRP system due to environment of elements to
- 33       be reinforced, including but not limited to the potential concerns listed below.
- 34       a. 100 percent humidity environment with chloramines.
- 35       5. Design for loss of section due to permanently installed post-installed anchor bolts whether
- 36       existing or shown as new construction in the Drawings.

37       **2.3 SOURCE QUALITY CONTROL**

- 38       A. Designer shall submit certification letter detailing materials QA/QC program and acceptance
- 39       criteria. Letter shall state material for this project has passed all acceptance criteria.

1 **PART 3 - EXECUTION**

2 **3.1 SURFACE PREPARATION**

3 A. Removal of Defective Concrete:

- 4 1. All defective areas of concrete substrate shall be removed according to ACI 546R, to at least  
5 1/2 IN beyond the repair area to exposed sound concrete. If any reinforcing or prestressing  
6 steel is exposed in the process and either it is deteriorated or its bond with the concrete is  
7 broken in the process, notify the District and the Engineer. If any deterioration is noticed in  
8 the repair area, its source shall be located and treated to the satisfaction of the Engineer  
9 prior to restoring the area. Upon removing defective concrete, and before restoring the  
10 section, the substrate shall be cleaned of any dust, laitance, grease, oil, curing compounds,  
11 impregnations, foreign particles, wax, and any other bond inhibiting materials.

12 B. Defective Reinforcement:

- 13 1. FRP systems shall not be applied to concrete suspected of containing corroded  
14 reinforcement. If any reinforcing or prestressing steel is exposed in the process and either it  
15 is deteriorated or its bond with the concrete is broken in the process, notify the Owner and  
16 the Engineer.

17 C. Structural Repair of the Substrate:

- 18 1. See the Drawings and Specification Section 03348.  
19 2. Repairs shall be made by the Structural Repair Contractor as defined in Section 03348.

20 D. Crack Repairs:

- 21 1. Installer shall evaluate existing substrate. If cracks are found that are incompatible with the  
22 FRP System then notify the Owner and the Engineer.

23 E. Surface Grinding:

- 24 1. All irregularities, unevenness, and sharp protrusions in the surface profile shall be ground to  
25 a smooth surface as required by the FRP System Designer. Grind all stain, paint, or any  
26 other surface coating that may affect the bond of the FRP System.

27 F. Surface Cleaning:

- 28 1. Clean substrate after concrete removal/repair. Clean any dust, laitance, grease, oil, curing  
29 compounds, wax, impregnations, stains, paint coatings, surface lubricants, foreign particles,  
30 weathered layers, or any other bond inhibiting material. If power wash is used, the surface  
31 shall be allowed to dry thoroughly before installing the FRP system. The cleaned surface  
32 shall be protected against redeposit of any bond inhibiting materials. Newly repaired or  
33 patched surfaces shall be cured with a curing compound per specification section 03311.

34 G. Surface Profile:

- 35 1. Prepared concrete surface shall be profiled for bonding by means of an abrasive blast or  
36 grinding to remove existing laitance and expose aggregate as required by the Designer  
37 (minimum surface profile of ICRI CSP-2).

38 H. In no case shall the surface preparation requirements be less than that required by the Designer  
39 for proper performance of the FRP system without written approval from the Engineer.

40 **3.2 INSTALLATION**

41 A. Install products in accordance with Designer's instructions.

42 B. Components that have exceeded their shelf life shall not be used.

43 C. Environmental Conditions:

- 44 1. Environmental conditions for installation shall be examined by the installer before and during  
45 installation of the FRP system to ensure conformity with the Contract Documents and FRP  
46 system designer's recommendations. Do not apply primers, resins, or adhesives on frozen,  
47 damp, or wet surfaces. Ambient and concrete surface temperatures shall be within those  
48 specified by the FRP system designer.

49 D. Alignment of Fibers:

- 50 1. The fibers shall be aligned on the structural member according to the FRP system designer's  
51 installation documents and the Contract Documents. Any deviation in the alignment by more  
52 than 5 degrees is not acceptable. Once installed the fibers shall be free of kinks, folds, and  
53 waviness.

- 1 E. Curing:  
2 1. The FRP system shall be allowed to cure for four (4) days minimum before full loads are  
3 applied. Field modification of resin chemistry to modify curing are not allowed. Curing of  
4 installed plies shall be monitored before installing of additional plies. In cases of curing  
5 irregularity, installation of subsequent plies shall be halted.
- 6 F. Coating Requirements:  
7 1. Comply with Specification Section 09960.  
8 2. Any coatings shall be reviewed by the manufacturer for compliance and compatibility with the  
9 FRP system being used.
- 10 G. No fasteners shall be drilled through FRP System during or after installation without written  
11 permission from Engineer and FRP system designer unless specifically shown on the approved  
12 Shop Drawings.  
13 1. If fastener is required to penetrate FRP System notify Engineer prior to installation.

14 **3.3 FIELD QUALITY CONTROL**

- 15 A. Contractor shall employ and pay for the Inspector to:  
16 1. Inspect FRP System installation as covered by these Specifications and the Designer's  
17 instructions.  
18 2. Test witness panels per these Specifications and the Designer's instructions.  
19 3. Designer shall submit certification that installation was completed in conformance with  
20 Designer's instructions and FRP system will perform as designed.  
21 4. Tests:  
22 a. Manufacturer shall submit installation QA/QC plan to ensure installation of FRP System  
23 per manufacturer's instructions. Tests listed below shall be minimum required.  
24 b. Perform tensile test per ASTM D3039 on all witness panels. The system will be deemed  
25 unacceptable if the average tensile strength and the lowest tensile strength are more  
26 than 5 percent and 10 percent below that specified in the Contract Documents,  
27 respectively.  
28 c. Measure thickness of FRP System. The system will not be acceptable if the number of  
29 plies is less than that specified or the cured thickness of the system is less than that  
30 required by more than 1/32 IN.  
31 d. Perform three (3) direct tension adhesion tests for every 1000 SQ FT of surface area to  
32 be covered by the FRP System. Direct tension test to be as described by ASTM D7522  
33 and/or ASTM D4541. Pull off tests shall be performed on an area adjacent to installed  
34 region wherever possible. Final location shall be determined by FRP system designer  
35 and acceptable to Engineer. Test shall be required for each type of substrate or for  
36 each surface preparation technique required by Designer. Acceptance and rejection  
37 criteria for adhesion tests shall be determined by Designer prior to installation of FRP  
38 System.

39 **END OF SECTION**

40





# DIVISION 04

MASONRY





1 2014/09/08

2

## SECTION 04050

3

### COLD AND HOT WEATHER MASONRY CONSTRUCTION

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

A. Section Includes:

7

1. Cold weather protection.

8

2. Hot weather protection.

9

B. Related Specification Sections include but are not necessarily limited to:

10

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

11

2. Division 01 - General Requirements.

12

##### 1.2 QUALITY ASSURANCE

13

A. Referenced Standards:

14

1. American Concrete Institute/American Society of Civil Engineers/The Masonry Society (ACI/ASCE/TMS):

15

a. ACI 530.1/ASCE 6/TMS 602, Specification for Masonry Structures.

16

17

2. Brick Industry Association (BIA):

18

a. Tech Note 1, Cold and Hot Weather Construction.

19

3. International Masonry Industry All-Weather Council (IMIAWC):

20

a. Recommended Practices and Guide Specifications for Masonry Construction.

21

4. National Concrete Masonry Association (NCMA).

22

a. TEK 3-1C, All Weather Concrete Masonry Construction.

23

##### 1.3 DEFINITIONS

24

A. Hot Weather Construction: Per ACI 530.1/ASCE 6/TMS 602, hot weather construction is defined as occurring when ambient temperatures exceed 100 DegF or 90 DegF when the wind velocity is greater than 8 mph.

25

26

27

B. Cold Weather Construction: Per ACI 530.1/ASCE 6/TMS 602, cold weather construction is defined as occurring when ambient temperature falls below 40 DegF or when the temperature of the masonry units is below 40 DegF.

28

29

30

#### PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)

31

#### PART 3 - EXECUTION

32

##### 3.1 ERECTION AND APPLICATION

33

A. General:

34

1. Comply with NCMA TEK 3-1C and BIA Tech Note 1 recommendations and practices.

35

2. Do not use frozen or ice coated materials.

36

3. At end of each day or at shutdown, cover tops of all walls not enclosed or sheltered with clear polyethylene minimum 6 mil thick.

37

38

a. Extend down each side of wall minimum of 16 IN and secure.

39

B. Temporary Facilities:

40

1. Construct and maintain temporary protection required to permit continuous and orderly progress of work.

41

42

2. Provide and maintain heat sufficient to assure temperature above 32 DegF within protected areas.

43

44

3. Remove all temporary facilities after completion of work.

- 1 C. Cold Weather Construction and Protection Requirements:
- 2 1. Prior to and during installation:
- 3 a. Air temperature 32 to 40 DegF: Heat mixing water or aggregate to produce mortar
- 4 temperatures between 40 and 120 DegF.
- 5 b. Air temperature 25 to 32 DegF:
- 6 1) Heat mixing water or aggregate to produce mortar temperatures between 40 and
- 7 120 DegF.
- 8 2) Maintain mortar temperatures above freezing until used.
- 9 c. Air temperature below 25 DegF:
- 10 1) Heat mixing water and aggregate to produce mortar temperatures between 40 and
- 11 120 DegF.
- 12 2) Maintain mortar temperatures above freezing until used.
- 13 3) Maintain temperature of units until laid at not less than 40 DegF.
- 14 4) Provide heat on both sides of walls under construction to maintain air temperature
- 15 above freezing.
- 16 5) Provide windbreaks or shelters when wind is in excess of 15 mph.
- 17 a) Wind breaks or shelters shall be translucent.
- 18 2. After installation:
- 19 a. Air temperature 32 to 40 DegF: Protect from rain or snow for not less than 24 HRS by
- 20 covering with weather-resistive translucent membrane.
- 21 b. Air temperature 25 to 32 DegF: Completely cover with translucent weather-resistive
- 22 membrane for not less than 24 HRS.
- 23 c. Air temperature 20 to 25 DegF: Completely protect with insulating blankets for not less
- 24 than 24 HRS or provide other protection approved by Engineer.
- 25 d. Air temperature below 20 DegF:
- 26 1) Provide enclosed translucent shelters and heating to maintain air temperature on
- 27 each side of wall above 32 DegF for 24 HRS.
- 28 2) Do not allow rapid drop in temperature after removal of heat.
- 29 e. Promptly repair all tears, holes, etc., to translucent membrane and shelter using
- 30 compatible patching material and tape as recommended by membrane manufacturer.

- 31 D. Hot Weather Construction and Protection Requirements:
- 32 1. Comply with requirements of IMIAWC, NCMA, BIA and ACI/ASCE/TMS.
- 33 2. Storage and preparation of materials.
- 34 a. Cover or shade masonry units and mortar materials from direct sun.
- 35 b. Maintain sand in a damp loose condition.
- 36 1) Sand moisture shall be maintained at minimum 8 percent.
- 37 2) Sprinkle with cool water as required to maintain moisture content.
- 38 c. Use cool water for mixing mortars.
- 39 d. Avoid using tools and equipment that have been sitting in the sun.
- 40 1) Sprinkle mortar boards, mortar pans, wheel barrows, mixers, etc., with cool water.
- 41 e. Wet brick units having high initial rates of absorption.
- 42 f. Do not wet concrete masonry units prior to use.
- 43 3. Installation:
- 44 a. Place masonry units within one minute of the spreading of the mortar.
- 45 1) Mortar beds shall not be spread more than 4 FT ahead of the masonry unit being
- 46 placed.
- 47 b. Provide wind screens and shading partitions as required to eliminate direct sunlight
- 48 exposure.
- 49 c. Wet installed units using fog spray of clean water.
- 50 d. Cover installed work immediately after installation to slow rate of loss of moisture from
- 51 units.
- 52 e. Fog-spray new masonry work until damp.
- 53 1) Repeat fog spraying minimum of three (3) times per day until masonry work has
- 54 cured for 72 HRS.
- 55 2) In high humidity conditions, Engineer reserves the right to discontinue fog spraying
- 56 if operation is found to be introducing excessive amounts of moisture into the Work.

57

**END OF SECTION**



1 2014/09/10

2

3

**SECTION 04110**  
**MASONRY MORTAR AND GROUT**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6 A. Section Includes:

- 7 1. Masonry mortar.  
8 2. Masonry grout.  
9 3. Pointing grout.

10 B. Related Specification Sections include but are not necessarily limited to:

- 11 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.  
12 2. Division 01 - General Requirements.  
13 3. Section 04210 - Brick Masonry.  
14 4. Section 04220 - Concrete Masonry.

15 **1.2 QUALITY ASSURANCE**

16 A. Referenced Standards:

- 17 1. American Concrete Institute/American Society of Civil Engineers/The Masonry Society  
18 (ACI/ASCE/TMS).  
19 a. ACI 530.1/ASCE 6/TMS 602, Specification for Masonry Structures.  
20 2. ASTM International (ASTM):  
21 a. C143, Standard Test Method for Slump of Hydraulic-Cement Concrete.  
22 b. C144, Standard Specification for Aggregate for Masonry Mortar.  
23 c. C150, Standard Specification for Portland Cement.  
24 d. C207, Standard Specification for Hydrated Lime for Masonry Purposes.  
25 e. C270, Standard Specification for Mortar for Unit Masonry.  
26 f. C404, Standard Specification for Aggregates for Masonry Grout.  
27 g. C476, Standard Specification for Grout for Masonry.  
28 h. C1019, Standard Test Method for Sampling and Testing Grout.  
29 i. C1093, Standard Practice for Accreditation of Testing Agencies for Masonry.  
30 j. C1384, Standard Specification for Admixtures for Masonry Mortars.  
31 k. C1714, Standard Specification for Preblended Dry Mortar Mix for Unit Masonry.  
32 3. Building Code:  
33 a. International Code Council (ICC):  
34 1) International Building Code and associated standards, 2006 Edition including all  
35 amendments, referred to herein as Building Code.

36 B. Qualifications:

- 37 1. Testing Laboratory shall be an independent agency qualified in accordance with  
38 ASTM C1093 for performing the testing indicated.  
39 a. Testing Laboratory shall have a minimum of 10 years experience in the testing of mortar  
40 and grout.  
41 2. Technician conducting tests shall have minimum of five (5) years experience in the testing of  
42 mortar and grout.

43 **1.3 DEFINITIONS**

44 A. Coarse grout and fine grout are defined by the aggregate size used in accordance with  
45 ASTM C476.

46 B. Coarse aggregate and fine aggregate are defined in ASTM C404, Table 1.

1 **1.4 SUBMITTALS**

- 2 A. Shop Drawings:
- 3 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 4 the submittal process.
- 5 2. Product technical data including:
- 6 a. Acknowledgement that products submitted meet requirements of standards referenced.
- 7 b. Proposed mortar mix design, including proposed pre-blended, prepackaged dry mortar
- 8 mixes.
- 9 1) Proposed mortar mix design to include brand, type and manufacturer of all
- 10 cementitious materials and source or producer of aggregate.
- 11 c. Proposed masonry grout mix design.
- 12 3. Test results:
- 13 a. Preconstruction mortar test results.
- 14 b. Preconstruction masonry grout test results.
- 15 c. Strength test results for all mortar and masonry grout (both coarse and fine grout) placed
- 16 during construction.
- 17 d. Slump test results of all masonry grout placed during construction.
- 18 B. Samples:
- 19 1. Actual colored mortar samples for color selection by Engineer.
- 20 a. Color card and plastic simulations are not acceptable.
- 21 C. Informational Submittals:
- 22 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 23 the submittal process.
- 24 2. Qualifications of testing lab and technician.

25 **1.5 DELIVERY, STORAGE, AND HANDLING**

- 26 A. Store cementitious materials on elevated platforms, under cover, and in a dry location.
- 27 1. Do not use cementitious materials that have become damp.
- 28 B. Store aggregates where grading and other required characteristics can be maintained and
- 29 contamination avoided.
- 30 C. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and
- 31 emptying into dispensing silo.
- 32 1. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover,
- 33 and in a dry location or in a metal dispensing silo with weatherproof cover.

34 **PART 2 - PRODUCTS**

35 **2.1 MATERIALS**

- 36 A. Portland Cement:
- 37 1. ASTM C150, Type I or II.
- 38 2. No air entrainment.
- 39 3. Natural color.
- 40 4. Maximum percent of alkalis: 0.60 in accordance with ASTM C150, Table 1A.
- 41 B. Hydrated Lime:
- 42 1. ASTM C207, Type S.
- 43 2. Type SA not acceptable.
- 44 3. Lime substitutes are not acceptable.
- 45 C. Mortar Aggregate: ASTM C144, free of gypsum.
- 46 D. Masonry Grout:
- 47 1. ASTM C476.
- 48 2. No admixtures allowed.
- 49 E. Grout Aggregate: ASTM C404.
- 50 F. Water: Potable.

- 1 G. Mortar Pigments:  
2 1. Commercial colorants suitably compounded for use in mortar mixes.  
3 2. Do not exceed manufacturer's recommended pigment-to-cement ratios.
- 4 H. Integral Water Repellent Admixture:  
5 1. Liquid polymeric admixture: ASTM C1384.  
6 2. Verify compatibility with liquid water repellent admixture being used in the fabrication of  
7 concrete masonry units.  
8 3. Do not use integral water repellent admixture in mortar for brick.

## 9 2.2 MIXES

- 10 A. Comply with ASTM C270, Table No. 1 for field mixed mortar; preblended mortar shall comply with  
11 ASTM C1714.  
12 1. Do not use masonry cement.  
13 2. Mix materials minimum of three (3) minutes and maximum of five (5) minutes.  
14 3. Adjust consistency to satisfaction of mason.  
15 4. Do not use admixtures unless otherwise indicated.  
16 5. Mortar type:  
17 a. New construction: Type S.  
18 b. Tuckpointing: Type N or Type O.
- 19 B. Masonry Grout:  
20 1. Comply with ASTM C476.  
21 2. Use no anti-freeze additives.  
22 3. Mix 5 minutes minimum.  
23 4. Slump: 8 to 11 IN.  
24 5. At Contractor's option, manufactured grout meeting the above minimum requirements may  
25 be used.  
26 6. Minimum 28-day compressive strength: 2,000 psi.

## 27 2.3 SOURCE QUALITY CONTROL

- 28 A. Perform preconstruction laboratory tests on proposed masonry grout mix prior to start of masonry  
29 work.  
30 1. Perform tests far enough in advance so that any necessary retesting can be accomplished  
31 before masonry construction begins.  
32 a. Test grout per ASTM C1019.
- 33 B. Source Limitations for Mortar Materials:  
34 1. Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a  
35 single manufacturer for each cementitious component and from one (1) source or producer  
36 for each aggregate.

## 37 PART 3 - EXECUTION

### 38 3.1 INSTALLATION

- 39 A. Install products in accordance with manufacturer's instructions and ACI 530.1/ASCE 6/TMS 602.  
40 B. Use coarse grout in spaces with least dimension over 2 IN.  
41 C. Consolidate all grout while installing.  
42 1. Consolidate grout pours 12 IN or less in height by mechanical vibration or by puddling.  
43 2. Consolidate grout pours exceeding 12 IN in height by mechanical vibration and reconsolidate  
44 by mechanical vibration after initial water loss and settlement has occurred.

### 45 3.2 FIELD QUALITY CONTROL

- 46 A. Mortar:  
47 1. If standard gray mortar begins to stiffen, it may be retempered by adding water and remixing.  
48 a. Standard gray mortar shall not be retempered more than one (1) time.  
49 2. All mortar must be used within 2-1/2 HRS maximum after initial mixing per ACI 530.1/ASCE  
50 6/TMS 602.

- 1 B. Engineer reserves right to alter mix design based on initial rate of absorption of masonry units.
- 2 C. Masonry Grout:
- 3 1. Use grout within 1-1/2 HRS maximum after initial mixing.
- 4 2. Use no grout after it has begun to set.
- 5 3. Do not retemper grout after initial mixing.
- 6 4. Place grout in lifts not exceeding 4 FT.
- 7 D. Masonry Grout Testing:
- 8 1. Testing and inspection services will be provided by the Owner's special masonry inspector.
- 9 a. Do not include in the bid price the cost of these services.
- 10 2. Conduct compressive strength tests and slump tests on all masonry grout used during
- 11 masonry construction.
- 12 3. Perform all compressive strength test sampling, testing and reporting per ASTM C1019.
- 13 4. Perform all slump test sampling, testing, and reporting per ASTM C143.
- 14 5. Frequency of sampling: One (1) sample (three (3) specimens) collected each grouting
- 15 operation during masonry construction.
- 16 6. Compressive strength testing:
- 17 a. One (1) strength test shall be the average of three (3) specimens from the same sample,
- 18 tested at 28 days.

19

**END OF SECTION**

1 2014/09/08

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3

**SECTION 04155**  
**MASONRY ACCESSORIES**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6 A. Section Includes: Masonry accessories.

7 B. Related Specification Sections include but are not necessarily limited to:

- 8 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 9 2. Division 01 - General Requirements.
- 10 3. Section 04210 - Brick Masonry.
- 11 4. Section 04220 - Concrete Masonry.
- 12 5. Section 05505 - Metal Fabrications.

13 **1.2 QUALITY ASSURANCE**

14 A. Referenced Standards:

- 15 1. ASTM International (ASTM):
  - 16 a. A82, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
  - 17 b. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and
  - 18 Steel Products.
  - 19 c. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel
  - 20 Hardware.
  - 21 d. A580, Standard Specification for Stainless Steel Wire.
  - 22 e. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel
  - 23 Sheet, Strip, Plate, and Flat Bar.
  - 24 f. A951, Standard Specification for Steel Wire for Masonry Joint Reinforcement.
  - 25 g. A1008, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-
  - 26 Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution
  - 27 Hardened, and Bake Hardenable.
  - 28 h. D412, Standard Test Method for Vulcanized Rubber and Thermoplastic Elastomers -
  - 29 Tension.
  - 30 i. D624, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and
  - 31 Thermoplastic Elastomers.
  - 32 j. D2000, Standard Classification System for Rubber Products in Automotive Applications.
  - 33 k. D2240, Standard Test Method for Rubber Property—Durometer Hardness.
  - 34 l. D2287, Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer
  - 35 Molding and Extrusion Compounds.
- 36 2. Building Code:
  - 37 a. International Code Council (ICC):
    - 38 1) International Building Code and associated standards, 2006 Edition including all
    - 39 amendments, referred to herein as Building Code.

40 **1.3 SUBMITTALS**

41 A. Shop Drawings:

- 42 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 43 the submittal process.
- 44 2. Product technical data including:
  - 45 a. Acknowledgement that products submitted meet requirements of standards referenced.
  - 46 b. Manufacturer's installation instructions.
  - 47 c. Tear resistance of flashing material.
  - 48 d. Manufacturer's recommendations for flashing adhesive.
  - 49 e. Manufacturer's data sheet on each product.

1 **PART 2 - PRODUCTS**

2 **2.1 ACCEPTABLE MANUFACTURERS**

3 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

- 4 1. Weep vents for cavity wall construction:
- 5 a. Heckman Building Products Inc.
- 6 b. Hohmann & Barnard, Inc.
- 7 c. Wire Bond.
- 8 d. Mortar Net USA, Ltd.
- 9 2. Reglets:
- 10 a. Hohmann & Barnard, Inc.
- 11 b. W. P. Hickman Co.
- 12 c. Superior Concrete Accessories, Inc.
- 13 3. Masonry anchors, horizontal joint reinforcing, veneer anchors and miscellaneous anchors:
- 14 a. Heckman.
- 15 b. Hohmann & Barnard, Inc.
- 16 c. Wire Bond.
- 17 4. Thru wall flashing:
- 18 a. EPDM:
- 19 1) Carlisle Syntech Systems, Inc.
- 20 2) Firestone Building Products Co.
- 21 b. Stainless steel:
- 22 1) Heckman Building Products.
- 23 2) Hohmann & Barnard, Inc.
- 24 5. Weep joint mortar protection system:
- 25 a. Mortar Net USA, Ltd.
- 26 b. Hohmann & Barnard, Inc.
- 27 c. Wire Bond.
- 28 6. Preformed control joint inserts:
- 29 a. Hohmann & Barnard, Inc.
- 30 b. Wire Bond.
- 31 c. Illinois Products Corporation (IPCO).
- 32 7. Grout screen:
- 33 a. Wire Bond.
- 34 b. Heckman Building Products.
- 35 c. Hohmann & Barnard, Inc.

36 B. Submit request for substitution in accordance with Specification Section 01640.

37 **2.2 MANUFACTURED UNITS**

- 38 A. Thru Wall Flashing and Stainless Steel Drip:
- 39 1. 40 mil EPDM manufactured specifically for thru wall flashing.
- 40 a. Tear resistance: ASTM D624, 150 LB/IN minimum.
- 41 b. Width as required.
- 42 1) Provide single piece full width, no horizontal joints will be allowed unless approved
- 43 in writing by Engineer.
- 44 c. Factory precut wherever possible.
- 45 d. Factory fabricated inside and outside corners when available.
- 46 2. Stainless steel drip:
- 47 a. ASTM A666, Type 316.
- 48 b. Finish: ASTM A480, 2D.
- 49 c. Minimum 26 GA.
- 50 d. Maximum lengths of 10 FT.
- 51 1) Extend horizontally the full depth of veneer.
- 52 e. Factory fabricated.
- 53 f. Factory fabricated inside and outside corners with a minimum return of 16 IN on each
- 54 leg.
- 55 1) Weld all joints and grind smooth.
- 56 g. Provide 1/2 IN drip leg on exterior side of wall.
- 57 h. Refer to the Drawings for profile.
- 58 i. Lap sealant: VULKEM 922.

- 1 B. Flashing Adhesive: As recommended by flashing manufacturer for sealing laps, sealing to  
2 vertical masonry and concrete surfaces and sealing to stainless steel surfaces.
- 3 C. Weep Vent:  
4 1. 90 percent open mesh vent designed to be placed in vertical mortar joint.  
5 2. Mortar Net USA, Ltd. "Mortar Net Weep Vents."  
6 3. Color: Gray or White to match mortar color.
- 7 D. Veneer Anchorage System for New Concrete Back-up:  
8 1. Anchors, dovetail:  
9 a. Hot-dipped galvanized, ASTM A153/A153M. 16 GA corrugated steel with dovetail.  
10 1) 1 IN wide x 2 3/4 IN long minimum or as required by Project conditions.  
11 a) Provide minimum 2 IN embedment into veneer mortar joint.  
12 2. Dovetail slots:  
13 a. Hot-dipped galvanized, ASTM A153/A153M. 22 GA steel.  
14 b. 1 IN wide, 1 IN deep, nominal 5/8 IN throat with filler.
- 15 E. Horizontal Joint Reinforcing:  
16 1. General:  
17 a. Conform to ASTM A951.  
18 b. Cold drawn wire, stainless steel, ASTM A580, Type 316  
19 c. 9 GA side rods.  
20 d. 9 GA cross rods.  
21 e. Prefabricated corner and tee sections with minimum length of 30 IN from point of  
22 intersection.  
23 2. Single wythe wall joint reinforcing:  
24 a. Ladder design.  
25 3. Composite wall joint reinforcing: Ladder design with double side rod.  
26 4. Cavity wall joint reinforcing with masonry back-up:  
27 a. Ladder design horizontal joint reinforcing.  
28 b. Wire eyes welded to horizontal joint reinforcing.  
29 1) Length as required to project through rigid insulation into airspace.  
30 c. 3/16 IN DIA adjustable pintle veneer anchors.  
31 1) Length as required to provide minimum 2 IN embed into veneer mortar joint.  
32 d. Hohmann & Barnard "270 Ladder."
- 33 F. Mesh Wall Ties:  
34 1. Stainless steel, ASTM E437, Type 304.  
35 2. 16 GA, 1/2 IN square mesh.  
36 3. Width: 2 IN less than nominal wall thickness.  
37 4. Length: As necessary to embed minimum 6 IN into each wall.
- 38 G. Grout Screen:  
39 1. Polypropylene monofilament.  
40 2. 1/4 x 1/4 IN mesh.  
41 3. Width of grout screen to be 2 IN less than nominal width of CMU.
- 42 H. Weep Joint Mortar Protection System:  
43 1. 100 percent recycled polyester.  
44 2. 90 percent minimum open weave mesh.  
45 3. Minimum 10 IN high by full width of air cavity.
- 46 I. Preformed Rubber Control Joint Inserts:  
47 1. ASTM D2000, 2AA-805.  
48 2. Hardness: ASTM D2240, Shore A Durometer, 85 +/-5.  
49 3. Ultimate elongation: 350 percent, ASTM D412.  
50 4. Tensile strength: 1000 psi, ASTM D412.  
51 5. Hohmann & Barnard #RS Series.
- 52 J. Corrugated Wall Ties:  
53 1. Stainless steel, Type 316, ASTM A666.  
54 2. Minimum: 18 GA steel.  
55 3. Length to be 2 IN less than wall thickness.  
56 4. Hohmann & Barnard D/A CWT.

1 **PART 3 - EXECUTION**

2 **3.1 INSTALLATION**

- 3 A. Install products in accordance with manufacturer's instructions.
- 4 B. Thru Wall Flashing and Stainless Steel Drip:
- 5 1. Install to provide positive drainage of cavity moisture.
- 6 2. Extend stainless steel drip beyond the exterior face of the wall to minimum distance possible
- 7 while still allowing drip to perform intended purpose.
- 8 3. Extend flashing horizontally beyond each edge of lintel or sills to next vertical mortar joint but
- 9 not less than 4 IN and turn up edge one (1) full veneer course.
- 10 a. Seal all joints.
- 11 4. Where thru wall flashing and stainless steel drip steps up or down in the wall, provide end
- 12 dam at step.
- 13 a. End dam shall extend up or down to tie into thru wall flashing step.
- 14 b. Seal all joints for continuous watertight barrier.
- 15 5. Lap stainless steel drip minimum of 2 IN and bond two (2) pieces together using stainless
- 16 steel pop rivets and two (2) beads of lap sealant.
- 17 6. At concrete masonry unit back-up, install upper edge of flashing into block joint.
- 18 7. Adhere vertical surface of flashing to back-up wall with adhesive recommended by flashing
- 19 manufacturer.
- 20 8. Extend flashing minimum of 6 IN above top of weep joint mortar protection system. Lap and
- 21 seal flashing at all inside and outside corners to provide continuous uninterrupted barrier.
- 22 C. Weeps:
- 23 1. Provide open weep joints at maximum 16 IN OC in head joint of first course of veneer
- 24 immediately above thru wall flashing.
- 25 a. Omit mortar bed on top of thru wall flashing at each open weep joint location to allow
- 26 moisture an unobstructed path to the exterior.
- 27 b. Weep joints shall be not more than one (1) brick course high.
- 28 2. Provide weep vents maximum 16 IN OC in top of head joint of top course of veneer or as
- 29 indicated on Drawings.
- 30 a. Do not use weep vents in weep joints at the bottom of the wall.
- 31 b. Set weep vents back away from face of veneer slightly so the front edge of the vent is
- 32 contained within the mortar joint.
- 33 D. Weep Joint Mortar Protection System:
- 34 1. Install continuous row(s) of material.
- 35 2. Provide multiple thicknesses of material compressed as necessary to completely fill the
- 36 entire air cavity.
- 37 3. Set material directly on top of thru wall flashing.
- 38 E. Butt joints of preformed control joint inserts tightly together and secure with adhesive or sealant
- 39 acceptable to insert manufacturer.
- 40 F. Anchoring Veneer:
- 41 1. Veneer with concrete block back-up:
- 42 a. Anchor veneer to new construction using horizontal joint reinforcing and adjustable pintle
- 43 veneer anchors.
- 44 2. Veneer with concrete back-up:
- 45 a. Anchor veneer to new construction using dovetail anchors and slots.
- 46 G. Reinforcing Masonry:
- 47 1. General:
- 48 a. Provide continuous horizontal joint reinforcing in all concrete masonry wall construction.
- 49 1) Embed longitudinal side rods in mortar for entire length with minimum cover of 5/8
- 50 IN on exterior side of walls and 1/2 IN at other locations.
- 51 a) For interior partitions, the "exterior" side of the wall is considered the side
- 52 having the most corrosive atmosphere or the corridor side of the wall.
- 53 2) Lap reinforcement minimum of 12 IN at ends.
- 54 a) Remove cross wires on one (1) side of the lap splice and bend the side rods
- 55 slightly so the lap is provided with 12 IN of uninterrupted wire lap occurring in
- 56 the same plane.
- 57 3) Do not bridge control joints with horizontal joint reinforcing.



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- 4) Do not bridge expansion joints with horizontal joint reinforcing.
- 5) At corners and wall intersections use prefabricated "L" and "T" horizontal joint reinforcing sections.
- 6) Cut and bend as required.
- b. Install reinforcing at 16 IN OC vertically unless noted otherwise on Drawings.
- c. Install reinforcing 8 IN OC vertically for a minimum of 24 IN at starter courses.
  - 1) Do not install horizontal joint reinforcing in veneer mortar joint having through-wall flashing.
- d. Install horizontal joint reinforcing and adjustable pintle veneer anchors at 8 IN OC in parapets.
  - 1) Parapets begin at the course immediately above the top of the roof structural member or top of concrete topping slab on precast roof structure.
- e. Install additional horizontal joint reinforcing and adjustable pintle veneer anchors 16 IN OC in courses on each side of vertical control joints and on each jamb of openings for full height of joint or opening.
  - 1) Alternate with normal wall horizontal joint reinforcing.
  - 2) Extend reinforcing minimum 32 IN beyond joint or jambs of opening.
- f. Reinforce masonry openings over 12 IN wide with horizontal joint reinforcing and adjustable pintle veneer anchors placed in three (3) horizontal joints above lintel and two (2) horizontal joints below sill.
  - 1) Extend minimum of 32 IN beyond jambs of opening.
- 2. Reinforcing concrete masonry:
  - a. Install reinforcing bars where indicated on Drawings.
    - 1) Provide means necessary to ensure position of vertical steel reinforcing meets requirements of Building Code.
  - b. At intersecting walls provide mesh wall ties in mortar joint at 16 IN OC vertically.
    - 1) Extend minimum 6 IN into each wall.
    - 2) Alternate mesh wall ties with horizontal joint reinforcing.
- 3. Repair all galvanized coatings damaged as a result of welding.
  - a. See Specification Section 05505 for galvanizing repair system.

**END OF SECTION**

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1 2014/09/08

2 **SECTION 04210**  
3 **BRICK MASONRY**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes: Brick masonry.
- 7 B. Related Specification Sections include but are not necessarily limited to:
- 8 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 9 2. Division 01 - General Requirements.
- 10 3. Section 04050 - Cold and Hot Weather Masonry Construction.
- 11 4. Section 04110 - Cement and Lime Mortars.
- 12 5. Section 04155 - Masonry Accessories.
- 13 6. Section 04510 - Masonry Cleaning.
- 14 7. Section 07900 - Joint Sealants.

15 **1.2 QUALITY ASSURANCE**

- 16 A. Referenced Standards:
- 17 1. ASTM International (ASTM):
- 18 a. C216, Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or
- 19 Shale).
- 20 B. All brick provided on this Project shall be from same production run.
- 21 1. Produce special shapes and solid units in manner which will ensure matching of color and
- 22 texture with field brick.
- 23 a. Solid units shall be 100 percent solid.
- 24 2. Special shapes shall be factory fabricated unless noted otherwise.

25 **1.3 SUBMITTALS**

- 26 A. Shop Drawings:
- 27 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 28 the submittal process.
- 29 2. Product technical data including:
- 30 a. Acknowledgement that products submitted meet requirements of standards referenced.
- 31 b. Manufacturer's installation instructions.
- 32 B. Samples:
- 33 1. Minimum 12 x 12 IN banded brick sample incorporating actual brick and mortar color being
- 34 used on Project for Engineer review.
- 35 2. Brick proposed for matching existing brick.

36 **1.4 DELIVERY, STORAGE, AND HANDLING**

- 37 A. Deliver units on pallets with tight covers or deliver in cubes and store on dunnage.
- 38 B. Inspect masonry upon delivery to assure color match with mock-up and dimensional quality and
- 39 trueness of brick units.
- 40 C. Remove unacceptable units from the Project Site.

1 **PART 2 - PRODUCTS**

2 **2.1 ACCEPTABLE MANUFACTURERS**

- 3 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:  
4 1. Brick:  
5 a. Endicott Clay Products Co.  
6 b. Sioux City Brick.  
7 c. Yankee Hill Brick & Tile.  
8 B. Submit request for substitution in accordance with Specification Section 01640.

9 **2.2 MATERIALS**

- 10 A. Brick:  
11 1. Size: Match existing.  
12 2. Color range: Match existing.  
13 3. ASTM C216, Type FBX, Grade SW.  
14 4. Include in bid special shaped, sized or cut brick units required for complete installation.  
15 a. Special shaped brick shall be fabricated in manufacturing plant and shall not be field  
16 fabricated by saw cutting unless otherwise noted.  
17 B. Accessories: See Specification Section 04155.

18 **PART 3 - EXECUTION**

19 **3.1 INSTALLATION**

- 20 A. Install products in accordance with manufacturer's instructions.  
21 B. Verify that all required accessory items are correct.  
22 C. General:  
23 1. Build in flashing, reinforcing, weeps, vents and related accessory items.  
24 a. See Specification Section 04155 for installation of accessory items.  
25 2. Install field brick in running bond.  
26 a. Provide special coursing where indicated on the Drawings.  
27 3. Perform all cutting with masonry saws using saw blades as recommended by masonry unit  
28 manufacturer.  
29 4. Drill holes with power drill using drill bits as recommended by masonry unit manufacturer.  
30 5. Holes made by chipping not acceptable.  
31 6. Cut as required to provide pattern required.  
32 7. Use 100 percent solid units where cutting or laying would expose holes.  
33 a. Fill solid with mortar all units in first course directly below thru wall flashing.  
34 b. Miter all brick at corners.  
35 8. Avoid use of less than half size units whenever possible.  
36 9. Do not install damaged units.  
37 10. Wet brick having absorption rates greater than 0.025 OZ/SI/MIN.  
38 a. Wet brick in accordance with manufacturer's instructions.  
39 D. Laying and Tooling:  
40 1. Lay out walls in advance for uniform and accurate spacing of bond patterns and joints.  
41 a. Properly locate openings, movement type joints, returns and offsets.  
42 2. Lay brick with completely filled bed and head joints except at weep locations.  
43 a. Omit mortar from head joint at weep joint locations.  
44 b. Butter ends with sufficient mortar to completely fill head joints and shove into place.  
45 c. Do not slush head joints.  
46 d. See Specification Section 04110 for mortar and grout.  
47 e. In cavity wall construction, taper mortar on inside edge of veneer to prevent mortar from  
48 falling into cavity.  
49 f. Protect cavity during laying of brick as required to prevent mortar droppings from filling  
50 cavity.  
51 g. Install weep joint mortar protection system in cavity per Specification Section 04155.

- 1 3. Maintain nominal 3/8 IN joint widths.
- 2 a. Cut joints flush where concealed.
- 3 b. Tool exposed joints concave.
- 4 c. Compress mortar in below grade joints.
- 5 d. Provide wider joints where noted on the Drawings.
- 6 e. Where brick sets on top of steel support, omit the mortar joint on top of the support
- 7 under the brick and set the brick directly on the thru wall flashing or the steel support
- 8 member unless a mortar joint is required to maintain coursing.
- 9 4. During tooling of joints, enlarge any voids or holes, except weep joints, and completely fill
- 10 with mortar.
- 11 5. Point-up all joints at corners, openings and adjacent work to provide neat, uniform
- 12 appearance.
- 13 6. Remove brick units disturbed after laying.
- 14 a. Clean and relay in fresh mortar.
- 15 b. Do not pound units to fit.
- 16 c. If adjustments are required, remove units, clean and reset in fresh mortar.
- 17 7. Where work is stopped and later resumed, rake back 1/2 brick unit length in each course.
- 18 a. Wet units lightly.
- 19 b. Remove loose units and mortar prior to laying fresh masonry.
- 20 8. As work progresses, build-in items indicated and specified.
- 21 a. Fill in solidly with mortar around built-in items.
- 22 E. Control Joints and Sealants:
- 23 1. Provide vertical expansion, control and isolation joints where indicated.
- 24 a. Where not indicated provide at maximum 16 FT OC.
- 25 b. Rake out all mortar from joint.
- 26 1) Exercise care not to damage thru wall flashing when cleaning mortar from vertical
- 27 joints.
- 28 c. Locate control joints at points of natural weakness in masonry.
- 29 2. See Specification Section 07900 for sealant installation requirements.

### 30 3.2 FIELD QUALITY CONTROL

- 31 A. Protect against weather when work is not in progress.
- 32 1. Cover top of walls with waterproof translucent membrane, extend at least 4 FT down both
- 33 sides of wall and anchor in place.
- 34 B. Protect against cold and hot weather as specified in Specification Section 04050.
- 35 C. Remove and replace loose, stained, or damaged bricks.
- 36 1. Provide new units to match.
- 37 2. Install in fresh mortar.
- 38 3. Point to eliminate evidence of replacement.
- 39 D. Tolerances:
- 40 1. Maximum variation from plumb in vertical lines and surfaces of columns, walls and arises:
- 41 a. 1/4 IN in 10 FT.
- 42 b. 3/8 IN in a story height not to exceed 20 FT.
- 43 c. 1/2 IN in 40 FT or more.
- 44 2. Maximum variation from plumb for external corners, expansion joints and other conspicuous
- 45 lines:
- 46 a. 1/4 IN in any story or 20 FT maximum.
- 47 b. 1/2 IN in 40 FT or more.
- 48 3. Maximum variation from level of grades for exposed lintels, sills, parapets, horizontal grooves
- 49 and other conspicuous lines:
- 50 a. 1/4 IN in any bay or 20 FT.
- 51 b. 1/2 IN in 40 FT or more.
- 52 4. Maximum variation from plan location of related portions of columns, walls and partitions:
- 53 a. 1/2 IN in any bay or 20 FT.
- 54 b. 3/4 IN in 40 FT or more.
- 55 5. Maximum variation in cross-sectional dimensions of columns and thicknesses of walls from
- 56 dimensions shown on Drawings:
- 57 a. Minus 1/4 IN.
- 58 b. Plus 1/2 IN.

- 1                   6. Maximum variation in mortar joint width:  
2                   a. Bed joints: 3/32 IN in 10 FT.  
3                   b. Head joints:  
4                    1) Minus 1/8 IN.  
5                    2) Plus 1/4 IN.
- 6                   E. Inspect wall to ensure that mortar droppings have not plugged weep joints or weep vents.
- 7                   **3.3 CLEANING**
- 8                   A. Clean brick masonry as wall is being constructed using fiber brush, wooden paddles and  
9                   scrapers.  
10                  1. After all brick construction is complete, wash wall using specified brick cleaning solution.  
11                  2. Refer to Specification Section 04510.

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**END OF SECTION**

1 2014/09/10

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**SECTION 04220**  
**CONCRETE MASONRY**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6 A. Section Includes:

- 7 1. Concrete masonry construction (CMU).
- 8 2. Cast stone sills and coping.
- 9 3. Integral water repellent admixture.

10 B. Related Specification Sections include but are not necessarily limited to:

- 11 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 12 2. Division 01 - General Requirements.
- 13 3. Division 03 - Concrete.
- 14 4. Section 04050 - Cold and Hot Weather Masonry Construction.
- 15 5. Section 04110 - Cement and Lime Mortars.
- 16 6. Section 04155 - Masonry Accessories.
- 17 7. Section 04210 - Brick Masonry.
- 18 8. Section 07210 - Building Insulation.
- 19 9. Section 07900 - Joint Sealants.

20 **1.2 QUALITY ASSURANCE**

21 A. Referenced Standards:

- 22 1. American Concrete Institute (ACI)/American Society of Civil Engineers (ASCE)/The Masonry  
23 Society (TMS):
  - 24 a. ACI 530.1/ASCE 6/TMS 602, Specification for Masonry Structures.
- 25 2. ASTM International (ASTM):
  - 26 a. C33, Standard Specification for Concrete Aggregates.
  - 27 b. C90, Standard Specification for Loadbearing Concrete Masonry Units.
- 28 3. National Concrete Masonry Association (NCMA):
  - 29 a. TEK 2-3A, Architectural Concrete Masonry Units.
  - 30 b. TEK 3-4B, Bracing Concrete Masonry Walls During Construction.
- 31 4. Building Code:
  - 32 a. International Code Council (ICC):
    - 33 1) International Building Code and associated standards, 2006 Edition including all  
34 amendments, referred to herein as Building Code.

35 B. All masonry units of any one (1) particular type, color or face style shall be from the same  
36 production run.

- 37 1. Special shapes shall be factory fabricated unless noted otherwise.

38 **1.3 DEFINITIONS**

- 39 A. Definitions to be in accordance with Standard Unit Nomenclature Table 1, NCMA TEK 2-3A.

40 **1.4 SUBMITTALS**

41 A. Shop Drawings:

- 42 1. See Specification Section 01340 for requirements for the mechanics and administration of  
43 the submittal process.
- 44 2. Product technical data including:
  - 45 a. Manufacturer's information on aggregate and cement type used in manufacture.
- 46 3. Certifications:
  - 47 a. Certification that concrete masonry units meet or exceed requirements of standards  
48 referenced.
  - 49 b. Certification that concrete masonry units meet all requirements for strength, absorption,  
50 density, moisture content and dimensions when tested according to ASTM C140.

- 1 4. Qualifications of testing lab and technician.
- 2 5. Test results for all masonry testing.
- 3 B. Informational Submittals:
- 4 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 5 the submittal process.

## 6 **1.5 DELIVERY, STORAGE, AND HANDLING**

- 7 A. Deliver units on pallets with tight covers or deliver in cubes and store on dunnage.
- 8 B. Protect units from damage.
- 9 C. Inspect units upon delivery for damage, to assure color match with mock-up or approved
- 10 samples, dimensional quality, and trueness of unit.
- 11 1. Remove damaged or otherwise unacceptable units from the Project Site.
- 12 D. Store units in accordance with manufacturer's recommendations.

## 13 **PART 2 - PRODUCTS**

### 14 **2.1 MATERIALS**

- 15 A. Concrete Masonry Units:
- 16 1. Modular units, ASTM C90.
- 17 a. Provide aggregate in accordance with ASTM C33.
- 18 b. Total linear drying shrinkage: ASTM C90.
- 19 c. Weight: Minimum of 125 LB/CF.
- 20 d. Medium weight or light weight units are not acceptable.
- 21 2. Face shell and web thickness: ASTM C90, Table 1.
- 22 3. Water absorption: ASTM C90 Table 2.
- 23 4. Concrete bricks of same material, texture and quality.
- 24 5. Compressive strength: ASTM C90, Table 2.
- 25 6. Dimensional tolerance: ASTM C90.
- 26 B. Reinforcing Bars: Refer to Specification Section 03208 and as indicated on Drawings.
- 27 C. Mortar: Refer to Specification Section 04110.
- 28 D. Masonry Grout: Refer to Specification Section 04110.
- 29 E. Masonry Accessories: Refer to Specification Section 04155.
- 30 F. Sealants: Refer to Specification Section 07900.

### 31 **2.2 FABRICATION**

- 32 A. Concrete Masonry Units:
- 33 1. Color: Standard gray.
- 34 2. Design compressive strength:  $f_m=1,500$  psi minimum.
- 35 a. Determine in accordance with unit strength method per ACI 530.1/ASCE 6/TMS 602.
- 36 3. Fabricated in the manufacturing plant.
- 37 4. Provide square corners.
- 38 B. Cast Stone:
- 39 1. Fabricate in the manufacturing plant.
- 40 2. Fabricate sizes and profiles indicated on Drawings.
- 41 a. See Specification Section 03208 for reinforcing.
- 42 3. Provide a smooth steel form finish on all concealed surfaces, fill all holes and grind off all fins
- 43 and projections in accordance with Specification Section 03348.
- 44 4. Provide acid washed finish on exposed surfaces.



1 **PART 3 - EXECUTION**

2 **3.1 PREPARATION**

- 3 A. Verify that anchors and flashings are correct.
- 4 B. Lay out walls in advance for uniform and accurate spacing of bond patterns and joints.
- 5 1. Properly locate openings, movement type joints, returns, and offsets weep joints and weep
- 6 vents.

7 **3.2 INSTALLATION**

- 8 A. Install products in accordance with manufacturer's instructions.
- 9 B. General:
- 10 1. Build in flashing, reinforcing, weeps, weep vents and related accessory items.
- 11 a. See Specification Section 04155 for installation of accessory items.
- 12 2. Perform all cutting with masonry saws using saw blades as recommended by masonry unit
- 13 manufacturer.
- 14 3. Drill holes with power drill using drill bits as recommended by masonry unit manufacturer.
- 15 4. Holes made by chipping unit will not be accepted.
- 16 5. Install field units in running bond.
- 17 a. Provide special coursing where indicated on the Drawings.
- 18 6. Cut as required to maintain bond pattern.
- 19 7. Use solid units where cutting or laying would expose holes and as noted on Drawings.
- 20 8. Avoid use of less than half size units, whenever possible.
- 21 9. Do not use chipped, cracked, spalled, stained or imperfect units exposed in finish work.
- 22 10. Do not wet concrete masonry units.
- 23 11. Build chases and recesses as indicated and required for work of other trades.
- 24 a. Provide not less than 8 IN of masonry between chase or recess and jamb of openings,
- 25 and between adjacent chases and recesses unless detailed otherwise on the Drawings.
- 26 C. Laying and Tooling:
- 27 1. Lay masonry units with completely filled bed and head joints.
- 28 a. Provide full mortar bed on all block cross webs and completely fill head joints.
- 29 1) Do not slush head joints.
- 30 2) Protect cells requiring grout fill from mortar droppings.
- 31 3) Omit mortar from head joint at weep joint opening.
- 32 b. In cavity wall construction, taper mortar on inside edge of veneer and outside edge of
- 33 masonry back-up to prevent mortar from falling into cavity.
- 34 c. Protect cavity during laying of masonry as required to prevent mortar droppings from
- 35 filling cavity.
- 36 d. Install weep joint mortar protection system in cavity per Specification Section 04155.
- 37 2. Maintain nominal 3/8 IN joint widths.
- 38 a. Cut joints flush where concealed.
- 39 b. Tool exposed joints concave.
- 40 c. Compress mortar in below ground joints and in joints concealed by insulation in cavity
- 41 wall construction.
- 42 d. Provide wider joints where necessary to maintain coursing or as noted on Drawings.
- 43 1) In no case shall any mortar joint be more than 3/4 IN wide.
- 44 e. Where masonry sits on top of steel support omit the mortar joint on top of the support
- 45 and sit masonry directly on top of the thru wall flashing or the steel support member
- 46 unless a mortar joint is required to maintain coursing.
- 47 3. Point-up all joints at corners, openings, and adjacent work to provide neat, uniform
- 48 appearance.
- 49 4. Remove masonry disturbed after laying.
- 50 a. Clean and relay in fresh mortar.
- 51 b. Do not pound units to fit.
- 52 c. If adjustments are required, remove units, clean, and reset in fresh mortar.
- 53 5. Where work is stopped and later resumed, rack back 1/2 masonry unit length in each course.
- 54 a. Remove loose units and mortar prior to laying fresh masonry.
- 55 6. As work progresses, build in items indicated on Drawings and specified.
- 56 a. Fill in solidly with mortar around built-in items.

- 1                   b. Where built-in items are to be embedded in cores of hollow masonry units, place grout  
2                   screen in joint below and fill core solid with mortar.
- 3           D. Control Joints and Sealants:
- 4           1. Provide vertical expansion, control and isolation joints where indicated on Drawings.
- 5           2. Where not indicated on Drawings, submit proposed control joint locations in accordance with  
6           the following requirements:
- 7           a. Provide control joints at maximum 24 FT OC.
- 8           b. Provide at all T intersections.
- 9           c. Locate joints so as to allow lintels and bond beams above and below openings to extend  
10           beyond the opening as indicated on the Drawings without control joints thru the lintel or  
11           bond beam.
- 12           3. Rake out mortar in joint.
- 13           4. Refer to Specification Section 07900 for sealant installation requirements.
- 14           a. Seal control and expansion joints.
- 15           E. Tolerances:
- 16           1. Maximum variation from plumb in vertical lines and surfaces of columns, walls, and arises:
- 17           a. 1/4 IN in 10 FT.
- 18           b. 3/8 IN in a story height not to exceed 20 FT.
- 19           c. 1/2 IN in 40 FT or more.
- 20           2. Maximum variation from plumb for external corners, expansion joints, and other conspicuous  
21           lines:
- 22           a. 1/4 IN in any story or 20 FT maximum.
- 23           b. 1/2 IN in 40 FT or more.
- 24           3. Maximum variation from level of grades for exposed lintels, sills, parapets, horizontal  
25           grooves, and other conspicuous lines:
- 26           a. 1/4 IN in any bay or 20 FT.
- 27           b. 1/2 IN in 40 FT or more.
- 28           4. Maximum variation from plan location of related portions of columns, walls, and partitions:
- 29           a. 1/2 IN in any bay or 20 FT.
- 30           b. 3/4 IN in 40 FT or more.
- 31           5. Maximum variation in cross-sectional dimensions of columns and thicknesses of walls from  
32           dimensions shown on Drawings:
- 33           a. Minus 1/4 IN.
- 34           b. Plus 1/2 IN.
- 35           6. Maximum variation in mortar joint width:
- 36           a. Bed joints: 3/32 IN in 10 FT.
- 37           b. Head joints:
- 38           1) Minus 1/8 IN.
- 39           2) Plus 1/8 IN.
- 40           F. Protect against weather when work is not in progress.
- 41           1. During inclement weather conditions, cover top of walls with translucent waterproof  
42           membrane.
- 43           2. See Specification Section 04050.
- 44           G. Protect against cold/hot weather as specified in Specification Section 04050.

45   **3.3 FIELD QUALITY CONTROL**

- 46           A. Bracing Concrete Masonry Walls During Construction:
- 47           1. At a minimum, provide bracing in accordance with NCMA TEK 3-4B.
- 48           2. Contractor is responsible for adequately bracing all masonry during construction.
- 49           B. Remove and replace loose, stained, damaged and other unacceptable units as directed by  
50           Engineer.
- 51           1. Provide new units to match.
- 52           2. Install in fresh mortar.
- 53           3. Point to eliminate evidence of replacement.
- 54           C. Special Masonry Inspection:
- 55           1. Masonry inspection services will be provided during the following construction activities:
- 56           a. Cost of masonry inspection services will be paid by Owner.

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- b. During laying of units:
  - 1) During the first day of the masonry construction, inspect proportions of site prepared mortar, construction of mortar joints, location of all reinforcing and connectors, size and location of structural elements, type, size and location of anchors, protection of masonry during cold weather.
  - 2) Inspection to be continuous the first full day of masonry construction which requires special inspection.
    - a) Thereafter, a minimum of 3 HRS every third day of construction until the concrete masonry work is complete.
  - 3) Inspection while laying masonry units may be made concurrently with other inspection duties provided all inspection duties are adequately performed.
  - 4) When deficiencies are found, additional inspection shall be provided as required until deficiencies have been corrected.
  - 5) If masonry crews change, an additional full day of inspection is required during the first day the new crew is on-site.
- c. Placement of reinforcing steel:
  - 1) Verification of all reinforcing including size, grade, lap lengths, and type.
  - 2) Inspection may be periodic as required to verify all reinforcing.
  - 3) Inspector to be present during the concrete pour in which any dowels connecting concrete to masonry are cast to verify proper location of dowels.
- d. Prior to each grouting operation, verify that grout space is clean, reinforcing is clean and connectors are properly placed, proportions of site-prepared grout are correct and mortar joints have been properly constructed.
  - 1) Inspection may be periodic as required to verify proper grout space.
- e. Verify compliance with Building Code and Specifications continuously during all grouting operations.
- f. Provide special inspection in accordance with the Building Code Table 1704.5.1 including observation of masonry work for conformance to the Contract Documents:
  - 1) Provide inspection reports to the Engineer, Building Official and Owner.
    - a) Notify Contractor of discrepancies for correction.
    - b) Notify Engineer, Building Official and Owner, in writing, when discrepancies have been satisfactorily corrected.
  - 2) Submit final signed report stating that work requiring special inspection was, to the best of the inspector's knowledge, in conformance to the Contract Documents and the applicable workmanship provisions of the Building Code.

**3.4 CLEANING**

- A. Clean concrete masonry as the wall is being constructed using fiber brushes, wooden paddles and scrapers.
  - 1. No acid-based cleaning solutions shall be used unless approved in writing by Engineer.

**END OF SECTION**



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**SECTION 04510**  
**MASONRY CLEANING**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes: Masonry cleaning.
- 7 B. Related Sections include but are not necessarily limited to:
- 8 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 9 2. Division 01 - General Requirements.

10 **1.2 QUALITY ASSURANCE**

- 11 A. Qualifications: Use experienced workmen familiar with product and its application.

12 **1.3 SUBMITTALS**

- 13 A. Shop Drawings:
- 14 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 15 the submittal process.
- 16 2. Product technical data including:
- 17 a. Manufacturer's application instructions.
- 18 b. Manufacturer's dilution recommendations.
- 19 c. Manufacturer's recommendations on neutralizing rinse.
- 20 B. Certifications: Certification that Contractor is experienced in this type of masonry cleaning.

21 **PART 2 - PRODUCTS**

22 **2.1 ACCEPTABLE MANUFACTURERS**

- 23 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 24 1. Cleaning solution: Detergent type.
- 25 a. Pro So Co.
- 26 b. Diedrich Technologies, Inc.
- 27 2. Cleaning solution for manganese or vanadium stained masonry:
- 28 a. Pro So Co.
- 29 b. Diedrich Technologies, Inc.
- 30 B. Submit request for substitution in accordance with Specification Section 01640.

31 **2.2 MATERIALS**

- 32 A. Detergent-Type Cleaning Solution: Pro So Co. "Sure Clean #600" detergent masonry cleaner.
- 33 B. Manganese or Vanadium-Stained Masonry: Pro So Co. "Vanatrol."
- 34 C. Water: Potable.
- 35 D. Neutralizing rinse as required by manufacturer.

36 **2.3 MIXES**

- 37 A. Dilute cleaning solution with potable water at rate which will provide for the weakest solution
- 38 allowable for cleaning wall.
- 39 B. If project conditions require solution of greater than 5 percent acid, obtain permission from
- 40 Engineer in writing prior to applying solution to wall surface.

1 **PART 3 - EXECUTION**

2 **3.1 PREPARATION**

- 3 A. Allow 28 days after completion of masonry work before start of cleaning.
- 4 B. Remove excess mortar using wooden paddles and scrapers.
- 5 C. Protect adjacent surfaces not to be cleaned.

6 **3.2 APPLICATION**

- 7 A. Protect adjacent surfaces subject to potential damage by cleaning solution.
- 8 B. Apply masonry cleaner to exposed-to-view masonry surfaces.
  - 9 1. Do not use wire brushes.
  - 10 2. Use only tools free of rust.
  - 11 3. Apply solution using fibered wall-washing brush.
- 12 C. Thoroughly rinse and pre-soak walls.
- 13 D. Flush all loose mortar and dirt from surface.
- 14 E. Wet to prevent "run-off" streaking.
- 15 F. Scrape off mortar and reapply cleaning solution.
- 16 G. After scrubbing, clean thoroughly with pressurized water.
- 17 H. Apply neutralizing rinse as recommended by manufacturer.

18

**END OF SECTION**



DIVISION 05

METALS







1 2014/09/10

2

## SECTION 05313

3

### METAL DECK

#### 4 PART 1 - GENERAL

##### 5 1.1 SUMMARY

6

A. Section Includes: Manufactured metal roof deck.

7

B. Related Specification Sections include but are not necessarily limited to:

8

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

9

2. Division 01 - General Requirements.

10

3. Section 05505 - Metal Fabrications.

11

4. Section 09960 - High Performance Industrial Coatings (HPIC).

12

##### 1.2 QUALITY ASSURANCE

13

A. Referenced Standards:

14

1. American Iron and Steel Institute (AISI):

15

a. S100, Specification for the Design of Cold-Formed Steel Structural Members.

16

2. ASTM International (ASTM):

17

a. A36/A36M, Standard Specification for Carbon Structural Steel.

18

b. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

19

c. A780/A780M, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

22

d. A924/A924M, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

23

e. A1008/A1008M, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

24

f. D746, Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.

25

g. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.

26

3. American Welding Society (AWS):

27

a. D1.1/D1.1M, Structural Welding Code - Steel.

28

b. D1.3/D1.3M, Structural Welding Code - Sheet Steel.

29

4. Steel Deck Institute (SDI):

30

a. 31, Design Manual for Composite Decks, Form Decks and Roof Decks.

31

5. Underwriters Laboratories, Inc. (UL):

32

a. Fire Resistance Directory.

33

B. Qualifications:

34

1. Manufacturer:

35

a. Member of SDI.

36

b. Structural design of manufactured deck shall be prepared by a qualified professional engineer retained by the manufacturer.

37

2. Welding work:

38

a. Qualify welding processes, operations, and operators in accordance with requirements of AWS D1.1 and AWS D1.3.

39

b. Welding operators to have been qualified during the 12 month period prior to commencement of welding, and be experienced in welding light gage metal.

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##### 1.3 SUBMITTALS

49

A. Shop Drawings:

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1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

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2. Fabrication and/or layout Drawings:
    - a. Detailed Shop Drawings showing the following:
      - 1) Complete framing and erection layouts.
      - 2) Location, length, type, cross section, thickness, and markings of metal deck units.
        - a) Size and location of openings.
        - b) Accessories and reinforcing.
      - 3) Sequence and procedure to be followed for erecting, fastening, and securing the deck units.
      - 4) Shop applied coatings.
      - 5) Details and gages of accessories and miscellaneous items showing sump pans, cant strips, ridge and valley plates, closure and filler strips and insulation supports.
      - 6) Welding procedures for installation including size, number, type and location of all welds required to install deck units.
      - 7) Recommended welding rod size, type, burn off rate and welder setting for deck thickness to be joined.
        - a) Define welds by use of standard AWS welding symbols.
      - 8) Correct fitting of members and accessories.
      - 9) Size and location of all openings in deck and all conditions requiring closure panels and supplementary framing.
      - 10) Shop Drawings shall not be reproductions of the Contract Drawings.
    3. Product technical data including:
      - a. Metal deck manufacturer's specifications and installation instructions.
      - b. Manufacturer's specifications and installation instructions for:
        - 1) Welds and welding procedure.
        - 2) Galvanizing repair paint.
        - 3) Screws.
        - 4) Joint sealing compound.
      - c. Manufacturer's load tables for deck to be furnished on this project, including:
        - 1) Allowable gravity load for metal roof deck.
        - 2) Allowable diaphragm shear values for metal roof deck.
        - 3) Allowable superimposed load for metal deck.
    4. Manufacturers certification that metal deck complies with specified requirements:
      - a. Manufacturer member of SDI.
      - b. Deck material, manufacturing, and shop testing and inspection are in accordance with SDI requirements.
      - c. Welder qualifications.
    5. Test reports.

#### 38 1.4 DELIVERY, STORAGE, AND HANDLING

- 39 A. Deliver, store, and handle metal deck as recommended by SDI.
  - 40 1. Exercise care to avoid damage to deck.
- 41 B. Protect materials from rusting, denting or crushing.
  - 42 1. Store metal deck on project site off the ground with one end elevated to provide drainage
  - 43 and protected from the elements with a waterproof covering, ventilated to avoid
  - 44 condensation.
  - 45 2. Prevent rust, deterioration and accumulation of foreign material.

#### 46 1.5 PROJECT CONDITIONS

- 47 A. Do not overload supporting members.
  - 48 1. Until the entire assembly is complete, the structural elements may not be stable or capable of
  - 49 supporting code or stated design loads.

## 50 PART 2 - PRODUCTS

### 51 2.1 ACCEPTABLE MANUFACTURERS

- 52 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 53 1. 1-1/2 IN deep metal roof deck:
    - 54 a. Vulcraft.

- 1                    b. Verco Decking, Inc.
- 2                    c. New Millennium Building Systems.
- 3                    d. Consolidated Systems, Inc.
- 4                    e. DACS, Inc.
- 5                    B. Submit request for substitution in accordance with Specification Section 01640.

6                    **2.2 METAL ROOF DECK**

- 7                    A. Design of the metal deck to be supplied to have been checked by SDI and found to conform to
- 8                    the standard specifications and load tables.
- 9                    1. The allowable superimposed live uniform loading per square foot for metal roof deck supplied
- 10                    for the spans indicated shall equal or exceed the allowable superimposed live uniform load
- 11                    per square foot for the same spans as indicated in the SDI latest tables.
- 12                    2. Maximum deflection: Less than 1/240 of span under live load.
- 13                    B. Use deck configurations complying with SDI 31 and as indicated.
- 14                    1. Painted deck: ASTM A1008.
- 15                    2. Galvanized deck: ASTM A653 with ASTM A924 G60 zinc coating.
- 16                    C. Metal Roof Deck, 1-1/2 IN Deep:
- 17                    1. Rib type 1.5B, sheet steel, 20 GA, minimum galvanized.
- 18                    2. Wide rib deck: Ribs spaced approximately 6 IN OC; width of rib opening at top surface
- 19                    maximum 2-1/2 IN; width of bottom rib surface minimum 1-3/4 IN.

20                    **2.3 FABRICATION**

- 21                    A. Standard Deck Profiles:

DEPTH	TYPE	RIB SPACING	TOP SURFACE MAXIMUM RIB OPENING	MINIMUM BOTTOM OF RIB WIDTH
1-1/2 IN	Roof Deck - Wide Rib ('B')	6 IN	2-1/2IN	1-3/4 IN

- 23
- 24                    B. Minimum Deck Thickness:
- 25                    1. Where gage of metal is indicated, provide the minimum uncoated thickness as specified by
- 26                    SDI.
- 27                    a. Delivered thickness of the uncoated steel: No less than 95 percent of the design
- 28                    thickness.
- 29                    2. Use steel with a minimum yield stress of 33 ksi.
- 30                    C. Fabrication:
- 31                    1. Fabricate deck units in lengths to span three or more support spacings with flush, telescoped
- 32                    or nested 2 IN end laps.
- 33                    a. End laps shall occur on supporting members.
- 34                    b. Provide deck units having overlapping male and female type side laps or joints to
- 35                    provide positive vertical and lateral alignment of adjacent deck units.

36                    **2.4 ACCESSORIES**

- 37                    A. Metal Closures:
- 38                    1. Form to configuration required to provide tight-fitting closures at open ends and sides of
- 39                    deck.
- 40                    2. Minimum thickness before galvanizing: 0.0358 IN (20 GA).
- 41                    B. Welding Washers:
- 42                    1. 16 GA bent steel plate with 3/8 IN center hole.
- 43                    2. Use at all deck units thinner than 20 GA.
- 44                    C. Filler Sheet: Flat or formed 20 GA galvanized steel.
- 45                    D. Roof Sump Pans:
- 46                    1. Fabricate from a single piece of galvanized sheet steel with level bottoms and sloping sides
- 47                    to direct water flow to drain.

- 1           2. Provide sump pans of adequate size to receive roof drains with bearing flanges minimum 3
- 2           IN wide.
- 3           3. Recess pans not less than 1-1/2 IN below roof deck surface, unless otherwise indicated or
- 4           required by deck configuration.
- 5           4. Minimum thickness before galvanizing: 0.0747 IN (14 GA).
- 6           E. Cant Strips:
- 7           1. Bend cant strips to form 45 degree slope not less than 5 IN wide, with top and bottom flanges
- 8           not less than 3 IN wide.
- 9           2. Minimum thickness before galvanizing: 0.0358 IN (20 GA).
- 10          F. Insulation supports.
- 11          G. Venting: Slotted openings in bottom flutes in accordance with manufacturer's standards.
- 12          H. Primer Paint: Deck manufacturer's baked on, rust-inhibitive paint applied at plant to chemically
- 13          cleaned and phosphate chemically treated metal surfaces.
- 14          I. Galvanized coating for metal deck accessories: Conform to ASTM A924 G60zinc coating.
- 15          J. Galvanized Repair Paint: Comply with Specification Section 09960 and ASTM A780 for repair of
- 16          damaged galvanized surfaces.
- 17          K. Screws:
- 18           1. Self-drilling, self-tapping, #12 size minimum hex washer head sheet metal screws.
- 19           2. Carbon steel by Hilti.
- 20           a. Organic zinc chromate coated, Hilti Kwik-cote.
- 21          L. Miscellaneous Steel Shapes: Comply with ASTM A36.
- 22          M. Sheet Metal Accessories: Same material and finish as deck members.
- 23          N. Flexible Closure Strips for Deck:
- 24           1. Vulcanized, closed cell expanded chloroprene elastomer, complying with ASTM D1056,
- 25           Grade SCE 41.
- 26           2. Brittleness temperature: -40 DegF, ASTM D746.
- 27           3. Flammability resistance: Self-extinguishing.
- 28           4. Install with adhesive in accordance with manufacturer's instructions.
- 29           a. Ensure complete closure.

## 30       **PART 3 - EXECUTION**

### 31       **3.1 PREPARATION**

- 32          A. Examine areas and conditions under which metal deck is to be installed for conditions detrimental
- 33          to proper and timely completion of work.
- 34          B. Do not proceed with work until unsatisfactory conditions have been corrected.
- 35          C. Do not start placement of metal deck until supporting work is in place and secured.
- 36          D. Deck will be subject to rejection if metal deck:
- 37           1. Units do not comply with requirements of SDI specifications and requirements herein.
- 38           2. Is improperly manufactured, painted or installed.
- 39           3. Is damaged so that strength is impaired.
- 40           4. Is not installed as specified.

### 41       **3.2 INSTALLATION**

- 42          A. Install roof deck units and accessories as indicated, in accordance with SDI 31, manufacturer's
- 43          recommendations, final approved Shop Drawings and as specified herein.
- 44           1. Furnish manufacturer's standard accessories as needed to complete the deck installation.
- 45          B. Locate deck bundles to prevent overloading of structure.
- 46          C. Do not overload metal deck or supporting members:
- 47           1. Contractor is solely responsible for safety, construction means, methods and sequencing of
- 48           the Work.

- 1           2.    Until the entire assembly is complete, the structural elements may not be stable or capable of
- 2           supporting code or stated design loads.
- 3           3.    Use care to assure deck construction loads are less than the recommendation of SDI 31,
- 4           except where temporary shoring is installed.
  
- 5           D.    Place each deck unit on supporting structural frame, adjust to final position and accurately align
- 6           with ends bearing on supporting members.
- 7           1.    Lap roof deck units at ends no less than 2 IN.
- 8           2.    Interlock units at sides without stretching, contracting, or deforming.
- 9           3.    Place deck units flat and square and secure to framing without warp or excessive deflection.
- 10          4.    Place units in accurate and close alignment for entire length of run and with close registration
- 11          of flutes of one unit with those of abutting unit.
  
- 12          E.    Plug weld sizes specified are effective fusion diameter of welds.
- 13          1.    Weld metal shall penetrate all layers of deck material and have good fusion to supporting
- 14          members.
- 15          2.    Do not burn through deck.
  
- 16          F.    Prevent over torquing of screw fasteners by using a tool with a depth limiting nosepiece and a
- 17          clutch.
  
- 18          G.    Fastening of 1-1/2 IN Deep Metal Roof Deck:
- 19          1.    Secure deck units to supporting frame and side laps as shown on the Drawings:
- 20           a.    Fasten edge ribs of panels at each support.
  
- 21          H.    Remove and replace deck which is structurally weak or unsound or which has burn holes due to
- 22          improper welding or damage which Engineer declares defective.
  
- 23          I.    Cut and fit deck units and accessories around other work projecting through or adjacent to
- 24          decking.
- 25          1.    Make cutting and fitting neat, square and trim.
- 26           a.    Cut deck by mechanical means, not by burning.
- 27          2.    Neatly and accurately install reinforcing at all openings except:
- 28           a.    Circular openings less than 6 IN DIA.
- 29           b.    Rectangular openings having no side dimension greater than 6 IN.
- 30          3.    Reinforce openings that have not been framed between 6 and 12 IN with 20 GA flat steel
- 31          sheet 12 IN greater in each dimension than opening.
- 32           a.    Place sheet around opening and fusion weld to top surface of deck at each corner and
- 33           midway along each side.
  
- 34          J.    Install insulation supports for support of roof insulation.
- 35          1.    Provide where top surface of roof deck does not occur adjacent to edge and openings as
- 36          required to completely support roof insulation.
- 37          2.    Weld into position.
  
- 38          K.    Install metal closure strips at all open uncovered ends and edges of roof deck, and in voids
- 39          between deck and other construction.
- 40          1.    Weld into position to provide a complete decking installation.
- 41          2.    Provide flexible closure strips instead of metal closures, at Contractor's option and when
- 42          approved by Engineer wherever their use will ensure complete closure.
- 43           a.    Install with elastomeric type adhesive in accordance with written directions and
- 44           recommendations of manufacturers of closure strips and adhesives.
  
- 45          L.    Ridge and Valley Plates:
- 46          1.    Weld ridge and valley plates to top surface of roof deck.
- 47          2.    Lap end joints not less than 3 IN with laps in direction of water flow.
  
- 48          M.    Roof Sump Pans:
- 49          1.    Place over openings in roof deck.
- 50          2.    Weld to top deck surface.
- 51           a.    Space welds maximum 12 IN OC with at least one weld at each corner and each side
- 52           midway between each corner.
- 53          3.    Cut opening in bottom of roof sump to accommodate drain size indicated.
  
- 54          N.    Cant Strips:
- 55          1.    Weld cant strips to top surface of roof deck at 12 IN OC.



**SECTION 05505**  
**METAL FABRICATIONS**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
- 7 1. Custom fabricated metal items and certain manufactured units not otherwise indicated to be
  - 8 supplied under work of other Specification Sections.
  - 9 2. Design of all temporary bracing not indicated on Drawings.
  - 10 3. Design of systems and components, including but not limited to:
  - 11 a. Stairs.
  - 12 b. Landings.
  - 13 c. Ladders.
  - 14 d. Grating.
  - 15 e. Checkered plate.
  - 16 f. Modular framing system.
  - 17 4. Provide galvanized steel structural and miscellaneous steel framing as necessary to support
  - 18 insulated metal wall panels.
  - 19 a. See Specification Section 07410.
- 20 B. Related Specification Sections include but are not necessarily limited to:
- 21 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
  - 22 2. Division 01 - General Requirements.
  - 23 3. Division 03 - Concrete.
  - 24 4. Section 05522 - Aluminum Railings.
  - 25 5. Section 06610 - Fiberglass Reinforced Plastic Fabrication.
  - 26 6. Section 07410 - Insulated Metal Wall Panels.
  - 27 7. Section 09960 - High Performance Industrial Coatings.

28 **1.2 QUALITY ASSURANCE**

- 29 A. Referenced Standards:
- 30 1. Aluminum Association (AA):
  - 31 a. ADM 1, Aluminum Design Manual.
  - 32 2. American Association of State Highway and Transportation Officials (AASHTO):
  - 33 a. HB, Standard Specifications for Highway Bridges.
  - 34 3. American Institute of Steel Construction (AISC):
  - 35 a. 325, Manual of Steel Construction - Allowable Stress Design (ASD).
  - 36 b. 360, Specifications for Structural Steel Buildings (referred to herein as AISC
  - 37 Specification).
  - 38 4. American National Standards Institute (ANSI):
  - 39 a. A14.3, Ladders - Fixed - Safety Requirements.
  - 40 5. American Society of Civil Engineers (ASCE):
  - 41 a. 7, Minimum Design Loads for Buildings and Other Structures.
  - 42 6. ASTM International (ASTM):
  - 43 a. A6, Standard Specification for General Requirements for Rolled Structural Steel Bars,
  - 44 Plates, Shapes, and Sheet Piling.
  - 45 b. A36, Standard Specification for Carbon Structural Steel.
  - 46 c. A47, Standard Specification for Ferritic Malleable Iron Castings.
  - 47 d. A48, Standard Specification for Gray Iron Castings.
  - 48 e. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded
  - 49 and Seamless.
  - 50 f. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished.
  - 51 g. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and
  - 52 Steel Products.
  - 53 h. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel
  - 54 Hardware.
  - 55 i. A197, Standard Specification for Cupola Malleable Iron.

- 1 j. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel  
2 Tubing for General Service.  
3 k. A276, Standard Specification for Stainless Steel Bars and Shapes.  
4 l. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile  
5 Strength.  
6 m. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked  
7 Austenitic Stainless Steel Pipes.  
8 n. A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi  
9 Minimum Tensile Strength.  
10 o. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel  
11 Parts, Equipment, and Systems.  
12 p. A496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.  
13 q. A500, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel  
14 Structural Tubing in Rounds and Shapes.  
15 r. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel  
16 Structural Tubing.  
17 s. A536, Standard Specification for Ductile Iron Castings.  
18 t. A554, Standard Specification for Welded Stainless Steel Mechanical Tubing.  
19 u. A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium  
20 Structural Steel.  
21 v. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel  
22 Sheet, Strip, Plate, and Flat Bar.  
23 w. A668, Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial  
24 Use.  
25 x. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip  
26 Galvanized Coatings.  
27 y. A786, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-  
28 Alloy, and Alloy Steel Floor Plates.  
29 z. A992, Standard Specification for Steel for Structural Shapes.  
30 aa. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain  
31 and Deformed, for Concrete.  
32 bb. B26, Standard Specification for Aluminum-Alloy Sand Castings.  
33 cc. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.  
34 dd. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods,  
35 Wire, Profiles, and Tubes.  
36 ee. B308, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.  
37 ff. B429, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.  
38 gg. B632, Standard Specification for Aluminum-Alloy Rolled Tread Plate.  
39 hh. F467, Standard Specification for Nonferrous Nuts for General Use.  
40 ii. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for  
41 General Use.  
42 jj. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.  
43 kk. F835, Standard Specification for Alloy Steel Socket Button and Flat Countersunk Head  
44 Cap Screws.  
45 ll. F879, Standard Specification for Stainless Steel Socket Button and Flat Countersunk  
46 Head Cap Screws.  
47 mm. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield  
48 Strength.  
49 nn. F1789, Standard Terminology for F16 Mechanical Fasteners.  
50 7. American Welding Society (AWS):  
51 a. A5.1/A5.1M, Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.  
52 b. D1.1, Structural Welding Code - Steel.  
53 c. D1.2, Structural Welding Code - Aluminum.  
54 d. D1.6/D1.6M, Structural Welding Code - Stainless Steel.  
55 8. National Association of Architectural Metal Manufacturers (NAAMM):  
56 a. AMP 510, Metal Stairs Manual.  
57 b. AMP 555, Code of Standard Practice for the Architectural Metal Industry (Including  
58 Miscellaneous Iron).  
59 c. MBG 531, Metal Bar Grating Manual.  
60 9. NACE International (NACE).



- 1 10. Nickel Development Institute (NiDI):
- 2 a. Publication 11007, Guidelines for the welded fabrication of nickel-containing stainless
- 3 steels for corrosion resistant services.
- 4 11. Occupational Safety and Health Administration (OSHA):
- 5 a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA
- 6 Standards.
- 7 12. Building Code:
- 8 a. International Code Council (ICC):
- 9 1) International Building Code and associated standards, 2006 Edition including all
- 10 amendments, referred to herein as Building Code.
- 11 B. Qualifications:
- 12 1. Qualify welding procedures and welding operators in accordance with AWS.
- 13 2. Fabricator shall have minimum of 10 years experience in fabrication of metal items specified.
- 14 3. Engineer for contractor-designed systems and components: Professional Civil or Structural
- 15 Engineer licensed in the State of Nebraska.

16 **1.3 DEFINITIONS**

- 17 A. Fasteners: As defined in ASTM F1789.
- 18 B. Galvanizing: Hot-dip galvanizing per ASTM A123/A123M or ASTM A153/A153M with minimum
- 19 coating of 2.0 OZ of zinc per square foot of metal (average of specimens) unless noted otherwise
- 20 or dictated by standard.
- 21 C. Hardware: As defined in ASTM A153/A153M.
- 22 D. Installer or Applicator:
- 23 1. Installer or applicator is the person actually installing or applying the product in the field at the
- 24 Project site.
- 25 2. Installer and applicator are synonymous.

26 **1.4 SUBMITTALS**

- 27 A. Shop Drawings:
- 28 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 29 the submittal process.
- 30 2. Fabrication and/or layout Drawings and details:
- 31 a. Submit drawings for all fabrications and assemblies.
- 32 1) Include erection Drawings, plans, sections, details and connection details.
- 33 b. Identify materials of construction, shop coatings and third party accessories.
- 34 3. Product technical data including:
- 35 a. Acknowledgement that products submitted meet requirements of standards referenced.
- 36 b. Manufacturer's installation instructions.
- 37 c. Provide manufacturer's standard allowable load tables for the following:
- 38 1) Grating and checkered plate.
- 39 2) Mechanical anchor bolts.
- 40 3) Adhesive anchor bolts.
- 41 4) Castings, trench covers and accessories.
- 42 5) Modular framing systems.
- 43 4. Contractor designed systems and components, including but not limited to, stairs, landings
- 44 ladders, grating and checkered plate:
- 45 a. Certification that manufactured units meet all design loads specified.
- 46 b. Shop Drawings and engineering design calculations:
- 47 1) Indicate design live loads.
- 48 2) Sealed by a professional Civil or Structural Engineer licensed in the State of
- 49 Nebraska.
- 50 3) Engineer will review for general compliance with Contract Documents.
- 51 B. Informational Submittals:
- 52 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 53 the submittal process.
- 54 2. Certification of welders and welding processes.
- 55 a. Indicate compliance with AWS.

1 **1.5 DELIVERY, STORAGE, AND HANDLING**

- 2 A. Deliver and handle fabrications to avoid damage.
- 3 B. Store above ground on skids or other supports to keep items free of dirt and other foreign debris
- 4 and to protect against corrosion.

5 **PART 2 - PRODUCTS**

6 **2.1 ACCEPTABLE MANUFACTURERS**

- 7 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

- 8 1. Abrasive stair nosings (embedded in concrete stairs):
- 9 a. American Safety Tread.
- 10 b. Balco.
- 11 2. Headed studs and deformed bar anchors:
- 12 a. Nelson Stud Welding Div., TRW Inc.
- 13 b. Stud Welding Products, Inc.
- 14 3. Mechanical anchor bolts:
- 15 a. Hilti Inc.
- 16 b. ITW Ramset/Red Head.
- 17 c. Simpson Strong-Tie.
- 18 4. Adhesive anchor bolts:
- 19 a. Hilti Inc.
- 20 b. ITW Ramset/Red Head.
- 21 c. Simpson Strong-Tie.
- 22 5. Self-tapping concrete anchors:
- 23 a. ITW Buildex.
- 24 6. Castings, trench covers and accessories:
- 25 a. Neenah Foundry Co.
- 26 b. Deeter Foundry Co.
- 27 c. Barry Craft Construction Casting Co.
- 28 d. McKinley Iron Works.
- 29 7. Aluminum ladders:
- 30 a. Any manufacturer capable of meeting the requirements of this Specification Section.
- 31 8. Galvanizing repair paint:
- 32 a. Clearco Products Co., Inc.
- 33 b. ZRC Products.
- 34 9. Modular framing system:
- 35 a. Unistrut Building Systems.
- 36 b. B-Line Systems.
- 37 c. Kindorf.
- 38 10. Manufactured Pipe Supports
- 39 a. B-Line Systems or approved equal.

- 40 B. Submit request for substitution in accordance with Specification Section 01640.

41 **2.2 MATERIALS**

- 42 A. Steel:
- 43 1. Structural:
- 44 a. W-shapes and WT-shapes: ASTM A992, Grade 50.
- 45 b. All other plates and rolled sections: ASTM A36.
- 46 2. Pipe: ASTM A53, Types E or S, Grade B or ASTM A501.
- 47 3. Structural tubing:
- 48 a. ASTM A500, Grade B (46 ksi minimum yield).
- 49 4. Bolts, nuts and washers, high strength:
- 50 a. ASTM A325.
- 51 b. Galvanized, ASTM A153/A153M where noted on Drawings.
- 52 c. Provide two (2) washers with all bolts.
- 53 5. Bolts and nuts:
- 54 a. ASTM A307, Grade A.
- 55 b. Galvanized, ASTM A153/A153M where noted on Drawings.
- 56 6. Welding electrodes: AWS D1.1, E70 Series.

- 1           7. Steel forgings: ASTM A668.
- 2           B. Iron:
- 3           1. Ductile iron: ASTM A536.
- 4           2. Gray cast iron: ASTM A48 (minimum 30,000 psi tensile strength).
- 5           3. Malleable iron: ASTM A47, ASTM A197.
- 6           C. Stainless Steel:
- 7           1. Stainless steel in welded applications: Low carbon 'L' type.
- 8           2. Minimum yield strength of 30,000 psi and minimum tensile strength of 75,000 psi.
- 9           a. Bars, shapes: ASTM A276, Type 304 or 316.
- 10          b. Tubing and pipe: ASTM A269, ASTM A312 or ASTM A554, Type 304 or 316.
- 11          c. Strip, plate and flat bars: ASTM A666, Type 304 or 316.
- 12          d. Bolts and nuts: ASTM F593, Type 303, 304 or 316.
- 13          3. Minimum yield strength of 25,000 psi and minimum tensile strength of 70,000 psi.
- 14          a. Strip, plate and flat bar for welded connections, ASTM A666, Type 304L or 316L.
- 15          4. Welding electrodes: In accordance with AWS for metal alloy being welded.
- 16          D. Aluminum:
- 17          1. Alloy 6061-T6, 32,000 psi tensile yield strength minimum.
- 18           a. ASTM B221 and ASTM B308 for shapes including beams, channels, angles, tees and
- 19           zees.
- 20           b. Weir plates, baffles and deflector plates, ASTM B209.
- 21          2. Alloy 6063-T5 or T6, 15,000 psi tensile yield strength minimum.
- 22           a. ASTM B221 and ASTM B429 for bars, rods, wires, pipes and tubes.
- 23          3. ASTM B26 for castings.
- 24          4. ASTM F468, alloy 2024 T4 for bolts.
- 25          5. ASTM F467, alloy 2024 T4 for nuts.
- 26          6. Electrodes for welding aluminum: AWS D1.2, filler alloy 4043 or 5356.
- 27          E. Washers: Same material and alloy as found in accompanying bolts and nuts.
- 28          F. Embedded Anchor Bolts:
- 29          1. Building anchor bolts:
- 30           a. ASTM F1554, Grade 55 with weldability supplement S1 or ASTM A36 for threaded rods
- 31           galvanized.
- 32          2. All other anchor bolts: Type 304 or 316 stainless steel with matching nut and washer.
- 33          G. Mechanical Anchor Bolts and Adhesive Anchor Bolts:
- 34          1. Stainless steel, Type 304, 314 or 316.
- 35          2. Provide minimum edge distance cover and spacing as recommended by manufacturer, or as
- 36          indicated on Drawings whichever is larger.
- 37           a. Minimum embedment as recommended by manufacturer or eight (8) diameters of bolt,
- 38           whichever is larger.
- 39           b. Notify Engineer if required depth of embedment cannot be achieved at a particular
- 40           anchor bolt location.
- 41           c. Follow manufacturer's recommendations for installation and torque.
- 42          3. Submit manufacturer's load test data to verify at least the anchor bolt capacities at the
- 43          following embedment depths:
- 44           a. Data must be based on actual tests performed in unreinforced mass of concrete of not
- 45           more than 4000 psi compressive strength.
- 46           b. Capacity must be at a concrete temperature of at least 130 DegF.
- 47

ANCHOR BOLT DIAMETER (IN)	EMBEDMENT (IN)	MINIMUM ULTIMATE TENSION CAPACITY (KIP)*, **
3/8	3	4.8
1/2	4	8.1
5/8	5	11.4
3/4	6	15.4
7/8	7	20.0
1	8	24.7
1-1/4	10	34.3

48 \* Data must be based on actual tests preformed in unreinforced mass concrete of not more than 4000 psi

49 compressive strength.

1 \*\* Capacity must be at a concrete temperature of at least 130 DegF.

- 2
- 3 1. Mechanical expansion anchor bolts:
  - 4 a. Kwik Bolt 3 (ICC-ES ESR-2302) and Kwik Bolt TZ (ICC-ES ESR-1917) by Hilti, Inc.
  - 5 b. Trubolt + (ICC-ES ESR-2427) by ITW Ramset/Red Head.
  - 6 c. Strong Bolt (ICC-ES ESR-1771) and Strong Bolt 2 (ICC-ES ESR-3037) by Simpson
  - 7 Strong-Tie.
- 8 2. Adhesive anchor bolts:
  - 9 a. HIT HY 150 Max-SD (ICC-ES ESR-3013) System and HIT-RE-500 SD (ICC-ES ESR-
  - 10 2322) System Adhesive Anchors by Hilti.
  - 11 b. EPCON G5 (ICC-ES ESR-1137) Adhesive Anchoring System by ITW Ramset/Red
  - 12 Head.
  - 13 c. SET-XP (ICC-ES ESR-2508) Adhesive Anchoring Systems by Simpson Strong Tie
  - 14 Anchor Systems.
- 15 3. Concrete screw type anchor bolts:
  - 16 a. KWIK HUS-EZ (ICC-ES ESR-3027) by Hilti Inc.
  - 17 b. Titan HD (ICC-ES ESR-2713) by Simpson Strong Tie Anchor Systems.
- 18 4. Self-tapping concrete anchors:
  - 19 a. Tapcon by ITW Buildex.
  - 20 b. Type 410 stainless steel.
  - 21 c. 1/4 IN DIA with 5/16 IN hex head.
  - 22 1) Minimum embedment as recommended by manufacturer.

23 H. Headed Studs: ASTM A108 with a minimum yield strength of 50,000 psi and a minimum tensile

24 strength of 60,000 psi.

25 I. Deformed Bar Anchors: ASTM A496 or ASTM A1064 with a minimum yield strength of 70,000

26 psi and a minimum tensile strength of 80,000 psi.

27 J. Iron and Steel Hardware: Galvanized in accordance with ASTM A153/A153M when required to

28 be galvanized.

29 K. Galvanizing Repair Paint:

- 30 1. High zinc dust content paint for re-galvanizing welds and abrasions.
- 31 2. ASTM A780.
- 32 3. Zinc content: Minimum 92 percent in dry film.
- 33 4. ZRC "ZRC Cold Galvanizing" or Clearco "High Performance Zinc Spray."

34 L. Dissimilar Materials Protection: See Specification Section 09960.

### 35 2.3 MANUFACTURED UNITS

36 A. Ladders:

- 37 1. General:
  - 38 a. Fully welded type.
    - 39 1) All welds to be full penetration welds.
  - 40 b. All ladders of a particular material shall have consistent construction and material
  - 41 shapes and sizes unless detailed otherwise on the Drawings.
  - 42 c. Design ladder in accordance with OSHA Standards, ANSI A14.3, ASCE 7 and
  - 43 applicable Building Codes.
  - 44 d. Ladders shall be designed to support a minimum concentrated live load of 300 LBS at
  - 45 any point to produce the maximum stress in the member being designed.
    - 46 1) Apply additional 300 LB loads for each section of ladder exceeding 10 FT.
  - 47 e. Maximum allowable stresses per AA ADM 1.
  - 48 f. Maximum lateral deflection: Side rail span/240 when lateral load of 100 LBS is applied
  - 49 at any location.
- 50 2. Material:
  - 51 a. Aluminum.
  - 52 b. Finish:
    - 53 1) Mill.
- 54 3. Rails:
  - 55 a. Round pipe:
    - 56 1) 1-1/2 IN nominal diameter.
    - 57 2) Schedule 80.

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- b. Spacing:
    - 1) Minimum clear distance between rails to be 18 IN.
    - 2) Step-through ladder extensions: 24 IN, centerline to centerline.
  - c. Provide cap at exposed top and bottom of side rails.
    - 1) Provide weep holes as necessary to prevent the accumulation of moisture within hollow members.
  - d. Extend side rails of step-through ladders a minimum of 42 IN above the landing.
4. Rungs:
    - a. Minimum 1 IN DIA or 1 IN square solid bar.
      - 1) Integral non-slip finish on all sides.
        - a) Non-slip finish: Coarse knurling or extruded serrations.
        - b) Shop or field-applied grit tape and cap type non-slip finish is not acceptable.
    - b. Rungs shall penetrate inside wall of side rails.
      - 1) Do not extend rungs beyond the outside face of the side rail.
      - 2) Provide full-penetration weld all around rung.
    - c. Rung spacing:
      - 1) Uniform, 12 IN.
      - 2) Top rung shall be level with landing or platform.
      - 3) Spacing of bottom rung from grade or platform may vary but shall not exceed 14 IN.
  5. Brackets:
    - a. Angle or bent plate brackets welded to side rails:
      - 1) 3/8 IN by 2-1/2 IN by length required.
      - 2) Provide punched holes for 3/4 IN bolts or anchors.
      - 3) Minimum distance from centerline of rung to wall or any obstruction: 7 IN.
      - 4) Maximum spacing: 4 FT OC.
  6. Provide ladder cage where shown on the Drawings.
    - a. Cage construction shall meet all requirements of OSHA Standards and this Specification Section:
      - 1) Hoops: Minimum 1/4 by 2 IN bar at 48 IN OC spacing.
      - 2) Vertical bars: Minimum 1/4 by 1-1/2 IN bar.
      - 3) Weld all connections.
      - 4) Construct cage of same materials as the ladder on which it is mounted.
      - 5) Mount cage on ladder by welding.
  7. Landings:
    - a. Construct landing, railing and all supports of same material as the ladder.
    - b. Design landing platform and supporting structure for not less than 100 psf plus a concentrated load of 300 LBS with a maximum deflection of 1/300 of span under a superimposed live load of 100 psi.
    - c. Grating:
      - 1) Minimum 1-1/2 IN non-slip grating per this Specification Section.
      - 2) Attach grating using stainless steel clips and bolts at 24 IN OC maximum spacing.
    - d. Structural support: Channel or tubular sections with bracing, plates, angles, etc., to support guardrail and grating and to support landing.
      - 1) Weld all connections.
    - e. Guardrails:
      - 1) Match ladder side rails.
        - a) Space intermediate rails equally between top rail and top of kickplate.
      - 2) Provide 4 IN high x 3/8 IN thick toeboard each side of landing.
- B. Bollards:
    1. 8 IN DIA extra strength steel pipe, ASTM A53.
      - a. Galvanized.
      - b. Paint Safety Yellow.
        - 1) See Specification Section 09960.
  - C. Abrasive Stair Nosings:
    1. Two (2) component consisting of an embedded sub-channel, installed with the concrete pour, and an abrasive tread plate to be installed later.
    2. 6063-T5 extruded aluminum, mill finished and heat treated.
    3. Complete with concrete anchors and tread plate securing screws.
    4. Tread plate:
      - a. Extruded aluminum.
      - b. Solid epoxy abrasive filler.

- 1                   1) Color: Safety yellow.
- 2                   5. Balco "DXH-330."
- 3                   6. Length:
- 4                   a. Concrete stairs:
- 5                    1) 4 IN less than overall stair width.
- 6                    2) Where tread mounted railing post occurs, hold nosing back 4 IN clear from railing
- 7                    centerline.
- 8                   b. Concrete landings at metal stairs: 4 IN less than clear width between stringers.
- 9                   D. Metal Stairs:
- 10                  1. Fabricated as indicated.
- 11                  2. Treads: Grating as specified.
- 12                  a. Provide integral corrugated non-slip nosing.
- 13                  3. Risers:
- 14                  a. Grating treads: Solid plate attached to trailing edge of tread as shown on Drawings.
- 15                  4. Landings:
- 16                  a. Grating as specified.
- 17                  b. Provide integral corrugated non-slip nosing at edge acting as stair tread/nosing.
- 18                  c. Nosing at concrete landing:
- 19                   1) Abrasive stair nosing.
- 20                  5. Fabricate and design stair, stringers, platforms and landings, and all associated connections
- 21                  to support a 100 psf uniform live load or a concentrated load of 1000 LBS, whichever
- 22                  requires the stronger component.
- 23                  a. Stair stringer connection configuration and minimum requirements are shown on the
- 24                  Drawings. Provide connection design and fabrication per these requirements and the
- 25                  loading requirements of this specification.
- 26                  6. Design, fabricate, and install in compliance with NAAMM and applicable codes.
- 27                  a. NAAMM AMP 510:
- 28                   1) Exterior at site structures and equipment: Industrial Class.
- 29                   2) Interior or exterior at buildings: Service Class.
- 30                  7. Handrails and guardrails: Refer to Specification Section 05522.
- 31                  8. Material:
- 32                  a. Treads with integral nosing and kick plate: Aluminum.
- 33                  b. Remainder: Steel, ASTM A36, galvanize after fabrication.
- 34                  E. Aluminum Checkered Plate:
- 35                  1. Conform to ASTM B632.
- 36                  a. Diamond pattern: Use one (1) pattern throughout Project.
- 37                  b. Material: Type 6061-T6.
- 38                  2. Design live load:
- 39                  a. 100 psf, uniform load.
- 40                  b. 300 LBS concentrated load on 4 IN square area.
- 41                  c. All components to be adequate for the uniform load or the concentrated load, whichever
- 42                  requires the stronger component.
- 43                  d. Maximum deflection: 1/300 of span under a superimposed live load of 50 psf.
- 44                  3. Reinforce as necessary with aluminum angles.
- 45                  4. Plate sections:
- 46                  a. Maximum 3 FT wide.
- 47                  b. Minimum 1/4 IN thick.
- 48                  c. Maximum 100 LBS per section if required to be removable.
- 49                  5. Provide joints at center of all openings unless shown otherwise.
- 50                  a. Reinforce joints and openings with additional angles to provide required load carrying
- 51                  capacity.
- 52                  6. Unless shown otherwise, frame for openings with aluminum checkered plate cover:
- 53                  a. Aluminum support angles:
- 54                   1) 3 by 2 by 1/4 IN minimum size with long leg vertical.
- 55                   2) 5/8 IN DIA adhesive anchor bolts spaced at maximum of 24 IN OC along each side
- 56                  with not less than two (2) anchor bolts per side.
- 57                  b. Aluminum concrete insert seats:
- 58                   1) 2 by 2 by 1/4 IN minimum size.
- 59                   2) Auto-welded studs or strap anchors at 18 IN OC with not less than two (2) studs or
- 60                  anchored per side.

- 1 c. Drill and tap frame to receive 3/8 IN DIA fasteners at not more than 24 IN OC with not  
 2 less than two (2) fasteners per side.  
 3 1) Fasteners: Stainless steel flat countersunk cap screws: ASTM F879.
- 4 F. Heavy-Duty Castings, Trench Covers, and Accessories:  
 5 1. Prefabricated, cast iron ASTM A48 or ductile iron ASTM A536  
 6 2. Design load: AASHTO HS-20 wheel loading for indicated span.  
 7 3. Machine horizontal mating surfaces.
- 8 G. Loose Lintels:  
 9 1. Steel, ASTM A36 or ASTM A572 Grade 50, sizes as indicated on Drawings.  
 10 2. Hot-dip galvanized per ASTM A123/A123M.
- 11 H. Modular Framing System:  
 12 1. Materials:  
 13 a. Steel: ASTM A1011, stainless steel, Grade 33.  
 14 1) Hot-dipped galvanized, ASTM A123 or ASTM A153.  
 15 b. Aluminum: ASTM B221 or ASTM B209.  
 16 c. Stainless steel: ASTM A666.  
 17 d. Fiberglass: See Specification Section 06610.  
 18 2. Channels and inserts:  
 19 a. Steel or stainless steel: Minimum 12 GA.  
 20 b. Aluminum: Minimum 0.080 IN.  
 21 c. Channels to have one (1) side with a continuous slot with in-turned lips.  
 22 1) Width: 1-5/8 IN.  
 23 2) Depth and configuration as necessary for loading conditions.  
 24 3. Fittings: Same material as system major components.  
 25 4. Fasteners:  
 26 a. Nuts: Toothed grooves in top of nuts to engage the in-turned lips of channel.  
 27 b. Bolts: Hex-head cap screws.  
 28 c. Same material as system major components.  
 29 5. End caps:  
 30 a. At each exposed end of each piece mounted on walls, or guardrails, or suspended from  
 31 framing 7 FT or less above the floor or platform.  
 32 a) Plastic for all exposed ends 7 FT or more above floor or platform.  
 33 b) Plastic or metallic for all other exposed ends.  
 34 6. Schedule:  
 35 a. Interior wet areas: Aluminum or Stainless steel.  
 36 1) Includes all areas not listed herein as corrosive.  
 37 b. Interior corrosive areas: Fiberglass or Stainless steel.  
 38 1) Including the following rooms or area:  
 39 a) Room FC-103 Fluoride.  
 40 c. Exterior areas: Aluminum or Stainless steel.  
 41 7. Provide dissimilar materials protection in accordance with Specification Section 09960.  
 42 8. Repair all cut ends or otherwise damaged areas of galvanized steel in accordance with  
 43 ASTM A780.
- 44 I. Fabricated Pipe Supports:  
 45 1. Material: Stainless steel.  
 46 2. Fabricated to meet the dimensions and maximum load capacity for the support types as  
 47 shown in the Drawings and as published by B-Line by Eaton.

## 48 2.4 FABRICATION

- 49 A. Verify field conditions and dimensions prior to fabrication.
- 50 B. Form materials to shapes indicated with straight lines, true angles, and smooth curves.  
 51 1. Grind smooth all rough welds and sharp edges.  
 52 a. Round all corners to approximately 1/16 IN nominal radius.
- 53 C. Provide drilled or punched holes with smooth edges.  
 54 1. Punch or drill for field connections and for attachment of work by other trades.
- 55 D. Weld Permanent Shop Connections:  
 56 1. Welds to be continuous fillet type unless indicated otherwise.  
 57 2. Full penetration butt weld at bends in stair stringers and ladder side rails.

- 1 3. Weld structural steel in accordance with AWS D1.1 using Series E70 electrodes conforming  
2 to AWS A5.1/A5.1M.  
3 4. Weld aluminum in accordance with AWS D1.2.  
4 5. Weld stainless steel in accordance with AWS D1.6.  
5 a. Treat all welded areas in accordance with ASTM A380.  
6 6. Weld stainless steel in accordance with AWS D1.6 and NiDI 11 007.  
7 7. All headed studs to be welded using automatically timed stud welding equipment.  
8 8. Grind smooth welds that will be exposed.
- 9 E. Conceal fastenings where practicable.
- 10 F. Fabricate work in shop in as large assemblies as is practicable.
- 11 G. Tolerances:
- 12 1. Rolling:
- 13 a. ASTM A6.  
14 b. When material received from the mill does not satisfy ASTM A6 tolerances for camber,  
15 profile, flatness, or sweep, the Contractor is permitted to perform corrective work by the  
16 use of controlled heating and mechanical straightening, subject to the limitations of the  
17 AISC Specification.
- 18 2. Fabrication tolerance:
- 19 a. Member length:
- 20 1) Both ends finished for contact bearing: 1/32 IN.  
21 2) Framed members:  
22 a) 30 FT or less: 1/16 IN.  
23 b) Over 30 FT: 1/8 IN.
- 24 b. Member straightness:
- 25 1) Compression members: 1/1000 of axial length between points laterally supported.  
26 2) Non-compression members: ASTM A6 tolerance for wide flange shapes.
- 27 c. Specified member camber (except compression members):
- 28 1) 50 FT or less: Minus 0/plus 1/2 IN.  
29 2) Over 50 FT: Minus 0/plus 1/2 IN (plus 1/8 IN per 10 FT over 50 FT).  
30 3) Members received from mill with 75 percent of specified camber require no further  
31 cambering.  
32 4) Beams/trusses without specified camber shall be fabricated so after erection,  
33 camber is upward.  
34 5) Camber shall be measured in fabrication shop in unstressed condition.
- 35 d. At bolted splices, depth deviation shall be taken up by filler plates.
- 36 1) At welded joints, adjust weld profile to conform to variation in depth.  
37 2) Slope weld surface per AWS requirements.
- 38 e. Finished members shall be free from twists, bends and open joints.
- 39 1) Sharp kinks, bends and deviation from above tolerances are cause for rejection of  
40 material.
- 41 H. Fabricate checkered plate, stairs, ladders and accessories using aluminum unless shown  
42 otherwise on Drawings.
- 43 1. Finish:
- 44 a. Mill, unless noted otherwise.  
45 b. Coat surfaces in contact with dissimilar materials.  
46 1) See Specification Section 09960.
- 47 I. Fabricate grating in accordance with NAAMM MBG 531.
- 48 1. Maximum tolerance for difference in depth between grating depth and seat or support angle  
49 depth: 1/8 IN.
- 50 2. Distance between edge of grating and face of embedded seat angle or face of wall or other  
51 structural member: 1/4 IN.
- 52 a. Tolerance: NAAMM MBG 531.
- 53 3. Removable sections: Not wider than 3 FT and not more than 100 LBS.
- 54 4. Ends and perimeter edges: Banded.
- 55 a. Provide full depth banding unless noted otherwise.  
56 b. Banding at trenches and sumps to be 1/4 IN less than grating depth to allow for  
57 drainage.
- 58 5. Openings through grating: Reinforced to provide required load carrying capacity and banded  
59 with 4 IN high toe plate.



- 1           6. Provide joints at openings between individual grating sections.
- 2           7. Fabricate grating so that bearing bars and cross bars in adjacent sections are aligned.
- 3           J. Fabricate checkered plate and miscellaneous metals in accordance with NAAMM AMP 555.
- 4           1. Workmanship: Class 2 unless noted otherwise.
- 5           K. See Specification Section 09960 for preparation and painting of ferrous metals and other
- 6           surfaces.
- 7           L. Passivate stainless steel items and stainless steel welds after they have been ground smooth,
- 8           where indicated on Drawings.
- 9           1. ASTM A380.

10       **2.5 SOURCE QUALITY CONTROL**

- 11       A. Surface Preparation:
  - 12       1. Refer to Specification Section 09960 for surface preparation requirements.
- 13       B. Shop Applied Paint Coating Application:
  - 14       1. Refer to Specification Section 09960 for painting requirements.
- 15       C. OWNER Pays for Field Inspection and Testing:
  - 16       1. Owner will employ and pay for services of an independent testing agency to inspect and test
  - 17       structural steel shop and field work for compliance with this Specification Section.
  - 18       2. Contractor responsible for testing to qualify shop and field welders and as needed for
  - 19       Contractor's own quality control to ensure compliance with Contract Documents.
  - 20       3. Contractor provides sufficient notification and access so inspection and testing can be
  - 21       accomplished.
  - 22       4. Contractor pays for retesting of failed tests and for additional testing required when defects
  - 23       are discovered.
- 24       D. CONTRACTOR Pays for Shop Inspection and Testing:
  - 25       1. Employ and pay for the services of a qualified independent testing agency to inspect and test
  - 26       all structural steel work for compliance with Contract Documents.
  - 27       2. Independent testing agency shall have a minimum of five (5) years performing similar work
  - 28       and shall be subject to Owner's approval.
- 29       E. Responsibilities of Testing Agency:
  - 30       1. Inspect shop and field welding in accordance with AWS Code including the following non-
  - 31       destructive testing:
    - 32       a. Visually inspect all welds.
    - 33       b. In addition to visual inspection, test 50 percent of full penetration welds and 20 percent
    - 34       of fillet welds with liquid dye penetrant.
    - 35       c. Test 20 percent of liquid dye penetrant tested full penetration welds with ultrasonic or
    - 36       radiographic testing.
  - 37       2. Inspect high-strength bolting in accordance with the RCSC Specification for Structural Joints
  - 38       Using High-Strength Bolts, Section 9.
    - 39       a. Verify direct tension indicator gaps.
  - 40       3. Inspect structural steel which has been erected.
  - 41       4. Inspect stud welding in accordance with AWS Code.
  - 42       5. Prepare and submit inspection and test reports to Engineer.
    - 43       a. Assist Engineer to determine corrective measures necessary for defective work.
- 44       F. See Section 01452 for the Special Inspection and Testing Program requirements.

45       **PART 3 - EXECUTION**

46       **3.1 PREPARATION**

- 47       A. Provide items to be built into other construction in time to allow their installation.
  - 48       1. If such items are not provided in time for installation, cut in and install.
- 49       B. Prior to installation, inspect and verify condition of substrate.
- 50       C. Correct surface defects or conditions which may interfere with or prevent a satisfactory
- 51       installation.
  - 52       1. Field welding aluminum is not permitted unless approved in writing by Engineer.

1 **3.2 INSTALLATION**

- 2 A. Set metal work level, true to line, plumb.
- 3 1. Shim and grout as necessary.
- 4 B. Contractor is solely responsible for safety.
- 5 1. Construction means and methods and sequencing of work is the prerogative of the
- 6 Contractor.
- 7 2. Take into consideration that full structural capacity of many structural members is not
- 8 realized until structural assembly is complete; e.g., until slabs, decks, and diagonal bracing
- 9 or rigid connections are installed.
- 10 3. Partially complete structural members shall not be loaded without an investigation by the
- 11 Contractor.
- 12 4. Until all elements of the permanent structure and lateral bracing system are complete,
- 13 temporary bracing for the partially complete structure will be required.
- 14 C. Adequate temporary bracing to provide safety, stability and to resist all loads to which the partially
- 15 complete structure may be subjected, including construction activities and operation of equipment
- 16 is the responsibility of the Contractor.
- 17 1. Plumb, align, and set structural steel members to specified tolerances.
- 18 2. Use temporary guys, braces, shoring, connections, etc., necessary to maintain the structural
- 19 framing plumb and in proper alignment until permanent connections are made, the
- 20 succeeding work is in place, and temporary work is no longer necessary.
- 21 3. Use temporary guys, bracing, shoring, and other work to prevent injury or damage to
- 22 adjacent work or construction from stresses due to erection procedures and operation of
- 23 erection equipment, construction loads, and wind.
- 24 4. Contractor shall be responsible for the design of the temporary bracing system and must
- 25 consider the sequence and schedule of placement of such elements and effects of loads
- 26 imposed on the structural steel members by partially or completely installed work, including
- 27 work of all other trades.
- 28 a. If not obvious from experience or from the Drawings, the Contractor shall confer with the
- 29 Engineer to identify those structural steel elements that must be complete before the
- 30 temporary bracing system is removed.
- 31 5. Remove and dispose of all temporary work and facilities off-site.
- 32 D. Examine work-in-place on which specified work is in any way dependent to ensure that conditions
- 33 are satisfactory for the installation of the work.
- 34 1. Report defects in work-in-place which may influence satisfactory completion of the work.
- 35 2. Absence of such notification will be construed as acceptance of work-in-place.
- 36 E. Field Measurement:
- 37 1. Take field measurements as necessary to verify or supplement dimensions indicated on the
- 38 Drawings.
- 39 2. Contractor responsible for the accurate fit of the work.
- 40 F. Check the elevations of all finished footings or foundations and the location and alignment of all
- 41 anchor bolts before starting erection.
- 42 1. Use surveyor's level.
- 43 2. Notify Engineer of any errors or deviations found by such checking.
- 44 G. Framing member location tolerances after erection shall not exceed the frame tolerances listed in
- 45 the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section.
- 46 H. Erect plumb and level; introduce temporary bracing required to support erection loads.
- 47 I. Use light drifting necessary to draw holes together.
- 48 1. Drifting to match unfair holes is not allowed.
- 49 J. Welding:
- 50 1. Conform to AWS D1.1 and requirements of the FABRICATION Article in PART 2 of this
- 51 Specification Section.
- 52 2. When joining two (2) sections of steel of different ASTM designations, welding techniques
- 53 shall be in accordance with a qualified AWS D1.1 procedure.
- 54 K. Shore existing members when unbolting of common connections is required.
- 55 1. Use new bolts for rebolting connections.

- 1 L. Clean stored material of all foreign matter accumulated during erection period.
- 2 M. Bolt Field Connections: Where practicable, conceal fastenings.
- 3 N. Field Welding:
- 4 1. Follow AWS procedures.
- 5 2. Grind welds smooth where field welding is required.
- 6 O. Field cutting grating or checkered plate to correct fabrication errors is not acceptable.
- 7 1. Replace entire section.
- 8 P. Remove all burrs and radius all sharp edges and corners of miscellaneous plates, angles, framing
- 9 system elements, etc.
- 10 Q. Unless noted or specified otherwise:
- 11 1. Connect steel members to steel members with 3/4 IN DIA ASTM A325 high strength bolts.
- 12 2. Connect aluminum to aluminum with 3/4 IN DIA aluminum bolts.
- 13 3. Connect aluminum to structural steel using 3/4 IN DIA stainless steel bolts.
- 14 a. Provide dissimilar metals protection.
- 15 4. Connect aluminum and steel members to concrete and masonry using stainless steel
- 16 expansion anchor bolts or adhesive anchor bolts unless shown otherwise.
- 17 a. Provide dissimilar materials protection.
- 18 5. Provide washers for all bolted connections.
- 19 6. Where exposed, bolts shall extend a maximum of 3/4 IN and a minimum of 1/2 IN above the
- 20 top nut.
- 21 a. If bolts are cut off to required maximum height, threads must be dressed to allow nuts to
- 22 be removed without damage to the bolt or the nuts.
- 23 R. Install and tighten ASTM A325 high-strength bolts in accordance with the AISC 325, Allowable
- 24 Stress Design (ASD).
- 25 1. Provide hardened washers for all ASTM A325 bolts.
- 26 a. Provide the hardened washer under the element (nut or bolt head) turned in tightening.
- 27 S. After bolts are tightened, upset threads of ASTM A307 unfinished bolts or anchor bolts to prevent
- 28 nuts from backing off.
- 29 T. Secure metal to wood with lag screws of adequate size with appropriate washers.
- 30 U. Do not field splice fabricated items unless said items exceed standard shipping length or change
- 31 of direction requires splicing.
- 32 1. Provide full penetration welded splices where continuity is required.
- 33 V. Provide each fabricated item complete with attachment devices as indicated or required to install.
- 34 W. Anchor such that work will not be distorted nor fasteners overstressed from expansion and
- 35 contraction.
- 36 X. Set beam and column base plates accurately on non-shrink grout as indicated on Drawings.
- 37 1. See Division 03 Specification Sections for non-shrink grout.
- 38 2. Set and anchor each base plate to proper line and elevation.
- 39 a. Use metal wedges, shims, or setting nuts for leveling and plumbing columns and beams.
- 40 1) Wedges, shims and setting nuts to be of same metal as base plate they support.
- 41 2) Tighten nuts on anchor bolts.
- 42 b. Fill space between bearing surface and bottom of base plate with non-shrink grout.
- 43 1) Fill space until voids are completely filled and base plates are fully bedded on
- 44 wedges, shims, and grout.
- 45 c. Do not remove wedges or shims.
- 46 1) Where they protrude, cut off flush with edge of base plate.
- 47 d. Fill sleeves around anchor bolts solid with non-shrink grout.
- 48 Y. Tie anchor bolts in position to embedded reinforcing steel using wire.
- 49 1. Tack welding prohibited.
- 50 a. Coat bolt threads and nuts with heavy coat of clean grease.
- 51 2. Anchor bolt location tolerance:
- 52 a. 1/16 IN.
- 53 b. Provide steel templates for all column anchor bolts.

- 1 Z. Install bollards in concrete as detailed.  
2 1. Fill pipe with concrete and round off at top.
- 3 AA. Provide abrasive stair nosings at each concrete stair landing having metal stair structure  
4 attaching to the concrete landing.  
5 1. Center stair nosings in stair width.  
6 2. Coordinate nosings with railing vertical posts.  
7 a. Maintain 2 IN clear between end of nosing and edge of railing base plate.
- 8 BB. Accurately locate and place frames for openings before casting into floor slab so top of plate is  
9 flush with surface of finished floor.  
10 1. Keep screw holes clean and ready to receive screws.
- 11 CC. Attach grating to end and intermediate supports with grating saddle clips and bolts.  
12 1. Maximum spacing: 2 FT OC with minimum of two (2) per side.  
13 2. Attach individual units of aluminum grating together with clips at 2 FT OC maximum with a  
14 minimum of two (2) clips per side.
- 15 DD. Coat aluminum surfaces in contact with dissimilar materials in accordance with Specification  
16 Section 09960.
- 17 EE. Repair damaged galvanized surfaces in accordance with ASTM A780.  
18 1. Prepare damaged surfaces by abrasive blasting or power sanding.  
19 2. Apply galvanizing repair paint to minimum 6 mils DFT in accordance with manufacturer's  
20 instructions.
- 21 FF. Anchor ladder to masonry structure with minimum 3/4 IN stainless steel anchor bolts.  
22 1. When anchoring into composite wall construction, provide minimum 6 IN embedment into  
23 concrete back-up wall.
- 24 GG. Anchor ladder at insulated metal wall panels using minimum 1/2 IN stainless steel bolts, nuts and  
25 washers.  
26 1. Through-bolt to supplemental framing on building interior.  
27 a. Provide sleeved spacers as necessary to prevent crushing of insulated metal wall  
28 panels.

### 29 3.3 FIELD QUALITY CONTROL

- 30 A. Tolerances (unless otherwise noted on the Drawings):  
31 1. Frame placement, after assembly and before welding or tightening.  
32 a. Deviation from plumb, level and alignment: 1 in 500, maximum.  
33 b. Displacement of centerlines of columns: 1/2 IN maximum, each side of centerline  
34 location shown on Drawings.
- 35 B. See Article 2.5 for Field Quality Control.  
36 1. See Section 01452 for the Special Inspection and Testing Program requirements.

### 37 3.4 CLEANING

- 38 A. After fabrication, erection, installation or application, clean all miscellaneous metal fabrication  
39 surfaces of all dirt, weld slag and other foreign matter.
- 40 B. All stainless steel products in addition to Paragraph A. above:  
41 1. Remove all heat tint, rusting, discoloration by passivation, ASTM A380, or other acceptable  
42 means as listed in NiDI 11 007 as approved by the Engineer.
- 43 C. Provide surface acceptable to receive field applied paint coatings specified in Specification  
44 Section 09960.

45

## END OF SECTION

1 2014/09/08

2

3

**SECTION 05522**  
**ALUMINUM RAILINGS**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6

A. Section Includes:

7

1. Mechanically fastened aluminum pipe and tube railing systems.

8

- a. Two-rail horizontal railing systems.

9

- b. Vertical picket infill railing systems.

10

- c. Handrail.

11

2. Aluminum guardrail gates.

12

B. Related Specification Sections include but are not necessarily limited to:

13

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

14

2. Division 01 - General Requirements.

15

3. Section 05505 - Metal Fabrications.

16

4. Section 09960 - High Performance Industrial Coatings.

17

**1.2 QUALITY ASSURANCE**

18

A. Referenced Standards:

19

1. Aluminum Association (AA):

20

- a. ADM 1, Aluminum Design Manual.

21

- b. DAF 45, Designation System for Aluminum Finishes.

22

2. ASTM International (ASTM):

23

- a. A582, Standard Specification for Free-Machining Stainless Steel Bars.

24

- b. B26, Standard Specification for Aluminum-Alloy Sand Castings.

25

- c. B179, Standard Specification for Aluminum Alloys in Ingot and Molten Forms for

26

- Castings from All Casting Processes.

27

- d. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

28

- e. B210, Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless

29

- Tubes.

30

- f. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods,

31

- Wire, Profiles, and Tubes.

32

- g. B429, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

33

3. National Association of Architectural Metal Manufacturers (NAAMM):

34

- a. AMP 521, Pipe Railing Systems Manual.

35

4. U.S. Department of Justice, Architectural and Transportation Barriers Compliance Board

36

- (Access Board):

37

- a. Americans with Disabilities Act (ADA):

38

- 1) Accessibility Guidelines for Buildings and Facilities (ADAAG).

39

5. Occupational Safety and Health Administration (OSHA):

40

- a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA

41

- Standards.

42

6. Building Code:

43

- a. International Code Council (ICC):

44

- 1) International Building Code and associated standards, 2006 Edition including all

45

- amendments, referred to herein as Building Code.

46

**1.3 DEFINITIONS**

47

A. Installer or Applicator:

48

1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.

49

2. Installer and applicator are synonymous.

50

51

B. Guardrail: A system of building components located near the open sides of elevated walking

52

surfaces for the purpose of minimizing the possibility of an accidental fall from the walking surface

53

to the lower level.

- 1 C. Handrail: A railing provided for grasping with the hand for support.
- 2 D. Railing: A generic term referring to guardrail, handrail and/or stair rails.
- 3 E. Stair Rail: A guardrail, installed at the open side of stairways with either a handrail mounted to
- 4 the inside face of the guardrail, or where allowed by applicable codes, with the top rail mounted at
- 5 handrail height and serving the function of a handrail.

6 **1.4 SUBMITTALS**

- 7 A. Shop Drawings:
  - 8 1. See Specification Section 01340 for requirements for the mechanics and administration of
  - 9 the submittal process.
  - 10 2. Fabrication and/or layout Drawings:
    - 11 a. Drawings showing profile, location, sections and fabrication details.
    - 12 b. Type and details of anchorage.
    - 13 c. Location and type of expansion joints.
    - 14 d. Materials of construction, shop coatings and all third-party accessories.
  - 15 3. Product technical data including:
    - 16 a. Acknowledgement that products submitted meet requirements of standards referenced.
    - 17 b. Manufacturer's installation details.
  - 18 4. Certification that railings have been designed and fabricated to meet the loading
  - 19 requirements specified.
  - 20 5. Calculations for all railing systems.
    - 21 a. Calculations shall be performed, sealed, signed and dated by a Registered Professional
    - 22 Structural Engineer licensed in the State of Nebraska.
    - 23 b. Calculations shall be specific to this Project and shall include all assumptions,
    - 24 references and design interpretations used to achieve the results obtained by the
    - 25 Engineer.
    - 26 c. Reduction in load criteria is not acceptable as reason for deviation from sizes indicated
    - 27 in the Specification.

28 **1.5 DELIVERY, STORAGE AND HANDLING**

- 29 A. Deliver and handle railings to preclude damage.
- 30 B. Store railings on skids, keep free of dirt and other foreign matter which will damage railings or
- 31 finish and protect against corrosion.

32 **PART 2 - PRODUCTS**

33 **2.1 ACCEPTABLE MANUFACTURERS**

- 34 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 35 1. Mechanically fastened component railing systems.
    - 36 a. Feeney, Inc.
    - 37 b. J. G. Braun.
    - 38 c. Hollaender Railing Systems.
    - 39 d. Moultrie Manufacturing Company (Wesrail).
- 40 B. Submit request for substitution in accordance with Specification Section 01640.

41 **2.2 MATERIALS**

- 42 A. Aluminum:
  - 43 1. Bar and tubes: ASTM B221:
    - 44 a. Alloy 6063-T5/T52 or 6005-T5.
  - 45 2. Pipe and round tubing: ASTM B429:
    - 46 a. Alloy 6061-T6.
  - 47 3. Drawn seamless tubing: ASTM B210:
    - 48 a. Alloy 6063-T832.
  - 49 4. Plate and Sheet ASTM B209:
    - 50 a. Alloy 6061-T6.
- 51 B. Aluminum-magnesium castings: ASTM B26.
  - 52 1. Alloy 535.

1 C. Stainless steel bar stock: ASTM A582, Type 303.

2 **2.3 PERFORMANCE AND DESIGN REQUIREMENTS**

3 A. Design railings and anchorage system in accordance with NAAMM AMP 521 to resist loading as  
4 required by Building Code.

5 1. Maximum allowable stresses per AA ADM 1.

6 B. Design railings in accordance with accessibility requirements per the Building Code and ADAAG.

7 **2.4 COMPONENTS**

8 A. Pipes and Tubes: Aluminum.

9 1. Guardrail: Minimum 1-1/2 IN DIA, Schedule 40.

10 2. Handrail: 1-1/4 IN DIA, Schedule 40.

11 3. Vertical pickets: 3/4 IN DIA, Schedule 10.

12 B. Fittings:

13 1. Machined aluminum or stainless steel bar stock.

14 2. Aluminum magnesium alloy castings.

15 3. Fasteners:

16 a. 302 series stainless steel Allen head set screws.

17 1) Rivets, adhesive or headed screws are not acceptable.

18 C. Flanges and Brackets:

19 1. Sand cast, aluminum magnesium alloy.

20 2. Provide flanges as indicated for mounting to:

21 a. Horizontal concrete surfaces: Hollaender "No. 144 Base Flange with No. 242 Cover".

22 b. Vertical concrete surfaces: Hollaender "No. 52E Extruded Heavy Duty Wall Flange".

23 c. Flange of structural members: Hollaender "No. 146 Series".

24 d. Web of structural members: Hollaender "No. 54 Series".

25 **2.5 ACCESSORIES**

26 A. Shims: Aluminum of same alloy as component being shimmed.

27 B. Expansion and Adhesive Anchors: See Specification Section 05505.

28 C. Toeboards: 4 IN high extruded toeboard with stiffener ribs and angled toe.

29 1. Similar to Hollaender "Model 94102."

30 D. Hinges: Cast aluminum.

31 1. Self-closing.

32 a. Stainless steel torsion spring.

33 2. Similar to Hollaender "#200 Gate Hinge."

34 E. Gate latch and stop: Cast aluminum.

35 1. Spring-loaded pin latch.

36 a. Stainless steel spring.

37 2. Similar to Hollaender "Gate Latch".

38 **2.6 FABRICATION**

39 A. General:

40 1. Verify field conditions and dimensions prior to fabrication.

41 2. All railings are to be mechanically fastened component system.

42 a. 2-rail system: Hollaender "Interna-Rail".

43 b. Vertical picket system: Hollaender "Interna-Rail with Component Infill."

44 3. Railing system shall be an engineered system designed specifically for use as guardrail  
45 system.

46 a. Fittings shall be internally connected, flush-fitting aluminum or stainless steel.

47 b. Fasteners shall be 302 series stainless steel Allen head set screws.

48 1) Rivets, adhesive or headed screws are not acceptable.

- 1 B. For fabrication of items which will be exposed to view, use only materials which are smooth and  
2 free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and  
3 roughness.
- 4 1. Form exposed work with smooth, short radius bends, accurate angles and straight edges.  
5 a. Ease exposed edges to a radius of approximately 1/32 IN.  
6 b. Form bent-metal corners to smallest radius possible without causing grain separation or  
7 otherwise impairing work.  
8 c. Drill or punch holes with smooth edges.
- 9 2. Form exposed connections with flush, smooth, hairline joints, using stainless steel or  
10 aluminum splice locks to splice sections together or by welding.  
11 a. Ease the edges of top rail splices and expansion joints and remove all burrs left from  
12 cutting.
- 13 C. Custom fabricate railings to dimensions and profiles indicated.
- 14 1. Where details are not indicated, space intermediate rails to requirements of the Building  
15 Code or OSHA Standards, whichever requires the more restrictive design.
- 16 2. Space vertical posts as required by loading requirements but not more than 4 FT on center.  
17 a. Avoid locating vertical posts at changes in direction of railing.  
18 b. Hold vertical post back 1 FT nominal from corner and provide radiused corners.  
19 c. Hold vertical post back 2 FT maximum from end terminations and provide "P" end loops.
- 20 3. Space handrail brackets as required by loading requirements but not more than 4 FT on  
21 center.
- 22 D. Mounting:
- 23 1. Provide manufacturer's standard cast fitting.  
24 a. Provide toeboards on walkway side of all elevated walkways, platforms and stair  
25 landings, and where indicated on the Drawings or required by OSHA Standards.
- 26 E. Guardrail Gates:
- 27 1. Constructed of same material and sizes as the guardrail system.  
28 2. Width of gate as shown on Drawings.
- 29 F. Finish:
- 30 1. Architectural Class 1 coating per AA DAF 45:  
31 a. AA-M12C22A41 clear anodized

## 32 PART 3 - EXECUTION

### 33 3.1 PREPARATION

- 34 A. Prior to installation, inspect and verify condition of substrate.
- 35 B. Correct surface defects or conditions which may interfere with or prevent a satisfactory  
36 installation.
- 37 1. Field welding aluminum is not permitted unless approved in writing by Engineer.

### 38 3.2 INSTALLATION

- 39 A. Install handrails and guardrails to meet loading requirements of the Building Code.
- 40 1. Provide safety glazing in all locations where required by the Building Code and CPSC 16  
41 CFR 1201.
- 42 B. Install products in accordance with manufacturer's instructions.
- 43 C. Set work accurately in location, alignment and elevation; plumb, level and true.
- 44 1. Measure from established lines and items which are to be built into concrete, masonry or  
45 similar construction.
- 46 D. Align railings prior to securing in place to assure proper matching at butting and expansion joints  
47 and correct alignment throughout their length.
- 48 1. Provide shims as required.
- 49 E. Roof-mounted guardrails:
- 50 1. Toprail elevation constant:  
51 a. 42 IN above walking surface high point.  
52 b. Adjust vertical post length to allow for roof slopes, camber, etc.



- 1                   2. Shim plates: Aluminum.
- 2                   a. Same size and shape as base plate.
- 3                   b. Drilled to match base plate anchorage.
- 4                   3. Flash in accordance with roofing manufacturer's requirements as detailed on drawings.
- 5                   F. Fit exposed ends of guardrails and handrails with solid terminations.
- 6                   1. Return ends of handrail to wall, but do not attach to wall.
- 7                   2. Where guardrail terminates at a wall, provide a vertical post or end-loop 4 IN off the wall to
- 8                   center of vertical member.
- 9                   G. Install weeps to drain water from hollow sections
- 10                  1. Drill 1/4 IN weep hole in railings closed at bottom:
- 11                  a. 1 IN above cast fittings.
- 12                  b. At low point of intermediate rails.
- 13                  2. Do not drill weep holes:
- 14                  a. In bottom of base plate.
- 15                  b. Below top of pipe flashing when railings are installed on the roof.
- 16                  H. Install proper sized expansion joints based on temperature at time of installation and differential
- 17                  coefficient of expansion of materials in all railings as recommended by manufacturer.
- 18                  1. Joints to be designed to allow expansion and contraction of railing and still meet design loads
- 19                  required.
- 20                  a. Top rail splices and expansion joints shall be located within 8 IN of post or other support.
- 21                  b. Where railings span building or tank expansion joints; provide a railing expansion joint in
- 22                  the span crossing the building or tank expansion joint.
- 23                  2. Provide expansion joints in any continuous run exceeding 20 FT in length.
- 24                  a. Space expansion joints at not more than 40 FT on center.
- 25                  3. Provide minimum 0.10 IN of expansion joint for each 20 FT length of top rail for each
- 26                  25 DegF differential between installation temperature and maximum design temperature.
- 27                  a. Maximum expansion joint width at time of installation shall not exceed 3/8 IN.
- 28                  1) Provide additional expansion joints as required to limit expansion joint width.
- 29                  4. Provide slip-joint with internal sleeve.
- 30                  a. Extend slip joint min 2 IN beyond joint at maximum design width.
- 31                  b. Fasten internal sleeve securely to one side
- 32                  1) Provide allen-head set screw located in bottom of rail.
- 33                  2) Rivets or exposed screw heads are not acceptable.
- 34                  5. Lubricate expansion joint splice bar for smooth movement of railing sections.
- 35                  I. Provide removable railing sections where indicated on Drawings.
- 36                  J. Attach handrails to walls or guardrail with brackets designed for condition:
- 37                  1. Provide brackets which provide a minimum 1-1/2 IN clearance between handrail and nearest
- 38                  obstruction.
- 39                  a. Handrails shall not project more than 4-1/2 IN into required stairway width.
- 40                  2. Anchor handrail brackets to concrete or masonry walls with 1/2 IN stainless steel adhesive
- 41                  anchors with stainless steel hex head bolts.
- 42                  K. Anchor roof-mounted guardrails to precast concrete tee or cored slab structure using 1/2 IN
- 43                  stainless steel through bolts, nuts and washers with additional bottom base plate placed on
- 44                  bottom side of structure.
- 45                  L. Anchor railings to concrete with minimum stainless steel adhesive anchors with stainless steel
- 46                  bolts, nuts and washers unless noted otherwise in the Contract Documents.
- 47                  1. Where exposed, bolts shall extend minimum 1/2 IN and maximum 3/4 IN above the top nut.
- 48                  a. If bolts are cut off to required height, threads must be dressed to allow nuts to be
- 49                  removed without damage to the bolt or the nut.
- 50                  b. Bevel the top of the bolt after cutting to provide a smooth surface.
- 51                  M. Anchor railings to metal structure with stainless steel bolts, nuts and washers.
- 52                  N. Install toeboards to fit tight to the walking surface.
- 53                  1. Attach to railing vertical post with manufacturer's standard mounting clamp:
- 54                  a. Adjustable.
- 55                  b. Designed to engage in extruded slot on back of toeboard.
- 56                  2. Provide splice bars, corner splices and brackets:
- 57                  a. Manufacturer's standard items as required for a complete installation.

- 1 3. Notch toeboards at base plates or other obstructions.
- 2 4. Bottom of toeboard shall not exceed 1/4 IN above walking surface.
- 3 O. Provide dissimilar materials protection:
- 4 1. Coat aluminum in contact with dissimilar metal or concrete in accordance with Specification
- 5 Section 09960.
- 6 P. Install guardrail gate plumb and level in location shown on Drawings.
- 7 1. Center gate in opening.
- 8 2. Top of gate to match top of guardrail.
- 9 3. Fasten hinges to gate and jamb post:
- 10 a. Minimum three (3) 1/4 IN stainless steel countersunk machine screws per leaf.
- 11 b. Drill and tap into railing and gate vertical posts.
- 12 4. Provide not less than two (2) hinges per gate.
- 13 5. Install gate latch and stop on strike side of opening.
- 14 a. Fasten to gate with 1/4 IN stainless steel countersunk machine screws.
- 15 b. Drill and tap into gate vertical post.
- 16 c. Drill hole in railing vertical post to receive latch pin.
- 17 6. Adjust to provide smooth operation:
- 18 a. Self-closing and self-latching.

19

**END OF SECTION**



# DIVISION 06

WOOD AND PLASTICS





1 2014/09/10

2

## SECTION 06100 ROUGH CARPENTRY

3

### 4 PART 1 - GENERAL

#### 5 1.1 SUMMARY

6

A. Section Includes: Rough carpentry.

7

B. Related Specification Sections include but are not necessarily limited to:

8

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

9

2. Division 01 - General Requirements.

10

3. Section 05505 - Metal Fabrications.

11

4. Section 07541 - PVC Membrane Roofing - Fully Adhered.

12

#### 1.2 QUALITY ASSURANCE

13

A. Referenced Standards:

14

1. APA - The Engineered Wood Association (APA):

15

a. PRP-108, Performance Standards and Qualification Policy for Structural Use Panels.

16

b. U450E, Storage and Handling of APA Trademarked Panels.

17

c. Y510T, Plywood Design Specification.

18

2. ASTM International (ASTM):

19

a. D2898, Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing.

20

b. D4442, Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.

21

c. D4444, Standard Test Method for Laboratory Standardization and Calibration of Hand-Held Moisture Meters.

22

d. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

23

3. American Wood Protection Association (AWPA):

24

a. U1, Use Category System: User Specification for Treated Wood.

25

4. Environmental Protection Agency (EPA).

26

5. National Institute of Standards and Technology (NIST):

27

a. PS-1, Construction and Industrial Plywood.

28

b. PS-2, Performance Standard for Wood-Based Structural-Use Panels.

29

c. PS-20, American Softwood Lumber Standard.

30

6. Underwriters Laboratories, Inc. (UL):

31

a. 723, Standard for Test for Surface Burning Characteristics of Building Materials.

32

7. Building Code:

33

a. International Code Council (ICC):

34

1) International Building Code and associated standards, 2006 Edition including all amendments, referred to herein as Building Code.

35

B. Qualifications:

36

1. Wood Treatment Plant: AWPA M3.

37

2. Treated Wood Inspection: AWPA M2.

38

C. Miscellaneous:

39

1. Factory marking:

40

a. Lumber:

41

1) Identify type, grade, moisture content, inspection service, producing mill, and other qualities specified.

42

2) Marking may be omitted, as allowed by Building Code, if certificate of inspection is provided for each shipment.

43

44

45

46

47

48

#### 49 1.3 SUBMITTALS

50

A. Shop Drawings:

51

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

52

2. Fabrication drawings of all fabricated items.

53

- 1 3. Product technical data including:
  - 2 a. Acknowledgement that products submitted meet requirements of standards referenced.
  - 3 b. Manufacturer's installation instructions for all products specified.
- 4 4. Certifications:
  - 5 a. Chemicals used in treatment process are registered with and approved by EPA.
  - 6 b. Moisture content of material prior to treatment: 25 percent maximum.
  - 7 c. Material has been kiln-dried after treatment (KDAT) to the moisture content specified.
- 8 5. Documentation of treatment of fire retardant treated material in accordance with standards
  - 9 referenced.

10 **1.4 DELIVERY AND STORAGE**

- 11 A. Delivery, storage and handling of untreated wood products:
  - 12 1. Lumber: As recommended by the grading agency indicated on the grade stamp.
  - 13 2. Plywood: APA U450E.
- 14 B. Delivery, storage, handling and disposal of treated wood products: AWPA M4.

15 **PART 2 - PRODUCTS**

16 **2.1 ACCEPTABLE MANUFACTURERS**

- 17 A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable
  - 18 Articles below are acceptable.
- 19 B. Submit request for substitution in accordance with Specification Section 01640.

20 **2.2 MATERIALS**

- 21 A. General:
  - 22 1. Lumber (for framing, blocking, nailers, furring, grounds and similar members):
    - 23 a. NIST PS-20.
    - 24 b. Species:
      - 25 1) Treated material: As indicated in the appropriate AWPA standard and as required
      - 26 to achieve UL rating listed herein.
    - 27 c. Grade:
      - 28 1) For nominal sizes up to and including 2 x 4: Standard and better.
      - 29 2) For nominal sizes up to 2 IN thick and wider than 4 IN: #2 and better.
  - 30 2. Non-structural plywood:
    - 31 a. NIST PS-1.
    - 32 b. C-C plugged:
      - 33 1) Exposure: EXT.
      - 34 2) Thickness: 3/4 IN.
      - 35 3) Touch sanded.
  - 36 3. Moisture content:
    - 37 a. Kiln-dry: ASTM D4442 and ASTM D4444.
    - 38 b. Lumber: 19 percent maximum.
    - 39 c. Plywood: 15 percent maximum.
- 40 B. Fire-Retardant Treated Material (FRTM):
  - 41 1. Acceptable manufacturer:
    - 42 a. Hoover Treated Wood Products, Inc.:
      - 43 1) Interior: "Pyro-Guard".
      - 44 2) Exterior: "Exterior Fire-X".
  - 45 2. Maximum moisture content:
    - 46 a. Prior to treatment: 25 percent.
    - 47 b. Kiln-dry after treatment (KDAT), ASTM D4442 and ASTM D4444:
      - 48 1) Lumber: 19 percent (KDAT).
      - 49 2) Plywood: 15 percent (KD-15).
  - 50 3. Fire-retardant preservative:
    - 51 a. Provide protection against decay:
      - 52 1) EPA registered for use as a wood preservative.
    - 53 b. Shall not bleed-through or adversely affect bond of any finish.
  - 54 4. Pressure-treat material in accordance with AWPA U1 and the following:
    - 55 a. Lumber: AWPA U1.

- 1 b. Plywood: AWPA U1.
- 2 5. UL Classified:
- 3 a. FR-S, UL 723.
- 4 b. Exterior: No increase in classification when subjected to the Standard Rain Test, ASTM
- 5 D2898.
- 6 c. Provide UL mark on each piece of FRTM.
- 7 6. Maximum flame spread rating: 25, ASTM E84.
- 8 7. Wherever practicable, material to be treated shall be manufactured in its final form prior to
- 9 treatment.
- 10 C. Fasteners and Anchors:
- 11 1. Proper type, size, material, and finish for application.
- 12 2. Nuts, bolts and washers: See Specification Section 05505.
- 13 3. Expansion anchors: See Specification Section 05505.
- 14 4. Adhesive anchors: See Specification Section 05505.

## 15 PART 3 - EXECUTION

### 16 3.1 PREPARATION

- 17 A. Verify measurements, dimensions, and shop drawing details before proceeding.
- 18 B. Coordinate location of studs, nailers, blocking, grounds and similar supports for attached work.
- 19 C. Eliminate sharp projections which would puncture roofing, flashing or underlayment material.

### 20 3.2 ERECTION AND INSTALLATION

- 21 A. General:
- 22 1. Provide treated material in accordance with appropriate AWPA standard for intended end
- 23 use.
- 24 2. Provide fire-retardant treated material for all wood used.
- 25 B. Attach work securely by anchoring and fastening as indicated or required to support applied
- 26 loading.
- 27 1. Provide washers under bolt heads and nuts.
- 28 2. Fasten plywood in accordance with APA recommendations.
- 29 3. Use galvanized nails and fasteners unless indicated otherwise.
- 30 a. When anchoring treated wood material use appropriately treated fasteners for corrosion
- 31 protection against the chemicals used in the wood treatment process.
- 32 4. Use common wire nails or screws for general work.
- 33 5. Use fasteners of size that will not penetrate members where opposite side will be exposed to
- 34 view or receive finish materials.
- 35 6. Install fasteners without splitting of wood; predrill as required.
- 36 7. Do not drive threaded friction type fasteners.
- 37 8. Tighten bolts and lag screws at installation and retighten as required.
- 38 C. Set work to required levels and lines, plumb, true.
- 39 1. Shim as required.
- 40 2. Cut and fit accurately.
- 41 D. Provide wood grounds, nailers, or blocking where required for attachment of other work and
- 42 surface applied items.
- 43 1. Form to shapes indicated or required.
- 44 a. Field treat cuts and holes in preservative and fire-retardant treated material in
- 45 accordance with AWPA M4 and manufacturer's published recommendations.
- 46 1) FRTM lumber:
- 47 a) Do not rip or mill.
- 48 b) Cross-cutting and drilling are allowable in accordance with manufacturer's
- 49 recommendations and UL requirements.
- 50 c) Resurfacing, planing or fabrication of special shapes or profiles shall be done
- 51 prior to treatment.
- 52 2) FRTM plywood:
- 53 a) Cross-cutting, ripping and drilling are allowable in accordance with
- 54 manufacturer's recommendations and UL requirements.

- 1                    3) Light sanding as permitted by UL to remove raised grain or prepare for finishing is  
2                    allowable.
- 3                    2. Grounds:
- 4                    a. Dressed, key beveled lumber minimum 1-1/2 IN wide of thickness required to bring face  
5                    of ground even with finish material.
- 6                    b. Remove temporary grounds when no longer required.
- 7                    3. Roofing nailers:
- 8                    a. Install per roofing manufacturer's recommendations.
- 9                    b. Match height of nailers to insulation.
- 10                   c. Anchor nailers to resist force of 300 PLF unless required otherwise by roofing  
11                   manufacturer.
- 12                   1) Metal decking attachment:
- 13                   a) Attach base nailer to metal roof deck using self-tapping stainless steel sheet  
14                   metal screws (STSMS) with plate washers or with minimum 3/8 IN Type 304  
15                   stainless steel hex head bolts with nuts and washers.
- 16                   b) Countersink heads of bolts flush with top of nailer.
- 17                   c) Provide size and spacing as required to meet loading criteria specified.
- 18                   d) Provide spacing of minimum 3/8 IN hex head bolts as required to meet loading  
19                   criteria specified.
- 20                   2) Concrete decking attachment:
- 21                   a) Attach base nailer to concrete roof deck using minimum 3/8 IN stainless steel  
22                   adhesive anchors with minimum 3 IN embedment.
- 23                   b) Countersink heads of bolts flush with top of nailer.
- 24                   c) Provide spacing as required to meet loading criteria specified.
- 25                   d. Provide 1/2 IN vent spaces between lengths of nailers.
- 26                   e. Install nailers over vapor retarder where indicated.
- 27                   E. Install wood furring plumb and level with closure strips at all edges and openings.
- 28                   F. When wood has been exposed to moisture allow to completely dry out prior to covering with  
29                   additional wood or another material.
- 30                   G. Correct or replace wood which shows bowing, warping or twisting to provide a straight, plumb and  
31                   level substrate for applications of other materials.

32

**END OF SECTION**



1 2014/09/08

2

## SECTION 06610

3

### FIBERGLASS REINFORCED PLASTIC FABRICATIONS

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

###### A. Section Includes:

7

1. Fiberglass reinforced plastic (FRP) fabrications including but not limited to:

8

- a. Solid plate.

9

- b. Modular framing system.

10

- c. Grating.

11

###### B. Related Specification Sections include but are not necessarily limited to:

12

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

13

2. Division 01 - General Requirements.

14

3. Section 05505 - Metal Fabrications.

15

##### 1.2 QUALITY ASSURANCE

16

###### A. Referenced Standards:

17

1. ASTM International (ASTM):

18

- a. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

19

2. Occupational Safety and Health Administration (OSHA):

20

- a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.

21

3. Building Code:

22

- a. International Code Council (ICC):

23

- 1) International Building Code and associated standards, 2006 Edition including all amendments, referred to herein as Building Code.

24

25

26

##### 1.3 DEFINITIONS

27

- A. FRP: Fiberglass Reinforced Plastic.

28

##### 1.4 SUBMITTALS

29

###### A. Shop Drawings:

30

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

31

2. Product technical data including:

32

- a. Acknowledgement that products submitted meet requirements of standards referenced.

33

- b. Manufacturer's installation instructions.

34

- c. Manufacturer's recommendations on reinforcing field cut openings.

35

3. Fabrication and/or layout Drawings.

36

- a. Plan showing profile, location, section and details of each item including anchorage or support system(s).

37

- b. Locations and type of expansion joints.

38

- c. Materials of construction including shop applied coatings.

39

- d. Listing of all accessory items being provided indicating material, finish, etc.

40

4. Manufacturer's full line of colors available for each component.

41

42

43

##### 1.5 DELIVERY, STORAGE, AND HANDLING

44

- A. Deliver and handle each item to preclude damage.

45

- B. Store all items on skids above ground.

46

1. Keep free of dirt and other foreign matter which will damage items or finish and protect from corrosion and UV exposure.

47

1 **PART 2 - PRODUCTS**

2 **2.1 ACCEPTABLE MANUFACTURERS**

3 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

- 4 1. Grating and solid plate:  
5 a. American Grating.  
6 b. Enduro Composite Systems.  
7 c. Fibergrate Composite Structures, Inc.  
8 d. IKG Industries.  
9 e. International Grating Inc.  
10 f. Seasafe, Inc.  
11 g. Strongwell.  
12 2. Modular framing system:  
13 a. AICKIN.  
14 b. Enduro Composite Systems.  
15 c. Seasafe, Inc.  
16 d. Unistrut.

17 B. Submit request for substitution in accordance with Specification Section 01640.

18 **2.2 MATERIALS**

19 A. Fiberglass Reinforced Plastic (FRP):

- 20 1. Vinyl ester with fiberglass reinforcing.  
21 a. Type V.  
22 2. Fire retardant.  
23 a. Flame spread: ASTM E84, 25 or less.  
24 3. Color: To be selected by Engineer when more than one (1) color is available for any one (1)  
25 component.

26 B. Fasteners, Clips, Saddles, and Miscellaneous Components:

- 27 1. Fiberglass where possible.  
28 2. Stainless steel may be used if fiberglass component is not available.

29 C. Adhesive: Recommended by manufacturer.

30 **2.3 FABRICATION**

31 A. General:

- 32 1. Verify field conditions and dimensions prior to fabrication.  
33 2. Preassemble items in shop to greatest extent possible.  
34 3. All components shall be treated with UV inhibitor.  
35 4. Drill or punch holes with smooth edges.

36 B. Grating:

- 37 1. Design live load:  
38 a. 100 psf uniform live load.  
39 b. 300 LBS concentrated load.  
40 c. Maximum deflection of 1/300 of span under a superimposed live load.  
41 d. Design for the most severe loading condition noted above.  
42 2. Minimum grating depth: 1-1/2 IN.  
43 3. Bar span: Maximum of 1-1/2 IN center to center.  
44 4. Walking surface: Manufacturer's standard applied abrasive grit coating.

45 C. Grating Supports:

- 46 1. Fiberglass.  
47 2. Embedded grating supports:  
48 a. Similar to Strongwell "Duradek Fiberglass Curb Angle."  
49 1) Size to suit depth of grating.  
50 2) Provide leg or strap for embedding and anchoring into concrete.  
51 3. Surface mounted grating supports:  
52 a. Pultruded angle:  
53 1) 3 IN by 3 IN by thickness necessary for loading conditions.

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  - 2
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  - 8
  - 9
- 2) Anchor to concrete using stainless steel adhesive anchors.
    - a) Size and spacing as necessary for loading conditions.
    - b) See Specification Section 05505.
  - D. Modular Framing System:
    - 1. Heavy duty pultruded.
    - 2. Shapes as required for condition.
    - 3. Fasteners: Stainless steel or fiberglass.
    - 4. Provide end caps for all exposed terminations.
  - E. Sheet Goods: Minimum 1/4 IN thick or as noted on Drawings.

## 10 PART 3 - EXECUTION

### 11 3.1 INSTALLATION

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  - 13
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  - 29
  - 30
  - 31
  - 32
- A. Install products in accordance with manufacturer's instructions.
  - B. Set work accurately in location, alignment and elevation, plumb, level, and true.
    - 1. Measure from established lines and levels.
    - 2. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry or similar construction.
    - 3. Tolerances:
      - a. Maximum variation from plumb in vertical line: 1/8 IN in 3 FT.
      - b. Maximum variation from level of horizontal line: 1/4 IN in 20 FT.
      - c. Maximum variation from plan location: 1/4 IN in 20 FT.
  - C. Fabricate FRP sheet goods to shapes and profiles as indicated on Drawings.
  - D. Coat all exposed surfaces of stainless steel fasteners with minimum 15 mil gel coating to match component being anchored.
  - E. Attach grating to each end and intermediate support clip or saddle with bolts, nuts and washers.
    - 1. Maximum spacing: 2 FT OC with minimum of two (2) per side.
    - 2. Attach clips or saddles to bearing bars only.
    - 3. Reinforce all field cut openings in accordance with manufacturer's recommendations.
  - F. File cut ends of all fiberglass and ease edges.
  - G. Seal cut ends of all items with catalyzed resin as recommended by manufacturer.
    - 1. Provide same resin used in fabrication of item as a minimum.
  - H. Provide all modular framing components as required to suit condition.
    - 1. Install in accordance with manufacturer's recommendations.

33 **END OF SECTION**

34





# DIVISION 07

THERMAL AND MOISTURE PROTECTION





1 2014/09/10

2

3

**SECTION 07120**  
**FLUID APPLIED WATERPROOFING**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6

A. Section Includes:

7

1. Fluid applied waterproofing.

8

2. Protection course.

9

3. Specific concrete finishing requirements.

10

B. Related Specification Sections include but are not necessarily limited to:

11

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

12

2. Division 01 - General Requirements.

13

3. Division 03 - Concrete.

14

4. Section 07210 - Building Insulation.

15

**1.2 QUALITY ASSURANCE**

16

A. Referenced Standards:

17

1. ASTM International (ASTM):

18

a. C836, Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.

19

b. D4258, Standard Practice for Surface Cleaning Concrete for Coating.

20

2. International Concrete Repair Institute (ICRI):

21

a. 310.2, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.

22

3. The Society for Protective Coatings/NACE International (SSPC/NACE):

23

a. SP 6/NACE No. 3, Commercial Blast Cleaning.

24

b. SP 13/NACE No. 6, Surface Preparation of Concrete.

25

26

B. Qualifications:

27

1. Applicator(s) licensed or approved in writing by manufacturer.

28

2. Applicator(s) shall have minimum of seven (7) years experience in application of cold liquid-applied elastomeric waterproofing membranes with minimum of two (2) years installation of products specified or accepted for use on this Project.

29

a. Provide list of projects completed in last two (2) years using products proposed for use.

30

1) Include name of structure, area waterproofed (SF) and name of contact with phone number.

31

32

33

34

C. Miscellaneous:

35

1. Manufacturer's authorized representative shall review substrate preparation and provide written approval of substrate prior to installation of product.

36

37

38

**1.3 DEFINITIONS**

39

A. Installer or Applicator:

40

1. Installer or applicator is the person actually installing or applying the product in the field at the

41

Project site.

42

2. Installer and applicator are synonymous.

43

**1.4 SUBMITTALS**

44

A. Shop Drawings:

45

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

46

2. Details showing flashing of penetrations, terminations, expansion joints, protection course attachment and other special conditions.

47

48

- 1           3. Product technical data including:
- 2           a. Acknowledgement that products submitted meet requirements of standards referenced.
- 3           b. Manufacturer's installation instructions.
- 4           4. Certification of Applicator qualifications.
- 5           5. Applicator's experience record.
- 6           6. Listing of projects completed in last two (2) years.
- 7           B. Informational Submittals:
- 8           1. See Specification Section 01340 for requirements for the mechanics and administration of
- 9           the submittal process.
- 10          2. Manufacturer's written approval of substrate.
- 11          3. Warranty.

12           **PART 2 - PRODUCTS**

13           **2.1 ACCEPTABLE MANUFACTURERS**

- 14          A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 15          1. Waterproofing system:
- 16           a. Tremco Sealants and Waterproofing.
- 17           b. Carlisle Coatings and Waterproofing.
- 18          B. Submit request for substitution in accordance with Specification Section 01640.

19           **2.2 MATERIALS**

- 20          A. Primer: Manufacturer's recommended primer appropriate to substrate.
- 21          B. Waterproofing System:
- 22           1. One (1) or two (2) component, moisture curing polyurethane elastomer meeting requirements
- 23           of ASTM C836.
- 24           2. Flowing type for surfaces up to 5 percent slope.
- 25           3. Non-flow type for surfaces exceeding 5 percent.
- 26           4. Carlisle "Liquiseal CCW-525" or Tremco "TREMproof 201/60."
- 27          C. Adhesive: Manufacturer's standard.
- 28          D. Flashing Reinforcement: Woven uncoated fiberglass mesh.
- 29          E. Sealant: Manufacturer's recommended sealant.
- 30          F. Protection Course:
- 31           1. Material capable of protecting cured membrane from damage caused by rocks and other
- 32           debris in the backfill material.
- 33           2. Acceptable to waterproofing manufacturer.
- 34          G. Backer Rod: Closed cell polyurethane foam rod.

35           **PART 3 - EXECUTION**

36           **3.1 PREPARATION**

- 37          A. Cure concrete and masonry in accordance with manufacturer's recommendations.
- 38           1. Verify moisture content does not exceed manufacturer's maximum allowable.
- 39           2. Ensure that curing agents used are compatible with coating system.
- 40          B. Remove surface contamination by high pressure water cleaning per ASTM D4258.
- 41          C. Verify that concrete has been troweled and broomed, free of fins, ridges or voids.
- 42           1. Verify that all tie holes and honeycomb areas, holes and voids have been patched in
- 43           accordance with Specification Section 03348 and coating manufacturer's recommendations.



- 1 D. Prepare substrate per manufacturer's published instructions and this Specification Section.
- 2 1. Concrete surfaces:
- 3 a. Abrasive blast in accordance with SSPC SP 13/NACE No. 6 to provide a profiled
- 4 surface.
- 5 1) Profile: ICRI 310.2, CSP 3 minimum.
- 6 2. Metal surfaces:
- 7 a. Abrasive blast in accordance with SSPC SP 6/NACE No. 3.
- 8 1) Minimum one (1) mil surface profile.
- 9 b. Prime coat all metal surfaces.
- 10 3. Flash all penetrations and other areas in accordance with manufacturer's instructions.
- 11 4. Clean and seal cracks and joints in accordance with manufacturer's instructions.
- 12 E. Protect adjacent surfaces.

13 **3.2 APPLICATION AND INSTALLATION**

- 14 A. Apply waterproofing system in accordance with manufacturer's printed instructions and this
- 15 Specification Section.
- 16 1. Provide minimum 60 mil dry film thickness.
- 17 2. Apply waterproofing to below grade surfaces as follows:
- 18 a. Apply to all new concrete wall surfaces at chemical building addition, including:
- 19 1) Chemical Feed Room FC-102 Containment Area.
- 20 2) Stair FC-104.
- 21 b. Extend waterproofing horizontally over footings and turn down to bottom of footing
- 22 unless shown otherwise on Drawings.
- 23 c. Terminate top of waterproofing in a saw-cut reglet approximately 4 IN below finished
- 24 grade.
- 25 B. Extend coating over all previously flashed areas.
- 26 C. Allow vertical applications to cure minimum of 12 HRS at 75 DegF or as recommended by
- 27 manufacturer, prior to backfilling.
- 28 D. Protection Course:
- 29 1. Protection course is to be installed prior to any perimeter insulation specified in Specification
- 30 Section 07210.
- 31 a. Secure protection course to prevent displacement during backfilling.
- 32 1) Adhere to cured waterproofing membrane.
- 33 2) Mechanical fasteners are not acceptable.

34 **END OF SECTION**

35



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**SECTION 07176**  
**LIQUID WATER REPELLENT**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6 A. Section Includes: Liquid water repellent.

7 B. Related Sections include but are not necessarily limited to:

- 8 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.  
9 2. Division 01 - General Requirements.  
10 3. Section 04210 - Brick Masonry.

11 **1.2 QUALITY ASSURANCE**

12 **1.3 SUBMITTALS**

13 A. Shop Drawings:

- 14 1. See Specification Section 01340 for requirements for the mechanics and administration of  
15 the submittal process.  
16 2. Product technical data including:  
17 a. Acknowledgement that products submitted meet requirements of standards referenced.  
18 b. Manufacturer's installation instructions.

19 B. Informational Submittals:

- 20 1. See Specification Section 01340 for requirements for the mechanics and administration of  
21 the submittal process.  
22 2. Warranty.

23 **1.4 WARRANTY**

24 A. Provide manufacturer's standard five (5) year performance warranty.

25 **PART 2 - PRODUCTS**

26 **2.1 ACCEPTABLE MANUFACTURERS**

27 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

- 28 1. Liquid water repellent:  
29 a. L&M Construction Chemicals, Inc.  
30 b. Chemprobe Technologies, Inc.  
31 c. Hydrozo, Inc.  
32 d. Degussa.

33 B. Submit request for substitution in accordance with Specification Section 01640.

34 **2.2 MATERIALS**

35 A. Liquid Water Repellent:

- 36 1. Clear, deep penetrating sealer formulated for sealing vertical concrete and brick surfaces.  
37 a. Water based, VOC compliant, odorless.  
38 1) VOC: Less than 195 g/L.  
39 b. Non-yellowing, non-staining.  
40 c. Provides both surface barrier and penetrating chemical action barrier.  
41 2. Surface barrier shall protect against water intrusion, mildew, dirt and airborne contaminants.  
42 3. L&M Construction Chemicals, Inc. "HYROPEL WB."

1 **PART 3 - EXECUTION**

2 **3.1 PREPARATION**

- 3 A. Protect adjacent surfaces not intended to be covered.
- 4 B. Clean surfaces to be covered in accordance with manufacturer's recommendations.
- 5 C. Make all mortar repairs at least 48 HRS prior to application.
- 6 D. Allow masonry surfaces to cure minimum of 10 days prior to application.

7 **3.2 INSTALLATION AND APPLICATION**

- 8 A. Install products in accordance with manufacturer's instructions.
  - 9 1. At a minimum apply material in accordance with manufacturer's recommended application
  - 10 rates using procedures and equipment recommended by manufacturer.
  - 11 a. Apply two (2) coats of material.
- 12 B. Apply liquid water repellent to exterior brick surfaces.

13 **3.3 FIELD QUALITY CONTROL**

- 14 A. Protect adjacent materials not required to be coated.

15 **END OF SECTION**

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3

**SECTION 07190**  
**UNDER SLAB VAPOR RETARDER**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6

A. Section Includes: Under slab vapor retarder.

7

B. Related Specification Sections include but are not necessarily limited to:

8

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

9

2. Division 01 - General Requirements.

10

**1.2 QUALITY ASSURANCE**

11

A. Referenced Standards:

12

1. American Concrete Institute (ACI):

13

a. 302.2R, Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.

14

2. ASTM International (ASTM):

15

a. D882, Standard Test Method for Tensile Properties of Thin Plastic Sheeting.

16

b. D1709, Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method.

17

c. E96, Standard Test Methods for Water Vapor Transmission of Materials.

18

d. E1643, Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

19

20

e. E1745, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

21

22

23

**1.3 SUBMITTALS**

24

A. Shop Drawings:

25

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

26

2. Product technical data including:

27

a. Acknowledgement that products submitted meet requirements of standards referenced.

28

b. Product data sheet on vapor retarder sheet and vapor retarder tape.

29

c. All accessories proposed for use.

30

d. Manufacturer's installation instructions.

31

32

B. Informational Submittals: Manufacturer's recommendation on vapor retarder tape.

33

**PART 2 - PRODUCTS**

34

**2.1 ACCEPTABLE MANUFACTURERS**

35

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

36

1. Vapor retarder:

37

a. Fortifiber Corporation.

38

b. Layfield Group

39

c. Raven Industries.

40

d. Reef Industries.

41

e. Stego Industries.

42

f. WR Meadows, Inc.

43

B. Submit request for substitution in accordance with Specification Section 01640.

1    **2.2 PERFORMANCE REQUIREMENTS**

- 2        A. Vapor Retarder:
- 3            1. ASTM E1745, Class A.
- 4            2. Thickness: Minimum 15 mil.
- 5            3. Water vapor permeance: 0.03 maximum per ASTM E96.
- 6            4. Puncture resistance: ASTM D1709, Method B, 2200 grams.
- 7            5. Minimum tensile strength: 45 LBS/IN, ASTM D882.

8    **2.3 ACCESSORIES**

- 9        A. Pipe Boots: Manufacturer's standard boot fabricated to maintain the integrity of the vapor
- 10         retarder system.
- 11        B. Vapor Retarder Tape: As recommended by vapor retarder manufacturers.

12    **PART 3 - EXECUTION**

13    **3.1 INSTALLATION**

- 14        A. Install products in accordance with manufacturer's instructions, ASTM E1643 and ACI 302.2R.
- 15        B. Provide vapor retarder at all new concrete slab construction.
- 16            1. Place continuous vapor retarder above granular fill subgrade material, unless noted
- 17             otherwise.
- 18        C. Lap minimum 6 IN and seal in accordance with ASTM E1643 and manufacturer's
- 19             recommendations.
- 20        D. Extend to extremities of area and seal to adjacent elements.
- 21        E. Seal all penetrations: Provide pipe boot for all pipes or conduit penetrating the floor slab.

22    **3.2 FIELD QUALITY CONTROL**

- 23        A. Ensure proper precautions are implemented to prevent damage to installed vapor retarder
- 24             membrane prior to and during pouring of concrete floor slab.
- 25        B. Inspect vapor retarder immediately prior to placement of concrete.
- 26            1. Patch all punctures, tears, holes, etc.
- 27             a. Repair with additional layer of vapor retarder and seal entire patch with vapor retarder
- 28             tape or as recommended by manufacturer.
- 29             b. Lap all repairs minimum 6 IN.

30    **END OF SECTION**

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**SECTION 07210**  
**BUILDING INSULATION**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
- 7 1. Building insulation.
- 8 a. Does not include roof insulation or roof vapor retarder; see Specification Section 07541.
- 9 B. Related Specification Sections include but are not necessarily limited to:
- 10 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 11 2. Division 01 - General Requirements.
- 12 3. Section 04210 - Brick Masonry.
- 13 4. Section 04220 - Concrete Masonry.

14 **1.2 QUALITY ASSURANCE**

- 15 A. Referenced Standards:
- 16 1. ASTM International (ASTM):
- 17 a. C272, Standard Test Method for Water Absorption of Core Materials for Structural
- 18 Sandwich Constructions
- 19 b. C518, Standard Test Method for Steady-State Thermal Transmission Properties by
- 20 Means of the Heat Flow Meter Apparatus.
- 21 c. C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- 22 d. C665, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light
- 23 Frame Construction and Manufactured Housing.
- 24 e. D1621, Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
- 25 f. E96, Standard Test Methods for Water Vapor Transmission of Materials.
- 26 2. Underwriters Laboratories, Inc. (UL):
- 27 a. Building Materials Directory.

28 **1.3 SUBMITTALS**

- 29 A. Shop Drawings:
- 30 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 31 the submittal process.
- 32 2. Product technical data including:
- 33 a. Acknowledgement that products submitted meet requirements of standards referenced.
- 34 b. Manufacturer's installation instructions.
- 35 c. Manufacturer's recommendations on sealants, tapes and mastics.
- 36 B. Informational Submittals:
- 37 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 38 the submittal process.
- 39 2. Certification from insulation manufacturer stating that insulation proposed is acceptable for
- 40 intended use per the Drawings.

41 **1.4 SITE CONDITIONS**

- 42 A. For purposes of this Specification Section, design frost line for this Project is 42 IN below grade.

1 **PART 2 - PRODUCTS**

2 **2.1 ACCEPTABLE MANUFACTURERS**

- 3 A. Subject to compliance with the Contact Documents, the following manufacturers are acceptable:
- 4 1. Rigid extruded polystyrene board insulation:
- 5 a. Dow.
- 6 b. Dyplast Products.
- 7 c. Diversifoam Products.
- 8 d. PACTIV.
- 9 e. Owens Corning.
- 10 2. Blanket or batt thermal insulation:
- 11 a. Owens-Corning Fiberglass Corp.
- 12 b. United States Gypsum Company (USG).
- 13 c. CertainTeed.
- 14 3. Vapor retarder:
- 15 a. Raven Industries.
- 16 b. Reef Industries.
- 17 c. Fortifiber Corp.
- 18 d. Alumiseal.
- 19 B. Submit request for substitution in accordance with Specification Section 01640.

20 **2.2 MATERIALS**

- 21 A. Rigid Polystyrene Board Insulation:
- 22 1. Extruded: ASTM C578, Type IV.
- 23 a. Water vapor transmission: ASTM E96, 1.1 perm-IN maximum.
- 24 b. Water absorption: ASTM C272, 0.3 percent maximum.
- 25 c. Thermal resistance: ASTM C518 at 75 DegF mean temperature, 5.0/IN.
- 26 2. Provide insulation designed for intended use.
- 27 a. Perimeter insulation and protection board.
- 28 1) Similar to Dow "Styrofoam."
- 29 2) Compressive strength: ASTM D1621, 30 psi.
- 30 3) Thickness:
- 31 a) Perimeter insulation: 2 IN.
- 32 b) Protection board: 1 IN.
- 33 4) Edges: Square.
- 34 b. Cavity insulation:
- 35 1) Similar to Dow "CAVITYMATE."
- 36 2) Compressive strength: ASTM D1621, 15 psi.
- 37 3) Thickness: 2 IN.
- 38 4) Edges: Square.
- 39 B. Sealant and Mastic (for setting polystyrene and/or polyisocyanurate insulation board):
- 40 Manufacturer's recommended standard.
- 41 C. Blanket or Batt Thermal Insulation:
- 42 1. Glass or other inorganic fibers and resinous binders formed into flexible blankets or semi-
- 43 rigid sheets.
- 44 2. Unfaced:
- 45 a. ASTM C665, Type 1.
- 46 3. Minimum thickness as noted on Drawings.
- 47 D. Vapor Retarder:
- 48 1. Fire rated, reinforced, 3 ply, Class 1 material.
- 49 2. Perm rating: Not exceeding 0.035 grains/HR-FT<sup>2</sup>-IN-Hg when determined in accordance
- 50 with ASTM E96.
- 51 3. Griffolyn "TX-1200FR."
- 52 E. Vapor Retarder Tape: As recommended by vapor retarder manufacturer.



1 **PART 3 - EXECUTION**

2 **3.1 INSTALLATION**

- 3 A. Install products in accordance with manufacturer's instructions.
- 4 B. General:
- 5 1. Insulate full thickness over surfaces to be insulated.
- 6 2. Fit tightly around obstructions, fill voids.
- 7 3. Cover all penetrations (electrical junction boxes, switch boxes, piping, conduits, etc.) with
- 8 insulation, taking care not to compromise the workings of the device.
- 9 4. Fit butted joints of batt or blanket insulations tightly together.
- 10 5. Apply single or double layer to achieve total thickness.
- 11 a. If double layer is provided, stagger all joints minimum 12 IN.
- 12 6. Do not use broken or torn pieces of insulation.
- 13 1. Install so that completed installation is vapor tight.
- 14 a. Seal all joints.
- 15 b. Seal to abutting materials to maintain vapor retarder integrity.
- 16 c. Provide manufacturer's recommended vapor retarder tape.
- 17 1) If vapor retarder tape fails to adhere to any surface, apply sprayed-on adhesive as
- 18 recommended by tape manufacturer to promote adhesion.
- 19 d. Provide manufacturer's recommended solvent-free sealant compatible with insulation
- 20 board for rigid board insulation.
- 21 1) Tape is not acceptable for use with rigid board insulation.
- 22 C. Blanket or Batt Insulation:
- 23 1. Verify that all piping, conduit, electrical box and other in-wall work is complete prior to
- 24 installing insulation and vapor retarder.
- 25 2. Install insulation friction fit between studs.
- 26 3. Tightly butt ends.
- 27 4. Install vapor retarder to warm side of building exterior wall.
- 28 a. Completely seal each wall area to surrounding construction.
- 29 b. Use widest practical sheet.
- 30 c. Install in continuous sheets, floor to structure above, without horizontal joints.
- 31 d. Fold flaps of vapor retarder over studs.
- 32 e. Tape flaps together continuously.
- 33 f. Tape bottom and top edges to structure continuously.
- 34 g. After installation of any additional conduit, boxes, piping or other items within wall
- 35 system, repair all tears or penetrations of vapor retarder with vapor retarder tape prior to
- 36 installation of gypsum board.
- 37 D. Rigid Board Insulation in Cavity Walls:
- 38 1. Do not proceed with installation until subsequent work which conceals insulation is ready to
- 39 be performed.
- 40 2. Set each piece of insulation flush with the abutting piece to eliminate ledges in the face of the
- 41 insulation.
- 42 3. Install mastic on face of concrete or masonry back-up in accordance with mastic and
- 43 insulation manufacturer's recommendation.
- 44 4. Press courses of insulation between wall ties (horizontal reinforcing) with edges butted tightly
- 45 both ways.
- 46 5. Set units firmly into mastic.
- 47 6. Seal all horizontal and vertical joints with sealant recommended by insulation manufacturer.
- 48 7. Do not use damaged insulation.
- 49 E. Rigid Insulation at Perimeter Below Grade:
- 50 1. Install insulation below grade on outside face of foundation walls.
- 51 a. Install in mastic with tight joints.
- 52 2. Where footings are located below the design frost line, extend insulation down to the design
- 53 frost line.
- 54 a. Where indicated on the Drawings, extend beyond the design frost line.
- 55 3. Where footings are located at the design frost line, extend insulation down to top of footing or
- 56 as indicated on Drawings.
- 57 4. Protect insulation from damage and/or displacement during backfilling.

1 **3.2 FIELD QUALITY CONTROL**

2 A. Repair or replace damaged insulation and/or vapor retarder as directed by Engineer.

3 **END OF SECTION**

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2

## SECTION 07410

3

### PREFORMED FACTORY-INSULATED METAL WALL PANELS

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

###### A. Section Includes:

7

1. Preformed factory-insulated metal wall panels.

8

2. Associated flashing and trim.

9

3. Supplemental framing and supports.

10

###### B. Related Specification Sections include but are not necessarily limited to:

11

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

12

2. Division 01 - General Requirements.

13

3. Section 05505 - Metal Fabrications.

14

4. Section 07600 - Flashing and Sheet Metal.

15

5. Section 07900 - Joint Sealants.

16

##### 1.2 QUALITY ASSURANCE

17

###### A. Referenced Standards:

18

1. American Architectural Manufacturers Association (AAMA):

19

a. 1503, Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors, and Glazed Wall Sections.

20

b. 2605, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

21

2. American Society of Civil Engineers (ASCE):

22

a. 7, Minimum Design Loads for Buildings and Other Structures.

23

3. ASTM International (ASTM):

24

a. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

25

b. C1363, Standard Test Method for the Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.

26

c. E72, Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.

27

d. E283, Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

28

e. E331, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

29

4. Underwriters Laboratories, Inc. (UL):

30

a. Building Materials Directory.

31

b. Fire Resistance Directory.

32

5. Building Code:

33

a. International Code Council (ICC):

34

1) International Building Code and associated standards, 2006 Edition including all amendments, referred to herein as Building Code.

35

36

37

38

39

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41

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43

44

###### B. Qualifications:

45

1. Installer shall be licensed or approved in writing by manufacturer.

46

2. Installer shall have minimum of 10 years experience in the installation of metal wall panel systems similar to system specified.

47

48

3. Installer shall have successfully completed two (2) projects of similar size, scope and complexity within past three (3) years.

49

50

4. All structural components of the system, including attachments to the structure, shall be designed and sealed by a Registered Professional Structural or Civil Engineer licensed in the State of Nebraska.

51

52

1 **1.3 DEFINITIONS**

- 2 A. Installer or Applicator:  
3 1. Installer or applicator is the person actually installing or applying the product in the field at the  
4 Project site.  
5 2. Installer and applicator are synonymous.  
6 B. PVDF: Polyvinylidene fluoride.

7 **1.4 SUBMITTALS**

- 8 A. Shop Drawings:  
9 1. See Specification Section 01340 for requirements for the mechanics and administration of  
10 the submittal process.  
11 2. Fabrication and/or layout Drawings:  
12 a. Drawings, prepared by manufacturer, showing anchorage, flashing, jointing and any  
13 special detailing different from or not indicated on the Drawings.  
14 3. Product technical data including:  
15 a. Acknowledgement that products submitted meet requirements of standards referenced.  
16 b. Manufacturer's complete installation and erection instructions and details showing all  
17 accessories required.  
18 B. Samples:  
19 1. For initial color selection, provide 2 IN x 3 IN metal samples for each color offered by  
20 manufacturer for Engineer's color selection.  
21 2. Provide minimum 24 IN x 24 IN panel samples showing panel profile,  
22 C. Informational Submittals:  
23 1. See Specification Section 01340 for requirements for the mechanics and administration of  
24 the submittal process.  
25 2. Installer qualifications and listing of projects completed in past three (3) years.  
26 3. Letter of acceptance of Installer from manufacturer.  
27 4. Instructions on proper cleaning methods and materials for Owner reference.  
28 5. Product data on insulation used.  
29 6. Certification of UL listing.  
30 D. Structural Engineer's sealed and signed calculations certifying that the systems structural  
31 components meet the requirements for lateral, and all other, loads required by the Building Code.

32 **PART 2 - PRODUCTS**

33 **2.1 ACCEPTABLE MANUFACTURER**

- 34 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:  
35 1. Factory-insulated metal wall panels:  
36 a. CENTRIA.  
37 b. Firestone Building Products.  
38 c. Green Span Profiles.  
39 B. Submit request for substitution in accordance with Specification Section 01640.

40 **2.2 MATERIALS**

- 41 A. Steel, ASTM A653, Grade A with minimum yield of 33,000 psi.  
42 1. Galvanized, G90 coating.  
43 B. Insulation (Core):  
44 1. Foamed-in-place urethane modified polyisocyanurate foam.  
45 2. Minimum 95 percent closed cell structure.  
46 3. Blowing agent: Non-CFC.  
47 4. Density: Minimum 2.6 pcf.  
48 C. Fasteners: 300 Series stainless steel.

- 1 D. Subgirts and Miscellaneous Supports: Galvanized steel.
- 2 1. Provide in accordance with Specification Section 05505.
- 3 E. Sealant: Manufacturer's standard.

4 **2.3 MANUFACTURED UNITS**

- 5 A. Factory-foamed wall panel system.
- 6 1. General:
  - 7 a. Metal face sheets bonded to factory foamed-in-place core.
  - 8 1) No glues or adhesives shall be used for bonding.
  - 9 2) Thermally-separated profile.
  - 10 3) Factory sealed double tongue-and-groove joint.
  - 11 b. Interior face sheet:
    - 12 1) Steel, 22 GA.
    - 13 2) Texture: Embossed, planked.
    - 14 3) Finish: Manufacturer's custom coil-coated finish system, Versacor "Ultra HF".
      - 15 a) Prime coat: 3 mil Versacor barrier coat.
      - 16 b) Top coat: 3 mil Urethane color coat.
  - 17 c. Exterior face sheet:
    - 18 1) Steel, 22 GA.
    - 19 2) Texture: As indicated.
    - 20 3) Finish: Natural Aggregate Texture:
      - 21 a) Prime coat: 0.2 mil primer.
      - 22 b) Intermediate coat: 0.8 mil low wax polyester.
      - 23 c) Texture coat: spray applied acrylic and silica aggregate.
      - 24 d) CENTRIA "Duracast".
- 25 2. Wall Panel Type 1:
  - 26 a. Centria "Versawall Striated".
  - 27 b. Thickness: Nominal 4 IN.
  - 28 c. Width: 36 IN module.
- 29 3. Wall Panel Type 2:
  - 30 a. Centria "Versawall Embossed".
  - 31 b. Thickness: Nominal 2 IN.
  - 32 c. Width: 36 IN module.
- 33 4. Wall Panel Type 3:
  - 34 a. Centria "Formawall Graphix".
    - 35 1) Embossed, flat.
  - 36 b. Thickness: Nominal 2 IN.
  - 37 c. Width: 36 IN module.
  - 38 d. Horizontal reveals as shown on exterior elevations.
    - 39 1) 2 IN high by 3/4 IN Deep.
    - 40 2) 24 IN on center.

41 **2.4 ACCESSORIES**

- 42 A. Perimeter Trim Pieces, Flashing and Fasteners:
  - 43 1. Match material, thickness, and color of metal wall panel face sheets.
- 44 B. Panel Clips:
  - 45 1. Galvanized steel.
  - 46 2. Concealed profile configured specifically to match metal wall panel profile.
    - 47 a. Clip shall engage face and liner panel edge without compressing panel insulation.
- 48 C. Subgirts and Miscellaneous Supports:
  - 49 1. Panel manufacturer shall design subgirt system for loading conditions specified.

50 **2.5 FABRICATION**

- 51 A. General:
  - 52 1. Fabricate to shapes indicated on Drawings.
    - 53 a. Provide custom fabricated trim pieces as required.
  - 54 2. Completely fabricate in factory and label all items for installation in the field.
  - 55 3. System shall be designed for wind loading in accordance with ASCE 7 and the Building
  - 56 Code.

1 **2.6 SOURCE QUALITY CONTROL**

- 2 A. Performance Testing:
- 3 1. Structural tests: Structural designs shall have been derived from witnessed tests per
  - 4 ASTM E72 "Chamber Method" using a 20 psf wind load.
  - 5 a. A deflection limit of L/180 shall apply to positive load only.
  - 6 2. Air infiltration: When tested per ASTM E283 under static a pressure of 1.56 psf, air
  - 7 infiltration shall not exceed 0.03 cfm per square foot of wall area.
  - 8 3. Water infiltration: When tested per ASTM E331 at a static pressure of 10 psf, there shall be
  - 9 no uncontrolled water penetration through the panel or joints.
  - 10 4. Thermal Movements: Allow for thermal movements from variations in both ambient and
  - 11 internal temperatures. Accommodate movement of support structure caused by thermal
  - 12 expansion and contraction.
  - 13 5. Thermal Performance: Thermal-resistance (R) value indicated, per ASTM C 1363, corrected
  - 14 to 15 mph wind outside and still air inside.

15 **2.7 MAINTENANCE MATERIALS**

- 16 A. Extra Materials:
- 17 1. Provide Owner with following extra materials:
  - 18 a. One (1) pint of touch-up paint for each color and each different finish specified.

19 **PART 3 - EXECUTION**

20 **3.1 EXAMINATION**

- 21 A. Examine existing steel and/or concrete support system prior to installation.
- 22 1. Inspect framing that will support metal wall panels to determine if support components are
  - 23 acceptable to insulated metal wall panel manufacturer.
  - 24 2. Confirm presence of acceptable framing members at recommended spacing to match
  - 25 installation requirements of metal wall panels.
  - 26 3. Confirm that panel supports are within tolerances acceptable to insulated metal wall panel
  - 27 system manufacturer but not greater than the following:
  - 28 a. 3/8 IN (9.5 mm) in any 20 FT (610 cm) in any direction.
  - 29 b. 3/4 IN (19 mm) over any single wall plane.
  - 30 4. Verify that window, door, louver and other penetrations match layout on Shop Drawings.
  - 31 5. Provide supplemental framing as necessary to support insulated metal wall panels.
  - 32 a. See Specification Section 05505.

33 **3.2 ERECTION AND INSTALLATION**

- 34 A. Provide all closures, trim, angles, plates, sealant, gaskets, fasteners, washers, etc., as required
- 35 for a complete water and air tight installation.
- 36 B. Install products in accordance with manufacturer's instructions.
- 37 C. Remove all strippable coating and provide a dry wipe-down cleaning of the panels as they are
- 38 erected.
- 39 D. Provide concealed fastening wherever practicable.
- 40 1. Provide prefinished fasteners to match finish of panels where fasteners must be exposed.
- 41 E. Touch up all damaged surfaces with paint supplied by panel manufacturer.

42 **END OF SECTION**

1 2014/09/08

2

## SECTION 07541

3

### PVC MEMBRANE ROOFING - FULLY ADHERED

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

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###### A. Section Includes:

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1. Thermal Barrier.

8

2. Vapor retarder.

9

3. Roof insulation.

10

4. Cover Board.

11

5. Membrane roofing and flashings.

12

6. Roof walkway protection.

13

7. Pipe, duct and conduit supports.

14

###### B. Related Specification Sections include but are not necessarily limited to:

15

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

16

2. Division 01 - General Requirements.

17

3. Section 06100 - Rough Carpentry.

18

4. Section 07600 - Flashing and Sheet Metal.

19

5. Section 16010 - Electrical: Basic Requirements.

20

##### 1.2 QUALITY ASSURANCE

21

###### A. Referenced Standards:

22

###### 1. ASTM International (ASTM):

23

a. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

24

b. C642, Standard Test Method for Density, Absorption, and Voids in Hardened Concrete.

25

c. C1177, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

26

d. C1289, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

27

e. D395, Standard Test Methods for Rubber Property - Compression Set.

28

f. D573, Standard Test Method for Rubber - Deterioration in an Air Oven.

29

g. D638, Standard Test Method for Tensile Properties of Plastics.

30

h. D746, Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.

31

i. D4434, Standard Specification for Poly (Vinyl Chloride) Sheet Roofing.

32

j. D5147, Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material.

33

k. E96, Standard Test Methods for Water Vapor Transmission of Materials.

34

###### 2. FM Global (FM):

35

a. Approval Standard 4470, Applied Roof Assemblies for use in Class 1 and Noncombustible Roof Deck Construction.

36

###### 3. Underwriters Laboratories, Inc. (UL):

37

a. 790, Standard for Standard Test Methods for Fire Tests of Roof Coverings.

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###### B. Qualifications:

44

1. Manufacturer shall have a minimum of 10 years continuous recent experience in the

45

manufacture of membrane roofing systems similar to system specified.

46

a. Manufacturer to have similar systems in place that meet or exceed warranty length as specified.

47

2. Applicator factory trained and approved in writing by roofing manufacturer.

48

3. Applicator shall have a minimum of 10 years experience installing membrane roofing

49

systems similar to system specified.

50

a. Minimum of five (5) years of the 10 years experience shall have been spent installing

51

roof systems manufactured by company proposed for use.

52

- b. Applicator shall have minimum of five (5) years installation experience using heat welded seaming equipment and testing of heat welded seams for seam integrity.
4. Manufacturer's Technical Field Representative shall have minimum 10 years experience in field installation and applicator training and approval process.

### 1.3 DEFINITIONS

- A. Installer or Applicator:
1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
  2. Installer and applicator are synonymous.

### 1.4 SYSTEM DESCRIPTION

- A. Fully adhered single-ply roofing system over concrete or metal deck, as indicated, including but not limited to:
1. Thermal barrier sheathing.
    - a. Provide where roofing system is installed over metal roof deck.
  2. Vapor retarder.
  3. Roof insulation.
  4. Cover board.
  5. Single-ply reinforced PVC membrane.
  6. Flashings, expansion joints, penetrations and/or other materials necessary for a complete installation.
  7. Walkway protection.

### 1.5 SUBMITTALS

- A. Shop Drawings:
1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.
  2. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
  3. Fabrication and/or layout Drawings:
    - a. Scaled outline of roof areas for all buildings showing:
      - 1) Slopes and tapered roof insulation layout.
        - a) Provide tapered insulation Shop Drawing illustrating installation patterns and dimensions for each tapered module.
      - 2) Walkway protection layout.
      - 3) Edge details.
      - 4) Penetrations and details.
        - a) Identify each penetration.
      - 5) Mechanical fastener locations.
      - 6) Any special conditions.
      - 7) Seam locations.
    - b. Minimum plan scale: 1/8 IN = 1 FT.
    - c. Minimum detail scale: 1-1/2 IN = 1 FT.
    - d. Manufacturer's complete installation drawings, including details.
    - e. If manufacturer's standard detail drawings are used as part of the Submittal information, the standard details shall be enhanced to show the actual project conditions of the substrate including insulation, cover board, vapor retarder, decking material, wall construction, parapet construction and height and coping condition.
- B. Maintenance Information:
1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.
- C. Miscellaneous Submittals:
1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.
  2. Certifications prior to installation:
    - a. Certification of manufacturer's qualifications.



- 1 b. Certification of applicator's qualifications and letter from manufacturer acknowledging  
2 applicator as a factory trained and manufacturer's approved applicator with the minimum  
3 number of years experience installing products specified per this Specification Section.
- 4 c. Certification of manufacturer's Technical Field Representative qualifications.
- 5 d. Letter from roofing manufacturer and insulation manufacturer stating that roof insulation  
6 being used is compatible with roofing system and will perform properly for intended use.
- 7 e. Letter from adhesive manufacturer and insulation manufacturer stating that adhesive  
8 being used is compatible with all products and will perform properly for intended use.
- 9 f. Copy of report identifying the location(s) of all seam failures and repairs made to that  
10 seam per the FIELD QUALITY CONTROL Article in PART 3 of this Specification  
11 Section.
- 12 g. Copy of punch list generated by manufacturer's technical field representative during final  
13 inspection of roofing, flashing and welded seams.
- 14 h. Copy of Pre-Installation Conference meeting minutes.
- 15 3. Certifications for final close-out:
  - 16 a. Written report prepared by manufacturer's Technical Field Representative stating that  
17 roof has been inspected for deficiencies, a listing of all deficiencies and corrections that  
18 have been made, and roofing system has been properly installed and is warrantable for  
19 period required by this Specification Section.
  - 20 b. Final Warranty documents signed by manufacturer's authorized representative.

## 21 **1.6 DELIVERY, STORAGE, AND HANDLING**

- 22 A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels  
23 intact.
- 24 B. Store membrane rolls lying down on pallets and fully protected from the weather with clean  
25 canvas tarpaulins.
  - 26 1. Unvented polyethylene tarpaulins are not acceptable.
- 27 C. Store adhesives at temperatures recommended by manufacturer.
- 28 D. Replace all materials that become damaged during storage prior to installation.
  - 29 1. Remove damaged material from the Site.
- 30 E. Store insulation in accordance with PIMA recommendations, indoors or above ground and  
31 protected from the elements.
  - 32 1. Protect insulation stored outdoors with breathable, waterproof tarpaulins.
    - 33 a. Factory packaging is not acceptable as a weather-resistant protection.
    - 34 2. Provide dunnage as necessary to keep insulation minimum 3 IN above grade or roof deck.
    - 35 3. Protect insulation from direct exposure to sunlight.
    - 36 4. Remove damaged insulation from the jobsite.

## 37 **1.7 WARRANTY**

- 38 A. Manufacturer's 10 Year System Warranty:
  - 39 1. Warranty to cover roofing membrane, insulation, and roofing manufacturer provided  
40 accessories.
  - 41 2. Warranty to cover manufacturer's authorized applicator workmanship applied to the roof  
42 membrane identified in the preceding paragraph.
  - 43 3. Warranty period to commence on date of Owner's acceptance of the building.

## 44 **PART 2 - PRODUCTS**

### 45 **2.1 ACCEPTABLE MANUFACTURERS**

- 46 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 47 1. PVC roofing membrane:
    - 48 a. Carlisle.
    - 49 b. I.B. Systems.
    - 50 c. Sika Sarnafil, Inc.
  - 51 2. Roof cover board:
    - 52 a. Georgia Pacific.
    - 53 b. USG.

- 1           3. Insulation:
- 2           a. Carlisle.
- 3           b. Atlas Building Products.
- 4           c. Hunter Panels.
- 5           d. I.B. Systems.
- 6           e. Sika Sarnafil, Inc.
- 7           4. Vapor retarder:
- 8           a. Sika Sarnafil, Inc.
- 9           b. I.B. Systems.
- 10          5. Thermal barrier sheathing:
- 11          a. Georgia Pacific.
- 12          b. USG.
- 13          6. Other materials:
- 14          a. Manufacturers as noted.

15   **2.2 DESIGN CRITERIA**

- 16    A. Roof Assembly:
- 17      1. Fire resistance: UL 790, Class A.
- 18      2. Hail and wind uplift resistance: FM Approval Standard 4470, Class 1-90minimum.
- 19        a. Exterior Fire: Class A.
- 20        b. Hail Resistance: Severe.

21   **2.3 SYSTEM COMPONENTS**

- 22    A. Membrane:
- 23      1. Reinforced PVC (polyvinyl chloride) sheet with lacquer coating.
- 24        a. Meet requirements of ASTM D4434, Type II, Grade 1.
- 25        b. Thickness:
- 26          1) 0.060 IN.
- 27          2) Sheet width to be determined by manufacturer.
- 28          3) Provide widest sheet possible.
- 29        c. Color:
- 30          1) White.
- 31          2) Reflectivity: 0.83.
- 32          3) Emissivity: 0.92.
- 33          4) Solar reflective index (SRI): Greater than 104.
- 34      2. Physical properties:
- 35        a. Tensile strength, minimum psi: ASTM D638, 1600.
- 36        b. Elongation at break, minimum: ASTM D638, 270 percent machine by 250 percent transverse.
- 37        c. Seam strength, minimum (percent of tensile strength): ASTM D638, 80.
- 38    B. Insulation:
- 39      1. Rigid, HCFC free, isocyanurate foam insulation boards with approved faces for adhered membrane application.
- 40        a. Size:
- 41          1) 4 FT x 4 FT with 4 IN thick base layer at roof drain locations and scupper openings unless noted otherwise on the Drawings.
- 42          2) 4 FT x 8 IN boards acceptable on mechanically attached applications.
- 43        b. ASTM C1289, Class 1, Type II, faced rigid cellular polyisocyanurate.
- 44        c. Density: 2 pcf.
- 45        d. Compressive strength: 25 psi.
- 46        e. Board edges: Square.
- 47        f. Thermal value: R value (long term thermal resistance) minimum 6.2.
- 48        g. Moisture vapor transmission: Less than 1.0 perm.
- 49        h. Thickness:
- 50          1) Minimum 1-1/2 IN base layer or as necessary to match existing roofing system.
- 51      2. Tapered insulation: Same material as base layer of insulation tapered to provide 1/4 IN per foot of slope.
- 52      3. Crickets and saddles: Same material as base layer of insulation tapered to provide 1/2 IN per foot of slope.
- 53
- 54
- 55
- 56
- 57

- 1 C. Vapor Retarder:
- 2 1. Self-adhered multi-ply reinforced sheet.
- 3 a. SBS modified bitumen with high-density polyethylene grid laminated between two (2)
- 4 layers of polyethylene film.
- 5 b. Thickness: 32 mil minimum.
- 6 c. Water vapor permeance: ASTM E96, maximum 0.10 perms.
- 7 d. Breaking strength, MD/XD: ASTM D5147, 64/88 LB/IN.
- 8 D. Thermal Barrier Sheathing:
- 9 1. Gypsum board sheathing: ASTM C1177.
- 10 2. Water and moisture-resistant treated gypsum core.
- 11 3. Glass mat facing front and back.
- 12 4. Mold resistant: ASTM D3273.
- 13 5. Class 'A' fire rated per UL 790.
- 14 6. Flame spread 15 and smoke developed 0 when tested in accordance with ASTM E84 or
- 15 UL 723.
- 16 7. Thickness: 1/2 IN.
- 17 8. Compatible with roofing vapor.
- 18 9. Georgia-Pacific "DensDeck Roof Board."
- 19 E. Cover Board:
- 20 1. Gypsum board sheathing: ASTM C1177.
- 21 2. Water and moisture-resistant treated gypsum core.
- 22 a. Top surface shall be pre-primed to enhance adhesion.
- 23 3. Glass mat facing front and back.
- 24 4. Mold resistant: ASTM D3273.
- 25 5. Class 'A' fire rated per UL 790.
- 26 6. Flame spread 15 and smoke developed 0 when tested in accordance with ASTM E84 or
- 27 UL 723.
- 28 7. Thickness:
- 29 a. 1/4 IN.
- 30 b. Size: 4 x 4 FT or 4 x 8 FT.
- 31 8. Georgia Pacific Corp. "Dens-Deck Prime."
- 32 a. If acceptable to roofing manufacturer, un-primed coverboard may be used with
- 33 manufacturer's recommended field-applied primer.
- 34 F. Adhesives:
- 35 1. Proper type as required for substrate and service being adhered.
- 36 2. Only solvent base adhesives are acceptable.
- 37 3. Provide primers as required for all adhesives.
- 38 G. Vent Pipe Flashing, Sealants, Prefabricated Inside and Outside Flashing Corners, Termination
- 39 Bars and Batten Strips:
- 40 1. Provide manufacturer's standard premolded, prefabricated PVC product that best suits the
- 41 condition encountered.
- 42 2. Provide aluminum termination bars.
- 43 a. Size: 2-1/4 IN deep by 0.10 IN thick extruded bar with predrilled holes at 8 IN OC.
- 44 3. Batten strips:
- 45 a. Minimum 14 GA channel shaped steel bar, galvanized, ASTM A653.
- 46 b. Fastener holes predrilled prior to galvanizing process.
- 47 4. Where profile of element being flashed or other field conditions preclude the use of
- 48 prefabricated flashings, provide manufacturer's standard "pourable sealant pocket".
- 49 a. Sealant Pocket Filler:
- 50 1) Grout: Cement based.
- 51 2) Sealant/filler: Manufacturer's recommended urethane sealant made specifically for
- 52 filling in voids.
- 53 H. Miscellaneous Fasteners and Anchors: Provide all miscellaneous fasteners and anchors as
- 54 required for a free draining, water and air tight roofing system.
- 55 I. Wood Blocking and Nailers: See Specification Section 06100.
- 56 J. Fasteners:
- 57 1. Corrosion resistant: Typical fasteners to be Type 316 stainless steel.

- 1 K. Roofing Accessories:
- 2 1. Sheet metal fabrications, including but not limited to:
- 3 a. Coping and fascia.
- 4 b. Scuppers, conductor heads and downspouts.
- 5 c. Flashing and counterflashing.
- 6 d. See Specification Section 07600.
- 7 2. Walkway protection:
- 8 a. Open grid, continuous mat.
- 9 b. Thickness: 9/16 IN.
- 10 c. Width: 36 IN nominal.
- 11 d. Color: Gray.
- 12 e. Sarnafil "Crossgrip Walkway".
- 13 3. Pipe, duct and conduit supports:
- 14 a. 100 percent recycled rubber.
- 15 1) Density: ASTM C642, minimum 0.50 OZ/cubic IN.
- 16 2) Compressive deformation:
- 17 a) ASTM D395.
- 18 b) 5 percent at 70 psi and 72 DegF.
- 19 3) Brittleness at low temperature: ASTM D746, -50 DegF.
- 20 4) Weathering: ASTM D573, 70 HRS at 120 DegF.
- 21 b. Uniform load capacity: 500 LB per lineal FT.
- 22 c. Size:
- 23 1) Width: 6 IN.
- 24 2) Length and height as necessary for item being supported.
- 25 d. Compatible with modular framing.
- 26 e. Provide modular framing, pipe supports, pipe clamps or other accessories as necessary
- 27 for items being supported.
- 28 f. Similar to Cooper B-Line "DURA-BLOK."

## 29 PART 3 - EXECUTION

### 30 3.1 PREPARATION

- 31 A. Pre-Installation Conference:
- 32 1. The applicator, roofing manufacturer's Technical Installation Representative, Owner's
- 33 Representative, Engineers Site Representative(s), Architect and Contractor shall attend a
- 34 pre-installation conference.
- 35 2. The meeting shall discuss all aspects of the Project including but not limited to:
- 36 a. Safety.
- 37 b. Setup.
- 38 c. Schedule.
- 39 d. Material storage and handling.
- 40 e. Replacement of unacceptable materials prior to and during installation and disposal of
- 41 unacceptable materials.
- 42 B. Applicator to verify that area to be roofed is free of ice/snow, water, dirt, incompatible materials,
- 43 sharp objects, and miscellaneous debris that may damage the membrane or the vapor retarder.

### 44 3.2 INSTALLATION

- 45 A. Install all materials in accordance with manufacturer's written instructions.
- 46 B. Manufacturer's installation procedures take precedence over this Specification Section.
- 47 C. Provide wood nailers and blocking as necessary for a complete installation.
- 48 D. Vapor Retarder:
- 49 1. Install over metal decking or concrete decking as applicable using adhesive recommended
- 50 by the manufacturer.
- 51 2. Cut around roof penetrations and seal vapor tight.
- 52 3. Extend vapor retarder up face of parapet wall to top of roof insulation.
- 53 4. Lap side joints minimum 4 IN, lap end joints minimum of 6 IN and seal all laps with adhesive
- 54 then tape raw edge of lap.

- 1           5. Repair all damage, tears, holes, and nicks in accordance with vapor retarder manufacturer's
- 2            recommendations.
- 3            a. Verify compatibility of adhesive with vapor retarder patching method and materials.
- 4           6. Do not piece vapor retarder together using scraps.
  
- 5           E. Installation of Sheathing over Metal Decking:
- 6            1. Install thermal barrier sheathing under vapor retarder using corrosion resistant fasteners
- 7            recommended by the manufacturer for uplift rating specified.
- 8            2. Cut and fit sheathing around all roof penetrations.
- 9            a. Butt tightly to adjacent structure and adjoining sheathing boards.
- 10           3. Calk around all penetrations with sealant acceptable to sheathing, roof membrane, insulation
- 11           and vapor retarder manufacturer.
  
- 12           F. Installation of Insulation:
- 13            1. Cut insulation neatly to fit around all roof penetrations, projections, and changes in thickness
- 14            of concrete topping.
- 15            2. Before installation is started, remove trash, debris, grease, oil, water, moisture and
- 16            contaminants from substrate to receive insulation.
- 17            a. Prepare all surfaces according to applicable Specification Sections.
- 18            3. Bottom layer of insulation shall be installed with all joints tightly butted and end joints
- 19            staggered 12 IN minimum.
- 20            a. Additional layers shall be installed over preceding layers with all joints tightly butted and
- 21            end joints staggered 12 IN minimum.
- 22            4. Attach insulation using adhesive in accordance with manufacturer's recommendations for
- 23            uplift rating specified.
- 24            5. Provide tapered insulation where shown on the Drawings or where required.
- 25            6. Provide crickets behind all roof penetrations larger than 12 IN.
- 26            7. Do not install boards that have been damaged and/or broken into pieces unless the area to
- 27            be insulated requires a smaller piece.
- 28            a. Trim damaged boards prior to use to provide straight edges and square corners.
  
- 29           G. Provide roofing manufacturer's recommended sleeper at all duct support structures, condensing
- 30           units or similar equipment.
- 31            1. Fasten sleeper to deck as necessary to resist uplift.
- 32            2. Flash sleeper to roof membrane as recommended by roofing manufacturer.
  
- 33           H. Installation of Cover Board:
- 34            1. Lay cover board over top of insulation tightly butted and cut to fit around all penetrations.
- 35            a. Stagger end joints 12 IN minimum.
- 36            2. Attach cover board using adhesive in accordance with manufacturer's recommendations for
- 37            uplift rating required.
- 38            3. Calk around all penetrations with sealant acceptable to insulation and roof membrane
- 39            manufacturer.
- 40            4. Do not install boards that have been broken into pieces smaller than 4 FT x 4 FT unless the
- 41            area to be covered requires a smaller piece.
- 42            a. Trim damaged boards prior to use to provide straight edges and square corners.
  
- 43           I. Installation of Roofing:
- 44            1. Install roof membrane and flashing using adhesives recommended by roofing manufacturer.
- 45            a. Where roofing crosses building expansion joints, provide manufacturer's recommended
- 46            expansion joint as shown on Drawings.
- 47            2. Extend roofing to face of adjacent building wall or parapet wall and secure.
- 48            3. Extend flashing up adjacent building wall and terminate with surface applied reglet and
- 49            counterflashing.
- 50            4. Extend flashing up parapet wall over top of wood blocking on top of parapet wall and down
- 51            opposite face to bottom of wood blocking unless noted otherwise.
- 52            a. Provide in one (1) piece with no horizontal joints.
- 53            b. Extend flashing onto roof surface as required by manufacturer.
- 54            5. Install flashing at all vertical surfaces, roof interruptions and penetrations.
- 55            a. Flash all roof penetrations in accordance with roofing manufacturer's standard details
- 56            unless indicated otherwise on the Drawings.
- 57            6. Heat weld and test all seams the same day they are laid.

- 1 7. Install walkway protection where indicated.
- 2 a. Walkway locations shown on Drawings are a general representation for required
- 3 walkways; coordinate with roof mounted equipment locations, penetrations, piping,
- 4 conduit or other field conditions to provide unobstructed walking path free of trip hazards
- 5 or other obstructions.
- 6 b. Provide continuous walkways of longest practicable length cut from full rolls.
- 7 1) Secure butt ends of adjacent walkway sections with connecting clips as provided by
- 8 manufacturer.
- 9 c. Use only full width pieces of walkway protection cut to fit.
- 10 1) Damaged sections of walkway protection will not be accepted.
- 11 d. Secure walkway with loops of membrane welded to the field sheet.

12 **3.3 FIELD QUALITY CONTROL**

- 13 A. Provide for manufacturer's Technical Field Representative time during Pre-Installation
- 14 Conference, job start-up, and every two (2) weeks, with a minimum of two (2) site visits during
- 15 roofing application.
- 16 1. Manufacturer's Technical Field Representative shall inspect all roofing, flashing, and spot
- 17 test welded seams at completion, generate punch list and provide copy of punch list to
- 18 Engineer.
- 19 2. Include all applicable costs.
- 20 B. Protect installed insulation from water using water cut-offs in bad weather and at end of work
- 21 period.
- 22 C. Remove and replace wet and/or damaged insulation and cover board.
- 23 D. On-site quality reviews of all welded seams shall be performed by Applicator prior to stopping
- 24 work each day:
- 25 1. Provide subsequent report identifying the location(s) of all seam failures and repairs made to
- 26 that seam.
- 27 a. Manufacturer's guidelines shall be followed and all protocol shall be maintained if a
- 28 seam fails the quality review.

29 **END OF SECTION**

1 2014/09/08

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**SECTION 07600**  
**FLASHING AND SHEET METAL**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6 A. Section Includes:

- 7 1. Architectural flashing and sheet metal work.
- 8 2. Factory formed fascia and coping systems.
- 9 3. Prefinished scuppers.
- 10 4. Prefinished gutters and downspouts.

11 B. Related Specification Sections include but are not necessarily limited to:

- 12 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 13 2. Division 01 - General Requirements.
- 14 3. Section 07541 - PVC Membrane Roofing - Fully Adhered.
- 15 4. Section 07720 - Roof Hatches.
- 16 5. Section 07900 - Joint Sealants.
- 17 6. Section 09960 - High Performance Industrial Coatings.

18 **1.2 QUALITY ASSURANCE**

19 A. Referenced Standards:

- 20 1. Aluminum Association (AA):
- 21 2. American Architectural Manufacturers Association (AAMA):
  - 22 a. 2605, Voluntary Specification, Performance Requirements and Test Procedures for
  - 23 Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- 24 3. American National Standards Institute/Single Ply Roofing Industry (ANSI/SPRI):
  - 25 a. ES-1, Wind Design Standard for Edge Systems Used with Low Slope Roof Systems.
- 26 4. ASTM International (ASTM):
  - 27 a. A240, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate,
  - 28 Sheet, and Strip for Pressure Vessels and for General Applications.
  - 29 b. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron
  - 30 Alloy Coated (Galvannealed) by the Hot-Dip Process.
  - 31 c. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- 32 5. FM Global (FM).
- 33 6. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
  - 34 a. Architectural Sheet Metal Manual.

35 B. Qualifications:

- 36 1. Sheet metal fabricator shall have minimum 10 years of experience in fabrication of sheet
- 37 metal items similar to items specified.
- 38 2. Sheet metal installer shall have minimum five (5) years of experience installing sheet metal
- 39 items specified.

40 **1.3 DEFINITIONS**

41 A. Installer or Applicator:

- 42 1. Installer or applicator is the person actually installing or applying the product in the field at the
- 43 Project site.
- 44 2. Installer and applicator are synonymous.

45 B. PVDF: Polyvinylidene fluoride.

46 **1.4 SUBMITTALS**

47 A. Shop Drawings:

- 48 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 49 the submittal process.

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2. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
  3. Fabrication and/or layout drawings.
    - a. Scaled drawing showing expansion joint locations, special conditions, profile, fastening and jointing details.
      - 1) Minimum plan scale: 1/8 IN = 1 FT.
      - 2) Minimum detail scale: 1-1/2 IN = 1 FT.
  4. Fabricator qualifications.
  5. Installer qualifications.
- B. Samples:
1. Finish and color samples for each product specified for Engineer preliminary color selection.
  2. For final color selection, provide two (2) 2 IN x 3 IN colored metal samples for each color selected during the preliminary color selection.
- C. Informational Submittals:
1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.
  2. Warranty: Manufacturer's sample warranty language.

19 **PART 2 - PRODUCTS**

20 **2.1 ACCEPTABLE MANUFACTURERS**

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  - 33
- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Pre-finished sheet metal:
    - a. Carlisle.
    - b. Firestone Building Products.
    - c. Peterson Aluminum Corp.
  2. Factory-formed fascia and coping system(s).
    - a. W.P. Hickman Co.
    - b. Metal Era, Inc.
  3. Butyl sealant:
    - a. Pecora.
    - b. Sika.
    - c. Tremco.
- B. Submit request for substitution in accordance with Specification Section 01640.

34 **2.2 MATERIALS**

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- A. Sheet Metal:
1. Aluminum: ASTM B209.
  2. Galvanized Steel: ASTM A653.
  3. Stainless Steel: ASTM A240.
    - a. Type 316L.
- B. Fasteners: Non-ferrous compatible with sheet metal.
- C. Sealants:
1. Non-curing Butyl Sealant:
    - a. Pecora "BA-98".
    - b. Sika "SikaLastomer 511".
    - c. Tremco "TremPro JS-773".
  2. Building sealants:
    - a. See Specification Section 07900.
- D. Extruded Aluminum Fascia Systems:
1. Fascia piece: Extruded aluminum, ASTM B209.
  2. Water dam: Steel, galvanized per ASTM A653.
  3. Compression clamp: Stainless steel or aluminum.
  4. Fasteners: Stainless steel or aluminum.



- 1 E. Factory Formed Aluminum Coping:
- 2 1. Coping piece: Aluminum.
- 3 2. Coping chair and anchor plate: Steel, galvanized or stainless steel.
- 4 F. Fasteners: Non-ferrous compatible with sheet metal.
- 5 G. Retainer Clips and Continuous Cleats: Galvanized steel or stainless steel.
- 6 H. Dissimilar Metal Protection: Comply with Specification Section 09960.

## 7 **2.3 MANUFACTURED ITEMS**

- 8 A. Factory Formed Fascia Systems:
- 9 1. Formed fascia cover snap locked to extruded aluminum anchor bar.
- 10 2. ANSI/SPRI ES-1 tested.
- 11 3. FM Approved.
- 12 4. Fascia cover:
- 13 a. Aluminum.
- 14 1) Thickness: 0.050 IN.
- 15 5. Factory fabricated accessories, including but not limited to:
- 16 a. Corners, end caps, end terminations.
- 17 b. Spill-out scuppers.
- 18 c. All accessories to be factory mitered and welded.
- 19 6. Profile:
- 20 a. Metal-Era "Perma-Tite System 200 Fascia".
- 21 b. Snap-on version.
- 22 c. Height: 6.75 IN.
- 23 B. Factory Formed Coping System:
- 24 1. Formed coping piece which locks to anchor plate fastened to top of wall.
- 25 2. ANSI/SPRI ES-1 tested.
- 26 3. FM approved.
- 27 4. Coping cover:
- 28 a. Aluminum.
- 29 1) Thickness: 0.050 IN.
- 30 5. Anchor plate: Galvanized steel , minimum 20 GA.
- 31 6. Splice plates: Aluminum, minimum 0.032 IN.
- 32 a. Continuous, minimum 6 IN long.
- 33 b. Front and back legs with extruded butyl seal.
- 34 c. Finish: Match coping.
- 35 7. Factory fabricated accessories, including but not limited to:
- 36 a. Corners, end caps, pilaster caps and end terminations.
- 37 b. All accessories to be factory mitered and welded.
- 38 8. Profile:
- 39 a. Metal-Era "Creative Design Cornice Coping."
- 40 b. Outside face: 8 IN.
- 41 c. Inside face: 6 IN.
- 42 C. Finish:
- 43 1. PVDF coating with minimum 70 percent resin content.
- 44 a. Meet requirements of AAMA 2605.
- 45 b. Premium "stone look" finish.
- 46 1) Color: To be selected.

## 47 **2.4 ACCESSORIES**

- 48 A. Accessories as required to form a complete water and airtight system.
- 49 B. Gutters:
- 50 1. Style 'F' gutter per SMACNA Figure 1-2.
- 51 2. Size as indicated on Drawings.
- 52 3. Pre-finished aluminum.
- 53 4. Seamless construction fabricated in longest practical lengths.

- 1 C. Downspouts:
- 2 1. Rectangular.
- 3 a. Open face with horizontal cross brace at 5 FT maximum spacing.
- 4 2. Materials to match gutters.
- 5 3. Seamless construction fabricated in longest practical lengths.

6 **2.5 FABRICATED ITEMS**

- 7 A. General:
- 8 1. Shop fabricate items to maximum extent possible.
- 9 a. Fabricate true and sharp to profiles and sizes indicated on Drawings.
- 10 1) Shop fabricate and weld or solder all corners.
- 11 2. Fabricate scuppers, gutters, downspouts and similar items using pre-finished aluminum,
- 12 unless noted otherwise.
- 13 3. Pre-finished aluminum:
- 14 a. Thickness: Minimum 0.050 IN.
- 15 b. Texture: Smooth.
- 16 c. Coated on exposed face with PVDF coating having a minimum 70 percent resin content
- 17 and a minimum 1.0 mil dry film thickness.
- 18 1) Meet requirements of AAMA 2605.
- 19 2) Color: Match coping and fascia.
- 20 B. Overflow Scuppers:
- 21 1. Roofing manufacturer's recommended through-wall scupper design.
- 22 a. Refer to Specification Section 07541.
- 23 b. Size and location(s) as shown on Drawings.
- 24 C. Retainer Clips and Continuous Cleats:
- 25 1. 0.050 IN stainless steel.
- 26 D. Downspouts:
- 27 1. Rectangular open-face style similar to SMACNA Figure 1-32E.
- 28 a. Horizontal cross brace at 5 FT maximum spacing.
- 29 2. Fabricated in longest practical lengths.

30 **PART 3 - EXECUTION**

31 **3.1 PREPARATION**

- 32 A. Provide items to be built into other construction to Contractor in time to allow their installation.

33 **3.2 INSTALLATION**

- 34 A. Install products in accordance with manufacturer's instructions, SMACNA, and as indicated on
- 35 Drawings.
- 36 B. Weld aluminum to achieve weathertight joints and required details.
- 37 1. Do not weld slip joints.
- 38 2. Touch-up damaged prefinished items.
- 39 C. Set top edges of membrane flashing and sheet metal flashing into reglets wherever practicable.
- 40 1. Provide surface applied terminations at existing construction and where reglets are not
- 41 practicable.
- 42 2. Provide counterflashing at all reglets and terminations.
- 43 3. Seal reglets and counterflashings in accordance with Specification Section 07900.
- 44 D. Fasten materials at intervals recommended by SMACNA.
- 45 E. Install slip joints to allow for thermal movement as recommended by SMACNA and manufacturer.
- 46 1. Maximum spacing: 10 FT OC.
- 47 2. Provide slip joint 24 IN from corners.
- 48 3. Provide slip joint at each vertical expansion joint location in wall.
- 49 a. Provide break in continuous cleat at each vertical expansion joint.
- 50 b. The above expansion joints do not include brick veneer expansion joints.

- 1 F. Seal slip joints with two (2) beads of non-curing butyl sealant on each side of slip joint overlap.
- 2 G. Form flashings to provide spring action with exposed edges hemmed or folded to create tight  
3 junctures.
- 4 H. Provide dissimilar metals and materials protection where dissimilar metals come in contact or  
5 where sheet metal contacts mortar, concrete masonry or concrete.
- 6 I. Provide all miscellaneous sheet metal items not specifically covered elsewhere, as indicated or  
7 required to provide a weathertight installation.  
8 1. Provide all components necessary to create weather-tight junctures between roofing and  
9 sheet metal work.
- 10 J. Provide sheet metal liner at exposed-to-view openings through roof deck, including but not limited  
11 to:  
12 1. Roof hatches: See Specification Section 07720.
- 13 K. Installation of through-wall overflow scuppers:  
14 1. Flash the opening in the parapet wall and install the scupper as indicated in SMACNA Figure  
15 1-27A.  
16 2. Seal all joints to provide complete weathertight installation.  
17 3. Flash roofing material onto scupper per roofing manufacturer's recommendations.  
18 a. See Specification Section 07541.
- 19 L. Installation of Gutters:  
20 1. Install gutters using gutter straps in accordance with SMACNA Table 1-8 and Figure 1-12.  
21 a. Provide gutter brackets or hangers at 24 IN OC maximum.  
22 b. Provide expansion joints in gutters per SMACNA Figure 1-5.  
23 c. Install gutters to provide positive drainage to downspout locations.  
24 d. Seal all joints in gutters to provide completely water tight system.
- 25 M. Installation of Downspouts:  
26 1. Install downspouts in locations shown on the Drawings.  
27 2. Provide downspout anchor straps per SMACNA Figure 1-35 as appropriate for downspout  
28 style.  
29 3. Provide gutter to downspout connection per SMACNA Figure 1-33B, Detail 1.  
30 4. Seal all joints in downspout for a complete watertight system.  
31 5. Angle bottom discharge of downspout out away from building.  
32 6. Anchor hanger straps to building wall with stainless steel screws.  
33 a. Provide minimum of two (2) anchors per strap.  
34 7. Maximum spacing of hanger straps shall be 10 FT with minimum of two (2) hanger straps per  
35 vertical piece of downspout.  
36 8. Spacing and location of hanger straps shall be consistent from downspout to downspout.

37 **END OF SECTION**  
38



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2

## SECTION 07720 ROOF HATCHES

3

### 4 PART 1 - GENERAL

#### 5 1.1 SUMMARY

6

A. Section Includes:

7

1. Roof hatches.

8

2. Hatch railing and gate system.

9

B. Related Specification Sections include but are not necessarily limited to:

10

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

11

2. Division 01 - General Requirements.

12

3. Section 07541- PVC Membrane Roofing - Fully Adhered.

13

4. Section 07600 - Flashing and Sheet Metal.

14

5. Section 09960 - High Performance Industrial Coatings.

15

#### 1.2 QUALITY ASSURANCE

16

A. Referenced Standards:

17

1. ASTM International (ASTM):

18

a. A240, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

19

b. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

20

21

2. Occupational Safety and Health Organization (OSHA).

22

#### 1.3 SUBMITTALS

23

A. Shop Drawings:

24

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

25

2. Scaled plan of roof showing location of all units and anchoring details.

26

a. Minimum plan scale: 1/8 IN = 1 FT.

27

b. Minimum detail scale: 1-1/2 IN = 1 FT.

28

3. Product technical data including:

29

a. Acknowledgement that products submitted meet requirements of standards referenced.

30

b. Manufacturer's installation instructions.

31

32

B. Operation and Maintenance Manuals:

33

1. See Specification Section 01342 for requirements for:

34

a. The mechanics and administration of the submittal process.

35

b. The content of Operation and Maintenance Manuals.

36

C. Informational Submittals:

37

1. Warranty.

38

#### 1.4 WARRANTY

39

A. Roof Hatches: Manufacturer's standard five (5) year warranty.

40

B. Hatch Rail System: Manufacturer's standard 25 year warranty.

41

### PART 2 - PRODUCTS

42

#### 2.1 ACCEPTABLE MANUFACTURERS

43

A. Products specified are manufactured by "The Bilco Company."

- 1 B. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:  
2 1. Roof hatches:  
3 a. Bilco.  
4 b. Dur-Red Products.  
5 c. Milcor Inc.  
6 C. Submit request for substitution in accordance with Specification Section 01640.

7 **2.2 MATERIALS**

- 8 A. Sheet Metal:  
9 1. Aluminum: ASTM B209.  
10 2. Stainless steel: ASTM A240, Type 316.  
11 3. Insulation: 2 IN polyisocyanurate.  
12 B. Gaskets: Extruded EPDM rubber.  
13 C. Hardware: Type 316 stainless steel, unless noted otherwise.  
14 D. Anchors:  
15 1. Stainless steel.  
16 2. See Specification Section 05505.  
17 E. Hatch Rail System:  
18 1. Posts and rails:  
19 a. Pultruded fiberglass.  
20 b. UV resistant.  
21 c. Fire retardant.  
22 2. Mounting brackets: Hot-dipped galvanized steel.  
23 3. Hinges and post guides: Aluminum, 6063T5 alloy.  
24 4. Fasteners: Type 316 stainless steel.

25 **2.3 MANUFACTURED UNITS**

- 26 A. General:  
27 1. 12 IN high.  
28 2. Fully welded corners.  
29 3. Hardware:  
30 a. Lifting mechanism and automatic hold-open device.  
31 1) Vinyl-covered grip handle.  
32 b. Hinges.  
33 c. Latch: Operating handles for inside and outside operation.  
34 d. Padlock hasp.  
35 4. Finish: Mill.  
36 B. Roof Hatches:  
37 1. Curb:  
38 a. 11 GA.  
39 b. Integral cap flashing.  
40 c. Mounting flange:  
41 1) Minimum 3-1/2 IN wide.  
42 2) Punched holes for fastening to roof deck.  
43 d. Insulated.  
44 2. Curb options:  
45 a. Provide fully enclosed curb with apron where indicated:  
46 1) Match curb material.  
47 2) Extend apron over edge of concrete wall.  
48 3. Cover:  
49 a. Exterior: 11 GA.  
50 b. Interior: 18 GA liner.  
51 c. Internally reinforced.  
52 1) Minimum 40 psf live loading.  
53 d. Insulated.  
54 e. Completely weather sealed and gasketed.  
55 4. Finish: Mill.

- 1 C. Hatch Rail System:
- 2 1. Manufacturer's standard OSHA Compliant railing and gate fall protection system.
- 3 2. Posts and rails:
- 4 a. Nominal 2 IN round profile.
- 5 b. Color: Safety Yellow.
- 6 3. Railing system designed to mount to roof hatch cap flashing without penetration of roofing
- 7 material.
- 8 a. Mounting brackets: 1/4 IN thick strap anchors with aluminum post supports.
- 9 4. Gate:
- 10 a. Same materials and construction as posts and rails.
- 11 b. Self-closing and self-latching.

## 12 PART 3 - EXECUTION

### 13 3.1 INSTALLATION

- 14 A. Install units in accordance with manufacturer's installation instructions.
- 15 B. Securely anchor units as appropriate.
- 16 1. Anchor to wood nailers with 1/2 x 3 IN lag bolts.
- 17 2. Anchor to concrete with 1/2 IN adhesive anchors.
- 18 3. Maximum anchor spacing: 12 IN.
- 19 4. Manufacturer's predrilled fastener locations take precedent over this specification.
- 20 5. Provide attachment at each corner as a minimum.
- 21 C. Flash and counterflash to provide weathertight installation.
- 22 1. Filter Chemical Addition: See Specification Section 07541.
- 23 2. Fluoride Transfer Pump Station: Provide fully enclosed curb and apron.
- 24 D. Provide aluminum sheet metal liner at opening through roof deck as shown on the Drawings.
- 25 1. See Specification Section 07600.
- 26 E. Provide hatch rail system at Filter Chemical Addition:
- 27 1. Fasten to roof hatch cap flashing in accordance with manufacturer's instructions.
- 28 2. Fasten without penetration of roofing membrane or flashing.
- 29 F. Adjust all components to provide smooth easy operation.
- 30 G. Provide dissimilar metals protection as required.
- 31 1. Refer to Specification Section 09960.

### 32 3.2 SCHEDULE

- 33 A. Model numbers refer to "Bilco" products.
- 34 B. Units:
- 35 1. Fluoride Transfer Pump Structure:
- 36 a. 60 IN x 84 IN: Model "D."
- 37 b. See Sheet 00S101.
- 38 2. Filter Chemical Addition:
- 39 a. 48 IN x 14 FT 0 IN: Model "L."
- 40 b. See Sheet FCA102.

41 **END OF SECTION**

42





1 2014/09/08

2 **SECTION 07900**  
3 **JOINT SEALANTS**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes: Sealant work.
- 7 B. Related Specification Sections include but are not necessarily limited to:
- 8 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 9 2. Division 01 - General Requirements.
- 10 3. Section 09960 - High Performance Industrial Coatings.
- 11 C. Work included consists of but is not necessarily limited to:
- 12 1. Sealing all joints which will permit penetration of dust, air or moisture, unless sealing work is
- 13 specifically required under other Specification Sections.
- 14 a. Work includes but is not limited to:
- 15 1) Flashing, reglets and retainers.
- 16 2) Masonry control joints, brick expansion joints and between masonry and other
- 17 materials.
- 18 3) Flooring joints.
- 19 4) Isolation joints.
- 20 5) Joints between paving or sidewalks and building.
- 21 6) Concrete construction, control and expansion joints.
- 22 7) Joints between precast roof units, between precast roof units and walls, and joints
- 23 between precast wall panels.
- 24 8) Penetrations of walls, floors and decks.
- 25 9) Perimeters of door and window frames, louvers, grilles, etc.
- 26 10) Thresholds.
- 27 11) Plumbing fixtures.
- 28 12) Other joints where sealant, expanding foam sealant or compressible sealant is
- 29 indicated.

30 **1.2 QUALITY ASSURANCE**

- 31 A. Referenced Standards:
- 32 1. American Concrete Institute (ACI):
- 33 a. 302.1R, Guide for Concrete Floor and Slab Construction.
- 34 2. ASTM International (ASTM):
- 35 a. C920, Standard Specification for Elastomeric Joint Sealants.
- 36 b. C1521, Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant
- 37 Joints.
- 38 3. NSF International (NSF):
- 39 a. 61, Drinking Water System Components -- Health Effects.
- 40 4. Underwriters Laboratories, Inc. (UL).
- 41 B. Qualifications: Sealant applicator shall have minimum five (5) years of experience using products
- 42 specified on projects with similar scope.
- 43 C. Mock-Ups:
- 44 1. Before sealant work is started, a mock-up of each type of joint shall be sealed where directed
- 45 by the Engineer.
- 46 a. The approved mock-ups shall show the workmanship, bond, and color of sealant
- 47 materials as specified or selected for the work and shall be the minimum standard of
- 48 quality on the entire project.
- 49 b. Each sample shall cure for a minimum of seven (7) days at which time the sealant
- 50 manufacturer's authorized factory representative shall perform adhesion tests on each
- 51 sample joint.
- 52 1) Perform adhesion tests per ASTM C1521.

- 1 2) If mock-up is not acceptable or if adhesion test fails, provide additional mock-up and  
2 adhesion testing as required until acceptable to Engineer.

3 **1.3 DEFINITIONS**

- 4 A. Corrosive Areas Include: Fluoride Feed Room FC-103.  
5 B. Defect(ive): Failure of water-tightness or airtightness.  
6 C. Finish sealant: Sealant material per this specification applied over face of compressible sealant  
7 or expanding foam sealant specified, to provide a finished, colored sealant joint.  
8 D. Installer or Applicator:  
9 1. Installer or applicator is the person actually installing or applying the product in the field at the  
10 Project site.  
11 2. Installer and applicator are synonymous.  
12 E. "Interior wet areas": Entire area is considered wet.  
13 F. "Seal," "sealing" and "sealant": Joint sealant work.

14 **1.4 SUBMITTALS**

- 15 A. Shop Drawings:  
16 1. See Specification Section 01340 for requirements for the mechanics and administration of  
17 the submittal process.  
18 2. Product technical data including:  
19 a. Acknowledgement that products submitted meet requirements of standards referenced.  
20 b. Manufacturer's installation instructions.  
21 c. Manufacturer's recommendations for joint cleaner, primer, backer rod, tooling and bond  
22 breaker.  
23 3. Certification from sealant manufacturer stating product being used is recommended for and  
24 is best suited for joint in which it is being applied.  
25 4. Certification of applicator qualification.  
26 B. Test Results:  
27 1. Provide adhesion test results for each sealant sample including adhesion results compared  
28 to adhesion requirements.  
29 2. Manufacturer's authorized factory representative recommended remedial measures for all  
30 failing tests.  
31 C. Samples:  
32 1. Cured sample of each color for Engineer's color selection.  
33 2. Color chart not acceptable.  
34 D. Informational Submittals:  
35 1. See Specification Section 01340 for requirements for the mechanics and administration of  
36 the submittal process.

37 **1.5 DELIVERY, STORAGE, AND HANDLING**

- 38 A. Deliver material in manufacturer's original unopened containers with labels intact: Labels shall  
39 indicate contents and expiration date on material.

40 **PART 2 - PRODUCTS**

41 **2.1 ACCEPTABLE MANUFACTURERS**

- 42 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:  
43 1. Compressible sealant:  
44 a. Polytite Manufacturing Corporation.  
45 b. Emseal.  
46 c. Norton.  
47 d. Sandell.  
48 2. Expanding foam sealant:  
49 a. Macklanburg Duncan.

- 1 b. Convenience Products.
- 2 c. FAI International, Inc.
- 3 d. Power Fasteners.
- 4 3. Polyether sealants:
  - 5 a. BASF Sonneborn.
  - 6 b. ChemLink, Inc.
- 7 4. Polysulfide rubber sealant:
  - 8 a. Pecora.
  - 9 b. BASF Sonneborn.
  - 10 c. PolySpec.
- 11 5. Polyurea joint filler:
  - 12 a. Dayton Superior Specialty Chemical Corporation.
  - 13 b. Euclid Chemical Co.
  - 14 c. L&M Construction Chemicals, Inc.
  - 15 d. BASF Sonneborn.
- 16 6. Polyurethane sealants:
  - 17 a. Pecora.
  - 18 b. Sika Chemical Corp.
  - 19 c. BASF Sonneborn.
  - 20 d. Tremco.
- 21 7. Silicone sealants:
  - 22 a. ChemLink.
  - 23 b. GE Construction Sealants.
  - 24 c. Dow Corning.
  - 25 d. Tremco.
- 26 8. Backer rod, compressible filler, primer, joint cleaners, bond breaker: As recommended by
- 27 sealant manufacturer.
- 28 B. Submit request for substitution in accordance with Specification Section 01640.

## 29 2.2 MATERIALS

- 30 A. Sealants - General:
  - 31 1. Provide colors matching materials being sealed.
  - 32 2. Where compound is not exposed to view in finished work, provide manufacturer's color which
  - 33 has best performance.
  - 34 3. Non-sagging sealant for vertical and overhead horizontal joints.
  - 35 4. Sealants for horizontal joints: Self-leveling pedestrian/traffic grade.
  - 36 5. Joint cleaner, primer, bond breaker: As recommended by sealant manufacturer.
  - 37 6. Sealant backer rod and/or compressible filler:
    - 38 a. Closed cell polyethylene, polyethylene jacketed polyurethane foam, or other flexible,
    - 39 nonabsorbent, non-bituminous material recommended by sealant manufacturer to:
      - 40 1) Control joint depth.
      - 41 2) Break bond of sealant at bottom of joint.
      - 42 3) Provide proper shape of sealant bead.
      - 43 4) Serve as expansion joint filler.
- 44 B. Compressible Sealant:
  - 45 1. Foamed polyurethane strip saturated with polymerized polybutylene waterproofing coated on
  - 46 front face with nonreactive release agent that will act as bond breaker for applied sealant.
    - 47 a. Polytite Manufacturing Corp. "Polytite-B."
  - 48 2. Adhesive: As recommended by sealant manufacturer.
- 49 C. Expanding Foam Sealant:
  - 50 1. One (1) or two (2) component fire rated moisture cured expanding urethane.
  - 51 2. Shall not contain formaldehyde.
  - 52 3. Density: Minimum 1.5 pcf.
  - 53 4. Closed cell content: Minimum 70 percent.
  - 54 5. R-value: Minimum 5.0/IN.
  - 55 6. Flame spread: Less than 25.
  - 56 7. Smoke developed: Less than 25.
- 57 D. Polyether Sealant:
  - 58 1. Silyl-terminated polyether polymer.

- 1                   2. ASTM C920, Type S, Grade NS, Class 50, Use NT, M, A, and O.
- 2                   a. BASF Sonneborn Sonolastic 150 with VLM Technology.
- 3                   b. ChemLink DuraLink.
- 4                   E. Polysulfide Rubber Sealant:
- 5                   1. One (1) or two (2) component.
- 6                   2. Meet ASTM C920.
- 7                   a. Pecora Synthacalk GC2+.
- 8                   b. BASF Sonneborn - Sonolastic Polysulfide Sealant.
- 9                   c. PolySpec THIOKOL 2235.
- 10                  F. Polyurea Joint Filler:
- 11                  1. Two (2) component, semi-rigid material for filling formed or saw-cut control joints in interior
- 12                  concrete slabs.
- 13                  a. Dayton Superior Specialty Chemical Corp. "Joint Fill, Joint Seal, Joint Saver II" as
- 14                  required for condition and recommended by manufacturer.
- 15                  b. Euclid Chemical Co. "EUCCO QWIK" joint.
- 16                  c. L&M Construction Chemicals, Inc. "Joint Tite 750".
- 17                  d. BASF Sonneborn "TF-100" control joint filler.
- 18                  2. Comply with ACI 302.1R performance recommendations regarding control and construction
- 19                  joints.
- 20                  3. Color: Gray.
- 21                  G. Polyurethane Sealant:
- 22                  1. One (1) or two (2) components.
- 23                  2. Meet ASTM C920 Type S or Type M, Grade NS or P, Class 25, Use NT, T, M, A and O.
- 24                  a. Pecora Dynatrol-IXL, Dynatrol II, Urexpan NR-200, NR-201.
- 25                  b. Sika Chemical Corporation Sikaflex-1a, Sikaflex-2C NS/SL.
- 26                  c. BASF Sonneborn Sonolastic NP-1, NP-II, SL-1 SL-2.
- 27                  d. Tremco Dymonic or Dymeric, Vulkem 116,227,45,245.
- 28                  H. Silicone Sealant:
- 29                  1. One (1) component.
- 30                  2. Meet ASTM C920, Type S, Grade NS, Class 25, Use NT, G, A, O.
- 31                  a. ChemLink: DuraSil.
- 32                  b. General Electric: Silpruf, Silglaze II.
- 33                  c. Dow Corning: 790, 795.
- 34                  d. Tremco: Spectrem 1, Spectrem 3, Tremsil 600.
- 35                  3. Mildew resistant for sealing around plumbing fixtures.
- 36                  a. General Electric: Sanitary 1700.
- 37                  b. Dow Corning: 786.

## 38                  **PART 3 - EXECUTION**

### 39                  **3.1    PREPARATION**

- 40                  A. Before use of any sealant, investigate its compatibility with joint surfaces, fillers and other
- 41                  materials in joint system.
- 42                  B. Use only compatible materials.
- 43                  C. Where required by manufacturer, prime joint surfaces.
- 44                  1. Limit application to surfaces to receive sealant.
- 45                  2. Mask off adjacent surfaces.
- 46                  D. Provide joint depth for joints receiving polyurea joint filler in accordance with manufacturer's
- 47                  recommendations.

### 48                  **3.2    INSTALLATION**

- 49                  A. Install products in accordance with manufacturer's instructions.
- 50                  B. Clean all joints.
- 51                  C. Make all joints water and airtight.

- 1 D. Make depth of sealing compounds, except expanding foam and polyurea sealant, not more than
- 2 one-half width of joint, but in no case less than 1/4 IN nor more than 1/2 IN unless recommended
- 3 otherwise by the manufacturer.
- 4 E. Provide correctly sized backer rod, compressible filler or compressible sealant in all joints to
- 5 depth recommended by manufacturer:
- 6 1. Take care to not puncture backer rod and compressible filler.
- 7 2. Provide joint backer rod as recommended by the manufacturer for polyurea joint filler.
- 8 F. Apply bond breaker where required.
- 9 G. Tool sealants using sufficient pressure to fill all voids.
- 10 H. Upon completion, leave sealant with smooth, even, neat finish.
- 11 I. Where piping, conduit, ductwork, etc., penetrate wall, seal each side of wall opening.
- 12 J. Install compressible sealant to position at indicated depth.
- 13 1. Size so that width of material is twice joint width.
- 14 2. Take care to avoid contamination of sides of joint.
- 15 3. Protect side walls of joint (to depth of finish sealant).
- 16 4. Install with adhesive faces in contact with joint sides.
- 17 5. Install finish sealant where indicated.
- 18 K. Install expanding foam sealant to minimum 4 IN depth or thickness of wall being penetrated if less
- 19 than 4 IN or as indicated on Drawings.
- 20 1. Hold material back from exposed face of wall as necessary to allow for installation of backer
- 21 rod and finish sealant.
- 22 a. Allow expanding foam sealant to completely cure prior to installing backer rod and finish
- 23 sealant.
- 24 2. Trim off excess material flush with surface of the wall if not providing finished sealant.

### 25 3.3 FIELD QUALITY CONTROL

- 26 A. Adhesion Testing:
- 27 1. Perform adhesion tests in accordance with ASTM C1521 per the following criteria:
- 28 a. Water bearing structures: One (1) test per every 1000 LF of joint sealed.
- 29 b. Masonry expansion and control joints: One (1) test per every 500 LF of joint sealed.
- 30 c. Chemical containment areas: One (1) test per every 1000 LF of joint sealed.
- 31 d. All other type of joints except butt glazing joints: One (1) test per every 3000 LF of joint
- 32 sealed.
- 33 e. Manufacturer's authorized factory representative shall recommend, in writing, remedial
- 34 measures for all failing tests.

### 35 3.4 SCHEDULE

- 36 A. Furnish sealant as indicated for the following areas:
- 37 1. Exterior areas:
- 38 a. Above grade: Polyether.
- 39 b. Below grade: Polyurethane.
- 40 2. Interior areas:
- 41 a. Noncorrosive areas:
- 42 1) Wet exposure: Polyether.
- 43 2) Dry exposure: Polyether.
- 44 b. Corrosive areas:
- 45 1) Wet exposure: Polysulfide.
- 46 2) Dry exposure: Polyurethane.
- 47 c. Sealant exposed to or having the potential of being exposed to concentrated chlorine
- 48 gas or chlorine liquid: Polysulfide.
- 49 d. Sinks, fixtures or other areas subject to potential splash, spillage or condensation:
- 50 Mildew Resistant Silicone.
- 51 3. Immersion:
- 52 a. Prolonged contact with or immersion in:
- 53 1) Potable water:
- 54 a) Polysulfide.
- 55 b) NSF 61 approved.

- 1                   2) Non-potable water: Polysulfide.
- 2                   4. Compressible sealant: Where indicated.
- 3                   5. Exterior wall penetrations: Expanding urethane foam, with finish sealant.
- 4                   a. Finish sealant:
- 5                    1) Exterior side:
- 6                     a) Above grade: Polyether.
- 7                     b) Below grade: Polyurethane.
- 8                    2) Interior side:
- 9                     a) Noncorrosive area:
- 10                    (1) Wet exposure: Polyether.
- 11                    (2) Dry exposure: Polyether.
- 12                     b) Corrosive area:
- 13                    (1) Wet exposure: Polysulfide.
- 14                    (2) Dry exposure: Polyurethane.
- 15                   6. Interior concrete slab formed or saw-cut control joints: Polyurea joint filler.

16

**END OF SECTION**



# DIVISION 08

DOORS AND WINDOWS







1 2014/09/08

2

3

**SECTION 08120**  
**ALUMINUM DOORS AND FRAMES**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6

A. Section Includes:

7

1. Flush aluminum doors.

8

2. Aluminum frames.

9

B. Related Specification Sections include but are not necessarily limited to:

10

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

11

2. Division 01 - General Requirements.

12

3. Section 07900 - Joint Sealants.

13

4. Section 08700 - Finish Hardware.

14

5. Section 08800 - Glass and Glazing.

15

6. Section 09960 - High Performance Industrial Coatings.

16

**1.2 QUALITY ASSURANCE**

17

A. Referenced Standards:

18

1. Aluminum Association (AA):

19

a. DAF 45, Designation System for Aluminum Finishes.

20

2. ASTM International (ASTM):

21

a. A240, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

22

b. A276, Standard Specification for Stainless Steel Bars and Shapes.

23

c. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

24

d. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

25

3. Door and Hardware Institute/American National Standards Institute (DHI/ANSI):

26

a. A115.1, Preparation of Mortise Locks in 1-3/8 IN and 1-3/4 IN Standard Steel Doors and Frames.

27

4. National Builders Hardware Association (NBHA):

28

a. Recommended Location for Builders Hardware.

29

5. Building Code:

30

a. International Code Council (ICC):

31

1) International Building Code and associated standards, 2006 Edition including all amendments, referred to herein as Building Code.

32

33

34

35

B. Qualifications:

36

1. Door and frame fabricator must have minimum 10 years experience in fabrication of flush aluminum doors and associated frames.

37

38

2. Installation: Door and frame installation shall be performed by experienced workmen having a minimum five (5) years experience installing products similar to those specified.

39

40

41

**1.3 DEFINITIONS**

42

A. Installer or Applicator:

43

1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.

44

2. Installer and applicator are synonymous.

45

46

**1.4 SUBMITTALS**

47

A. Shop Drawings:

48

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

49

- 1 2. Product technical data including:
  - 2 a. Acknowledgement that products submitted meet requirements of standards referenced.
  - 3 b. Manufacturer's installation instructions.
- 4 3. Schedule of doors and frames using same reference numbers as indicated on Drawings.
- 5 4. Certifications:
  - 6 a. Certification of manufacturer qualifications.
  - 7 b. Certification of installer qualifications.
- 8 B. Samples:
  - 9 1. 6 x 6 IN sample of door section showing edge construction, core, impact reinforcement and
  - 10 face sheet.
  - 11 2. 6 x 6 IN sample of door frame specified, showing weatherstripping, anchoring device, stops
  - 12 and all parts of the frame necessary for complete installation.
- 13 C. Operation and Maintenance Manuals:
  - 14 1. See Specification Section 01340 for requirements for:
    - 15 a. The mechanics and administration of the submittal process.
    - 16 b. The content of Operation and Maintenance Manuals.

## 17 1.5 DELIVERY, STORAGE, AND HANDLING

- 18 A. Store doors and frames in a dry, weather protected area.
  - 19 1. Place units on wood skids providing a minimum 6 IN air space above the ground.
  - 20 2. Do not store units flat, set frames and doors on edge providing minimum 1/2 IN air circulation
  - 21 space between each unit.
  - 22 3. Provide covering which will ensure air flow around each unit to prevent trapping of moisture.
  - 23 4. If door wrapper becomes wet immediately remove and provide dry protection equivalent to
  - 24 wrapper removed.
- 25 B. Where storage recommendations by unit manufacturer conflict with the above requirements, the
- 26 more stringent requirement shall apply.

## 27 PART 2 - PRODUCTS

### 28 2.1 ACCEPTABLE MANUFACTURERS

- 29 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 30 1. Aluminum doors and frames:
    - 31 a. Alutech Corp.
    - 32 b. Commercial Door Systems.
    - 33 c. Special-Lite, Inc.
- 34 B. Submit request for substitution in accordance with Specification Section 01640.

### 35 2.2 MATERIALS

- 36 A. Aluminum:
  - 37 1. Sheet:
    - 38 a. ASTM B209.
    - 39 b. Alloy 5005 architectural quality.
  - 40 2. Extrusions:
    - 41 a. Aluminium ASTM B221.
    - 42 b. 6063T5.
- 43 B. Stainless Steel:
  - 44 1. ASTM A276 or ASTM A240.
  - 45 2. Type 304 or 316.
- 46 C. FRP Sheet:
  - 47 1. Fiberglass Reinforced Plastic.
- 48 D. Insulation:
  - 49 1. Closed cell urethane.
    - 50 a. CFC and HCFC free.
    - 51 b. Ozone depletion potential: 0.

1 c. Density: Minimum 5.0 pcf.

2 E. Fasteners:

- 3 1. Stainless steel.  
4 a. Type 304 or 316.

5 **2.3 ACCESSORIES**

6 A. Lites (Glass Panels):

- 7 1. Screw-applied aluminum stops.  
8 a. Exterior face: No exposed fasteners.  
9 b. Interior face: Countersunk Phillips head machine screws.  
10 2. Glass: See Specification Section 08800.

11 **2.4 FABRICATION**

12 A. General:

- 13 1. Fabricate rigid, neat in appearance and free from defects.  
14 2. Form to indicated sizes and profiles.  
15 3. Fit and assemble in shop wherever practical.  
16 4. Mark work that cannot be fully assembled in shop to assure proper assembly at site.  
17 5. Factory prepare for finish hardware, in accordance with hardware schedule, templates  
18 provided by hardware supplier, DHI/ANSI A115.1, and NBHA.  
19 a. Locate hardware in accordance with "Recommended Location for Builders Hardware,"  
20 by NBHA.  
21 b. See Specification Section 08700 for hardware.  
22 6. Conceal fastenings wherever practical.  
23 a. Exposed fasteners to be countersunk Phillips or Jackson flat head screws and bolts.

24 B. Doors:

- 25 1. Nominal 1-3/4 IN thick.  
26 2. Face:  
27 a. FRP sheet.  
28 b. Thickness: 0.125 IN.  
29 c. Texture: Sandstone.  
30 3. Core:  
31 a. Insulated.  
32 b. Minimum R 5.8.  
33 4. Hardware reinforcement:  
34 a. Aluminum or stainless steel.  
35 b. Reinforce hinges using continuous bar in hinge stile, tapped for hinges.  
36 c. Reinforce for hardware using plate screwed to tubular frame.

37 C. Frames:

- 38 1. Tubular design.  
39 a. Minimum thickness: 0.120 IN.  
40 b. Site-line:  
41 1) Minimum: 1-3/4 IN.  
42 2) Maximum: 2-1/4 IN.  
43 c. Depth:  
44 1) Minimum: 6 IN.  
45 2. Frames to be vertically reinforced at jambs.  
46 a. Reinforce for hinge using bar in hinge side of frame, tapped for hinges.  
47 b. Reinforce for all other hardware using plate screwed to frame.  
48 c. Reinforcement sizes shall be determined by the frame manufacturer.  
49 1) Minimum thickness: 1/4 IN.  
50 d. Wood blocking is not acceptable.  
51 3. Stops:  
52 a. Screw applied or snap-on.  
53 b. Weatherstripping: Resilient bulb type.  
54 1) Brush or pile weatherstripping will not be accepted.

- 1 D. Finish:
- 2 1. Aluminum:
- 3 a. Anodized: Architectural Class 1 coating per AA DAF 45.
- 4 1) Interior doors and frames: Clear, AA-M12C22A41
- 5 2) Exterior doors and frames: Dark bronze: AA-M12C22A42 or A44.
- 6 2. FRP Facing:
- 7 a. Interior doors: White.
- 8 b. Exterior doors: Dark Bronze.

9 **PART 3 - EXECUTION**

10 **3.1 INSTALLATION**

- 11 A. Install doors and frames in accordance with manufacturer's instructions.
- 12 B. Provide dissimilar materials protection.
- 13 1. See Specification Section 09960.
- 14 C. Plumb, align, and brace securely until permanently anchored.
- 15 1. Number and location of anchors shall be in accordance with frame manufacturer's
- 16 recommendation with minimum of three (3) anchors per jamb.
- 17 D. Hardware: See Specification Section 08700.
- 18 E. Seal perimeter of door frame.
- 19 1. See Specification Section 07900.

20 **3.2 FIELD QUALITY CONTROL**

- 21 A. Repair all damaged finishes or replace framing member or door as directed by Engineer.
- 22 1. Use only materials and finishes as recommended or furnished by door and frame
- 23 manufacturer.
- 24 2. Final repaired finish shall match surrounding original finish or item being repaired shall be
- 25 replaced with new item.

26 **3.3 CLEANING**

- 27 A. Clean doors and frames as recommended by manufacturer prior to acceptance by Owner.

28 **3.4 PROTECTION**

- 29 A. Protect doors and frames during construction.

30 **END OF SECTION**

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## SECTION 08220

3

### FIBERGLASS REINFORCED PLASTIC (FRP) DOORS AND FRAMES

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

A. Section Includes: FRP doors and frames.

7

B. Related Specification Sections include but are not necessarily limited to:

8

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

9

2. Division 01 - General Requirements.

10

3. Section 08700 - Finish Hardware.

11

4. Section 08800 - Glass and Glazing.

12

##### 1.2 QUALITY ASSURANCE

13

A. Referenced Standards:

14

1. ASTM International (ASTM):

15

a. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

16

2. Door and Hardware Institute/American National Standards Institute (DHI/ANSI):

17

a. A115.1, Preparation of Mortise Locks in 1-3/8 IN and 1-3/4 IN Standard Steel Doors and Frames.

18

3. Steel Door Institute (SDI):

19

a. 117, Manufacturing Tolerances for Standard Steel Doors and Frames.

20

b. All applicable SDI publications.

21

B. Qualifications:

22

1. Manufacturer shall have been producing products specified for minimum of 10 years.

23

2. Installer shall have minimum of five (5) years of experience in the installation of fiberglass reinforced plastic doors and frames.

24

a. Experience shall include field repair of fiberglass and gel coating.

25

C. Doors and frames shall be fabricated and prepared for hardware by single manufacturer.

26

27

##### 1.3 DEFINITIONS

28

A. FRP: Fiberglass Reinforced Plastic.

29

B. Installer or Applicator:

30

1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.

31

2. Installer and applicator are synonymous.

32

##### 1.4 SUBMITTALS

33

A. Shop Drawings:

34

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

35

2. Product technical data including:

36

a. Acknowledgement that products submitted meet requirements of standards referenced.

37

b. Manufacturer's installation instructions.

38

3. Schedule of doors and frames specific to this Specification Section, using same reference numbers as used on Drawings.

39

4. Certification of manufacturer's qualifications.

40

5. Certification of installer's experience.

41

B. Informational Submittals: Warranty.

42

1 **1.5 DELIVERY, STORAGE, AND HANDLING**

- 2 A. Store doors and frames in a dry, weather protected area.  
3 1. Place units on wood skids providing a minimum 6 IN air space above the ground.  
4 2. Do not store units flat, set frames and doors on edge providing a minimum 1/2 IN air  
5 circulation space between each unit.  
6 3. Provide covering which will ensure air flow around each unit to prevent trapping moisture.  
7 4. If door wrapper becomes wet, remove immediately and provide dry protection equivalent to  
8 wrapper removed.  
9 B. Storage recommendations by unit manufacturer shall take precedence over the above  
10 requirements.

11 **1.6 WARRANTY**

- 12 A. Materials and workmanship: To be free of defects for ten (10) years.  
13 B. Corrosion: To be free of defects for the lifetime of the assembly.  
14 C. Warranty against door warpage of more than 1:100 when measured diagonally across the door.

15 **PART 2 - PRODUCTS**

16 **2.1 ACCEPTABLE MANUFACTURERS**

- 17 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:  
18 1. FRP doors and frames:  
19 a. Corrim Company.  
20 b. Universal Pultrusions.  
21 B. Submit request for substitution in accordance with Specification Section 01640.

22 **2.2 MATERIALS**

- 23 A. Fiberglass reinforced plastic (FRP):  
24 1. Resin: Vinyl Ester.  
25 a. UV stabilized.  
26 2. Fiberglass content (by weight): Minimum 30 percent, maximum 40 percent.  
27 B. Supports and Reinforcing: Non-swelling polymer or equivalent corrosion-resistant material.  
28 C. Inserts, Bolts and Fasteners: Stainless steel.

29 **2.3 ACCESSORIES**

- 30 A. Frame Anchors:  
31 1. Jamb anchors in masonry: 9 GA stainless steel masonry wire anchor,.  
32 2. Floor anchors: 12 GA stainless steel,.  
33 3. Anchors in existing openings: Stainless steel machine screws and stainless steel expansion  
34 shield.  
35 B. Glass Lites:  
36 1. Fixed, applied stops on each face with snap-in retainer and trim fabricated from non-  
37 corrosive materials.  
38 a. No exposed fasteners on exterior of door allowed.  
39 b. Doors may be glazed at the factory or at manufacturer's option may be glazed in the  
40 field.  
41 2. Reinforce cut-out in door panel with minimum 1.5 IN SQ fiberglass tubing.  
42 3. Glass: See Specification Section 08800.

43 **2.4 FABRICATION**

- 44 A. General:  
45 1. Fabricate rigid, neat in appearance and free from defects.  
46 2. Fit and assemble in shop wherever practical.  
47 3. Mark work that cannot be fully assembled in shop to assure proper assembly at site.

- 1 4. For door frames, all surfaces, both exposed and concealed, shall be gel coated to prevent  
2 acid attack of the glass reinforcing.  
3 5. Fabricate doors and frames to tolerance requirements of SDI 117.  
4 6. Fit doors to SDI clearances.  
5 7. Prepare for finish hardware in accordance with hardware schedule, templates provided by  
6 hardware supplier, and DHI/ANSI A115.1.  
7 a. Locate finish hardware in accordance with SDI.  
8 b. See Specification Section 08700 for hardware.
- 9 B. FRP Doors:  
10 1. Thickness: 1-3/4 IN.  
11 2. Face sheets, 0.125 IN thick.  
12 3. Fabricate with flush top closure.  
13 4. Fill and dress all joints.  
14 5. Core: Polyurethane foam.  
15 a. Density: Minimum of 6 pounds per cubic foot.  
16 b. Flame spread and smoke developed: ASTM E 84, Class B.  
17 6. Finish:  
18 a. Two part aliphatic polyurethane, low VOC, Industrial Coating.  
19 b. Thickness: 5 mils.  
20 c. Sheen: Gloss.  
21 d. Impact Resistance per ASTM D 2794: 140 in lbs.  
22 e. Color: To be selected.
- 23 C. Frames:  
24 1. Profile: 2 IN x 5-3/4 IN with equal rabbets on each side.  
25 a. Thickness: 0.1875 IN minimum.  
26 2. One (1) piece shop-fabricated.  
27 1) Field-assembled frames will not be accepted.  
28 3. Corner reinforcement: Minimum 4 x 4 x 0.25 IN FRP angle attached to top reinforcing bar  
29 with concealed stainless steel screws.  
30 4. Hinge reinforcement: Minimum 0.25 IN thick polymer plate attached to frame.  
31 5. Minimum 0.25 IN thick polymer plate reinforcement bonded and mechanically fastened to  
32 frame for strikes, closers and surface-mounted hardware.

## 33 PART 3 - EXECUTION

### 34 3.1 INSTALLATION

- 35 A. Install doors and frames in accordance with SDI and manufacturer's instructions.  
36 1. Manufacturer's instructions take precedent over SDI.
- 37 B. Place frames prior to construction of enclosing walls and ceilings.
- 38 C. Plumb, align, and brace securely until permanently anchored.
- 39 D. After completion of walls, remove temporary braces and spreaders.
- 40 E. Immediately after erection, repair damaged areas of urethane coating.
- 41 F. Install three (3) silencers on strike jamb of frame.  
42 1. See Specification Section 08700.
- 43 G. Number and location of anchors shall be in accordance with frame manufacturer's  
44 recommendation with minimum of three (3) anchors per jamb.
- 45 H. Protect frames during construction.
- 46 I. Cover all thru bolts and other stainless steel accessories with minimum 5 mil urethane coating to  
47 match door frame.

48 **END OF SECTION**

49





1 2014/09/08

2

## SECTION 08365

3

### OVERHEAD DOOR - SECTIONAL ALUMINUM

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

###### A. Section Includes:

7

1. Sectional aluminum overhead doors.

8

2. Motor operator.

9

###### B. Related Specification Sections include but are not necessarily limited to:

10

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

11

2. Division 01 - General Requirements.

12

3. Section 11005 - Equipment: Basic Requirements.

13

4. Division 16 - Electrical.

14

##### 1.2 QUALITY ASSURANCE

15

###### A. Referenced Standards:

16

1. Aluminum Association (AA):

17

a. DAF 45, Designation System for Aluminum Finishes.

18

2. American National Standards Institute/ Door & Access Systems Manufacturers' Association, International (ANSI/DASMA):

19

a. ANSI/DASMA 102, Specifications for Sectional Doors.

20

3. ASTM International (ASTM):

21

a. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

22

b. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

23

24

c. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

25

4. National Electrical Manufacturers Association (NEMA):

26

a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

27

5. Building Code:

28

a. International Code Council (ICC):

29

1) International Building Code and associated standards, 2006 Edition including all amendments, referred to herein as Building Code.

30

31

32

33

B. Qualifications: Installer shall be licensed or approved in writing by door manufacturer.

34

##### 1.3 DEFINITIONS

35

###### A. Installer or Applicator:

36

1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.

37

2. Installer and applicator are synonymous.

38

39

##### 1.4 SUBMITTALS

40

###### A. Shop Drawings:

41

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

42

2. Product technical data including:

43

a. Acknowledgement that products submitted meet requirements of standards referenced.

44

b. Manufacturer's installation instructions.

45

3. Schedule of doors using same reference number for openings as indicated on Drawings.

46

4. Warranty.

47

5. Certification of installer qualifications.

48

6. Motor operator and accessories technical data including wiring and control diagrams for motor operators and control stations.

49

50

- 1 B. Operation and Maintenance Manuals:
- 2 1. See Specification Section 01342 for requirements for:
- 3 a. The mechanics and administration of the submittal process.
- 4 b. The content of Operation and Maintenance Manuals.
- 5 C. Miscellaneous Submittals:
- 6 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 7 the submittal process.

## 8 **PART 2 - PRODUCTS**

### 9 **2.1 ACCEPTABLE MANUFACTURERS**

- 10 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 11 1. Insulated Sectional aluminum overhead doors:
- 12 a. Fimbel Architectural Door Specialties.
- 13 b. Haas Door Co.
- 14 c. Overhead Door Co.
- 15 B. Submit request for substitution in accordance with Specification Section 01640.

### 16 **2.2 MATERIALS**

- 17 A. Aluminum:
- 18 1. Sheet: ASTM B209.
- 19 2. Extrusions: ASTM B221.
- 20 B. Steel:
- 21 1. Galvanized: ASTM A653, G90.
- 22 C. Insulation:
- 23 1. Polyurethane foam.
- 24 2. CFC free.
- 25 D. Weatherstripping: Neoprene, vinyl, or PVC.
- 26 E. Fasteners: Aluminum or stainless steel.

### 27 **2.3 MANUFACTURED ITEMS**

- 28 A. General:
- 29 1. Meet ANSI/DASMA 102.
- 30 2. Wind Load Resistance: Design for components and cladding wind loading requirements of
- 31 Building Code for the wind speed shown on sheet 00S001.
- 32 B. Track:
- 33 1. Steel.
- 34 2. Manufacturer's heavy duty 2 IN or 3 IN as required for door opening size.
- 35 a. Provide lift-clearance track.
- 36 1) Door FC-101B: 4 FT – 0 IN high lift.
- 37 2) Door FC-102B: 2 FT – 0 IN high lift.
- 38 C. Counterbalancing System:
- 39 1. Helical torsion 100,000 cycle springs having a 25-percent safety factor, fixed to cast anchors,
- 40 mounted on a single steel torsion rod.
- 41 2. Cable drums to have graduated spiral groove for adjustment and galvanized lift cables with
- 42 minimum 7:1 safety factor.
- 43 D. Hardware:
- 44 1. Steel or aluminum.
- 45 2. All hardware is to be rated for heavy duty service.
- 46 E. Door Sections:
- 47 1. General:
- 48 a. HAAS Door Company: "Model CHT-2050".
- 49 b. Minimum 2 IN thick.

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2. Insulated sections:
    - a. Panel faces: Minimum 24 GA aluminum.
      - 1) Stucco embossed both faces.
      - 2) V-grooves at 3 IN on center.
    - b. Thermal break at intersections of door panels.
    - c. End stiles: Steel.
      - 1) Minimum 16 GA.
    - d. Intermediate reinforcing: Steel.
      - 1) Minimum 18 GA.
    - e. Insulated, minimum R value 15.
    - f. Finish:
      - 1) Manufacturer's standard polyurethane primer and polyester finish coat.
        - a) Color shall match anodized aluminum full-view sections as closely as practicable.
  3. Full-view sections:
    - a. Aluminum extrusion rail and stile construction.
      - 1) Tubular extrusions with thru-bolt construction.
      - 2) Extrusion thickness: 0.065 IN minimum.
    - b. Narrow Line Frame construction:
      - 1) Top and bottom rails: 2 IN high maximum.
      - 2) End stiles: 3 IN wide.
      - 3) Intermediate stiles: 2 IN wide.
    - c. Glazing:
      - 1) Insulated glass units:
        - a) Thickness: 1/2 IN minimum; 5/8 IN maximum.
        - b) See Specification Section 08800.
    - d. Finish:
      - 1) Anodized: Architectural Class 1 coating per AA DAF 45.
        - a) Dark bronze: AA-M12C22A42 or A44.
- F. Weatherstripping:
1. Bottom: Compressible electric safety edge.
    - a. See requirements in Accessories Article of this Specification Section.
  2. Top and sides: Continuous adjustable neoprene or EPDM strip.
- G. Trim Pieces: Material and finish to match adjacent construction.
- H. Operation: Motor-operated with chain operator backup.

36 **2.4 ACCESSORIES**

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- A. Motor Operator:
    1. Minimum 1/2 HP, 120/1/60.
      - a. Motor shall be sized by door manufacturer for door size indicated on Drawings.
      - b. See Specification Section 11005 for additional motor requirements.
        - 1) Provide manufacturer's standard reversing controller with motor thermal protection if motor is not internally protected as specified in Specification Section 11005.
    2. Electric instant reversing with instant reversing electric safety edge at bottom of door.
      - a. Provide complete wiring connections from instant reversing electric safety edge to motor operator including all intermediate junction boxes, conduit, disconnect, wiring and low voltage wiring.
    3. Opening/closing rate: Between 2/3 and 1 FPS.
    4. Controls:
      - a. Provide connection in door operator so remote dry contacts can initiate opening of door.
      - b. Three (3) pushbutton wall station.
        - 1) NEMA 250, Type 4X.
        - 2) Open, close, stop.

53 **2.5 MAINTENANCE MATERIALS**

- 54
- A. Provide 2 OZ of touch-up paint for each color door on Project.

1 **PART 3 - EXECUTION**

2 **3.1 INSTALLATION**

- 3 A. Install products in accordance with manufacturer's instructions.
- 4 B. Installation shall be done by manufacturer's authorized installer.
- 5 C. Provide all necessary trim, weatherstripping, closures, plates, angles, and bracing for a complete
- 6 weathertight vibration free installation.
- 7 D. Electrical disconnect and conduit and wiring from standard three (3) pushbutton control to motor
- 8 operator is to be provided by Division 16.

9 **3.2 ADJUSTMENT**

- 10 A. Prior to occupancy, adjust door for smooth operation.

11 **END OF SECTION**

1 2014/09/15

2 **SECTION 08700**  
3 **FINISH HARDWARE**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6 A. Section Includes:

- 7 1. Finish hardware.  
8 2. Electrified door hardware.  
9 3. Electric door assisting device.  
10 4. Inspection and testing of door operation.

11 B. Related Specification Sections include but are not necessarily limited to:

- 12 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.  
13 2. Division 01 - General Requirements.  
14 3. Section 08120 - Aluminum Doors and Frames.  
15 4. Section 08220 - Fiberglass Reinforced Plastic (FRP) Doors and Frames.  
16 5. Section 08900 - Curtainwall System.  
17 6. Division 16 - Electrical.

18 **1.2 QUALITY ASSURANCE**

19 A. All door hardware shall be provided by a single hardware supplier.

20 B. Referenced Standards:

- 21 1. Americans with Disabilities Act (ADA):  
22 a. Accessibility Guidelines for Buildings and Facilities (ADAAG).  
23 2. American National Standards Institute/Builders Hardware Manufacturers Association  
24 (ANSI/BHMA):  
25 a. A156.1, Butts and Hinges.  
26 b. A156.3, Exit Devices.  
27 c. A156.4, Door Controls - Closers.  
28 d. A156.6, Architectural Door Trim.  
29 e. A156.8, Door Controls - Overhead Stops and Holders.  
30 f. A156.13, Mortise Locks and Latches Series 1000.  
31 g. A156.16, Auxiliary Hardware.  
32 h. A156.18, Materials and Finishes.  
33 i. A156.19, Power Assist and Low Energy Power Operated Doors.  
34 j. A156.21, Thresholds.  
35 3. Door and Hardware Institute (DHI).  
36 4. Steel Door Institute (SDI).  
37 5. Building Code:  
38 a. International Code Council (ICC):  
39 1) International Building Code and associated standards, 2006 Edition including all  
40 amendments, referred to herein as Building Code.

41 C. Qualifications:

- 42 1. Installation shall be inspected by a certified Architectural Hardware Consultant (AHC).  
43 2. Installation of electrified hardware shall be inspected by a certified Electrified Hardware  
44 Consultant (EHC).

45 **1.3 DEFINITIONS**

46 A. AHC: Architectural Hardware Consultant, certified by DHI.

47 B. EHC: Electrified Hardware Consultant, certified by DHI.

48 C. Installer or Applicator:

- 49 1. Installer or applicator is the person actually installing or applying the product in the field at the  
50 Project site.

- 1           2. Installer and applicator are synonymous.
- 2           D. All weather: Capable of operation from -50 to +120 DegF.
- 3           E. Active Leaf: Right-hand leaf when facing door from keyed side unless noted otherwise on
- 4           Drawings.
- 5           F. FRP: Fiberglass reinforced plastic.

6   **1.4 SUBMITTALS**

- 7           A. Shop Drawings:
  - 8           1. See Specification Section 01340 for requirements for the mechanics and administration of
  - 9           the submittal process.
  - 10           2. Qualifications
    - 11           a. AHC and EHC qualifications.
    - 12           b. No submittals will be reviewed until Engineer has received qualifications.
  - 13           3. Product technical data including:
    - 14           a. Acknowledgement that products submitted meet requirements of standards referenced.
    - 15           b. Certification that electrified door hardware has been reviewed by EHC and coordinated
    - 16           with electric door assisting device and access control system.
    - 17           c. Manufacturer's installation instructions.
    - 18           d. Complete wiring layout/diagrams for electric door assisting device.
  - 19           4. Schedule of all hardware being used on each door.
    - 20           a. Number hardware sets and door references same as those indicated on Drawings.
  - 21           5. Technical data sheets on each hardware item proposed for use.
- 22           B. Informational Submittals:
  - 23           1. Warranty information for all hardware devices having extended warranties.
  - 24           2. Certifications:
    - 25           a. Certification from AHC and EHC stating all door hardware has been provided per
    - 26           approved Shop Drawings, has been installed in accordance with manufacturer's
    - 27           recommended installation instructions and all doors have been inspected and tested and
    - 28           found to be in proper working order.
      - 29           1) Door assemblies required to swing in the direction of egress have been inspected
      - 30           and tested in accordance with NFPA 101.
- 31           C. Operation and Maintenance Manuals:
  - 32           1. See Specification Section 01342 for requirements for:
  - 33           a. The mechanics and administration of the submittal process.
  - 34           b. The content of Operation and Maintenance Manuals.

35   **1.5 WARRANTY**

- 36           A. Provide all individual manufacturers' extended warranties as advertised.

37   **PART 2 - PRODUCTS**

38   **2.1 ACCEPTABLE MANUFACTURERS**

- 39           A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 40           1. Locksets and Latchsets:
    - 41           a. Corbin/Russwin.
    - 42           b. Best Access Systems.
  - 43           2. Closers:
    - 44           a. LCN.
    - 45           b. Norton.
    - 46           c. Corbin/Russwin.
  - 47           3. Hinges:
    - 48           a. Stanley Works.
    - 49           b. Hager Hinge Co.
    - 50           c. McKinney Manufacturing Co.
  - 51           4. Door stops and holders:
    - 52           a. Trimco.

- 1                   b. Rockwood.
- 2                   c. Ives.
- 3                   5. Overhead stops:
- 4                   a. Glynn-Johnson Corp.
- 5                   b. Rockwood.
- 6                   c. Trimco
- 7                   d. Rixson.
- 8                   6. Weatherstripping and thresholds:
- 9                   a. Pemko Manufacturing Co.
- 10                  b. Reese Enterprises, Inc.
- 11                  c. Zero Weatherstripping, Inc.
- 12                  d. National Guard Products, Inc.
- 13                  7. Exit devices:
- 14                  a. Von Duprin, Inc.
- 15                  b. Corbin/Ruswin.
- 16                  c. Precision.
- 17                  d. Sargent.
- 18                  8. Door bolts, coordinators and strikes:
- 19                  a. Ives.
- 20                  b. Trimco.
- 21                  c. Hager.
- 22                  d. Rockwood.
- 23                  e. Dorma.
- 24                  9. Electric door assisting device:
- 25                  a. Horton Automatics.
- 26                  b. Norton.
- 27                  10. Magnetic door position switches: By Others.
- 28                  11. Other materials: As noted.
- 29                  B. Submit request for substitution in accordance with Specification Section 01640.

30   **2.2 MATERIALS**

- 31                  A. General: As indicated in the FABRICATION Article in PART 2 of this Specification Section.
- 32                  B. Fasteners: Stainless steel or aluminum.
- 33                  C. Keys: Brass or bronze.

34   **2.3 ACCESSORIES**

- 35                  A. Strikes: Stainless Steel.
- 36                    1. Furnish strike boxes.
- 37                    2. Appropriate for function and hardware listed.
- 38                    3. Provide stainless steel dustproof strikes for all doors with bolts into floor or threshold.
- 39                    4. Jamb strikes: Curved lips.
- 40                      a. Extended lips when required.
- 41                  B. Electric Door Assisting Device (Door Operator):
- 42                    1. This device to be installed on doors FPA-103A and FPA-104A.
- 43                    2. Low energy, self-contained, electromechanical type.
- 44                      a. 120 Vac, 60 cycle, 1 PH, 15 amp.
- 45                    3. Direct current operation.
- 46                    4. Door capable of manual operation with power on or off without damage to operating unit.
- 47                    5. Manual/automatic operation.
- 48                    6. Comply with ADA and ANSI/BHMA A156.19.
- 49                    7. Adjustable opening and closing speed with range of 3 to 10 seconds.
- 50                    8. Adjustable time delay prior to closing with range of 5 to 28 seconds.
- 51                    9. Activating switch:
- 52                      a. Extruded aluminum or stainless steel, momentary contact.
- 53                      b. Interior: Wall mounted.
- 54                      c. Exterior: Pedestal mounted.
- 55                        1) Pedestal:
- 56                        a) Rectangular aluminum pedestal with top cap.
- 57                        (1) 4 IN by 6 IN by 40 IN tall.

- 1 (2) Minimum 3/16 IN wall thickness.
- 2 (3) Finish: Dark Bronze Anodized.
- 3 b) Norton 500 series.
- 4 d. Engraved with international handicap insignia.
- 5 10. Provide unit complete with all required wiring for interconnecting activating switch with
- 6 controller and any other miscellaneous items required for complete installation.
- 7 11. Interlock door assisting device with access control system to prevent operation from locked
- 8 side when doors are secured.
- 9 a. Access control system shall unlock door; actuation of door shall be a separate operation.
- 10 b. Actuation of door assisting device shall unlock and retract latch.
- 11 c. Non-access controlled door assisting device to be always active.
- 12 12. Finish to match door and frame on which device is used.
- 13 a. Conceal all conduit running to and from the device.

14 **2.4 FABRICATION**

- 15 A. General:
  - 16 1. Generally prepare for Phillips head machine screw installation.
  - 17 2. Exposed screws to match hardware finish or, if exposed in surfaces of other work, to match
  - 18 finish of other work as closely as possible.
  - 19 3. Provide concealed fasteners unless thru bolted.
  - 20 4. Through bolt closers on all doors.
  - 21 5. Furnish items of hardware for proper door swing.
  - 22 6. Furnish lock devices which allow door to be opened from inside room without a key or any
  - 23 special knowledge.
- 24 B. Hardware:
  - 25 1. Provide following ANSI/BHMA A156.18 finishes:
    - 26 a. Locksets, latchsets and strikes: 630.
    - 27 b. Door pulls, push bars, push plates: 630.
    - 28 c. Kickplates:
      - 29 1) Stainless steel: 630.
      - 30 2) FRP: Urethane coated to match door finish.
    - 31 d. Exit devices: 630 or 626.
    - 32 e. Butt hinges: 630.
    - 33 f. Door stops, dead locks, mortise bolts, and miscellaneous hardware: 630 if available,
    - 34 626 if 630 not available.
    - 35 g. Door overhead stops: 630.
    - 36 a. Closers:
      - 37 1) Standard closers: 600 prime coat with 689 finish coat, unless noted otherwise.
      - 38 2) Corrosion resistant closers: 630.
- 39 C. Mortise Locks and Latches:
  - 40 1. ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 1.
    - 41 a. Meet requirements of ADA.
  - 42 2. Antifriction two-piece mechanical latchbolt with stainless steel anti-friction insert.
    - 43 a. One-piece stainless steel deadbolt, minimum 1-1/4 IN x 9/ 16 IN thick with 1 IN throw.
    - 44 b. 2-3/4 IN backset.
    - 45 c. Cylinder: Brass, 6 pin, with interchangeable core.
      - 46 1) Match existing facility keyway.
    - 47 d. ADA compliant thumb turn lever.
  - 48 3. Locking, latching and retracting mechanism and lock case:
    - 49 a. Non-ferrous lock case.
  - 50 4. Trim design: Corbin/Ruswin Princeton Series "PSF".
  - 51 5. Type and function as indicated in Hardware Schedule in PART 3 of this Specification
  - 52 Section.
- 53 D. Door Closers:
  - 54 1. ANSI/BHMA A156.4, Grade 1.
  - 55 2. Size door closers to comply with ANSI recommendations for door size and location.
  - 56 3. Fabricate all closers with integral back check.
  - 57 4. Provide integral stop unless noted otherwise.
    - 58 a. Do not provide integral stop at closers indicated to be installed on pull side of door.
    - 59 b. Provide all weather fluid for all closers.



- 1 5. Full cover.
- 2 a. Manufacturer's standard plastic cover.
- 3 6. Arms, brackets, and plates: As required for complete installation.
- 4 7. Closers:
- 5 a. Standard closer:
- 6 1) LCN 4040 Series.
- 7 2) Norton 7500 Series.
- 8 3) Corbin-Russwin DC6200 Series.
- 9 b. Corrosion resistant closer: Norton 7500 SS Series.
- 10 8. Provide manufacturer's standard 10 year warranty.
- 11 A. Hinges:
- 12 1. Butt hinges:
- 13 a. ANSI/BHMA A156.1.
- 14 1) A5111: Stainless steel, full-mortise, anti-friction bearing, Grade 1.
- 15 b. Ball bearing.
- 16 c. Flat button tips.
- 17 1) Provide non-removable pin (NRP) at:
- 18 a) Exterior doors.
- 19 b) Reverse handed doors equipped with locks.
- 20 d. Butt hinges:
- 21 1) Hager BB1199.
- 22 2) McKinney T4B3386.
- 23 e. Transfer hinge:
- 24 1) Hager BB1199ETW.
- 25 2) McKinney T4B3386CC.
- 26 f. Hinge size:
- 27 1) Doors up to and including 46 IN wide: 4.5 IN x 4.5 IN.
- 28 2) Doors over 46 IN up to and including 60 IN wide: 5 IN high x 4.5 IN.
- 29 g. Quantities:
- 30 1) Door height 61-90 IN: Three (3).
- 31 2) Door height 91-114 IN: Four (4).
- 32 h. Provide transfer hinge as necessary where electrified lockset or exit device is specified.
- 33 B. Overhead Door Holders/Stop:
- 34 1. ANSI/BHMA A156.8.
- 35 2. Provide 'hold-open' function on all stops unless noted otherwise.
- 36 3. Surface mounted stops: Rockwood N14400 Series or Glynn Johnson 90 Series.
- 37 4. Concealed stops: Rockwood N11000 Series or Glynn Johnson 100 Series.
- 38 C. Kickplates:
- 39 1. ANSI/BHMA A156.6.
- 40 2. 8 IN high x 2 IN less than door width.
- 41 3. Beveled on all edges.
- 42 4. Thickness:
- 43 a. Stainless steel: 0.050 IN.
- 44 b. FRP: 0.125 IN.
- 45 D. Thresholds:
- 46 1. Aluminum.
- 47 2. ANSI/BHMA A156.21.
- 48 3. Thermally broken unit.
- 49 4. Height: 1/2 IN high maximum.
- 50 5. Width: 4 IN.
- 51 6. Provide cutouts where necessary to accommodate exit devices or bolts.
- 52 E. Exit Devices:
- 53 1. ANSI/BHMA A156.3, Grade 1.
- 54 2. Trim Style: #17 Lever.
- 55 3. Type and function as indicated in Hardware Schedule in PART 3 of this Specification
- 56 Section.
- 57 a. Provide Power Supply, Electrified Trim, Electric Latch Retraction, Request to Exit or
- 58 other options as necessary to coordinate with Electric Door Assisting Device and Access
- 59 Control System.

- 1 F. Weatherstripping: See Specification Section 08120.
- 2 G. Silencers:
- 3 1. FRP frames: Trimco 1229A or Rockwood 608.
- 4 2. Self-adhesive silencers are not acceptable.
- 5 H. Keying:
- 6 1. Establish keying with Owner.
- 7 a. Coordinate with existing facility keying system.
- 8 b. Tag and identify keys.
- 9 c. Provide two (2) keys for each lock or cylinder.
- 10 d. Master key and key in groups as directed.
- 11 e. Provide construction master keys for all exterior doors.
- 12 I. Bolts:
- 13 1. ANSI/BHMAA 156.16.
- 14 2. Rockwood 580 Series with strike.
- 15 a. Top bolt: 8 IN length.
- 16 b. Bottom bolt: 18 IN length.

## 17 **PART 3 - EXECUTION**

### 18 **3.1 INSTALLATION**

- 19 A. Install products in accordance with manufacturer's installation instructions, supervised or
- 20 inspected by an AHC or EHC as appropriate.
- 21 B. Provide all hardware in accordance with Building Code.
- 22 C. Use SDI mounting heights for hardware.
- 23 D. Closers:
- 24 1. Mount closers on push side of doors unless noted otherwise.
- 25 2. Mount closers on pull side of the door at doors
- 26 a. FP-002D.
- 27 b. FP-002-F.
- 28 c. FC-102A.
- 29 E. Overhead Stops:
- 30 1. Provide overhead stop when corrosion resistant closer is specified.
- 31 2. Provide at interior doors not scheduled to receive a closer as follows:
- 32 a. Doors that swing more than 105 degrees without encountering a wall or obstruction.
- 33 1) Stop shall limit swing of door from impacting wall or obstruction.
- 34 b. Inactive leafs of pairs of doors.
- 35 F. Provide silencers for door frames.
- 36 1. FRP frames: See Specification Section 08220.
- 37 G. Provide door sweep and threshold at all exterior doors.
- 38 1. Set thresholds in a full bed of sealant.
- 39 2. Mount door sweeps on exterior face of door.
- 40 H. Mount kickplates on push side of doors.
- 41 1. Provide FRP kickplates on FRP doors.
- 42 2. Provide stainless steel kickplates on aluminum doors.
- 43 I. Electric Door Assisting Device (Door Operator):
- 44 1. Install electric door assisting device in accordance with manufacturer's installation
- 45 instructions.
- 46 2. Provide sheet metal header enclosure to match door operator.
- 47 3. Conceal all conduit serving the overhead operator and remote push button activation
- 48 devices.
- 49 4. Coordinate power supply requirements with Division 16.
- 50 5. Coordinate door controls with access control system.

1 **3.2 FIELD QUALITY CONTROL**

- 2 A. Adjust and check each operating item of hardware to assure proper operation or function.  
3 1. Lubricate moving parts with lubricant recommended by manufacturer.
- 4 B. During week prior to startup, make a final check and adjustment of all hardware items.  
5 1. Clean and lubricate as necessary to assure proper function and operation.  
6 2. Adjust door control devices to compensate for operation of heating and ventilating  
7 equipment.
- 8 C. Inspection and Testing:  
9 1. AHC or EHC, as appropriate, shall inspect and test all door assemblies and provide written  
10 certification that door assemblies are in proper working order.  
11 a. Door assemblies required to swing in the direction of egress shall be inspected and  
12 tested in accordance with NFPA 101.  
13 2. Submit documentation and certification of testing in accordance with the certifications  
14 paragraph in the SUBMITTALS Article in PART 1 of this Specification Section.

15 **3.3 SCHEDULES**

- 16 A. Hardware Function:  
17 1. Provide as indicated in following table in accordance with.  
18 1) All electric lock hardware to be 24 Vdc.  
19 2. Mortise Locksets: ANSI/BHMA A156.13.  
20

ANSI Function	Description
F01	Passage
F07	Storeroom

- 21  
22 3. Exit Devices: ANSI/BHMA A156.3.  
23

ANSI Function	Description
02	Exit Only
03	Night Latch
14	Passage

- 24  
25 B. Hardware Schedule:  
26 HW-1: Butt Hinges  
27 Lockset F07  
28 Surface Bolts top and bottom of inactive leaf.  
29 2 Kickplates  
30 2 Closers  
31  
32 HW-2:  
33 Butt Hinges  
34 Latchset F01  
35 Kickplate  
36 Closer  
37  
38 HW-3:  
39 Butt Hinges  
40 Latchset F01  
41 Surface Bolts top and bottom of inactive leaf.  
42 2 Overhead Stops  
43  
44 HW-4:  
45 Butt Hinges  
46 Latchset F01  
47 Overhead Stop  
48

1 HW-5:  
2 Butt Hinges  
3 Mortise Exit Device Function 14  
4 Closer  
5 Kickplate  
6  
7 HW-6:  
8 Butt Hinges  
9 Transfer Hinge  
10 Mortise Exit Device Function 03 with Electrified Trim  
11 Closer  
12 Kickplate  
13  
14 HW-7:  
15 Butt Hinges  
16 Transfer Hinge  
17 Mortise Exit Device Function 03 with Electrified Trim (Active Leaf)  
18 Surface Vertical Rod Exit Device – 02 (Inactive Leaf)  
19 Closer (Active Leaf)  
20 Overhead Stop (Inactive Leaf)  
21 2 Kickplates  
22  
23 HW-8:  
24 Butt Hinges  
25 Transfer Hinge  
26 Mortise Exit Device Function 14 with Electric Latch Retraction (Active Leaf)  
27 Concealed Vertical Rod Exit Device Function 02 with Dummy Trim (Inactive Leaf)  
28 Electric Door Assisting Device (Active Leaf)  
29 Closer (Inactive Leaf)  
30 2 Kickplates  
31  
32 HW-9:  
33 Butt Hinges  
34 Transfer Hinge  
35 Mortise Exit Device Function 03 with Electric Latch Retraction (Active Leaf)  
36 Concealed Vertical Rod Exit Device Function 02 with Dummy Trim (Inactive Leaf)  
37 Electric Door Assisting Device (Active Leaf)  
38 Closer (Inactive Leaf)  
39 2 Kickplates

40

**END OF SECTION**

1 2014/09/08

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3

**SECTION 08800**  
**GLASS AND GLAZING**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6

A. Section Includes: Glass and glazing.

7

B. Related Specification Sections include but are not necessarily limited to:

8

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

9

2. Division 01 - General Requirements.

10

3. Section 07900 - Joint Sealants.

11

4. Section 08120 - Aluminum Doors and Frames.

12

5. Section 08220 - Fiberglass Reinforced Plastic (FRP) Doors and Frames.

13

6. Section 08900 - Curtainwall System.

14

**1.2 QUALITY ASSURANCE**

15

A. Referenced Standards:

16

1. American National Standards Institute (ANSI):

17

a. Z97.1, Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

18

2. ASTM International (ASTM):

19

a. C1036, Standard Specification for Flat Glass.

20

b. C1048, Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.

21

c. E2190, Standard Specification for Insulating Glass Unit Performance and Evaluation.

22

3. Code of Federal Regulations (CFR):

23

a. Title 16 - Commercial Practices, Chapter ii - Consumer Product Safety Commission (CPSC), Subchapter B - Consumer Product Safety Act Regulations:

24

1) 16 CFR 1201, Safety Standard for Architectural Glazing Materials.

25

4. Glass Association of North America (GANA):

26

a. Glazing Manual.

27

5. Insulating Glass Certification Council (IGCC).

28

6. Insulating Glass Manufacturers Alliance (IGMA):

29

a. TM-3000, North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use.

30

7. Building Code:

31

a. International Code Council (ICC):

32

1) International Building Code and associated standards, 2006 Edition including all amendments, referred to herein as Building Code.

33

34

**1.3 DEFINITIONS**

35

A. Installer or Applicator:

36

1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.

37

2. Installer and applicator are synonymous.

38

B. Safety Glazing: Glazing meeting the requirements of the Building Code and CPSC 16 CFR 1201.

39

C. Other terms as identified in CPSC 16 CFR 1201.

40

41

**1.4 SUBMITTALS**

42

A. Shop Drawings:

43

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

44

- 1 2. Product technical data including:
- 2 a. Acknowledgement that products submitted meet requirements of standards referenced.
- 3 b. Manufacturer's installation instructions.
- 4 3. Certification that insulated glass units meet requirements of IGCC and are certified by IGCC
- 5 to ASTM E2190.
- 6 B. Samples:
- 7 1. 12 x 12 IN sample of each type, color, and thickness specified units.

## 8 **1.5 WARRANTY**

- 9 A. Insulating Glass Units:
- 10 1. Warrant glass units from failure of insulating glass seal resulting in fogging or moisture
- 11 accumulation on internal glass surfaces.
- 12 2. Period: Minimum 10 years from date of acceptance.

## 13 **PART 2 - PRODUCTS**

### 14 **2.1 ACCEPTABLE MANUFACTURERS**

- 15 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 16 1. Oldcastle BE.
- 17 2. Pilkington.
- 18 3. PPG.
- 19 4. Viracon.
- 20 5. Visteon.
- 21 B. Submit request for substitution in accordance with Specification Section 01640.

### 22 **2.2 MATERIALS**

- 23 A. Float Glass:
- 24 1. ASTM C1036.
- 25 a. Clear glass: Type I, Class 1, Quality Q3.
- 26 b. Tinted glass: Type I, Class 2, Quality Q3.
- 27 2. Thickness: 1/4 IN.
- 28 B. Tempered Float Glass:
- 29 1. ANSI Z97.1.
- 30 2. ASTM C1036.
- 31 a. Clear glass: Type I, Class 1, Quality Q3.
- 32 b. Tinted glass: Type I, Class 2, Quality Q3.
- 33 3. ASTM C1048.
- 34 a. Clear glass: Kind FT, Condition A.
- 35 b. Tinted Glass: Kind FT, Condition A.
- 36 4. Thickness:
- 37 a. Overhead door glazing: 1/8 IN.
- 38 b. All other uses: 1/4 IN.

### 39 **2.3 MANUFACTURED UNITS**

- 40 A. General:
- 41 1. Insulating glass units: ASTM E2190.
- 42 a. Air space: Hermetically sealed and dehydrated.
- 43 b. Stainless steel "warm-edge" spacer.
- 44 B. Insulating Glass Units:
- 45 1. 1 IN units:
- 46 a. Two (2) sheets of 1/4 IN thick clear glass.
- 47 b. Air space: 1/2 IN.

- 1 C. Insulated Low Emissivity Glass Units:
- 2 1. Viracon "VRE26-65".
- 3 2. 1 IN units:
- 4 a. Two (2) sheets of 1/4 IN thick glass.
- 5 1) Outside lite: VRE26 Solarblue with Low-E coating on #2 surface.
- 6 2) Air space: 1/2 IN.
- 7 3) Inside lite: Clear.
- 8 b. Performance:
- 9 1) Visible light transmittance: 37 percent.
- 10 2) Visible light reflectance outside: 14 percent.
- 11 3) Solar energy transmittance: 20 percent.
- 12 4) U value:
- 13 a) Winter: 0.30.
- 14 b) Summer: 0.27.
- 15 5) Shading coefficient: 0.31.
- 16 6) Solar Heat Gain Coefficient: 0.27.
- 17 7) Relative heat gain: 66.
- 18 3. 1/2 IN units:
- 19 a. Two (2) sheets of 1/8 IN thick glass.
- 20 1) Outside lite: VRE26 Solarblue with Low-E coating on #2 surface.
- 21 2) Air space: 1/4 minimum, 3/8 IN maximum.
- 22 3) Inside lite: Clear.
- 23 D. Insulated Low E Translucent Glass Units:
- 24 1. Viracon "VRE26-V1086".
- 25 2. 1 IN units:
- 26 a. Two (2) sheets of 1/4 IN thick glass.
- 27 1) Outside lite: VRE26 Solarblue with Low-E coating on #2 surface.
- 28 2) Air space: 1/2 IN.
- 29 3) Inside lite: Clear with V1086 Simulated Sandblast ceramic frit on #3 surface.
- 30 3. 1/2 IN units:
- 31 a. Two (2) sheets of 1/8 IN thick glass.
- 32 1) Outside lite: VRE26 Solarblue with Low-E coating on #2 surface.
- 33 2) Air space: 1/4 minimum, 3/8 IN maximum.
- 34 3) Inside lite: Clear with V1086 Simulated Sandblast ceramic frit on #3 surface.
- 35 E. Insulated Spandrel Glass:
- 36 1. Viracon "V26-V911".
- 37 2. 1 IN units:
- 38 a. Two (2) sheets of 1/4 IN thick glass.
- 39 1) Outside lite: V26 Solarblue.
- 40 2) Air space: 1/2 IN.
- 41 3) Inside lite: Clear with V911 ceramic frit on #4 surface.

## 42 2.4 ACCESSORIES

- 43 A. Glazing Compounds:
- 44 1. Non-sag, non-stain type.
- 45 2. Pigmented to match frame units not requiring painting.
- 46 3. Compatible with adjacent surfaces.
- 47 4. One- or two-part polyurethane or silicone sealant for use in setting glass.
- 48 a. Provide glazing compounds which will not be affected by chemicals stored in rooms
- 49 where glazing compounds are used.
- 50 B. Sealant Tape: Butyl rubber sealant tape or ribbon having a continuous neoprene shim.
- 51 C. Gaskets:
- 52 1. Flexible polyvinyl chloride or neoprene.
- 53 a. Provide gaskets which will not be affected by chemicals stored in rooms where gaskets
- 54 are used.
- 55 2. Extruded of profile and hardness required to receive glass and provide a watertight
- 56 installation.

- 1 D. Setting Blocks and Spacers:
- 2 1. Neoprene or EPDM, compatible with sealants used.
- 3 2. Setting blocks: 70-90 durometer.
- 4 3. Spacers: 40-50 durometer.
- 5 E. Compressible Filler Stock: Closed-cell jacketed rod stock of synthetic rubber or plastic foam.
- 6 F. Shims, Clips, Springs, Angles, Beads, Attachment Screws and Other Miscellaneous Items: As
- 7 required by condition.

## 8 **PART 3 - EXECUTION**

### 9 **3.1 INSTALLATION**

- 10 A. Provide safety glazing in all locations where required by the Building Code and CPSC 16 CFR
- 11 1201.
- 12 B. Install in accordance with recommendations of manufacturer, GANA Glazing Manual and IGMA
- 13 TM-3000.
- 14 C. Install setting blocks in adhesive or sealant.
- 15 D. Install spacers inside and out, of proper size and spacing, for all glass sizes larger than 50 united
- 16 inches, except where gaskets are used for glazing.
- 17 E. Provide 1/8 IN minimum bite of spacers on glass.
- 18 F. Spacer thickness to equal sealant width.
- 19 G. Prevent sealant exudation from glazing channels of insulating glass which is more than 1/2 IN
- 20 thick; colored, heat absorbing, coated or laminated glass sizes larger than 75 united inches; and
- 21 other glass more than 9/32 IN thick or larger than 125 united inches.
- 22 1. Leave void at heel (or install filler) at jambs and head.
- 23 2. Do not leave void (or install filler) at sill.
- 24 H. Miter cut and bond gasket ends together at corners.
- 25 I. Immediately after installation, attach crossed streamers to framing held away from glass.
- 26 J. See Specification Section 07900 for sealants.

### 27 **3.2 FIELD QUALITY CONTROL**

- 28 A. Do not install glass with edge damage.
- 29 B. Do not apply anything to surfaces of glass.
- 30 C. Remove and replace damaged glass.

### 31 **3.3 CLEANING**

- 32 A. Maintain glass reasonably clean during construction, so that it will not be damaged by corrosive
- 33 action and will not contribute to deterioration of other materials.
- 34 B. Wash and polish glass on both faces not more than seven (7) days prior to acceptance of work in
- 35 each area.
- 36 1. Comply with glass manufacturer's recommendations.

### 37 **3.4 SCHEDULES**

- 38 A. Glass Type 1: Clear Monolithic Glass.
- 39 B. Glass Type 2: 1 IN Insulated Glass Units.
- 40 C. Glass Type 3: 1 IN Insulated Low E Glass Units.
- 41 D. Glass Type 4: 1 IN Insulated Low E Translucent Glass Units.
- 42 E. Glass Type 5: 1 IN Insulated Spandrel Glass Units.



- 1 F. Glass Type 6: 1/2 IN Insulated Low E Glass Units.
- 2 G. Glass Type 7: 1/2 IN Insulated Low E Translucent Glass Units.

**END OF SECTION**

- 3
- 4



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**SECTION 08900**  
**CURTAINWALL SYSTEM**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6

A. Section Includes:

7

1. Curtainwall system.

8

a. Outside, structural silicone glazed (SSG) system.

9

2. Entrance door(s) and hardware.

10

3. Coordination with access control system.

11

4. Electric door assisting device.

12

5. Sun shades.

13

B. Related Specification Sections include but are not necessarily limited to:

14

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

15

2. Division 01 - General Requirements.

16

3. Section 07600 - Flashing and Sheet Metal.

17

4. Section 07900 - Joint Sealants.

18

5. Section 08700 - Finish Hardware.

19

6. Section 08800 - Glass and Glazing.

20

7. Division 16 - Electrical.

21

**1.2 QUALITY ASSURANCE**

22

A. Referenced Standards:

23

1. Aluminum Association (AA):

24

a. DAF 45, Designation System for Aluminum Finishes.

25

2. American Architectural Manufacturers Association (AAMA):

26

a. AG, AAMA Glossary.

27

b. 1503, Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors, and Glazed Wall Sections.

28

3. Americans with Disabilities Act (ADA):

29

a. Accessibility Guidelines for Buildings and Facilities (ADAAG).

30

4. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA):

31

a. A156.19, Power Assist and Low Energy Power Operated Doors.

32

5. American Society of Civil Engineers (ASCE):

33

a. 7, Minimum Design Loads for Buildings and Other Structures.

34

6. ASTM International (ASTM):

35

a. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

36

b. C1363, Standard Test Method for the Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.

37

c. E283, Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

38

d. E330, Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

39

e. E331, Standard Test Method for Water Penetration of Exterior Windows, Doors, Skylights, and Curtain Walls by Uniform Static Air Pressure Difference.

40

41

7. American Welding Society (AWS):

42

a. D1.2, Structural Welding Code - Aluminum.

43

8. Building Code:

44

a. International Code Council (ICC):

45

1) International Building Code and associated standards, 2006 Edition including all amendments, referred to herein as Building Code.

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- 1 B. Qualifications:
- 2 1. Curtainwall system:
- 3 a. Curtainwall manufacturer shall have minimum of 10 years experience in the design and
- 4 production of curtainwall systems similar to system specified.
- 5 1) All structural components of the system shall be designed and sealed by a
- 6 Registered Professional Civil or Structural Engineer licensed in the State of
- 7 Nebraska.
- 8 b. Installing contractor shall be licensed or approved in writing by the curtainwall
- 9 manufacturer.
- 10 c. Installing contractor shall have a minimum of five (5) years experience installing systems
- 11 similar to system specified.
- 12 d. Installing contractor and installers shall have successfully completed two (2) projects of
- 13 similar size, scope and complexity within the past year.
- 14 2. Qualify welders and welding process in accordance with AWS D1.2.
- 15 3. Independent laboratory shall have minimum 10 years experience in performing tests
- 16 specified.
- 17 a. All testing shall be done by personnel having minimum five (5) years experience in
- 18 performing tests specified.

### 19 1.3 DEFINITIONS

- 20 A. Industry standard terminology and definitions refer to AAMA Glossary (AAMA AG).
- 21 B. Installer or Applicator:
- 22 1. Installer or applicator is the person actually installing or applying the product in the field at the
- 23 Project site.
- 24 2. Installer and applicator are synonymous.
- 25 C. All weather: Capable of operation from -50 to +120 DegF.

### 26 1.4 SUBMITTALS

- 27 A. Shop Drawings:
- 28 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 29 the submittal process.
- 30 2. Fabrication and/or layout Drawings:
- 31 a. Manufacturer prepared computer generated Drawings showing movement type joints,
- 32 anchorage, flashing, jointing and all other accessories required, and any special
- 33 detailing required by the system.
- 34 b. Provide complete erection Drawings.
- 35 1) Show:
- 36 a) References to all details and sections.
- 37 b) All expansion joints.
- 38 c) Size of all glazing panels and steel reinforcements.
- 39 d) All glass thicknesses.
- 40 e) Finish.
- 41 f) All unusual framing conditions that will require frame sightlines in excess of
- 42 sightlines specified or detailed.
- 43 2) Minimum plan scale: 1/8 IN = 8 FT.
- 44 3) Minimum detail scale: 1-1/2 IN = 1 FT.
- 45 c. Provide distinction, properly identified, between factory fabricated/assembled
- 46 components and field fabricated/assembled components.
- 47 3. Product technical data for framing system, doors and major accessories.
- 48 a. Acknowledgement that products submitted meet requirements of standards referenced.
- 49 b. Manufacturer's installation instructions.
- 50 c. Technical data sheets for and all system components.
- 51 d. Elevation drawings indicating all frame, window and door dimensions and details.
- 52 4. Informational Submittals:
- 53 a. Structural Engineer's sealed and signed calculations certifying that the system structural
- 54 components meet the requirements for lateral, and all other, loads required by the
- 55 Building Code.
- 56 b. Complete wiring layout/diagrams for electric door assisting device.
- 57 c. Test results:
- 58 1) ASTM E283 test results for air infiltration.

- 1                                   2) ASTM E331 test results for water resistance.
- 2                                   3) ASTM E330 test results for uniform load structural test.
- 3                                   4) AAMA 1503 test results for thermal tests.
- 4                                   d. ASTM C1363 and AAMA 1503 test results for condensation resistance factor.
- 5                                   5. Qualifications:
- 6                                   a. Manufacturer:
- 7                                   1) Certification of design and production experience.
- 8                                   2) Certification of and experience qualifications of Structural Engineer.
- 9                                   b. Installing Contractor:
- 10                                  1) Certification of approval or license to install product from manufacturer.
- 11                                  2) Certificate of experience.
- 12                                  3) Listing of projects completed in past five (5) years.
- 13                                    a) Completed projects information to include square footage of curtainwall
- 14                                    installed, cost of curtainwall, manufacturer and system, and contact name and
- 15                                    telephone number.
- 16                                  c. Installers:
- 17                                  1) Provide qualifications for all personnel expected to be working on this Project.
- 18                                  2) Provide qualifications when someone new is brought onto Project after Project start.
- 19                                  6. Warranty: Sample language of manufacturer's warranty to be provided on this Project.
- 20                                  B. Samples:
- 21                                    1. General: Tag, identify and provide statement regarding use for all fasteners, anchor clips,
- 22                                    closures and sealants.
- 23                                    2. Metal samples showing specified anodized finishes.
- 24                                    a. Fabrication Sample of each vertical-to-horizontal intersection of aluminum-framed
- 25                                    curtain wall systems, made from 12 IN (300 mm) lengths of full-size components and
- 26                                    showing details of the following:
- 27                                    1) Joinery.
- 28                                    2) Glazing.
- 29                                    b. Provide minimum three (3) 2 x 3 IN aluminum samples of finish specified.
- 30                                  C. Operation and Maintenance Manuals:
- 31                                    1. See Specification Section 01340 for requirements for:
- 32                                    a. The mechanics and administration of the submittal process.
- 33                                    b. The content of Operation and Maintenance Manuals.
- 34                                  D. Miscellaneous Submittals:
- 35                                    1. See Specification Section 01340 for requirements for the mechanics and administration of
- 36                                    the submittal process.

37 **1.5 DELIVERY, STORAGE, AND HANDLING**

- 38                                  A. Store units in vertical position off ground with wood spacers between each unit.
- 39                                    1. Store in accordance with manufacturer's recommendations.

40 **PART 2 - PRODUCTS**

41 **2.1 ACCEPTABLE MANUFACTURERS**

- 42                                  A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 43                                    1. Curtainwall system:
- 44                                    a. Kawneer Co., Inc.
- 45                                    b. Oldcastle Building Envelope.
- 46                                    c. United States Aluminum.
- 47                                    d. YKK-AP America.
- 48                                    e. Wausau Windows and Wall Systems.
- 49                                    2. Electric door assisting device: See Specification Section 08700.
- 50                                  B. Submit request for substitution in accordance with Specification Section 01640.

51 **2.2 MATERIALS**

- 52                                  A. Aluminum:
- 53                                    1. Extrusions: ASTM B221, 6063-T6 alloy.

- 1           2. Sheet: ASTM B209.
- 2           B. Plated Steel:
- 3           1. Nickel/chrome plate: ASTM B456, SC3.
- 4           C. Fasteners:
- 5           1. Aluminum:
- 6           2. Stainless steel: 300 series.
- 7           3. Steel: Zinc coated.
- 8           a. ASTM B633, SC3.
- 9           D. Structural Thermal Barrier: Extruded copolymer.
- 10          1. ASTM E2692.
- 11          E. Sealants: As recommended by manufacturer for joint type.

## 12   **2.3 PERFORMANCE AND DESIGN REQUIREMENTS**

- 13          A. Structural Criteria:
- 14           1. Design curtainwall system for components and cladding wind loads as specified in the
- 15            Building Code using Section 6 (Method 2) of ASCE 7.
- 16           a. See Structural Drawings for wind velocity and required design coefficients.
- 17           b. Topographic factor ( $K_{ZT}$ ): 1.00.

## 18   **2.4 COMPONENTS**

- 19          A. Curtainwall System:
- 20           1. Sight line: Minimum 2-1/2 IN and maximum of 3-1/2 IN.
- 21           2. Depth of framing members: 7-1/2 IN nominal.
- 22           3. Pressure plate: Aluminum.
- 23           4. Reinforcing: Aluminum, stainless steel or plated steel.
- 24           5. Complete extruded aluminum framing system and glazing including sills, mullions, division
- 25            bars, anchors and accessories.
- 26           a. Provide insulating material to achieve thermal separation of interior and exterior
- 27            components.
- 28           b. Use no through metal connectors.
- 29           6. System to receive 1 IN insulating glass units.
- 30           a. See Specification Section 08800.
- 31           7. Provide complete system under single responsibility.
- 32           8. Kawneer "1600 UT System 2".
- 33          B. Entrance Doors:
- 34           1. Aluminum.
- 35           a. Extrusion wall thickness: Minimum 0.187 IN.
- 36           2. Stiles: 3-1/2 IN minimum.
- 37           3. Top rail: 3-1/2 IN minimum.
- 38           4. Cross rail: 6 IN.
- 39           5. Bottom Rail: 10 IN.
- 40           6. Single acting operation.
- 41           7. Kawneer "Series 350 Heavy Wall".
- 42           a. Prepare and reinforce door for hardware specified in Specification Section 08700.
- 43          C. Finishes:
- 44           1. Architectural Class 1 coating per AA DAF 45.
- 45           a. Anodized: Dark Bronze: AA-M12C22A42 or A44.

## 46   **2.5 ACCESSORIES**

- 47          A. Flashings:
- 48           1. Minimum 0.040 IN aluminum.
- 49           2. Finish to match aluminum frame color if exposed.
- 50           3. Mill finish if concealed.
- 51          B. Coping: See Specification Section 07600.

- 1 C. Sun Shades:  
2 1. General:  
3 a. Designed for seamless integration with curtainwall system.  
4 b. Tested for combined wind, snow and dead loads as specified herein.  
5 c. Thermally broken attachment.  
6 d. Finish to match curtainwall system.  
7 2. Outrigger style:  
8 a. Outrigger:  
9 1) Square.  
10 2) 36 IN deep.  
11 b. Fascia: Rectangular.  
12 c. Blade: Arch.  
13 d. Kawneer "Versoleil SunShade Outrigger System".  
14 1) Provide factory fabricated inside and outside corner units.  
15 3. Single-blade style:  
16 a. Horizontal blade:  
17 1) Profile: Airfoil.  
18 2) Depth: 6 IN.  
19 b. Adjustable bracket.  
20 c. Provide end caps for exposed ends.  
21 d. Kawneer "Versoleil SunShade Single Blade System".  
22 D. Fasteners:  
23 1. Finish exposed fasteners to match finish of system.  
24 2. Provide Phillips flat head screws where exposed.

## 25 2.6 FABRICATION

- 26 A. General:  
27 1. Fully degrease and clean members prior to assembly or application of sealing compound or  
28 protective coatings.  
29 2. Weld using methods recommended by manufacturer and AWS to avoid discoloration.  
30 3. Grind exposed welds smooth and restore finish.  
31 4. Ease corners of cut edges to a radius of approximately 1/64 IN.  
32 5. Conceal fasteners wherever possible.  
33 6. Fit and assemble work at shop to maximum extent possible.  
34 7. Maintain true continuity of line and accurate relation of planes and angles.  
35 8. Provide secure attachment and support at mechanical joints, with hairline fit of contacting  
36 members.  
37 9. Reinforce work as necessary to withstand wind loadings and to support system.  
38 10. Separate dissimilar metals with bituminous paint or preformed separators to prevent  
39 corrosion.  
40 11. Separate metal surfaces at moving joints with plastic inserts or other nonabrasive concealed  
41 inserts to permanently prevent freeze-up of joint.  
42 12. Prepare and reinforce frames for hardware.

## 43 2.7 SOURCE QUALITY CONTROL

- 44 A. General Performance: Comply with performance requirements specified, as determined by  
45 testing of glazed aluminum curtain walls representing those indicated for this Project without  
46 failure due to defective manufacture, fabrication, installation, or other defects in construction.  
47 B. Glazed aluminum curtain walls shall withstand movements of supporting structure including, but  
48 not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly  
49 distributed and concentrated live loads. Failure also includes the following:  
50 1. Thermal stresses transferring to building structure.  
51 2. Glass breakage.  
52 3. Loosening or weakening of fasteners, attachments, and other components.  
53 4. Failure of operating units.  
54 C. Testing Requirements:  
55 1. Utilize independent testing laboratories specifically qualified to conduct all performance test  
56 required.

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2. Performance tests may be conducted in manufacturer's laboratories provided they are witnessed and certified by qualified independent testing laboratory personnel.
  3. Perform all tests on "Test Unit":
    - a. Full sized unit for Project or a minimum two-story high, 6 FT wide unit mounted in test chamber in exact accordance with Project conditions including anchorage system, calking, sealing, etc.
    - b. Unit for test to be completely assembled glazed unit.
    - c. Thermal tests may be conducted on 4 x 6 FT unit.
  4. Test air infiltration first, water resistance second.
    - a. Other tests may be in any order.
- D. Air Infiltration Test (Curtainwall Framing):
1. Test in accordance with ASTM E283.
  2. Air infiltration: 0.06 CFM/MIN/SF of wall area when tested at 6.24 psf pressure differential.
- E. Water Resistance Test:
1. Static Pressure: Test in accordance with ASTM E331.
    - a. No uncontrolled leakage allowed at 15 psf pressure differential at a rate of 5 GAL/HR/SF.
  2. Dynamic Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to AAMA 501.1 at dynamic pressure equal to 15psf.
    - a. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation.
      - 1) Water leakage does not include water controlled by flashing and gutters that is drained to exterior.
- F. Uniform Load Structural Test:
1. Subject unit to load equal to 150 percent of design wind load.
  2. Test in accordance with ASTM E330.
  3. No failure or permanent deformation of structural members allowed.
- G. Thermal Tests:
1. Perform all thermal tests on unit sized as required to produce representative areas of framing, vision glass, translucent glass and spandrel glass.
  2. Provide test unit which reflects most restrictive situation on Project (i.e., worst framing, glass, spandrel proportions for producing desired thermal results).
  3. Submit elevations indicating which areas were selected from Project along with calculations verifying that test areas are in fact proportional to area selected.
  4. The glazed wall system shall be capable of withstanding expansion and contraction of components caused by ambient air temperature range from -10 to +120 DegF without buckling, stress on glass, edge seal failure, excess stress on curtainwall structure anchors and fasteners or reduction in performance.
    - a. Test in accordance with AAMA 1503.
- H. Energy Performance: Glazed aluminum curtain walls shall be tested in accordance with NFRC and AAMA Standards.
- I. Condensation Resistance: AAMA 1503:
1. Minimum condensation resistance factor (CRF):
    - a. CRF<sub>glass</sub> (clear) = 60.
    - b. CRF<sub>frame</sub> = 66.
- J. Sound Transmission: Provide glazed aluminum curtain walls with fixed glazing and framing areas having the following sound-transmission characteristics:
1. ASTM E 90 and ASTM E 1425:
    - a. STC-31 or OITC-25.
      - 1) Based on 1 IN insulating glass (1/4 IN, 1/2 IN AS, 1/4 IN).



1 **PART 3 - EXECUTION**

2 **3.1 INSTALLATION**

- 3 A. Verify suitability of substrate to accept installation.
- 4 1. Correct defects.
- 5 B. Install products in accordance with manufacturer's instructions.
- 6 C. Set units plumb, level and true to line.
- 7 D. Anchor securely in place.
- 8 E. Separate metal surfaces from sources of corrosion of electrolytic action.
- 9 F. Set sill and base members in a bed of sealant.
- 10 G. Provide joint fillers or gaskets for weathertight construction.
- 11 H. Seal all joints within and at perimeter of system.
- 12 I. Install flashing where shown on Drawings and/or where required.

13 **3.2 CLEANING**

- 14 A. Clean all surfaces promptly after installation.
- 15 B. Exercise care to avoid damage to finish, surrounding structure, fastenings, etc., and to protective
- 16 coating, if any.
- 17 C. Remove excess glazing and sealant compounds and dirt and leave clean.
- 18 D. Protect work and take other precautions required to ensure that work will be without damage at
- 19 time of acceptance.

20 **END OF SECTION**

21





DIVISION 09  
FINISHES





1 2014/09/05

2

3

**SECTION 09721**  
**EPOXY FLOORING SYSTEMS**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6

A. Section Includes:

7

1. Surface preparation of substrate.

8

2. Epoxy flooring system.

9

B. Related Sections include but are not necessarily limited to:

10

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

11

2. Division 01 - General Requirements.

12

3. Division 03 - Concrete.

13

**1.2 QUALITY ASSURANCE**

14

A. Referenced Standards:

15

1. ASTM International (ASTM):

16

a. C307, Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing.

17

b. D2240, Standard Test Method for Rubber Property—Durometer Hardness.

18

c. D4060, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abrader.

19

d. D4258, Standard Practice for Surface Cleaning Concrete for Coating.

20

e. D4259, Standard Practice for Abrading Concrete.

21

f. D4261, Standard Practice for Surface Cleaning Concrete Unit Masonry for Coating.

22

g. D4262, Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.

23

h. D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.

24

i. D4414, Standard Practice for Measurement of Wet Film Thickness by Notch Gages.

25

j. D6132, Standard Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Using an Ultrasonic Gage.

26

k. D7234, Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.

27

l. E337, Standard Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures).

28

m. F1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

29

n. F2170, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

30

2. International Concrete Repair Institute (ICRI):

31

a. 310.2, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.

32

3. The Society for Protective Coatings/NACE International (SSPC/NACE):

33

a. SP 13/NACE No. 6, Surface Preparation of Concrete.

34

44 B. Qualifications:

45

1. Applicator shall be licensed or approved, in writing, by manufacturer.

46

2. Applicator to have minimum of five (5) years experience installing epoxy systems similar to those specified herein.

47

3. Subject to compliance with requirements, only the following Special Coatings System Installers are acceptable:

48

a. McGill Restoration, Omaha, NE.

49

b. Surface Sealers, Lincoln, NE.

50

c. W.S. Bunch Co., Omaha, NE.

51

53 C. Single-Source Responsibility:

54

1. Provide complete system produced by a single manufacturer.

- 1 2. Thinners and solvents shall be approved in writing by the manufacturer.  
2 a. Do not exceed manufacturer's recommended limits for thinner.
- 3 D. Mock-Ups:  
4 1. Construct sample floor and wall areas minimum 4 FT by 4 FT by 4 FT high.  
5 a. Sample areas shall be constructed using same substrate condition as exists for areas  
6 where flooring material is to be installed.  
7 1) For concrete substrate, provide minimum 3 IN thick slab with welded wire  
8 reinforcement.  
9 2) Provide walls on two sides to create corner condition.  
10 b. Provide separate mock-up for each wall and floor substrate condition.  
11 c. Sample shall not be built into permanent construction.  
12 d. Sample floor area shall include sample of each texture of skid resistant material for  
13 Engineer's selection.  
14 e. Sample shall include all corners, coves, bases, expansion joints, terminations, substrate  
15 crack repair and other special detailing as required by Project conditions.  
16 2. If not acceptable, construct additional sample areas as required.  
17 a. After sample area is accepted destroy all previous samples not accepted.  
18 b. Accepted sample shall constitute minimum standard of quality for actual construction.  
19 c. Maintain sample during construction and protect from damage.  
20 d. Store sample in close proximity to area of work.  
21 3. Remove when directed by Engineer.
- 22 E. Manufacturer's authorized representative shall observe and accept, in writing, the substrate prior  
23 to application of system.

### 24 1.3 DEFINITIONS

- 25 A. Installer or Applicator:  
26 1. Installer or applicator is the person(s) actually installing or applying the product in the field at  
27 the Project site.  
28 2. Installer and applicator are synonymous.
- 29 B. DFT: Dry film thickness.

### 30 1.4 SUBMITTALS

- 31 A. Shop Drawings:  
32 1. See Specification Section 01340 for requirements for the mechanics and administration of  
33 the submittal process.  
34 2. Product technical data including:  
35 a. Acknowledgement that products submitted meet requirements of standards referenced.  
36 b. Manufacturer's installation instructions.  
37 c. Complete physical and chemical characteristics.  
38 d. Manufacturer's recommendations for adhesives, primer, and miscellaneous materials  
39 used.  
40 e. Manufacturer's curing and finishing requirements for concrete floor substrates.  
41 3. Applicator qualifications.  
42 a. Certification that installer is licensed or approved in writing by manufacturer to install  
43 material.  
44 b. Provide references for minimum of three (3) projects in last five (5) years including:  
45 1) Type of installation.  
46 2) Product installed.  
47 3) Square footage of material installed.  
48 4) Name and telephone number of client contact.  
49 4. Letter from manufacturer's authorized representative stating that the substrate surface  
50 preparation is acceptable for installation of material.
- 51 B. Samples:  
52 1. 4 IN by 4 IN color samples of manufacturer's full range of colors for Engineer's initial color  
53 selection.  
54 2. Provide range of skid resistance available.

### 55 1.5 DELIVERY STORAGE AND HANDLING

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

## 5 1.6 PROJECT CONDITIONS

- 6 A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures
- 7 are between 50 and 95 DegF.
- 8 B. Do Not Apply Coatings:
- 9 1. In snow, rain, fog, or mist.
- 10 2. When relative humidity exceeds 85 percent.
- 11 3. At temperatures less than 5 DegF above the dew point.
- 12 4. To damp or wet surfaces.

## 13 1.7 EXTRA MATERIALS

- 14 A. Furnish extra materials described below that are from same production run as materials applied.
- 15 1. Package materials for storage and identify with labels describing contents.
- 16 2. Quantity: Furnish an additional 5 percent, but not less than 1 GAL of each material and color
- 17 applied.

# 18 PART 2 - PRODUCTS

## 19 2.1 ACCEPTABLE MANUFACTURERS

- 20 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 21 1. Epoxy Flooring and Wall Systems:
- 22 a. Dudick, Inc.
- 23 b. Dur-A-Flex.
- 24 c. Stonhard.
- 25 d. Tnemec.
- 26 B. Submit request for substitution in accordance with Specification Section 01640.

## 27 2.2 MATERIALS

- 28 A. Products listed below are manufactured by Tnemec:
- 29 1. Products of other listed manufacturers are acceptable for use providing the product is of the
- 30 same generic resin, requires comparable surface preparation, has comparable application
- 31 requirements, provides the same finish and color options and will withstand the atmospheric
- 32 conditions of the location where it is to be applied.
- 33 B. Epoxy Flooring System:
- 34 1. Filler-Surfacer: 100 percent solids epoxy.
- 35 a. Tnemec Series 215 Surfacing Epoxy with fumed silica additive.
- 36 2. Moisture Mitigation Primer: Polyurethane Modified Concrete.
- 37 a. Tnemec Series 241 Ultra-Tread MVT.
- 38 3. Intermediate Coat: 100 percent solids epoxy with colored quartz aggregate.
- 39 a. Tnemec Series 222 Deco-Tread.
- 40 4. Grout Coat: 100 percent solids clear epoxy.
- 41 a. Tnemec Series 284 Deco-Clear.
- 42 5. Chemical Resistant Grout Coat: Modified Novalac Polyamine Epoxy.
- 43 a. Tnemec Series 286 Deco-Clear CR.
- 44 6. Top Coat: Clear aliphatic moisture-cured urethane.
- 45 a. Tnemec Series 248 Everthane.

## 46 2.3 ACCESSORIES

- 47 A. Cove base cap, termination strips and transition strips.
- 48 1. Manufacturer's recommended aluminum or stainless steel profiles.

## 49 2.4 PERFORMANCE REQUIREMENTS

- 50 A. Moisture mitigation primer:

- 1 1. Moisture vapor transmission resistance:
- 2 a. ASTM F1869: 10 LBS.
- 3 2. Relative humidity resistance:
- 4 a. ASTM F2170: 90 percent.
- 5 B. System performance:
- 6 1. Tensile Strength: ASTM 307, 2100 psi.
- 7 2. Hardness: ASTM D2240, Shore D 70.
- 8 3. Abrasion Resistance: ASTM D4060.
- 9 a. CS-17 wheel, 1,000 cycles; not more than 60mg lost.
- 10 4. Adhesion: ASTM D7234, cohesive failure of concrete.

## 11 **PART 3 - EXECUTION**

### 12 **3.1 EXAMINATION**

- 13 A. Examine substrates and conditions, with Applicator present, for compliance with requirements for
- 14 maximum moisture content and other conditions affecting performance of work.
- 15 B. Test pH of surface to be painted in accordance with ASTM D4262.
- 16 1. If surface pH is not within coating manufacturer's required acceptable range, use methods
- 17 acceptable to coating manufacturer as required to bring pH within acceptable range.
- 18 2. Retest pH until acceptable results are obtained.
- 19 C. Verify that moisture content of surface to be painted is within coating manufacturer's
- 20 recommended acceptable limits.
- 21 1. Test surface to be coated in accordance with ASTM D4263 to determine the presence of
- 22 moisture.
- 23 a. If moisture is detected, test moisture content of surface to be coated in accordance with
- 24 ASTM F1869 or ASTM F2170.
- 25 b. Provide remedial measures as necessary to bring moisture content within coating
- 26 manufacturer's recommended acceptable limits.
- 27 c. Retest surface until acceptable results are obtained.
- 28 2. Maximum Moisture Content of Substrates: When measured with an electronic moisture
- 29 meter as follows:
- 30 a. Concrete: 12 percent.
- 31 b. Masonry (Clay and CMU): 12 percent.
- 32 D. Verify compatibility with and suitability of substrates, including compatibility with existing finishes
- 33 or primers.

### 34 **3.2 PREPARATION**

- 35 A. General:
- 36 1. Protect adjacent equipment and other surfaces not requiring coating.
- 37 2. Prepare substrate in accordance with manufacturer's instructions.
- 38 3. Fill all voids with filler-surfacer compound as necessary to provide a smooth, flat substrate.
- 39 4. Substrate to be free of oil, grease, curing compounds, form release agents, surface laitance,
- 40 dirt and any other contaminant that will prohibit the bonding of the flooring material.
- 41 B. Concrete and Concrete Masonry:
- 42 1. Cure in accordance with manufacturer's recommendations.
- 43 a. New concrete and masonry shall cure minimum 28 days prior to installation of epoxy
- 44 coating system.
- 45 2. Grind concrete surfaces as required to produce a smooth, level surface, and remove
- 46 contaminants.
- 47 3. Concrete surfaces shall be cleaned in accordance with ASTM D4258.
- 48 4. Abrasive blast concrete surfaces in accordance with ASTM D4259 and SSPC SP 13/NACE
- 49 No. 6.
- 50 a. Provide Concrete Surface Profile 4 to 9 per ICRI 310.2.
- 51 5. Clean concrete unit masonry surfaces in accordance with Specification Section 04220 and
- 52 ASTM D4261.

### 53 **3.3 INSTALLATION**



- 1 A. Install products in accordance with manufacturer's instructions.
- 2 1. Mix and place in accordance with manufacturer's instructions.
- 3 2. Cure each coat in accordance with manufacturer's instructions and place subsequent coats
- 4 within allowable recoat window.
- 5 3. Match selected samples and mock-up.
- 6 B. Ensure application environment, temperature and humidity level are within manufacturer's
- 7 published limitations.
- 8 C. Begin coating application only after unsatisfactory conditions have been corrected.
- 9 D. Epoxy Flooring System:
- 10 1. Prime in accordance with manufacturer's instructions.
- 11 a. Apply moisture mitigation primer at 55 to 60 SF per GAL.
- 12 b. Broadcast to refusal with aggregate.
- 13 2. Install base and edge terminations and transition strips using adhesive concealed
- 14 mechanical anchorages.
- 15 a. No feathered edges will be accepted.
- 16 3. Place double-broadcast intermediate coat directly over primed concrete.
- 17 a. Provide 2 coats to a total thickness of 1/8 IN.
- 18 4. Apply the grout coat(s) over the intermediate coat.
- 19 a. Provide chemical resistant grout coat at Fluoride room FC-103.
- 20 b. Apply 1 or 2 coats at 160 to 200 SF per GAL as necessary to provide 8.0 to 10.0 mil
- 21 DFT per coat.
- 22 c. Provide texture and slip resistance to match approved mock-up.
- 23 5. Apply top coat over grout coat.
- 24 a. Apply top coat at 590 SF per GAL to provide 2.5 mil DFT.
- 25 6. Provide radius cove base min 4 IN high.
- 26 a. Extend base to top of curb at concrete curb or containment areas.
- 27 b. Provide manufacturer's recommended cove cap at top of coved base.
- 28 7. Provide termination strips where abutting dissimilar materials.
- 29 8. Provide transition strips at stair openings, doorways or other areas adjacent to different floor
- 30 finishes.
- 31 9. Provide texture in accordance with approved mock-up for all skid resistant floor areas.
- 32 10. Flooring is to be installed in continuous single operation with no cold joints unless approved
- 33 in writing by Engineer.
- 34 a. If applicator requires cold joints, submit written request to Engineer identifying where the
- 35 joint is to be located and how the joint is to be treated to accomplish a "seamless"
- 36 appearance and a "seamless" performance in the floor.
- 37 E. Repair or remove and replace unacceptable coatings to satisfaction of Engineer at no additional
- 38 expense to Owner.
- 39 F. Cure coating in accordance with manufacturer's recommendations.
- 40 1. Allow no traffic on recently installed floor until completely cured.

### 41 3.4 FIELD QUALITY CONTROL

- 42 A. Contractor Performed Testing:
- 43 1. The Contractor shall provide ongoing testing and inspection as specified herein, including but
- 44 not limited to the following:
- 45 a. Thickness Testing:
- 46 1) Measure wet film thickness during application in accordance with ASTM D4414.
- 47 a) Ensure a monolithic coating and uniform thickness during the application
- 48 process.
- 49 2) Dry Film Thickness (DFT) shall be measured in accordance with ASTM D6132.
- 50 b. Bond Strength:
- 51 1) Measure bond strength of the protective coating to the concrete substrate in
- 52 accordance with ASTM D7234.
- 53 a) Bond strength of the coating to the concrete shall be greater than the tensile
- 54 strength of the concrete.
- 55 b) One 50 mm dolly shall be fixed to each location and pulled in accordance with
- 56 ASTM D7234.
- 57 (1) For each test that fails, two (2) additional tests shall be performed in the
- 58 adjacent area.

- 1 (2) Further bond tests may be performed to determine the extent of potentially
- 2 deficient bonded areas at no additional cost to the Owner.
- 3 (3) Repairs shall be made by applicator in strict accordance with
- 4 manufacturer's recommendations.
- 5 (4) The number of test sites and locations to be tested shall be determined by
- 6 the Owner after application of coating. The Contractor will apply the dollies,
- 7 perform the tests and repair the coating in the presence of the Owner.
- 8 (5) Any coated areas that do not pass the bond strength tests shall be
- 9 removed and replaced at the expense of the Contractor.

10 B. Instrumentation:

- 11 1. Contractor shall utilize instrumentation as necessary to measure, monitor and record
- 12 environmental surface conditions as indicated, including but not limited to the following:
- 13 a. Dry film thickness gage:
- 14 1) Ultrasonic: ASTM D6132.
- 15 b. Wet Film Thickness Gauge: ASTM D4414.
- 16 c. Sling Psychrometer: ASTM E337.
- 17 d. Surface Temperature Thermometer.
- 18 e. Anemometer.
- 19 f. Moisture Meter.
- 20 g. Adhesion test apparatus: ASTM D7234.
- 21 2. Instrumentation shall be adequate to measure and record applicable data within the
- 22 tolerance indicated in the standard referenced for specific tests.
- 23 a. Calibrate all instrumentation prior to each use.

24 C. Maintain Daily Records:

- 25 1. Record the following information during application of each coat applied:
- 26 a. Date, starting time, end time, and all breaks taken by painters.
- 27 b. Air temperature:
- 28 1) Dry Bulb.
- 29 2) Wet Bulb.
- 30 c. Relative humidity.
- 31 d. Dew point.
- 32 e. Moisture content of concrete substrate prior to coating.
- 33 f. pH level of concrete substrate prior to coating.
- 34 g. Surface temperature of substrate.
- 35 h. Provisions utilized to maintain work area within manufacturer's recommended application
- 36 parameters including temporary heating, ventilation, cooling, dehumidification and
- 37 provisions utilized to mitigate wind-blown dust and debris from contaminating the wet film.
- 38 i. Record environmental conditions, substrate moisture content and surface temperature
- 39 information not less than once every 4 HRS during application.
- 40 1) Record hourly when:
- 41 a) Temperatures are below 50 DegF or above 100 DegF.
- 42 b) Significant changes in weather conditions occur.
- 43 c) Precipitation is imminent or occurring.
- 44 2. Record the following information daily for the coating manufacturer's recommended curing
- 45 period:
- 46 a. Date and start time of cure period for each item or area.
- 47 b. Record environmental conditions not less than once every 12 HRS.
- 48 1) Record not less than once every four (4) HRS when:
- 49 a) Ambient temperature is below 35 DegF.
- 50 b) Significant changes in weather conditions occur.
- 51 c) Precipitation is imminent or occurring.
- 52 c. Provisions utilized to protect each item or area and to maintain areas within
- 53 manufacturer's recommended curing parameters.
- 54 3. Format for daily record to be computer generated.
- 55 4. Daily record shall be accessible to Engineer anytime during normal project working hours.

56 D. Manufacturer's authorized installation technician shall be present during first 1,000 SF of floor

57 installation to assist applicator and to observe, monitor and ensure quality of workmanship.

58 **3.5 PROTECTION**

1 A. After material has achieved initial cure, provide non-staining paper and minimum 1/4 IN thick  
2 plywood, hardboard or oriented strand board protection until building is accepted by Owner.

3 **3.6 CLEANING**

4 A. Immediately prior to acceptance by Owner, remove floor protection and clean floors as  
5 recommended by manufacturer.

6 **END OF SECTION**

7



1 2014/09/08

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3

**SECTION 09910**  
**ARCHITECTURAL COATINGS**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
- 7 1. Surface Preparation.
- 8 2. Field application of:
- 9 a. Architectural Coatings.
- 10 b. Special Coatings.
- 11 c. Any other coating, thinner, accelerator, inhibitor, etc., specified or required as part of a
- 12 complete System specified in this Specification Section.
- 13 3. Environmental controls for field application of coatings.
- 14 B. Related Specification Sections include but are not necessarily limited to:
- 15 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 16 2. Division 01 - General Requirements.
- 17 3. Specification Section 09960 - High Performance Industrial Coatings (HPIC).

18 **1.2 QUALITY ASSURANCE**

- 19 A. Referenced Standards:
- 20 1. ASTM International (ASTM):
- 21 a. D523, Standard Test Method for Specular Gloss.
- 22 b. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
- 23 c. D4259, Standard Practice for Abrading Concrete.
- 24 d. D4261, Standard Practice for Surface Cleaning Concrete Unit Masonry for Coating.
- 25 e. D4262, Standard Test Method for pH of Chemically Cleaned or Etched Concrete
- 26 Surfaces.
- 27 f. D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet
- 28 Method.
- 29 g. F1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete
- 30 Subfloor Using Anhydrous Calcium Chloride.
- 31 2. The Society for Protective Coatings (SSPC):
- 32 a. SP 1, Solvent Cleaning.
- 33 b. SP 2, Hand Tool Cleaning.
- 34 c. SP 3, Power Tool Cleaning.
- 35 d. SP 16, Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless
- 36 Steels, and Non-Ferrous Metals.
- 37 3. The Society for Protective Coatings/NACE International (SSPC/NACE):
- 38 a. SP 6/NACE No. 3, Commercial Blast Cleaning.
- 39 b. SP 7/NACE No. 4, Brush-off Blast Cleaning.
- 40 c. SP 13/NACE No. 6, Surface Preparation of Concrete.
- 41 4. United States Environmental Protection Agency (EPA).
- 42 B. Mock-Ups:
- 43 1. Erect a sample wall, minimum 8 FT high x 8 FT long, substrate, surface preparation and
- 44 special coating specified.
- 45 2. Acceptance of sample wall will define minimum level of quality of workmanship acceptable
- 46 for the Project.
- 47 3. Acceptance of sample wall does not constitute approval of deviations from the Contract
- 48 Documents.

49 **1.3 DEFINITIONS**

- 50 A. Installer or Applicator:
- 51 1. Installer or applicator is the person actually installing or applying the product in the field at the
- 52 Project site.
- 53 2. Installer and applicator are synonymous.

- 1 B. Approved Factory Finish: Finish on a product in compliance with the finish specified in the  
2 Specification Section where the product is specified.
- 3 C. Finished Area:  
4 1. An area that is listed in or has finish called for on Room Finish Schedule.  
5 2. An area that is indicated on Drawings to be painted.
- 6 D. Gloss Range:  
7 1. Specular gloss measured in accordance with ASTM D523:  
8 a. Flat: Below 15, at 60 degrees.  
9 b. Eggshell: Between 20 and 35, at 60 degrees.  
10 c. Semi-gloss: Between 35 and 70, at 60 degrees.  
11 d. Gloss: More than 70, at 60-degrees.
- 12 E. Paint includes the following:  
13 1. Architectural paints (AP) include: Acrylic latex or alkyd enamel coatings.  
14 2. Special coatings (SC) include: Water-based pigmented resin particles suspended in acrylic  
15 latex solution.

#### 16 1.4 SUBMITTALS

- 17 A. Shop Drawings:  
18 1. See Specification Section 01340 for requirements for the mechanics and administration of  
19 the submittal process.  
20 2. Product technical data including:  
21 a. Acknowledgement that products submitted meet requirements of standards referenced.  
22 b. Manufacturer's surface preparation instructions.  
23 c. Manufacturer's application instructions.
- 24 B. Samples:  
25 1. Special Coatings: Manufacturer's full line of colors and patterns for Engineer's preliminary  
26 color selection.  
27 a. After preliminary color selection by Engineer provide two (2) 8 by 10 IN samples of final  
28 color and pattern selected.
- 29 C. Informational Submittals:  
30 1. See Specification Section 01340 for requirements for the mechanics and administration of  
31 the submittal process.  
32 2. Test results.

#### 33 1.5 DELIVERY, STORAGE, AND HANDLING

- 34 A. Deliver in original containers, labeled as follows:  
35 1. Name or type number of material.  
36 2. Manufacturer's name and item stock number.  
37 3. Contents, by volume, of major constituents.  
38 4. Warning labels.  
39 5. VOC content.
- 40 B. Store materials in tightly covered containers in well-ventilated areas with ambient temperatures  
41 continuously maintained at not less than 45 DegF.

#### 42 1.6 PROJECT CONDITIONS

- 43 A. Verify that atmosphere in area where painting is to take place is within paint manufacturer's  
44 acceptable temperature, humidity and sun exposure limits.  
45 1. Provide temporary heating, shade and/or dehumidification as required to bring area within  
46 acceptable limits.  
47 a. Provide temporary dehumidification equipment properly sized to maintain humidity levels  
48 required by paint manufacturer.  
49 b. Provide clean heat with heat exchanger type equipment sufficient in size to maintain  
50 temperature on a 24 HR basis.  
51 1) Vent exhaust gases to exterior environment.  
52 2) No exhaust gases shall be allowed to vent into the space being painted or any  
53 adjacent space.

1 **PART 2 - PRODUCTS**

2 **2.1 ACCEPTABLE MANUFACTURERS**

- 3 A. Provide products from a single manufacturer to the greatest extent practicable.
- 4 B. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 5 1. Architectural paints:
- 6 a. Benjamin Moore.
- 7 b. PPG Industries.
- 8 c. Pratt & Lambert.
- 9 d. Sherwin Williams.
- 10 e. Tnemec.
- 11 2. Special coatings:
- 12 a. Master Coating Technologies - Zolatone.
- 13 b. Triarch.
- 14 C. Submit request for substitution in accordance with Specification Section 01640.

15 **2.2 MATERIALS**

- 16 A. General:
- 17 1. For unspecified materials such as thinner, provide manufacturer's recommended products.
- 18 2. Unless noted otherwise, products listed are manufactured by the manufacturer listed below.
- 19 a. Products of other manufacturers will be considered for use provided that the product:
- 20 1) Is of the same generic formulation.
- 21 2) Has comparable application requirements.
- 22 3) Meets the same VOC levels or better.
- 23 4) Provides the same finish and color options.
- 24 3. Coatings shall comply with the VOC limits of EPA.
- 25 4. Colors:
- 26 a. Colors and gloss will be selected from the manufacturer's complete offering, including
- 27 special colors and premium offerings.
- 28 B. Architectural Coatings:
- 29 1. Product List:
- 30

GENERIC DESCRIPTION	PRODUCT
Acrylic Primer	PPG Pure Performance 9-900 Interior Primer
Acrylic Latex Eggshell	PPG Pure Performance 9-300XI Zero-VOC

- 31 C. Special Coatings:
- 32 1. Product List:
- 33

GENERIC DESCRIPTION	PRODUCT
Speacial Coating Acrylic Primer	Zolatone SP203 Acrylic Basecoat.
Special Coating Stain Blocker	Zolatone SP222 Eco-Block.
Special Coating Base Coat	Zolatone Flex Base Coat.
Special Coating Finish Coat	Zolatone Flex Finish Coat.

1 **2.3 PAINT SYSTEMS:**

Substrate	Prime Coat	Intermediate Coat(s)	Finish Coat
Ferrous Metals		See Specification Section 09960	
Galvanized Steel		See Specification Section 09960	
Metal Deck		See Specification Section 09960	
Surfaces scheduled to receive "AP"	300 to 400 SF/GAL Acrylic Primer	300 to 400 SF/GAL Acrylic Latex Eggshell	300 to 400 SF/GAL Acrylic Latex Eggshell
Surfaces scheduled to receive "SC"	250 to 350 SF/GAL Special Coating Acrylic Primer	250 to 300 SF/GAL Special Coating Base Coat	125 to 150 SFGAL Special Coating Finish Coat

2 **PART 3 - EXECUTION**

3 **3.1 ITEMS TO BE PAINTED**

- 4 A. Interior Areas:
- 5 1. Refer to Room Finish Schedule on Drawings.
- 6 a. If space is scheduled to be painted, paint all appurtenant surfaces within the space
- 7 unless specifically noted otherwise.
- 8 b. Provide coating manufacturer's recommended bonding primer.
- 9 c. Appurtenant surfaces include but are not limited to:
- 10 1) Columns, beams, bracing and similar components.
- 11 2) Underside of roof or floor decks above.
- 12 3) Conduit, boxes, covers and supports.
- 13 4) Ductwork, duct insulation and duct supports.
- 14 5) Piping, pipe insulation and jacketing.
- 15 6) Miscellaneous ferrous metal surfaces.
- 16 2. Concrete walls and columns.
- 17 3. Concrete masonry.
- 18 4. Sectional overhead doors.

19 **3.2 ITEMS NOT TO BE PAINTED**

- 20 A. General: Do not paint items listed in this Article, unless noted otherwise.
- 21 B. Items with Approved Factory Finish: These items may require repair of damaged painted areas
- 22 or painting of welded connections.
- 23 C. Electrical Equipment.
- 24 D. Moving parts of mechanical and electrical units where painting would interfere with the operation
- 25 of the unit.
- 26 E. Code labels, equipment identification or rating plates and similar labels, tagging and identification.
- 27 F. Contact surfaces of friction-type structural connections.
- 28 G. Stainless steel surfaces.
- 29 H. Aluminum surfaces except:
- 30 1. Where specifically shown in the Contract Documents.
- 31 2. Appurtenant surfaces as described in the ITEMS TO BE PAINTED article.
- 32 I. Fiberglass surfaces except:
- 33 1. Appurtenant surfaces as described in the ITEMS TO BE PAINTED article.
- 34 J. Architectural finishes:
- 35 1. Concrete indicated to receive another finish.
- 36 2. Precast concrete surfaces, unless specifically indicated to be painted.



- 1           3. Prefinished masonry surfaces:
- 2           a. Face brick.
- 3           4. Anodized aluminum.
- 4           5. PVDF coated metals.
- 5           6. Aluminum windows, curtainwall and storefront framing systems.
- 6           7. Finish hardware.
- 7           8. Glass and glazing.
- 8           9. Ceramic, porcelain, quarry tile or natural stone.
- 9           10. Acoustical materials.
- 10          11. Building specialties.
- 11          12. Louvers.

12       **3.3 EXAMINATION**

- 13       A. General: Verify.

14       **3.4 PREPARATION**

- 15       A. General:

- 16       1. Prepare surfaces to be painted in accordance with coating manufacturer's instructions and this Specification Section unless noted otherwise in this Specification Section.
- 17       a. Where discrepancy between coating manufacturer's instructions and this Specification Section exists, the more stringent preparation shall be provided unless approved otherwise, in writing, by the Engineer.
- 18       2. Remove all dust, grease, oil, compounds, dirt and other foreign matter which would prevent bonding of coating to surface.
- 19       3. Adhere to manufacturer's recoat time surface preparation requirements.
- 20       a. Surfaces that have exceeded coating manufacturer's published recoat time and/or have exhibited surface chalking shall be prepared prior to additional coating in accordance with manufacturer's published recommendations.
- 21       2. Remove all dust, grease, oil, compounds, dirt and other foreign matter which would prevent bonding of coating to surface.
- 22       3. Adhere to manufacturer's recoat time surface preparation requirements.
- 23       a. Surfaces that have exceeded coating manufacturer's published recoat time and/or have exhibited surface chalking shall be prepared prior to additional coating in accordance with manufacturer's published recommendations.
- 24       a. Surfaces that have exceeded coating manufacturer's published recoat time and/or have exhibited surface chalking shall be prepared prior to additional coating in accordance with manufacturer's published recommendations.
- 25       exhibited surface chalking shall be prepared prior to additional coating in accordance with manufacturer's published recommendations.
- 26       with manufacturer's published recommendations.

- 27       B. Protection:

- 28       1. Protect surrounding surfaces not to be coated.
- 29       2. Remove and protect hardware, accessories, plates, fixtures, finished work, and similar items; or provide ample in-place protection.
- 30       3. Protect code labels, equipment identification or rating plates and similar labels, tagging and identification.
- 31       3. Protect code labels, equipment identification or rating plates and similar labels, tagging and identification.
- 32       identification.

- 33       C. Prepare and paint before assembly all surfaces which are inaccessible after assembly.

- 34       D. Existing surfaces:

- 35       1. Wherever existing work is cut, patched or modified; repair and repaint to match new work.
- 36       2. Where a wall or ceiling is disturbed and patched, paint entire wall or ceiling.

- 37       E. Ferrous Metal:

- 38       1. Complete fabrication, welding or burning before beginning surface preparation.
- 39       a. Chip or grind off flux, spatter, slag or other laminations left from welding.
- 40       b. Remove mill scale.
- 41       c. Grind smooth rough welds and other sharp projections.
- 42       2. Solvent clean in accordance with SSPC SP 1 to remove all dust, grease, oil, compounds, dirt and other foreign matter.
- 43       and other foreign matter.
- 44       3. Exterior exposure:
- 45       a. Commercial blast clean in accordance with SSPC SP 6/NACE No. 3.
- 46       4. Interior exposure:
- 47       a. Hand tool cleaning in accordance with SSPC SP 2 and/or power tool cleaning in accordance with SSPC SP 3.
- 48       accordance with SSPC SP 3.

- 49       F. Galvanized Steel and Non-ferrous Metals:

- 50       1. Solvent clean to remove all dust, grease, oil, compounds, dirt and other foreign matter.
- 51       2. Brush-off blast in accordance with SSPC SP 16 or hand tool cleaning in accordance with SSPC SP 2 to remove surface contaminants.
- 52       SSPC SP 2 to remove surface contaminants.

- 53       G. Gypsum Wallboard:

- 54       1. Repair minor irregularities left by finishers.
- 55       2. Avoid raising nap of paper face on gypsum wallboard.
- 56       3. Verify moisture content is less than 8 percent before painting.

4. After application of prime coat and between subsequent coats, inspect surface and repair holes, dents, irregularities or other defects as necessary to provide a smooth, uniform finish.

### 3.5 APPLICATION

#### A. General:

1. Thin, mix and apply coatings in accordance with manufacturer's installation instructions.
  - a. Where discrepancy exists between manufacturer's instructions and this Specification Section, the more stringent requirement shall apply.
  - b. Backroll spray applied coatings.
2. Temperature and weather conditions:
  - a. Do not paint surfaces when surface temperature is below 50 DegF unless product has been formulated specifically for low temperature application and application is approved in writing by Engineer and paint manufacturer's authorized representative.
  - b. Avoid painting surfaces exposed to hot sun.
  - c. Do not paint on damp surfaces.
3. Apply materials under adequate illumination.
4. Evenly spread to provide full, smooth coverage.
  - a. All paint systems are "to cover."
    - 1) When color or undercoats show through, apply additional coats until paint film is of uniform finish and color.
  - b. Finished paint system shall be uniform and without voids, bugholes, holidays, laps, brush marks, roller marks, runs, sags or other imperfections.
5. If so directed by Engineer, do not apply consecutive coats until Engineer has had an opportunity to observe and approve previous coats.
6. Work each application of material into corners, crevices, joints, and other difficult to work areas.
7. When coating rough surfaces, hand brush and backroll coating to work into all recesses.
8. Smooth out runs or sags immediately, or remove and recoat entire surface.
9. Allow preceding coats to dry before recoating.
  - a. Recoat within time limits specified by coating manufacturer.
  - b. If recoat time limits have expired re-prepare surface in accordance with coating manufacturer's printed recommendations.
10. Allow coated surfaces to cure prior to allowing traffic or other work to proceed.
11. Finish colors not otherwise indicated shall be selected by Engineer from paint manufacturer's complete offering.

#### B. Fillers, surfacers or patching compounds:

1. Provide fillers, surfacers or patching compounds in accordance with manufacturer's recommendations and as specified herein as necessary to provide a smooth, defect free substrate.

#### C. Prime Coat Application:

1. Prime all surfaces indicated to be painted.
  - a. Apply prime coat in accordance with coating manufacturer's written instructions and as written in this Specification Section.
2. Ensure field-applied coatings are compatible with factory-applied coatings or existing coatings.
  - a. Employ services of coating manufacturer's qualified technical representative.
    - 1) Certify through material data sheets.
    - 2) Perform test patch.
  - b. If field-applied coating is found to be not compatible, require the coating manufacturer's technical representative to recommend, in writing, product to be used as barrier coat, thickness to be applied, surface preparation and method of application.
  - c. At Contractor's option, coatings may be removed, surface re-prepared, and new coating applied using appropriate paint system listed in the MATERIALS Article, Paint Systems paragraph of this Specification Section.
    - 1) All damage to surface as result of coating removal shall be repaired to original condition or better by Contractor at no additional cost to Owner.
3. Special coatings prime coat application:
  - a. Prime new gypsum board surfaces using sealer as recommended by manufacturer.
    - 1) Apply at rate per manufacturer's recommendation.

- 1 4. Touch up damaged primer coats prior to applying finish coats.
- 2 a. Restore primed surface equal to surface before damage.

3 **3.6 FIELD QUALITY CONTROL**

- 4 A. Contractor to provide protection for painted surfaces.
- 5 1. Surfaces showing chalking, chipping, scratches, telegraphing of surface imperfections or
- 6 other defects will not be accepted.
- 7 B. Maintain Daily Records:
- 8 1. Record the following information during application of each coat of paint applied:
- 9 a. Date, starting time, end time, and all breaks taken by painters.
- 10 b. Air temperature.
- 11 c. Relative humidity.
- 12 d. Moisture content and surface temperature of substrate prior to each coat.
- 13 e. Provisions utilized to maintain work area within manufacturer's recommended
- 14 application parameters including temporary heating, ventilation, cooling,
- 15 dehumidification and provisions utilized to mitigate wind blown dust and debris from
- 16 contaminating the wet paint film.
- 17 f. Record environmental conditions, substrate moisture content and surface temperature
- 18 information not less than once every four (4) hours during application.
- 19 1) Record hourly when temperatures are below 50 DegF or above 100 DegF.
- 20 2. Record the following information daily for the paint manufacturer's recommended curing
- 21 period:
- 22 a. Date and start time of cure period for each item or area.
- 23 b. Record environmental conditions not less than once every 12 HRS.
- 24 c. Provisions utilized to protect each item or area and to maintain areas within
- 25 manufacturer's recommended curing parameters.
- 26 3. Format for daily record to be computer generated.
- 27 C. Measure surface temperature of items to be painted with surface temperature gage specifically
- 28 designed for such.
- 29 D. Measure substrate humidity with humidity gage specifically designed for such.
- 30 E. Provide wet paint signs.

31 **3.7 CLEANING**

- 32 A. Clean paint spattered surfaces.
- 33 1. Use care not to damage finished surfaces.
- 34 B. Remove masking, adhesive residue or other foreign materials.
- 35 C. Upon completion of painting, replace hardware, accessories, plates, fixtures, and similar items.
- 36 D. Remove surplus materials, scaffolding, and debris.

37 **END OF SECTION**

38



1 2014/09/10

2

## SECTION 09960

3

### HIGH PERFORMANCE INDUSTRIAL COATINGS

#### 4 PART 1 - GENERAL

##### 5 1.1 SUMMARY

6

###### A. Section Includes:

7

1. High performance industrial coatings (HPIC).

8

2. Any other coating, thinner, accelerator, inhibitor, etc., specified or required as part of a complete System specified in this Specification Section.

9

10

3. Minimum surface preparation requirements.

11

###### B. Related Specification Sections include but are not necessarily limited to:

12

1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

13

2. Division 1 - General Requirements.

14

3. Division 2 - Site Work.

15

4. Section 03348 - Concrete Finishing and Repair of Surface Defects.

16

5. Section 04220 - Concrete Masonry.

17

6. Section 05505 - Metal Fabrications.

18

7. Section 09910 - Architectural Coatings.

19

8. Section 10400 - Identification Devices.

20

9. Section 11005 - Equipment: Basic Requirements.

21

10. Division 15 - Mechanical.

22

11. Division 16 - Electrical.

##### 23 1.2 QUALITY ASSURANCE

24

###### A. Referenced Standards:

25

###### 1. ASTM International (ASTM):

26

a. D4258, Standard Practice for Surface Cleaning Concrete for Coating.

27

b. D4259, Standard Practice for Abrading Concrete.

28

c. D4261, Standard Practice for Surface Cleaning Concrete Unit Masonry for Coating.

29

d. D4262, Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.

30

e. D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.

31

f. F1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

32

33

g. F2170, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs

34

Using in situ Probes.

35

###### 2. Environmental Protection Agency (EPA).

36

###### 3. International Concrete Repair Institute (ICRI):

37

a. 310.2, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair

38

###### 4. National Association of Pipe Fabricators (NAPF):

39

a. 500-03, Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings:

40

1) 500-03-04, Abrasive Blast Cleaning for Ductile Iron Pipe.

41

2) 500-03-05, Abrasive Blast Cleaning for Cast Ductile Iron Fittings.

42

###### 5. National Bureau of Standards (NBS):

43

a. Certified Coating Thickness Calibration Standards.

44

###### 6. NSF International (NSF).

45

###### 7. The Society for Protective Coatings (SSPC):

46

a. PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.

47

b. SP 1, Solvent Cleaning.

48

c. SP 2, Hand Tool Cleaning.

49

d. SP 3, Power Tool Cleaning.

50

e. SP 16, Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.

51

52

53

54

55

- 1           8. The Society for Protective Coatings/NACE International (SSPC/NACE):
- 2           a. SP 5/NACE No. 1, White Metal Blast Cleaning.
- 3           b. SP 6/NACE No. 3, Commercial Blast Cleaning.
- 4           c. SP 7/NACE No. 4, Brush-off Blast Cleaning.
- 5           d. SP 10/NACE No. 2, Near-White Blast Cleaning.
- 6           e. SP 13/NACE No. 6, Surface Preparation of Concrete.
  
- 7           B. Qualifications:
- 8           1. Coating manufacturer's authorized representative shall provide written statement attesting
- 9           that applicator has been instructed on proper preparation, mixing and application procedures
- 10           for coatings specified.
- 11           2. Applicators shall have minimum of 10 years experience in application of similar products on
- 12           similar project.
- 13           a. Provide references for minimum of three (3) different projects completed in last five (5)
- 14           years with similar scope of work.
- 15           b. Include name and address of project, size of project in value (painting) and contact
- 16           person.
  
- 17           C. Miscellaneous:
- 18           1. Furnish paint through one (1) manufacturer unless noted otherwise.
  
- 19           D. Deviation from specified mil thickness or product type is not allowed without written authorization
- 20           of Engineer.
  
- 21           E. Material shall not be thinned unless approved, in writing, by paint manufacturer's authorized
- 22           representative.

23 **1.3 DEFINITIONS**

- 24           A. Installer or Applicator:
- 25           1. Installer or applicator is the person actually installing or applying the product in the field at the
- 26           Project site.
- 27           2. Installer and applicator are synonymous.
  
- 28           B. Approved Factory Finish: Finish on a product in compliance with the finish specified in the
- 29           Specification Section where the product is specified or in Specification Section 11005.
  
- 30           C. Corrosive Environment: Immersion in or subject to condensation, spillage or splash of a
- 31           corrosive material such as water, or chemical solution; or exposure to highly corrosive, caustic or
- 32           acidic agent, chemicals, chemical fumes, chemical mixture, or solutions.
- 33           1. For purposes of this Specification Section, corrosive environments include:
- 34           a. Piping Gallery.
- 35           b. Chemical Area, unless listed as Highly Corrosive Area below.
- 36           c. Filter Cells.
  
- 37           D. Highly Corrosive Environment: Immersion in or subject to condensation, spillage or splash of a
- 38           highly corrosive material such as wastewater, or chemical solution; or exposure to highly
- 39           corrosive, caustic or acidic agent, chemicals, chemical fumes, chemical mixture, or solutions.
- 40           1. For purposes of this Specification Section, highly corrosive environments include:
- 41           a. Fluoride Room.
  
- 42           E. Holiday:
- 43           1. A void, crack, thin spot, foreign inclusion, or contamination in the coating film that
- 44           significantly lowers the dielectric strength of the coating.
- 45           2. May also be identified as a discontinuity or pinhole.
  
- 46           F. Exposed Exterior Surface:
- 47           1. Exterior surface which is exposed to view.
- 48           2. Exterior surface which is exposed to weather but not necessarily exposed to view.
  
- 49           G. Finished Area: An area that is listed in or has finish called for on Room Finish Schedule or is
- 50           indicated on Drawings to be painted.
  
- 51           H. Immersion Service:
- 52           1. Any surface immersed in water or some other liquid.
- 53           2. Surface of any pipe, valve, or any other component of the piping system subject to
- 54           condensation including the pipe support system.

- 1 I. Surface Hidden from View: Surfaces such as those within pipe chases, surfaces between top
- 2 side of ceilings and underside of floor or roof structures above, surfaces under overhanging
- 3 walkways if over five feet above adjacent walking surfaces.
- 4 J. HPIC: High performance industrial coatings.
- 5 1. Epoxies, urethanes, vinyl ester, waterborne vinyl acrylic emulsions, acrylates, silicones,
- 6 alkyds, acrylic emulsions and any other coating listed as a HPIC.
- 7 K. Water level for purposes of painting: See Drawings.

#### 8 **1.4 SUBMITTALS**

- 9 A. Shop Drawings:
  - 10 1. See Specification Section 01340 for requirements for the mechanics and administration of
  - 11 the submittal process.
  - 12 2. Applicator experience qualifications.
    - 13 a. No submittal information will be reviewed until Engineer has received and approved
    - 14 applicator qualifications.
  - 15 3. Product technical data including:
    - 16 a. Acknowledgement that products submitted meet requirements of standards referenced.
    - 17 b. Manufacturer's application instructions.
    - 18 c. Manufacturer's surface preparation instructions.
    - 19 d. If products being used are manufactured by Company other than listed in the
    - 20 MATERIALS Article of this Specification Section, provide complete individual data sheet
    - 21 comparison of proposed products with specified products including application
    - 22 procedure, coverage rates and verification that product is designed for intended use.
    - 23 e. Contractor's written plan of action for containing airborne particles created by blasting
    - 24 operation and location of disposal of spent contaminated blasting media.
    - 25 f. Coating manufacturer's recommendation on abrasive blasting.
    - 26 g. Manufacturer's recommendation for universal barrier coat.
    - 27 h. Manufacturer's recommendation for providing temporary or supplemental heat or
    - 28 dehumidification or other environmental control measures.
  - 29 4. Manufacturer's statement regarding applicator instruction on product use.
  - 30 5. Certification that High Performance Coating Systems proposed for use have been reviewed
  - 31 and approved by Senior Corrosion Specification Specialist employed by the coating
  - 32 manufacturer.
- 33 B. Samples:
  - 34 1. Manufacturer's full line of colors for Engineer's preliminary color selection.
  - 35 2. After preliminary color selection by Engineer provide two (2) 3 x 5 IN samples of each final
  - 36 color selected.
- 37 C. Informational Submittals:
  - 38 1. See Specification Section 01340 for requirements for the mechanics and administration of
  - 39 the submittal process.
  - 40 2. Approval of application equipment.
  - 41 3. Applicator's daily records:
    - 42 a. Submit daily records at end of each week in which painting work is performed unless
    - 43 requested otherwise by Engineer's on-site representative.

#### 44 **1.5 DELIVERY, STORAGE, AND HANDLING**

- 45 A. Deliver in original containers, labeled as follows:
  - 46 1. Name or type number of material.
  - 47 2. Manufacturer's name and item stock number.
  - 48 3. Contents, by volume, of major constituents.
  - 49 4. Warning labels.
  - 50 5. VOC content.
- 51 B. Store materials in tightly covered containers in well-ventilated areas with ambient temperatures
- 52 continuously maintained at not less than 45 DegF.

1 **1.6 PROJECT CONDITIONS**

- 2 A. Verify that atmosphere in area where painting is to take place is within paint manufacturer's
- 3 acceptable temperature, humidity and sun exposure limits.
- 4 1. Provide temporary heating, shade and/or dehumidification as required to bring area within
- 5 acceptable limits.
- 6 a. Provide temporary dehumidification equipment properly sized to maintain humidity levels
- 7 required by paint manufacturer.
- 8 b. Provide clean heat with heat exchanger type equipment sufficient in size to maintain
- 9 temperature on a 24 HR basis.
- 10 1) Vent exhaust gases to exterior environment.
- 11 2) No exhaust gases shall be allowed to vent into the space being painted or any
- 12 adjacent space.
- 13 2. Do not apply coatings in snow, rain, fog or mist.

14 **PART 2 - PRODUCTS**

15 **2.1 ACCEPTABLE MANUFACTURERS**

- 16 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 17 a. Carboline Protective Coatings.
- 18 b. PPG Industries.
- 19 c. Sherwin Williams.
- 20 d. Tnemec.
- 21 e. Induron Coatings, Inc.
- 22 B. Submit request for substitution in accordance with Specification Section 01640.

23 **2.2 MATERIALS**

- 24 A. For unspecified materials such as thinner, provide manufacturer's recommended products.
- 25 B. High Performance Industrial Coatings: Unless noted otherwise, products listed are manufactured
- 26 by Tnemec.
- 27 1. Products of other manufacturers will be considered for use provided that the product:
- 28 a. Is of the same generic resin.
- 29 b. Requires comparable surface preparation.
- 30 c. Has comparable application requirements.
- 31 d. Meets the same VOC levels or better.
- 32 e. Provides the same finish and color options.
- 33 f. Will withstand the atmospheric or immersion conditions of the location where it is to be
- 34 applied.
- 35 2. Coatings shall comply with the VOC limits of EPA.
- 36 3. Where manufacturer's product data sheet indicates a minimum dry film thickness (DFT) per
- 37 coat that is greater than specified herein, mil thickness for entire coating system shall be
- 38 increased proportionately.
- 39 4. Product List:
- 40

GENERIC DESCRIPTION	PRODUCT
Modified Aromatic Polyurethane Primer	Series 1 Omnithane
Modified Polyamine Epoxy (NSF 61)	Series 22 Pota-Pox 100
Polyamidoamine Epoxy	Series L69 Hi-Build Epoxoline II
Zinc-Rich Urethane	Series 94-H <sub>2</sub> O Hydro-Zinc
Self-crosslinking Hydrophobic Acrylic	Series 115 Uni-Bond DF



GENERIC DESCRIPTION	PRODUCT
Modified Polyamidoamine Epoxy	Series 135 Chembuild
Polyamide Epoxy (NSF 61)	Series L140 Pota-Pox Plus
Modified Polyamine Epoxy	Series 201 Epoxoprime
Modified Polyamine Epoxy Surfacer/Filler	Series 215 Surfacing Epoxy
Epoxy Modified Cementitious Mortar	Series 218 Mortar Clad
Modified Polyamine Epoxy	Series 237 Power-Tread
Polyamine Novolac Epoxy	Series 282 Tneme-Glaze
Modified Aliphatic Amine Epoxy Mortar	Series 434 Perma-Shield H <sub>2</sub> S
Modified Polyamine Epoxy	Series 435 Perma-Glaze
Fiber-Reinforced Modified Polyamine Epoxy	Series 436 Perma-Shield FR
Hydrophobic Aromatic Polyurethane	Series 446 Perma-Shield MCU
Polyfunctional Hybrid Urethane (Gloss)	Series 740 UVX
Polyfunctional Hybrid Urethane (Semi-Gloss)	Series 750 UVX
Fluid-applied acrylic insulation coating	Series 971 Aerolon Acrylic
Inorganic Hybrid Water-Based Epoxy	Series 1254 Epoxoblock WB
HDP Acrylic Polym with Thermal Glass Beads	Series 1028T Enduratone with Thermal Glass Beads
Water-based Cementitious Epoxy	Series 1224 Epoxoline WB

1 **2.3 PAINT SYSTEMS:**

2

Environment	Surface Preparation	Dry Film Thickness (DFT)		
		Prime Coat	Intermediate Coat(s)	Finish Coat
<b>Ferrous Metals (Structural &amp; Miscellaneous Metals)</b>				
Interior atmospheric	SSPC SP-10/ NACE No. 2 min. 2 mil anchor profile	2.5 to 3.5 mil Series 94-H <sub>2</sub> O	3.0 to 4.0 mil Series L69	3.0 to 4.0 mil Series L69
Immersion – non NSF	SSPC SP-10/ NACE No. 2	2.5 to 3.5 mil Series 94-H <sub>2</sub> O	3.0 to 4.0 mil Series L69	3.0 to 4.0 mil Series L69
Immersion – NSF	SSPC SP-5/ NACE No.1	2.5 to 3.5 mil Series 94-H <sub>2</sub> O		20 to 25 mil Series 22
Exterior atmospheric	SSPC SP-6/ NACE No. 3	2.5 to 3.5 mil Series 94-H <sub>2</sub> O	3.0 to 5.0 mil Series L69	2.5 to 3.5 mil Series 740
<b>Galvanized Steel</b>				
Interior atmospheric	SSPC SP-16	4.0 to 6.0 mil Series 135		2.0 to 3.0 mil Series L69
Immersion – non NSF	SSPC SP-16	4.0 to 6.0 mil Series 135	2.0 to 3.0 mil Series L69	2.0 to 3.0 mil Series L69
Immersion – NSF	SSPC SP-16	3.0 to 4.0 mil Series L140		3.0 to 4.0 mil Series L140
Exterior atmospheric	SSPC SP-16	4.0 to 6.0 mil Series 135		2.5 to 3.5 mil Series 740
Field cut pipe threads	SSPC SP-3	4.0 to 6.0 mil Series 135	Coat per exposure above	Coat per exposure above
<b>Non Ferrous Metals, including piping</b>				
Interior atmospheric	SSPC SP-2	3.0 to 4.0 mil Series L69		3.0 to 4.0 mil Series L69
Immersion – non NSF	SSPC SP-16	3.0 to 4.0 mil Series L69		5.0 to 6.0 mil Series L69
Immersion – NSF	SSPC SP-16	3.0 to 4.0 mil Series L140		3.0 to 4.0 mil Series L140
Exterior atmospheric	SSPC SP-2	4.0 to 6.0 mil Series L69		2.5 to 3.5 mil Series 750
<b>Ferrous Piping</b>				
Interior atmospheric	SSPC SP-6/ NACE No. 3	2.5 to 3.5 mil Series 94-H <sub>2</sub> O	3.0 to 4.0 mil Series L69	3.0 to 4.0 mil Series L69
Immersion – non NSF	SSPC SP-5/ NACE No.1	2.5 to 3.5 mil Series 94-H <sub>2</sub> O	3.0 to 4.0 mil Series L69	3.0 to 4.0 mil Series L69

Environment	Surface Preparation	Dry Film Thickness (DFT)		
		Prime Coat	Intermediate Coat(s)	Finish Coat
Immersion – NSF	SSPC SP-5/ NACE No.1	2.5 to 3.5 mil Series 94-H <sub>2</sub> O		20 to 25 mil Series 22
Exterior atmospheric	SSPC SP-10/ NACE No. 2	2.5 to 3.5 mil Series 94-H <sub>2</sub> O	3.0 to 4.0 mil Series L69	2.5 to 3.5 mil Series 750
<b>Ductile Iron Piping</b>				
Interior atmospheric	Pipe: NAPF 500-03-04 Fittings: NAPF 500-03-05	3.0 to 4.0 mil Series L69	3.0 to 4.0 mil Series L69	3.0 to 4.0 mil Series L69
Immersion – non NSF	Pipe: NAPF 500-03-04 Fittings: NAPF 500-03-05	3.0 to 4.0 mil Series L69	3.0 to 4.0 mil Series L69	3.0 to 4.0 mil Series L69
Immersion – NSF	Pipe: NAPF 500-03-04 Fittings: NAPF 500-03-05	3.0 to 4.0 mil Series L140		20.0 to 25.0 mil Series 22
Exterior atmospheric	Pipe: NAPF 500-03-04 Fittings: NAPF 500-03-05	3.0 to 4.0 mil Series L69	3.0 to 4.0 mil Series L69	2.5 to 3.5 mil Series 750
<b>Cast Iron Piping</b>				
Interior atmospheric	SSPC SP-1	4.0 to 6.0 mil Series 135	2.0 to 3.0 mil Series L69	2.0 to 3.0 mil Series L69
Exterior atmospheric	SSPC SP-1	4.0 to 6.0 mil Series 135	2.0 to 3.0 mil Series L69	2.5 to 3.5 mil Series 750

Environment	Surface Preparation	Filler/ Surfer	Prime Coat	Intermediate Coat	Finish Coat
<b>Concrete</b>					
Interior walls, ceilings, etc. atmospheric	SSPC SP-13/ NACE No. 6 ICRI CSP 5	Series 218 and/or 215 as necessary to fill holes and depressions	250 to 300 SF/GAL Series L69		250 to 300 SF/GAL Series L69
Interior – Secondary Containment	SSPC SP-13/ NACE No. 6 ICRI CSP 5	Series 218 and/or 215 as necessary to fill holes and depressions	50 to 60 mil Series 206SC	211-0215 Fiberglass mat Saturated with 8.0 to 12 mils Series 237SC	10 to 12 mil Series 237SC
Interior – Secondary Containment (Highly Corrosive)	SSPC SP-13/ NACE No. 6 ICRI CSP 5	Series 218 and/or 215 as necessary to fill holes and depressions	6.0 to 8.0 mil Series 251SC	211-0215 Fiberglass mat Saturated with 8.0 to 12 mils Series 252SC	6.0 to 8.0 mil Series 252SC
Immersion – non NSF	SSPC SP-13/ NACE No. 6 ICRI CSP 5	1/16 to 1/4 IN Series 218			16 to 20 mil Series 22
Immersion – NSF	SSPC SP-13/ NACE No. 6 ICRI CSP 5	1/16 to 1/4 IN Series 218			16 to 20 mil Series 22
Secondary Containment (Horizontal Surface)	SSPC SP-13/ NACE No. 6 ICRI CSP 5	1/16 to 1/4 IN Series 218	10.0 to 12.0 mil Series 282		10.0 to 12.0 mil Series 282
Secondary Containment (Vertical Surface)	SSPC SP-13/ NACE No. 6 ICRI CSP 5	1/16 to 1/4 IN Series 218	8.0 to 10.0 mil Series 282		8.0 to 10.0 mil Series 282
<b>CMU</b>					
Interior atmospheric	Refer to PART 3	100 to 150 SF/Gal Series 1254	175 to 200 SF/Gal Series L69		175 to 200 SF/Gal Series L69

## 1 PART 3 - EXECUTION

### 2 3.1 ITEMS TO BE PAINTED

- 3 A. Exterior surfaces, including but not limited to:
- 4 1. Piping, valves, fittings, hydrants and supports:
- 5 a. Existing 54 IN Bypass piping.
- 6 b. As indicated in Division 2 and Division 15.
- 7 2. Pumps and motors.
- 8 3. Miscellaneous ferrous metal surfaces:
- 9 a. Items specifically noted on Drawings to be painted.
- 10 4. Miscellaneous galvanized steel surfaces:
- 11 a. Pipe Bollards.
- 12 b. Embed Plates.
- 13 c. Loose lintels.

- 1 d. Steel components of concrete lintels.
- 2 e. Items specifically noted on Drawings to be painted.
- 3 5. Appurtenant surfaces attached to or adjacent to a surface indicated to be painted:
- 4 a. Conduit, boxes, covers and supports.
- 5 B. Interior Areas:
- 6 1. Refer to Room Finish Schedule on Drawings.
- 7 a. If space is scheduled to be painted, paint all appurtenant surfaces within the space
- 8 unless specifically noted otherwise. Appurtenant surfaces include but are not limited to:
- 9 1) Columns.
- 10 2) Curbs.
- 11 3) Equipment pads.
- 12 4) Equipment supports.
- 13 5) Underside of roof or floor decks above:
- 14 a) Including semi-exposed or concealed from view unless noted otherwise.
- 15 6) Conduit, boxes, covers and supports.
- 16 7) Miscellaneous ferrous metal surfaces.
- 17 2. Concrete:
- 18 a. Roof deck, girders, beams, purlins, columns and appurtenant surfaces.
- 19 1) Underside of concrete walkways within 2 FT of high water level.
- 20 b. Chemical storage areas:
- 21 1) Secondary containment enclosures.
- 22 3. Piping, valves, fittings, hydrants and supports:
- 23 a. As indicated in Division 15.
- 24 b. Paint pipe insulation jacketing as required for pipe system identification.
- 25 1) At the Contractor's option, integrally colored pipe insulation jacketing may be
- 26 provided in lieu of painting.
- 27 4. Pumps and motors.
- 28 5. Ferrous metal process equipment.
- 29 a. Items specifically noted on Drawings to be painted.
- 30 6. Miscellaneous galvanized steel surfaces:
- 31 a. Pipe Bollards.
- 32 b. Embed Plates.
- 33 c. Loose lintels.
- 34 d. Steel components of concrete lintels.
- 35 e. Seismic angles at masonry partitions.
- 36 f. Items specifically noted on Drawings to be painted.
- 37 7. Copper and brass surfaces.

### 38 3.2 ITEMS NOT TO BE PAINTED

- 39 A. General: Do not paint items listed in this Article, unless noted otherwise.
- 40 B. Items with Approved Factory Finish: These items may require repair of damaged painted areas
- 41 or painting of welded connections.
- 42 C. Electrical Equipment.
- 43 D. Moving parts of mechanical and electrical units where painting would interfere with the operation
- 44 of the unit.
- 45 E. Code labels, equipment identification or rating plates and similar labels, tagging and
- 46 identification.
- 47 F. Contact surfaces of friction-type structural connections.
- 48 G. Stainless steel surfaces except:
- 49 1. Piping where specifically noted to be painted.
- 50 2. Banding as required to identify piping.
- 51 H. Aluminum surfaces except:
- 52 1. Where specifically shown in the Contract Documents.
- 53 2. Where in contact with concrete.
- 54 3. Where in contact with dissimilar metals.
- 55 4. Appurtenant surfaces as described in the ITEMS TO BE PAINTED article.

- 1 I. Fiberglass Surfaces Except:
- 2 1. Fiberglass piping where specifically noted to be painted.
- 3 2. Piping supports where specifically noted to be painted.
- 4 3. Appurtenant surfaces as described in the ITEMS TO BE PAINTED article.
- 5 J. Interior of Pipe, Ductwork, and Conduits.
- 6 1. See Division 15 for interior pipe linings.
- 7 K. Galvanized steel items, unless specifically noted to be painted.
- 8 L. Architectural finishes:
- 9 1. Prefinished masonry surfaces:
- 10 a. Precolored masonry (exterior face).
- 11 1) Interior face shall be painted where scheduled.
- 12 b. Burnished (ground face) concrete masonry.
- 13 c. Face brick.
- 14 2. Plastic laminate.
- 15 3. Solid surface material.
- 16 4. Standing and running trim.
- 17 5. Fiberglass fabrications.
- 18 6. Anodized aluminum.
- 19 7. PVDF coated metals.
- 20 8. Factory finished doors and frames.
- 21 9. Aluminum windows, curtainwall and storefront framing systems.
- 22 10. Finish hardware.
- 23 11. Glass and glazing.
- 24 12. Ceramic, porcelain, quarry tile or natural stone.
- 25 13. Acoustical materials.
- 26 14. Building specialties.
- 27 15. Louvers.
- 28 16. Casework and countertops.
- 29 17. Pipe insulation and jacketing.

30 **3.3 EXAMINATION**

- 31 A. Concrete and Concrete Unit Masonry:
- 32 1. Test pH of surface to be painted in accordance with ASTM D4262.
- 33 a. If surface pH is not within coating manufacturer's required acceptable range, use
- 34 methods acceptable to coating manufacturer as necessary to bring pH within acceptable
- 35 range.
- 36 b. Retest pH until acceptable results are obtained.
- 37 2. Verify that moisture content of surface to be painted is within coating manufacturer's
- 38 recommended acceptable limits.
- 39 a. Test surface to be coated in accordance with ASTM D4263 to determine the presence of
- 40 moisture.
- 41 1) If moisture is detected, test moisture content of surface to be coated in accordance
- 42 with ASTM F1869 or ASTM F2170.
- 43 2) Provide remedial measures as necessary to bring moisture content within coating
- 44 manufacturer's recommended acceptable limits.
- 45 3) Retest surface until acceptable results are obtained.

46 **3.4 PREPARATION**

- 47 A. General:
- 48 1. Prepare surfaces to be painted in accordance with coating manufacturer's instructions and
- 49 this Specification Section unless noted otherwise in this Specification Section.
- 50 a. Where discrepancy between coating manufacturer's instructions and this Specification
- 51 Section exists, the more stringent preparation shall be provided unless approved
- 52 otherwise, in writing, by the Engineer.
- 53 2. Remove all dust, grease, oil, compounds, dirt and other foreign matter which would prevent
- 54 bonding of coating to surface.

- 1                   3. Adhere to manufacturer's recoat time surface preparation requirements.
- 2                   a. Surfaces that have exceeded coating manufacturer's published recoat time and/or have
- 3                   exhibited surface chalking shall be prepared prior to additional coating in accordance
- 4                   with manufacturer's published recommendations.
- 5                   1) Minimum SSPC SP 7/NACE No. 4 unless otherwise approved by Engineer.
- 6                   B. Protection:
- 7                   1. Protect surrounding surfaces not to be coated.
- 8                   2. Remove and protect hardware, accessories, plates, fixtures, finished work, and similar items;
- 9                   or provide ample in-place protection.
- 10                  3. Protect code labels, equipment identification or rating plates and similar labels, tagging and
- 11                  identification.
- 12                  C. Prepare and paint before assembly all surfaces which are inaccessible after assembly.
- 13                  D. Ferrous Metal:
- 14                  1. Prepare ductile iron pipe in accordance with pipe manufacturer's recommendations and
- 15                  NAPF.
- 16                  a. All piping, pumps, valves, fittings and any other component used in the water piping
- 17                  system that requires preparation for painting shall be prepared in accordance with
- 18                  requirements for immersion service.
- 19                  b. Prepare all areas requiring patch painting in accordance with recommendations of
- 20                  manufacturer and NAPF.
- 21                  c. Remove bituminous coating per piping manufacturer, paint manufacturer and NAPF
- 22                  recommendations.
- 23                  1) The most stringent recommendations shall apply.
- 24                  2. Complete fabrication, welding or burning before beginning surface preparation.
- 25                  a. Chip or grind off flux, spatter, slag or other laminations left from welding.
- 26                  b. Remove mill scale.
- 27                  c. Grind smooth rough welds and other sharp projections.
- 28                  3. Solvent clean in accordance with SSPC SP 1.
- 29                  4. Restore surface of field welds and adjacent areas to original surface preparation.
- 30                  E. Galvanized Steel and Non-ferrous Metals:
- 31                  1. Solvent clean in accordance with SSPC SP 1 followed by brush-off blast clean in accordance
- 32                  with SSPC SP 16 to remove zinc oxide and other foreign contaminants.
- 33                  a. Provide uniform 1 mil profile surface.
- 34                  F. Concrete:
- 35                  1. Cure for minimum of 28 days.
- 36                  2. Concrete surfaces shall be cleaned in accordance with ASTM D4258.
- 37                  3. Abrasive blast concrete surfaces in accordance with ASTM D4259 and SSPC SP 13/NACE
- 38                  No. 6.
- 39                  a. Provide profile as recommended by coating manufacturer or as listed in MATERIALS
- 40                  article of this Specification Section.
- 41                  4. Test pH and moisture content in accordance with EXAMINATION article in this specification
- 42                  section.
- 43                  G. Concrete Unit Masonry:
- 44                  1. Cure for minimum of 28 days.
- 45                  2. Remove all mortar spatters and protrusions.
- 46                  3. Verify that concrete unit masonry surfaces have been cleaned in accordance with
- 47                  Specification Section 04220 and ASTM D4261.
- 48                  4. Test pH and moisture content in accordance with EXAMINATION article in this specification
- 49                  section.
- 50                  H. Preparation by Abrasive Blasting:
- 51                  1. Schedule the abrasive blasting operation so blasted surfaces will not be wet after blasting
- 52                  and before painting.
- 53                  2. Provide compressed air for blasting that is free of water and oil.
- 54                  a. Provide accessible separators and traps.
- 55                  3. Protect nameplates, valve stems, rotating equipment, motors and other items that may be
- 56                  damaged from blasting.

4. All abrasive-blasted ferrous metal surfaces shall be inspected immediately prior to application of paint coatings.
    - a. Inspection shall be performed to determine cleanliness and profile depth of blasted surfaces and to certify that surface has been prepared in accordance with these Specifications.
  5. Perform additional blasting and cleaning as required to achieve surface preparation required.
    - a. Re-blast surfaces not meeting requirements of these Specifications.
    - b. Prior to painting, re-blast surfaces allowed to set overnight and surfaces that show rust bloom.
    - c. Surfaces allowed to set overnight or surfaces which show rust bloom prior to painting shall be re-inspected prior to paint application.
  6. Profile depth of blasted surface: Not less than 1 mil or greater than 2 mils unless required otherwise by coating manufacturer.
  7. Ensure abrasive blasting operation does not result in embedment of abrasive particles in paint film.
  8. Confine blast abrasives to area being blasted.
    - a. Provide shields of polyethylene sheeting or other such barriers to confine blast material.
    - b. Plug pipes, holes, or openings before blasting and keep plugged until blast operation is complete and residue is removed.
  9. Abrasive blasting media may be recovered, cleaned and reused providing Contractor submits, for Engineer's review, a comprehensive recovery plan outlining all procedures and equipment proposed in reclamation process.
  10. Properly dispose of blasting material contaminated with debris from blasting operation.
- I. All Plastic Surfaces: Sand using 80-100 grit sandpaper to scarify surfaces.

### 3.5 APPLICATION

- A. General:
1. Thin, mix and apply coatings by brush, roller, or spray in accordance with manufacturer's installation instructions.
    - a. Application equipment must be inspected and approved in writing by coating manufacturer.
  2. Temperature and weather conditions:
    - a. Do not paint surfaces when surface temperature is below 50 DegF unless product has been formulated specifically for low temperature application and application is approved in writing by Engineer and paint manufacturer's authorized representative.
    - b. Avoid painting surfaces exposed to hot sun.
    - c. Do not paint on damp surfaces.
  3. Immediately after surface has been inspected, apply structural steel and miscellaneous steel prime coat in the factory.
    - a. Finish coats shall be applied in the field.
    - b. Prime coat referred to here is prime coat as indicated in this Specification.
      - 1) Prime coating applied in factory (shop) as part of Fabricator's standard rust inhibiting and protection coating is not acceptable as replacement for specified prime coating.
  4. Apply materials under adequate illumination.
  5. Provide complete coverage to mil thickness specified.
    - a. Thickness specified is dry mil thickness.
  6. Evenly spread to provide full, smooth coverage.
    - a. All paint systems are "to cover."
      - 1) In situations of discrepancy between manufacturer's square footage coverage rates and mil thickness, mil thickness requirements govern.
    - b. When color or undercoats show through, apply additional coats until paint film is of uniform finish and color.
    - c. Finished paint system shall be uniform and without voids, bugholes, holidays, laps, brush marks, roller marks, runs, sags or other imperfections.
  7. If so directed by Engineer, do not apply consecutive coats until Engineer has had an opportunity to observe and approve previous coats.
  8. Work each application of material into corners, crevices, joints, and other difficult to work areas.
  9. Avoid degradation and contamination of blasted surfaces and avoid inter-coat contamination.
    - a. Clean contaminated surfaces before applying next coat.



- 1 10. Smooth out runs or sags immediately, or remove and recoat entire surface.
- 2 11. Allow preceding coats to dry before recoating.
- 3 a. Recoat within time limits specified by coating manufacturer.
- 4 b. If recoat time limits have expired re-prepare surface in accordance with coating
- 5 manufacturer's printed recommendations.
- 6 12. Allow coated surfaces to cure prior to allowing traffic or other work to proceed.
- 7 13. Coat all aluminum in contact with dissimilar materials.
- 8 14. When coating rough surfaces which cannot be backrolled sufficiently, hand brush coating to
- 9 work into all recesses.
- 10 15. Backroll surfaces if paint coatings are spray applied.

- 11 B. Prime Coat Application:
- 12 1. Prime all surfaces indicated to be painted.
- 13 a. Apply prime coat in accordance with coating manufacturer's written instructions and as
- 14 written in this Specification Section.
- 15 2. Employ services of coating manufacturer's qualified technical representative to ensure that
- 16 field-applied coatings are compatible with factory-applied or existing coatings.
- 17 a. Certify through material data sheets.
- 18 b. Perform test patch.
- 19 c. If field-applied coating is found to be not compatible, require the coating manufacturer's
- 20 technical representative to recommend, in writing, product to be used as barrier coat,
- 21 thickness to be applied, surface preparation and method of application.
- 22 d. At Contractor's option, coatings may be removed, surface re-prepared, and new coating
- 23 applied using appropriate paint system listed in the MATERIALS Article, Paint Systems
- 24 paragraph of this Specification Section.
- 25 1) All damage to surface as result of coating removal shall be repaired to original
- 26 condition or better by Contractor at no additional cost to Owner.
- 27 3. Prime ferrous metals embedded in concrete to minimum of 1 IN below exposed surfaces.
- 28 4. Apply zinc-rich primers while under continuous agitation.
- 29 5. Brush or spray bolts, welds, edges and difficult access areas with primer prior to primer
- 30 application over entire surface.
- 31 6. Touch up damaged primer coats prior to applying finish coats.
- 32 a. Restore primed surface equal to surface before damage.
- 33 7. All surfaces of steel lintels and steel components of concrete lintels used in wall construction
- 34 shall be completely painted with both prime and finish coats prior to placing in wall.

- 35 C. Finish Coat Application:
- 36 1. Apply finish coats in accordance with coating manufacturer's written instructions and in
- 37 accordance with this Specification Section; manufacturer instructions take precedent over
- 38 these Specifications.
- 39 2. Touch up damaged finish coats using same application method and same material specified
- 40 for finish coat.
- 41 a. Prepare damaged area in accordance with the PREPARATION Article of this
- 42 Specification Section.

### 43 3.6 FIELD QUALITY CONTROL

- 44 A. Contractor to provide protection for surfaces painted with epoxy coatings to prevent chalking.
- 45 1. Surfaces showing chalking will not be accepted.
- 46 2. Solvent clean surfaces in accordance with SSPC SP1 and abrasive blast in accordance with
- 47 SSPC SP7/NACE No. 4.
- 48 3. Recoat with intermediate and finish coats in accordance with coating system specified
- 49 herein.
- 50 B. Instrumentation:
- 51 1. Provide instrumentation as necessary to measure and record atmospheric and substrate
- 52 conditions, including but not limited to:
- 53 a. Dry Film Thickness Gauge.
- 54 b. Wet Film Thickness Gauge.
- 55 c. Sling Psychrometer.
- 56 d. Surface Temperature Gauge.
- 57 e. Anemometer.
- 58 f. Moisture Meter.

- 1 C. Maintain Daily Records:
- 2 1. Record the following information during application:
- 3 a. Date, starting time, end time, and all breaks taken by painters.
- 4 b. Air temperature.
- 5 c. Relative humidity.
- 6 d. Dew point.
- 7 e. Moisture content and pH level of concrete or masonry substrates prior to coating.
- 8 f. Surface temperature of substrate.
- 9 g. Provisions utilized to maintain work area within manufacturer's recommended
- 10 application parameters including temporary heating, ventilation, cooling,
- 11 dehumidification and provisions utilized to mitigate wind blown dust and debris from
- 12 contaminating the wet paint film.
- 13 h. For exterior painting:
- 14 1) Sky condition.
- 15 2) Wind speed and direction.
- 16 i. Record environmental conditions, substrate moisture content and surface temperature
- 17 information not less than once every four (4) hours during application.
- 18 1) Record hourly when temperatures are below 50 DegF or above 100 DegF.
- 19 2. Record the following information daily for the paint manufacturer's recommended curing
- 20 period:
- 21 a. Date and start time of cure period for each item or area.
- 22 b. For exterior painting:
- 23 1) Sky conditions.
- 24 2) Wind speed and direction.
- 25 3) Air temperature.
- 26 a) Dry Bulb.
- 27 b) Wet Bulb.
- 28 4) Relative humidity.
- 29 5) Dew point.
- 30 6) Surface temperatures.
- 31 c. Record environmental conditions not less than once every four (4) hours.
- 32 1) Record hourly when temperatures are below 50 DegF or above 100 DegF.
- 33 d. Provisions utilized to protect each item or area and to maintain areas within
- 34 manufacturer's recommended curing parameters.
- 35 3. Format for daily record to be computer generated.
- 36 D. Measure wet coating with wet film thickness gages.
- 37 E. Measure coating dry film thickness in accordance with SSPC PA 2 using Mikrotest gage
- 38 calibrated against NBS "Certified Coating Thickness Calibration Standards."
- 39 1. Engineer may measure coating thickness at any time during project to assure conformance
- 40 with these Specifications.
- 41 F. Measure surface temperature of items to be painted with surface temperature gage specifically
- 42 designed for such.
- 43 G. Measure substrate humidity with humidity gage specifically designed for such.
- 44 H. Provide wet paint signs.

45 **3.7 CLEANING**

- 46 A. Clean paint spattered surfaces.
- 47 1. Use care not to damage finished surfaces.
- 48 B. Upon completion of painting, replace hardware, accessories, plates, fixtures, and similar items.
- 49 C. Remove surplus materials, scaffolding, and debris.

50 **END OF SECTION**



DIVISION 10  
SPECIALTIES





1 2014/09/08

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**SECTION 10200**  
**LOUVERS AND VENTS**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6 A. Section Includes: Louvers.

7 B. Related Sections include but are not necessarily limited to:

- 8 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 9 2. Division 01 - General Requirements.
- 10 3. Section 07600 - Flashing and Sheet Metal.
- 11 4. Section 07900 - Joint Sealants.

12 **1.2 QUALITY ASSURANCE**

13 A. Referenced Standards:

- 14 1. Aluminum Association (AA):
  - 15 a. DAF 45, Designation System for Aluminum Finishes.
- 16 2. Air Movement and Control Association (AMCA).
- 17 3. ASTM International (ASTM):
  - 18 a. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods,
  - 19 Wire, Profiles, and Tubes.

20 **1.3 SUBMITTALS**

21 A. Shop Drawings:

- 22 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 23 the submittal process.
- 24 2. Product technical data including:
  - 25 a. Acknowledgement that products submitted meet requirements of standards referenced.
  - 26 b. Manufacturer's installation instructions.

27 **PART 2 - PRODUCTS**

28 **2.1 ACCEPTABLE MANUFACTURERS**

29 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

- 30 1. Louvers:
  - 31 a. Airolite Co.
  - 32 b. Construction Specialties, Inc.
  - 33 c. Ruskin Manufacturing.
  - 34 d. Industrial Louvers, Inc.
  - 35 e. American Warming.

36 B. Submit request for substitution in accordance with Specification Section 01640.

37 **2.2 MANUFACTURED UNITS**

38 A. Louvers:

- 39 1. 4 IN deep.
- 40 2. Drainable with blades at 37-1/2 degrees.
- 41 3. Continuous blade appearance.
- 42 4. ASTM B221 extruded aluminum, alloy 6063T5, minimum 0.081 IN thick.
- 43 5. Minimum free area: 8.58 SF for 4 x 4 FT louver.
- 44 6. Maximum pressure drop: 0.10 IN of water at 700 fpm.
- 45 7. Water penetration: 0.01 OZ/SF at 873 fpm.
- 46 8. AMCA certified.

- 1 9. Ruskin "ELF 375DX".
- 2 10. Insect screen:
- 3 a. 18-16 mesh aluminum.
- 4 b. Install in standard aluminum frame.
- 5 B. Anchors, Fasteners, Reinforcing: Aluminum or stainless steel.
- 6 C. Finish:
- 7 1. Architectural Class 1 coating per AA DAF 45.
- 8 a. AA-M12C22A42 dark bronze anodized.
- 9 D. Refer to Mechanical Drawings for louver size.
- 10 1. Refer to Architectural Drawings for louver shapes.

11 **PART 3 - EXECUTION**

12 **3.1 INSTALLATION**

- 13 A. Install products in accordance with manufacturer's instructions.
- 14 B. Install anchoring and bracing accessories as required.
- 15 C. Seal around perimeter on exterior and interior.
- 16 1. See Section 07900.
- 17 D. Install 0.040 IN aluminum flashing at sill to match louver.
- 18 1. See Section 07600.

19 **END OF SECTION**

1 2014/08/19

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**SECTION 10400**  
**IDENTIFICATION DEVICES**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
- 7 1. Tag, tape and stenciling systems for equipment, piping, valves, pumps, ductwork and similar
- 8 items, and hazard and safety signs.
- 9 B. Related Specification Sections include but are not necessarily limited to:
- 10 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 11 2. Division 01 - General Requirements.

12 **1.2 QUALITY ASSURANCE**

- 13 A. Referenced Standards:
- 14 1. American Society of Mechanical Engineers (ASME):
- 15 a. A13.1, Scheme for the Identification of Piping Systems.
- 16 2. Instrumentation, Systems, and Automation Society (ISA).
- 17 3. National Electrical Manufacturers Association/American National Standards Institute
- 18 (NEMA/ANSI):
- 19 a. Z535.1, Safety Color Code.
- 20 b. Z535.2, Environmental and Facility Safety Signs.
- 21 c. Z535.3, Criteria for Safety Symbols.
- 22 d. Z535.4, Product Safety Signs and Labels.
- 23 4. National Fire Protection Association (NFPA):
- 24 a. 70, National Electrical Code (NEC).
- 25 5. Occupational Safety and Health Administration (OSHA):
- 26 a. 29 CFR 1910.145, Specification for Accident Prevention Signs and Tags.

27 **1.3 SUBMITTALS**

- 28 A. Shop Drawings:
- 29 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 30 the submittal process.
- 31 2. Product technical data including:
- 32 a. Catalog information for all identification systems.
- 33 b. Acknowledgement that products submitted meet requirements of standards referenced.
- 34 3. Identification register, listing all items in PART 3 of this Specification Section to be identified,
- 35 type of identification system to be used, lettering, location and color.

36 **PART 2 - PRODUCTS**

37 **2.1 ACCEPTABLE MANUFACTURERS**

- 38 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 39 1. W.H. Brady Co.
- 40 2. Panduit.
- 41 3. Seton.
- 42 4. National Band and Tag Co.
- 43 5. Carlton Industries, Inc.
- 44 B. Submit request for substitution in accordance with Specification Section 01640.

1 **2.2 MANUFACTURED UNITS**

- 2 A. Type A1 - Round Metal Tags:
  - 3 1. Materials:
    - 4 a. Aluminum or stainless steel.
    - 5 b. Stainless steel shall be used in corrosive environments.
  - 6 2. Size:
    - 7 a. Diameter: 1-1/2 IN minimum.
    - 8 b. Thickness: 0.035 IN (20 GA) minimum.
  - 9 3. Fabrication:
    - 10 a. 3/16 IN minimum mounting hole.
    - 11 b. Legend: Stamped and filled with black coloring.
  - 12 4. Color: Natural.
- 13 B. Type A2 - Rectangle Metal Tags:
  - 14 1. Materials: Stainless steel.
  - 15 2. Size:
    - 16 a. 3-1/2 IN x 1-1/2 IN minimum.
    - 17 b. Thickness: 0.036 IN (20 GA) minimum.
  - 18 3. Fabrication:
    - 19 a. 3/16 IN minimum mounting hole.
    - 20 b. Legend: Stamped and filled with black coloring.
  - 21 4. Color: Natural.
- 22 C. Type A3 - Metal Tape Tags:
  - 23 1. Materials: Aluminum or stainless steel.
  - 24 2. Size:
    - 25 a. Width 1/2 IN minimum.
    - 26 b. Length as required by text.
  - 27 3. Fabrication:
    - 28 a. 3/16 IN minimum mounting hole.
    - 29 b. Legend: Embossed.
  - 30 4. Color: Natural.
- 31 D. Type B1- Square Nonmetallic Tags:
  - 32 1. Materials: Fiberglass reinforced plastic.
  - 33 2. Size:
    - 34 a. Surface: 2 x 2 IN minimum.
    - 35 b. Thickness: 100 mils.
  - 36 3. Fabrication:
    - 37 a. 3/16 IN mounting hole with metal eyelet.
    - 38 b. Legend: Preprinted and permanently embedded and fade resistant.
  - 39 4. Color:
    - 40 a. Background: Manufacturer standard or as specified.
    - 41 b. Lettering: Black.
- 42 E. Type B2 - Nonmetallic Signs:
  - 43 1. Materials: Fiberglass reinforced or durable plastic.
  - 44 2. Size:
    - 45 a. Surface: As required by text.
    - 46 b. Thickness: 60 mils minimum.
  - 47 3. Fabrication:
    - 48 a. Rounded corners.
    - 49 b. Drilled holes in corners with grommets.
    - 50 c. Legend: Preprinted, permanently embedded and fade resistant for a 10 year minimum
    - 51 outdoor durability.
  - 52 4. Color:
    - 53 a. Background: Manufacturer standard or as specified.
    - 54 b. Lettering: Black.
  - 55 5. Standards for OSHA signs: NEMA/ANSI Z535.1, NEMA/ANSI Z535.2, NEMA/ANSI Z535.3,
  - 56 NEMA/ANSI Z535.4, OSHA 29 CFR 1910.145.
- 57 F. Type C - Laminated Name Plates:
  - 58 1. Materials: Phenolic or DR (high impact) acrylic.



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2. Size:
    - a. Surface: As required by text.
    - b. Thickness: 1/16 IN.
  3. Fabrication:
    - a. Outdoor rated and UV resistant when installed outdoors.
    - b. Two (2) layers laminated.
    - c. Legend: Engraved through top lamination into bottom lamination.
    - d. Two (2) drilled side holes, for screw mounting.
  4. Color: Black top surface, white core, unless otherwise indicated.
- G. Type D - Self-Adhesive Tape Tags and Signs:
1. Materials: Vinyl tape or vinyl cloth.
  2. Size:
    - a. Surface: As required by text.
    - b. Thickness: 5 mils minimum.
  3. Fabrication:
    - a. Indoor/Outdoor grade.
    - b. Weather and UV resistant inks.
    - c. Permanent adhesive.
    - d. Legend: Preprinted.
    - e. Wire markers to be self-laminating.
  4. Color: White with black lettering or as specified.
  5. Standards for OSHA signs: NEMA/ANSI Z535.1, NEMA/ANSI Z535.2, NEMA/ANSI Z535.3, NEMA/ANSI Z535.4, OSHA 29 CFR 1910.145.
- H. Type F - Underground Warning Tape:
1. Materials: Polyethylene.
  2. Size:
    - a. 6 IN wide (minimum).
    - b. Thickness: 3.5 mils.
  3. Fabrication:
    - a. Legend: Preprinted and permanently imbedded.
    - b. Message continuous printed.
    - c. Tensile strength: 1750 psi.
  4. Color: As specified.
- I. Type G - Stenciling System:
1. Materials:
    - a. Exterior type stenciling enamel.
    - b. Either brushing grade or pressurized spray can form and grade.
  2. Size: As required.
  3. Fabrication:
    - a. Legend: As required.
  4. Color: Black or white for best contrast.
- J. Underground Tracer Wire:
1. Materials:
    - a. Wire:
      - 1) 12 GA AWG.
      - 2) Solid.
    - b. Wire nuts: Waterproof type.
    - c. Split bolts: Brass.

## 2.3 ACCESSORIES

- A. Fasteners:
  1. Bead chain: #6 brass, aluminum or stainless steel.
  2. Plastic strap: Nylon, urethane or polypropylene.
  3. Screws: Self-tapping, stainless steel.
  4. Adhesive, solvent activated.

## 2.4 MAINTENANCE MATERIALS

- A. Where stenciled markers are provided, clean and retain stencils after completion and include in extra stock, along with required stock of paints and applicators.

1 **PART 3 - EXECUTION**

2 **3.1 GENERAL INSTALLATION**

- 3 A. Install identification devices at specified locations.
- 4 B. All identification devices to be printed by mechanical process, hand printing is not acceptable.
- 5 C. Attach tags to equipment with sufficient surface or body area with solvent activated adhesive
- 6 applied to back of each tag.
- 7 D. Attach tags with 1/8 IN round or flat head screws to equipment without sufficient surface or body
- 8 area, or porous surfaces.
- 9 1. Where attachment with screws should not or cannot penetrate substrate, attach with plastic
- 10 strap.
- 11 E. Single items of equipment enclosed in a housing or compartment to be tagged on outside of
- 12 housing.
- 13 1. Several items of equipment mounted in housing to be individually tagged inside the
- 14 compartment.
- 15 F. Tracer Wire:
- 16 1. Attach to pipe at a maximum of 10 FT intervals with tape or tie-wraps.
- 17 2. Continuous pass from each valve box and above grade at each structure.
- 18 3. Coil enough wire at each valve box to extend wire a foot above the ground surface.
- 19 4. 1,000 FT maximum spacing between valve boxes.
- 20 5. If split bolts are used for splicing, wrap with electrical tape.
- 21 6. If wire nuts are used for splicing, knot wire at each splice point leaving 6 IN of wire for
- 22 splicing.
- 23 7. Use continuous strand of wire between valve box where possible.
- 24 a. Continuous length shall be no shorter than 100 FT.

25 **3.2 SCHEDULES**

- 26 A. Process Systems:
- 27 1. General:
- 28 a. Provide arrows and markers on piping.
- 29 1) At 20 FT maximum centers along continuous lines.
- 30 2) At changes in direction (route) or obstructions.
- 31 3) At valves, risers, "T" joints, machinery or equipment.
- 32 4) Where pipes pass through floors, walls, ceilings, cladding assemblies and like
- 33 obstructions provide markers on both sides.
- 34 b. Position markers on both sides of pipe with arrow markers pointing in flow direction.
- 35 1) If flow is in both directions use double headed arrow markers.
- 36 c. Apply tapes and stenciling in uniform manner parallel to piping.
- 37 2. Trenches with piping:
- 38 a. Tag type: Type F - Underground Warning Tape
- 39 b. Location: Halfway between top of piping and finished grade.
- 40 c. Letter height: 1-1/4 IN minimum.
- 41 d. Natural gas:
- 42 1) Color: Yellow with black letters.
- 43 2) Legend:
- 44 a) First line: "CAUTION CAUTION CAUTION"
- 45 b) Second line: "BURIED GAS LINE BELOW"
- 46 e. Potable water:
- 47 1) Color: Blue with black letters.
- 48 2) Legend:
- 49 a) First line: "CAUTION CAUTION CAUTION"
- 50 b) Second line: "BURIED WATER LINE BELOW"
- 51 f. Sanitary sewer lines:
- 52 1) Color: Green with black letters.
- 53 2) Legend:
- 54 a) First line: "CAUTION CAUTION CAUTION"
- 55 b) Second line: "BURIED SEWER LINE BELOW"

- 1 g. Chemical feed piping (e.g., chlorine solution, polymer solution, , etc.):
- 2 1) Color: Yellow with black letters.
- 3 2) Legend:
- 4 a) First line: "CAUTION CAUTION CAUTION"
- 5 b) Second line: "BURIED CHEMICAL LINE BELOW"
- 6 h. Other piping (e.g., compressed air, etc.):
- 7 1) Color: Yellow with black letters.
- 8 2) Legend:
- 9 a) First line: "CAUTION CAUTION CAUTION"
- 10 b) Second line: "BURIED PIPE LINE BELOW"
- 11 3. Yard valves, buried, with valve box and concrete pad:
- 12 a. Tag type: Type A2 - Rectangle Metal Tags.
- 13 b. Fastener: 3/16 IN x 7/8 IN plastic screw anchor with 1 IN #6 stainless steel pan head
- 14 screw.
- 15 c. Legend:
- 16 1) Letter height: 1/4 IN minimum.
- 17 2) Valve designation as indicated on the Drawings (e.g., "V-xxx").
- 18 4. Valves:
- 19 a. Tag type:
- 20 1) Outdoor locations: Type B1 - Square Nonmetallic Tags.
- 21 2) Indoor noncorrosive:
- 22 a) Type B1 - Square Nonmetallic Tags.
- 23 3) Indoor corrosive:
- 24 a) Type B1 - Square Nonmetallic Tags.
- 25 4) For filter control valves, provide double sided valve tags
- 26 a) Side 1 shall display valve tag number.
- 27 b) Side 2 shall display valve function (influent, drain, wash water, etc.)
- 28 b. Fastener:
- 29 1) Type A1: Chain of the same material.
- 30 2) Type B1: Stainless steel chain.
- 31 c. Color: Per ASME A13.1 corresponding to the piping system.
- 32 d. Legend:
- 33 1) Letter height: 1/4 IN minimum.
- 34 2) Valve designation as indicated on the Drawings (e.g., "V-xxx").
- 35 5. Process equipment (e.g., pumps, pump motors, etc.):
- 36 a. Tag type:
- 37 1) Type B2 - Nonmetallic Signs.
- 38 2) Type D - Self-Adhesive Tape Tags and Signs.
- 39 3) Type G - Stenciling System.
- 40 b. Fastener:
- 41 1) Self.
- 42 2) Screws.
- 43 3) Adhesive.
- 44 c. Legend:
- 45 1) Letter height: 1/2 IN minimum.
- 46 2) Equipment designation as indicated on the Drawings (e.g., "Primary Sludge Pump
- 47 P-xxx").
- 48 6. Piping systems:
- 49 a. Tag type:
- 50 1) Outdoor locations: Type G - Stenciling System.
- 51 2) Indoor locations:
- 52 a) Type D - Self-Adhesive Tape Tags and Signs.
- 53 b) Type G - Stenciling System.
- 54 b. Fastener: Self.
- 55 c. Color: Per ASME A13.1.
- 56 d. Legend:
- 57 1) Letter height: Manufacturers standard for the pipe diameter.
- 58 2) Mark piping in accordance with ASME A13.1.
- 59 3) Use piping designation as indicated on the Drawings.
- 60 4) Arrow: Single arrow.

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7. Tanks (less than 1000 GAL) (e.g., chemical tanks, etc.):
    - a. Tag type:
      - 1) Type D - Self-Adhesive Tape Tags and Signs.
      - 2) Type G - Stenciling System.
    - b. Fastener: Self.
    - c. Legend:
      - 1) Letter height: 2 IN minimum.
      - 2) Equipment designation as indicated on the Drawings (e.g., "Polymer Storage Tank Txxx")
  8. Equipment that starts automatically:
    - a. Tag type:
      - 1) Type B2 - Nonmetallic Signs.
      - 2) Type D - Self-Adhesive Tape Tags and Signs.
    - b. Fastener:
      - 1) Type B2 - Screw or adhesive.
      - 2) Type D - Self.
    - c. Size: 5 IN x 7 IN.
    - d. Location: {Equipment name}.
    - e. Legend:
      - 1) OSHA Warning Sign.
      - 2) Description of Warning: "THIS MACHINE STARTS AUTOMATICALLY".
- B. Instrumentation Systems:
1. Instrumentation Equipment (e.g., flow control valves, primary elements, etc.):
    - a. Tag type:
      - 1) Outdoor locations: Type B1 - Square Nonmetallic Tags.
      - 2) Indoor noncorrosive:
        - a) Type A1 - Round Metal Tags.
        - b) Type B1 - Square Nonmetallic Tags.
      - 3) Indoor corrosive:
        - a) Stainless steel Type A1 - Round Metal Tags.
        - b) Type B1 - Square Nonmetallic Tags.
    - b. Fastener:
      - 1) Type A1: Chain of the same material.
      - 2) Type B1: Stainless steel chain.
    - c. Legend:
      - 1) Letter height: 1/4 IN minimum.
      - 2) Equipment ISA designation as indicated on the Drawings (e.g., "FIT-xxx").
  2. Enclosure for instrumentation and control equipment, (e.g., PLC control panels, etc.):
    - a. Tag type: Type C - Phenolic Name Plates.
    - b. Fastener: Screws.
    - c. Legend:
      - 1) Letter height: 1/2 IN minimum.
      - 2) Equipment name (e.g., "PLC CONTROL PANEL PCP-xxx").
  3. Components inside equipment enclosure, (e.g., PLC's, control relays, contactors, and timers):
    - a. Tag type: Type D - Self-Adhesive Tape Tags.
    - b. Fastener: Self.
    - c. Legend:
      - 1) Letter height: 3/16 IN minimum.
      - 2) Description or function of component (e.g., "PLC-xxx" or "CR-xxx").
  4. Through enclosure door mounted components (e.g., selector switches, controller digital displays, etc.):
    - a. Tag type: Type C - Phenolic Name Plates.
    - b. Fastener: Screws.
    - c. Legend:
      - 1) Letter height: 1/4 IN minimum.
      - 2) Component ISA tag number as indicated on the Drawings (e.g., "HS-xxx").
- C. HVAC Systems:
1. General:
    - a. Provide arrows and markers on ducts.
      - 1) At 20 FT maximum centers along continuous lines.

- 1                                   2) At changes in direction (route) or obstructions.
- 2                                   3) At dampers, risers, branches, machinery or equipment.
- 3                                   4) Where ducts pass through floors, walls, ceilings, cladding assemblies and like
- 4                                   obstructions provide markers on both sides.
- 5                                   b. Position markers on both sides of duct with arrow markers pointing in flow direction.
- 6                                   1) If flow is in both directions use double headed arrow markers.
- 7                                   c. Apply tapes and stenciling in uniform manner parallel to ducts.
- 8                                   2. HVAC Equipment (e.g., unit heaters, exhaust fans, air handlers, etc.):
- 9                                   a. Tag type:
- 10                                   1) Type B2 - Nonmetallic Signs.
- 11                                   2) Type C - Phenolic Name Plates.
- 12                                   b. Fastener: Screws.
- 13                                   c. Legend:
- 14                                   1) Letter height: 1 IN minimum.
- 15                                   2) Equipment designation as indicated on the Drawings (e.g., "EF-xxx").
- 16                                   3. Ductwork:
- 17                                   a. Tag type:
- 18                                   1) Type D - Self-Adhesive Tape Tags and Signs.
- 19                                   2) Type G - Stenciling System.
- 20                                   b. Fastener: Self.
- 21                                   c. Legend:
- 22                                   1) Letter height: 1 IN minimum.
- 23                                   2) Description of ductwork, (e.g., "AIR SUPPLY").
- 24                                   3) Arrows: Single arrow.
- 25                                   4. Enclosure for instrumentation and control equipment, (e.g., fan control panels, etc.):
- 26                                   a. Tag type: Type C - Phenolic Name Plates.
- 27                                   b. Fastener: Screws.
- 28                                   c. Legend:
- 29                                   1) Letter height: 1/2 IN minimum.
- 30                                   2) Equipment designation as indicated on the Drawings (e.g., "FAN CONTROL
- 31                                   PANEL FCP-xxx").
- 32                                   5. Wall mounted thermostats:
- 33                                   a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
- 34                                   b. Fastener: Self.
- 35                                   c. Legend:
- 36                                   1) Letter height: 3/16 IN minimum.
- 37                                   2) Description of equipment controlled (e.g., "UH-xxx" or AHU-xxx").
- 38                                   6. Components inside equipment enclosure, (e.g., controller's, control relays, contactors, and
- 39                                   timers):
- 40                                   a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
- 41                                   b. Fastener: Self.
- 42                                   c. Legend:
- 43                                   1) Letter height: 3/16 IN minimum.
- 44                                   2) Description or function of component (e.g., "CR-xxx").
- 45                                   7. Through enclosure door mounted equipment (e.g., selector switches, controller digital
- 46                                   displays, etc.):
- 47                                   a. Tag type: Type C - Phenolic Name Plates.
- 48                                   b. Fastener: Screws.
- 49                                   c. Legend:
- 50                                   1) Letter height: 1/4 IN minimum.
- 51                                   2) Component tag number as indicated on the Drawings or as defined by contractor
- 52                                   (e.g., "HS-xxx").
- 53                                   D. Electrical Systems:
- 54                                   1. Trenches with ductbanks, direct-buried conduit, or direct-buried wire and cable.
- 55                                   a. Tag type: Type F - Underground Warning Tape.
- 56                                   b. Letter height: 1-1/4 IN minimum.
- 57                                   c. Location:
- 58                                   1) Where trench is 12 IN or more below finished grade: In trench 6 IN below finished
- 59                                   grade.
- 60                                   2) Where trench is less than 12 IN below finished grade: In trench 3 IN below finished
- 61                                   grade.

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- d. Electrical power (e.g., low and medium voltage):
    - 1) Color: Red with black letters.
    - 2) Legend:
      - a) First line: "CAUTION CAUTION CAUTION".
      - b) Second line: "BURIED ELECTRIC LINE BELOW".
  - e. Communications (e.g., telephone, instrumentation, LAN, SCADA):
    - 1) Color: Orange with black letters.
    - 2) Legend:
      - a) First line: "CAUTION CAUTION CAUTION".
      - b) Second line: "BURIED COMMUNICATION LINE BELOW".
  - 2. Exterior pad mounted equipment (e.g., transformers, switchgear):
    - a. Tag type: Type D - Self-Adhesive Tape Tags.
    - b. Fastener: Self.
    - c. General legend:
      - 1) Letter height:
        - a) First line: 1-1/2 IN minimum.
        - b) Subsequent lines: 1/2 IN minimum.
      - 2) First line: Equipment name (e.g., "GENERATOR ISOLATION TRANSFORMER FP-GIT-01").
      - 3) Second line: System voltage (e.g., "480 V: 480/277 V").
  - 3. Switchboards:
    - a. Tag type: Type C - Phenolic Name Plates.
    - b. Fastener: Screws.
    - c. Main equipment legend:
      - 1) Letter height:
        - a) First line: 1 IN minimum.
        - b) Subsequent lines: 3/8 IN minimum.
      - 2) First line: Equipment name (e.g., "SWITCHBOARD FP-SWBD-01").
      - 3) Second line:
        - a) Source of power (e.g., "FED FROM AUTOMATIC TRANSFER SWITCH FP-ATS-01 LOCATED IN ELECTRICAL ROOM FP-105").
        - b) Include the building name or number if the source is in another building.
      - 4) Third line: System voltage and phase (e.g., "480/277 V, 3PH").
    - d. Main and feeder device legend:
      - 1) Letter height: 3/8 IN minimum.
      - 2) Description of load (e.g., "MAIN DISCONNECT", "TRANSFORMER LV DIST FP-TLD-01").
  - 4. Panelboards and transformers:
    - a. Tag type: Type C - Phenolic Name Plates.
    - b. Fastener: Screws.
    - c. Legend:
      - 1) Letter height:
        - a) First line: 3/8 IN minimum.
        - b) Subsequent lines: 3/16 IN minimum.
      - 2) First line: Equipment name (e.g., "PANELBOARD FP-PLD-01" or "TRANSFORMER LV DIST FP-TLD-01").
      - 3) Second line (panelboards only): System voltage and phase (e.g., "208/120V, 3PH").
      - 4) Third line:
        - a) Source of power (e.g., "FED FROM SWITCHBOARD FP-SWBD-01 LOCATED IN ELECTRICAL ROOM FP-105").
        - b) Include the building name or number if the source is in another building.
  - 5. Transfer switches:
    - a. Tag type: Type C - Phenolic Name Plates.
    - b. Fastener: Screws.
    - c. Legend:
      - 1) Letter height:
        - a) First line: 3/8 IN minimum.
        - b) Subsequent lines: 3/16 IN minimum.
      - 2) First line: Equipment name (e.g., "AUTOMATIC TRANSFER SWITCH FP-ATS-01").

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6. Safety switches, separately mounted circuit breakers and motor starters, VFD's, etc.:
    - a. Tag type: Type C - Phenolic Name Plates.
    - b. Fastener: Screws.
    - c. Legend:
      - 1) Letter height: 1/4 IN minimum.
      - 2) First line: Description of load equipment is connected to (e.g., "PUMP FC-FLTP-01").
  7. Enclosure for instrumentation and control equipment, (e.g., pump control panels, etc.):
    - a. Tag type: Type C - Phenolic Name Plates.
    - b. Fastener: Screws.
    - c. Legend:
      - 1) Letter height: 1/2 IN minimum.
      - 2) Equipment name (e.g., "PUMP CONTROL PANEL FC-FLTPCP-01").
  8. Components inside equipment enclosures (e.g., circuit breakers, fuses, control power transformers, control relays, contactors, timers, etc.):
    - a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
    - b. Fastener: Self.
    - c. Legend:
      - 1) Letter height: 3/16 IN minimum.
      - 2) Description or function of component (e.g., "M1", "CR1" or "TR1").
  9. Through enclosure door mounted equipment (e.g., selector switches, controller digital displays, etc.):
    - a. Tag type: Type C - Phenolic Name Plates.
    - b. Fastener: Screws.
    - c. Legend:
      - 1) Letter height: 1/4 IN minimum.
      - 2) Component tag number as indicated on the Drawings or as defined by contractor (e.g., "FC-FLTP-HS1").
  10. Conductors in control panels and in pull or junction boxes where multiple circuits exist.
    - a. Tag type: Type D - Self-Adhesive Tape Tags.
    - b. Fastener: Self.
    - c. Tag conductor at both ends.
    - d. Legend:
      - 1) Letter height: 1/8 IN minimum.
      - 2) Circuit number or wire number as scheduled on the Drawings or as furnished with the equipment.
  11. Conductors in cable trays.
    - a. Tag type: Type D - Self-Adhesive Tape Tags.
    - b. Fastener: Self.
    - c. Tag all conductors at the same location in the tray at 50FT maximum intervals.
    - d. Legend:
      - 1) Letter height: 1/8 IN minimum.
      - 2) Circuit number or wire number as scheduled on the Drawings.
  12. Conductors in handholes and manholes.
    - a. Tag type: Type A3 - Metal Tape Tags.
    - b. Fastener: Nylon strap.
    - c. Tag conductor at both ends.
    - d. Legend:
      - 1) Letter height: 1/8 IN minimum.
      - 2) Circuit number or wire number as scheduled on the Drawings.
  13. Grounding conductors associated with grounding electrode system in accordance with the following:
    - a. Tag type: Type D - Self-Adhesive Tape Tags.
    - b. Fastener: Self.
    - c. Legend:
      - 1) Letter height: 1/8 IN minimum.
      - 2) Function of conductor (e.g., "MAIN BONDING JUMPER", "TO GROUND RING", "TO MAIN WATER PIPE").
  14. Flash protection for switchboards, panelboards, industrial control panels and motor control centers:
    - a. Tag type: Type D - Self-Adhesive Tape Signs.
    - b. Fastener: Self.

- 1 c. Legend: Per NFPA 70.  
2  
3 15. Cable trays:  
4 a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.  
5 b. Fastener: Self.  
6 c. Size: 1-3/4 IN x 2-1/2 IN.  
7 d. Location:  
8 1) Every 50 FT maximum.  
9 2) Label each barriered section of tray, see section 16132.  
10 e. Legend:  
11 1) OSHA Danger Sign.  
12 16. Entrances to electrical rooms:  
13 a. Tag type: Type B2 - Nonmetallic Signs.  
14 b. Fastener: Screw or adhesive.  
15 c. Size: 5 IN x 7 IN.  
16 d. Location: Each door to room.  
17 e. Legend:  
18 1) OSHA Danger Sign.  
19 2) Description of Danger: "HIGH VOLTAGE, AUTHORIZED PERSONNEL ONLY".  
20 17. Equipment where more than one (1) voltage source is present:  
21 a. Tag type:  
22 1) Type B2 - Nonmetallic Signs.  
23 2) Type D - Self-Adhesive Tape Signs.  
24 b. Fastener:  
25 1) Screw or adhesive.  
26 2) Self.  
27 c. Size: 1-3/4 IN x 2-1/2 IN.  
28 d. Location: Exterior face of enclosure or cubical.  
29 e. Legend:  
30 1) OSHA Danger Sign.  
31 2) Description of Danger: "MULTIPLE VOLTAGE SOURCES".

**END OF SECTION**



1 2012/06/11

2 **SECTION 10444**  
3 **SIGNAGE**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
- 7 1. Room identification signs.
  - 8 2. Plaque.
- 9 B. Related Specification Sections include but are not necessarily limited to:
- 10 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
  - 11 2. Division 01 - General Requirements.
  - 12 3. Section 10400 - Identification Devices.

13 **1.2 QUALITY ASSURANCE**

- 14 A. Referenced Standards:
- 15 1. Americans with Disabilities Act (ADA):
    - 16 a. Accessibility Guidelines for Buildings and Facilities (ADAAG).
  - 17 2. Building Code:
    - 18 a. International Code Council (ICC):
      - 19 1) International Building Code and associated standards, 2006 Edition including all
      - 20 amendments, referred to herein as Building Code.

21 **1.3 DEFINITIONS**

- 22 A. Wet and/or Corrosive Areas: For the purposes of this Specification Section, the entire facility is
- 23 considered wet and/or corrosive:

24 **1.4 SUBMITTALS**

- 25 A. Shop Drawings:
- 26 1. See Specification Section 01340 for requirements for the mechanics and administration of
  - 27 the submittal process.
  - 28 2. Product technical data including:
    - 29 a. Acknowledgement that products submitted meet requirements of standards referenced.
    - 30 b. Manufacturer's installation instructions.
    - 31 c. Color charts for Engineer's color selection.
      - 32 1) Color selection shall be made from manufacturer's complete color line including all
      - 33 premium and special colors.
  - 34 3. Schedule of all signs indicating text and graphics.
  - 35 4. Layout Drawings of all signage showing size, letter style, text, border, finish, and installation
  - 36 detail.
- 37 B. Samples:
- 38 1. Room identification signs.
  - 39 2. Plaques.

40 **PART 2 - PRODUCTS**

41 **2.1 ACCEPTABLE MANUFACTURERS**

- 42 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 43 1. Room identification signs:
    - 44 a. Andco.
    - 45 b. ASE - Architectural Signs and Engraving.
    - 46 c. ASI Sign Systems.

- 1 d. Best Manufacturing Co.
- 2 e. Mohawk Engraving Co., Inc.
- 3 f. Nelson-Harkins.
- 4 g. Southwell.
- 5 h. The Supersine Co.
- 6 2. Plaque:
- 7 a. Andco.
- 8 b. ARK-Ramos.
- 9 c. Metal Arts.
- 10 d. Metallic Arts.
- 11 B. Submit request for substitution in accordance with Specification Section 01640.

12 **2.2 MATERIALS**

- 13 A. Room Identification Signs: Aluminum or fiberglass suitable for raised lettering and Braille.
- 14 B. Plaque: Cast Bronze.

15 **2.3 FABRICATION**

- 16 A. Room Identification Signs:
- 17 1. General:
- 18 a. Raised text, border and graphics.
- 19 1) Minimum 1/32 IN height.
- 20 2) Provide international graphic symbology for all stairs.
- 21 b. Grade 2 Braille.
- 22 c. Finish: Eggshell.
- 23 1) Color: To be selected.
- 24 d. Text:
- 25 1) Typeface: Sans Serif.
- 26 2) Size: Minimum 3/4 IN high.
- 27 e. Text as indicated in the SCHEDULES Article in PART 3 of this Specification Section.
- 28 f. All signs shall comply with requirements of ADA.
- 29 2. Stair Identification Signs:
- 30 a. Minimum 18 IN by 12 IN sign:
- 31 1) Raised text, border and graphics height: Minimum 1/32 IN.
- 32 B. Hazard Communication Signage (OSHA signage): See Specification Section 10400.
- 33 C. Plaque:
- 34 1. Cast one-piece unit complete with mounting device.
- 35 2. Size: 24 IN by 36 IN.
- 36 3. Text, border and text style to be determined.

37 **2.4 MAINTENANCE MATERIALS**

- 38 A. Where stenciled markers are provided, clean and retain stencils after completion and include in
- 39 extra stock, along with required stock of paints and applicators.

40 **PART 3 - EXECUTION**

41 **3.1 INSTALLATION**

- 42 A. Room Identification Signs:
- 43 1. Install signs on walls adjacent to the latch side of doors using stainless steel screws
- 44 (minimum of two (2)).
- 45 a. Stainless steel screws shall be painted to match sign color.
- 46 2. Where no adjacent wall space is available, mount signs on nearest adjacent wall.
- 47 a. Mounting of signs shall be such that a person may approach to within 3 IN of sign
- 48 without encountering any protruding objects or standing in swing of door travel.
- 49 3. Mount 60 IN above finish floor to centerline of sign.
- 50 B. Plaque location to be determined by Owner.

1 **3.2 SCHEDULES**

2 A. Room Identification Signs:  
3

BUILDING LOCATION	MOUNTING	VERBIAGE	REMARKS
FILTER BUILDING			
DOOR FP-001A	EXTERIOR	AUTHORIZED PERSONNEL ONLY	2
DOOR FP-002A	EXTERIOR	AUTHORIZED PERSONNEL ONLY	2
DOOR FP-002C	INTERIOR	STAIR – NOT AN EXIT	1, 3
DOOR FP-002D	INTERIOR	STAIR	1, 3
DOOR FP-002F	INTERIOR	STAIR	1, 3
FILTER CHEMICAL ADDITION			
DOOR FC-101A	EXTERIOR	AUTHORIZED PERSONNEL ONLY	2
DOOR FC-102A	INTERIOR	CHEMICAL FEED ROOM	3
DOOR FC-103A	INTERIOR	FLUORIDE FEED ROOM	2
DOOR FC-104A	INTERIOR	STAIR – NOT AN EXIT	1, 2
REMARKS:			
1. Provide Universal Graphic Symbology.			
2. Mount adjacent to pull side of door.			
3. Mount adjacent to push side of door.			

4

5

6

**END OF SECTION**





DIVISION 11  
EQUIPMENT





1 2014/09/15

2

3

**SECTION 11005**  
**EQUIPMENT: BASIC REQUIREMENTS**

4

**PART 1 - GENERAL**

5

**1.1 SUMMARY**

6

A. Section Includes:

7

1. Requirements of this Specification Section apply to all equipment provided on the Project including those found in other Divisions even if not specifically referenced in individual "Equipment" Articles of those Specification Sections.

8

9

10

B. Related Specification Sections include but are not necessarily limited to:

11

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

12

2. Division 01 - General Requirements.

13

3. Section 03308 - Concrete, Materials and Proportioning.

14

4. Section 05505 - Metal Fabrications.

15

5. Section 06610 - Fiberglass Reinforced Plastic Fabrications.

16

6. Section 07900 - Joint Sealants.

17

7. Section 09960 - High Performance Industrial Coatings.

18

8. Section 10400 - Identification Devices.

19

9. Division 11 - Equipment.

20

10. Section 13442 - Primary Elements and Transmitters.

21

11. Division 14 - Conveying Systems.

22

12. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.

23

13. Division 16 - Electrical.

24

**1.2 QUALITY ASSURANCE**

25

A. Referenced Standards:

26

1. American Bearing Manufacturers Association (ABMA).

27

2. American Gear Manufacturers Association (AGMA).

28

3. ASTM International (ASTM):

29

- a. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

30

4. International Electrotechnical Commission (IEC).

31

5. Institute of Electrical and Electronics Engineers, Inc. (IEEE).

32

6. National Electrical Manufacturers Association (NEMA):

33

- a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

34

- b. ICS 6, Enclosures for Industrial Control and System.

35

- c. MG 1, Motors and Generators.

36

7. InterNational Electrical Testing Association (NETA):

37

- a. ATS, Acceptance Testing Specification for Electrical Power Distribution Equipment and Systems.

38

8. National Fire Protection Association (NFPA):

39

- a. 70, National Electrical Code (NEC):

40

- 1) Article 430, Motors, Motor Circuits, and Controllers.

41

9. National Institute for Certification in Engineering Technologies (NICET).

42

10. National Institute of Standards and Technology (NIST).

43

11. Occupational Safety and Health Administration (OSHA):

44

- a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.

45

12. Underwriters Laboratories, Inc. (UL).

46

- a. 508, Standard for Safety Industrial Control Equipment.

47

- b. 508A, Standard for Safety Industrial Control Panels.

48

49

B. Electrical Equipment and Connections Testing Program:

50

1. Testing firm:

51

- a. An independent firm performing, as the sole or principal part of its business for a minimum of 10 years, the inspection, testing, calibration, and adjusting of systems.

52

53

- 1                   b. Must have an established monitoring and testing equipment calibration program with
- 2                   accuracy traceable in an unbroken chain, according to NIST.
- 3                   2. Field personnel:
- 4                   a. Minimum of one (1) year field experience covering all phases of electrical equipment
- 5                   inspection, testing, and calibration.
- 6                   b. Relay test technician having previous experience with testing and calibration of relays of
- 7                   the same manufacturer and type used on project and proficient in setting and testing the
- 8                   types of protection elements used.
- 9                   c. Supervisor certified by NETA or NICET.
- 10                  3. Analysis personnel:
- 11                  a. Minimum three (3) years combined field testing and data analysis experience.
- 12                  b. Supervisor certified by NETA or NICET.
- 13                  C. Miscellaneous:
- 14                  1. A single manufacturer of a "product" to be selected and utilized uniformly throughout Project
- 15                  even though:
- 16                  a. More than one (1) manufacturer is listed for a given "product" in Specifications.
- 17                  b. No manufacturer is listed.
- 18                  2. Equipment, electrical assemblies, related electrical wiring, instrumentation, controls, and
- 19                  system components shall fully comply with specific NEC requirements related to area
- 20                  classification and to NEMA 250 and NEMA ICS 6 designations shown on Electrical Power
- 21                  Drawings.
- 22                  3. Variable speed equipment applications: The driven equipment manufacturer shall have
- 23                  single source responsibility for coordination of the equipment and VFD system and sure their
- 24                  compatibility.

### 25   1.3   DEFINITIONS

- 26                  A. Product: Manufactured materials and equipment.
- 27                  B. Major Equipment Supports - Supports for Equipment:
- 28                  1. Located on or suspended from elevated slabs with supported equipment weighing 2000 LBS
- 29                  or greater, or;
- 30                  2. Located on or suspended from roofs with supported equipment weighing 500 LBS or greater,
- 31                  or;
- 32                  3. Located on slab-on-grade or earth with supported equipment weighing 5000 LBS or more.
- 33                  C. Equipment:
- 34                  1. One (1) or more assemblies capable of performing a complete function.
- 35                  2. Mechanical, electrical, instrumentation or other devices requiring an electrical, pneumatic,
- 36                  electronic or hydraulic connection.
- 37                  3. Not limited to items specifically referenced in "Equipment" articles within individual
- 38                  Specifications.
- 39                  D. Installer or Applicator:
- 40                  1. Installer or applicator is the person actually installing or applying the product in the field at the
- 41                  Project site.
- 42                  2. Installer and applicator are synonymous.

### 43   1.4   SUBMITTALS

- 44                  A. Shop Drawings:
- 45                  1. General for all equipment:
- 46                  a. See Specification Section 01340 for requirements for the mechanics and administration
- 47                  of the submittal process.
- 48                  b. Data sheets that include manufacturer's name and complete product model number.
- 49                  1) Clearly identify all optional accessories that are included.
- 50                  c. Acknowledgement that products submitted comply with the requirements of the
- 51                  standards referenced.
- 52                  d. Manufacturer's delivery, storage, handling, and installation instructions.
- 53                  e. Equipment identification utilizing numbering system and name utilized in Drawings.
- 54                  f. Equipment installation details:
- 55                  1) Location of anchorage.
- 56                  2) Type, size, and materials of construction of anchorage.
- 57                  3) Anchorage setting templates.



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- 4) Manufacturer's installation instructions.
  - g. Equipment area classification rating.
  - h. Shipping and operating weight.
  - i. Equipment physical characteristics:
    - 1) Dimensions (both horizontal and vertical).
    - 2) Materials of construction and construction details.
  - j. Equipment factory primer and paint data.
  - k. Manufacturer's recommended spare parts list.
  - l. Equipment lining and coatings.
  - m. Equipment utility requirements include air, natural gas, electricity, and water.
  - n. Ladders and platforms provided with equipment:
    - 1) Certification that all components comply fully with OSHA requirements.
    - 2) Full details of construction/fabrication.
    - 3) Scaled plan and sections showing relationship to equipment.
  - 2. Mechanical and process equipment:
    - a. Operating characteristics:
      - 1) Technical information including applicable performance curves showing specified equipment capacity, rangeability, and efficiencies.
      - 2) Brake horsepower requirements.
      - 3) Copies of equipment data plates.
    - b. Piping and duct connection size, type and location.
    - c. Equipment bearing life certification.
    - d. Equipment foundation data:
      - 1) Equipment center of gravity.
      - 2) Criteria for designing vibration, special or unbalanced forces resulting from equipment operation.
  - 3. Electric motor:
    - a. Motor manufacturer and model number.
    - b. Complete motor nameplate data.
    - c. Weight.
    - d. NEMA design type.
    - e. Enclosure type.
    - f. Frame size.
    - g. Winding insulation class and temperature rise.
    - h. Starts per hour.
    - i. Bearing data and lubrication system.
    - j. Fabrication and/or layout drawings:
      - 1) Dimensioned outlined drawing.
      - 2) Connection diagrams including accessories (strip heaters, thermal protection, etc.).
    - k. Certifications:
      - 1) When utilized with a reduced voltage starter, certify that motor and driven equipment are compatible.
      - 2) When utilized with a variable frequency controller, certify motor is inverter duty and the controller and motor are compatible.
        - a) Include minimum speed at which the motor may be operated for the driven machinery.
    - l. Electrical gear:
      - 1) Unless specified in a narrow-scope Specification Section, provide the following:
        - a) Equipment ratings: Voltage, continuous current, kVa, watts, short circuit with stand, etc., as applicable.
      - 2) Control panels:
        - a) Panel construction.
        - b) Point-to-point ladder diagrams.
        - c) Scaled panel face and subpanel layout.
        - d) Technical product data on panel components.
        - e) Panel and subpanel dimensions and weights.
        - f) Panel access openings.
        - g) Nameplate schedule.
        - h) Panel anchorage.
  - 4. Systems schematics and data:
    - a. Provide system schematics where required in system specifications.
      - 1) Acknowledge all system components being supplied as part of the system.

- 1 2) Utilize equipment, instrument and valving tag numbers defined in the Contract
- 2 Documents for all components.
- 3 3) Provide technical data for each system component showing compliance with the
- 4 Contract Document requirements.
- 5 4) For piping components, identify all utility connections, vents and drains which will be
- 6 included as part of the system.
- 7 5. For factory painted equipment, provide paint submittals in accordance with Specification
- 8 Section 09960.
- 9 6. Qualifications for :
- 10 a. Electrical equipment and connections testing firm and personnel.
- 11 7. Testing plans, in accordance with PART 3 of this Specification Section:
- 12 a. Electrical equipment and connection testing.
- 13 B. Operation and Maintenance Manuals:
- 14 1. See Specification Section 01 3304 for requirements for:
- 15 a. The mechanics and administration of the submittal process.
- 16 b. The content of Operation and Maintenance Manuals.
- 17 C. Informational Submittals:
- 18 1. Sample form letter for equipment field certification.
- 19 2. Certification that equipment has been installed properly, has been initially started up, has
- 20 been calibrated and/or adjusted as required, and is ready for operation.
- 21 3. Certification for major equipment supports that equipment foundation design loads shown on
- 22 the Drawings or specified have been compared to actual loads exhibited by equipment
- 23 provided for this Project and that said design loadings are equal to or greater than the loads
- 24 produced by the equipment provided.
- 25 4. Field noise testing reports if such testing is specified in narrow-scope Specification Sections.
- 26 5. Notification, at least one (1) week in advance, that motor testing will be conducted at factory.
- 27 6. Certification from equipment manufacturer that all manufacturer-supplied control panels that
- 28 interface in any way with other controls or panels have been submitted to and coordinated
- 29 with the supplier/installer of those interfacing systems.
- 30 7. Motor test reports.
- 31 8. Certification prior to Project closeout that electrical panel drawings for manufacturer-supplied
- 32 control panels truly represent panel wiring including any field-made modifications.
- 33 9. Preliminary field quality control testing format to be used as a basis for final field quality
- 34 control reporting.
- 35 10. Testing and monitoring reports in accordance with PART 3 of this Specification Section.
- 36 11. Certification that driven equipment and VFD are compatible.

## 37 **PART 2 - PRODUCTS**

### 38 **2.1 ACCEPTABLE MANUFACTURERS**

- 39 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 40 1. Motors:
- 41 a. Baldor.
- 42 b. General Electric.
- 43 c. Marathon Electric.
- 44 d. Reliance Electric.
- 45 e. Siemens.
- 46 f. Teco-Westinghouse.
- 47 g. U.S. Motors.
- 48 h. WEG.
- 49 2. Mechanical variable speed drives:
- 50 a. Reeves.
- 51 b. U.S. Motors (VariDrive).
- 52 B. Submit request for substitution in accordance with Specification Section 01640.

1 **2.2 MANUFACTURED UNITS**

2 A. General:

- 3 1. Furnished equipment manufacturer's field quality control services and testing as specified in  
4 the individual equipment Specification Sections.  
5 2. Execute pre-demonstration requirements in accordance with Specification Section 01650.  
6 3. Perform and report on all tests required by the equipment manufacturer's Operation and  
7 Maintenance Manual.  
8 4. Provide testing of electrical equipment and connections in accordance with Division 16.  
9 5. Equip testing and analysis personnel with all appropriate project related reference material  
10 required to perform tests, analyze results, and provide documentation including, but not  
11 limited to:  
12 a. Contract Drawings and Specifications.  
13 b. Related construction change documentation.  
14 c. Approved Shop Drawings.  
15 d. Approved Operation and Maintenance Manuals.  
16 e. Other pertinent information as required.

17 B. Equipment Monitoring and Testing Plans:

- 18 1. Approved in accordance with Shop Drawing submittal schedule.  
19 2. Included as a minimum:  
20 a. Qualifications of firm, field personnel, and analysis personnel doing the Work.  
21 b. List and description of testing and analysis equipment to be utilized.  
22 c. List of all equipment to be testing, including:  
23 1) Name and tag numbers identified in the Contract Documents.  
24 2) Manufacturer's serial numbers.  
25 3) Other pertinent manufacturer identification,

26 C. Instruments Used in Equipment and Connections Quality Control Testing:

- 27 1. Minimum calibration frequency:  
28 a. Field analog instruments: Not more than 6 months.  
29 b. Field digital instruments: Not more than 12 months.  
30 c. Laboratory instruments: Not more than 12 months.  
31 d. If instrument manufacturer's calibration requirements are more stringent, those  
32 requirements shall govern.  
33 2. Carry current calibration status and labels on all testing instruments.  
34 3. See individual testing programs for additional instrumentation compliance requirements.

35 D. Testing and Monitoring Program Documentation:

- 36 1. Provide reports with tabbed sections for each piece of equipment tested.  
37 2. Include all testing results associated with each piece of equipment under that equipment's  
38 tabbed section.  
39 a. Include legible copies of all forms used to record field test information.  
40 3. Prior to start of testing, submit one (1) copy of preliminary report format for Engineer review  
41 and comment  
42 a. Include data gathering and sample test report forms that will be utilized.  
43 4. In the final report, include as a minimum, the following information for all equipment tested:  
44 a. Equipment identification, including:  
45 1) Name and tag numbers identified in the Contract Documents.  
46 2) Manufacturer's serial numbers.  
47 3) Other pertinent manufacturer identification,  
48 b. Date and time of each test.  
49 c. Ambient conditions including temperature, humidity, and precipitation.  
50 d. Visual inspection report.  
51 e. Description of test and referenced standards, if any, followed while conducting tests.  
52 f. Results of initial and all retesting.  
53 g. Acceptance criteria.  
54 h. "As found" and "as left" conditions.  
55 i. Corrective action, if required, taken to meet acceptance.  
56 j. Verification of corrective action signed by the Contractor, equipment supplier, and  
57 Owner's representative.  
58 k. Instrument calibration dates of all instruments used in testing.  
59 5. Provide three (3) bound final reports prior to Project final completion.

- 1 E. Other Testing:
- 2 1. Perform tests and inspections not specifically listed but required to assure equipment is safe
- 3 to energize and operate.
- 4 2. Subbase that supports the equipment base and that is made in the form of a cast iron or
- 5 steel structure that has supporting beams, legs, and cross members that are cast, welded, or
- 6 bolted shall be tested for a natural frequency of vibration after equipment is mounted.
- 7 a. The ratio of the natural frequency of the structure to the frequency of the disturbing force
- 8 shall not be between 0.5 and 1.5.
- 9 F. Electric Motors:
- 10 1. Where used in conjunction with adjustable speed AC or DC drives, provide motors that are
- 11 fully compatible with the speed controllers.
- 12 2. Design for frequent starting duty equivalent to duty service required by driven equipment.
- 13 3. Design for full voltage starting.
- 14 4. Design bearing life based upon actual operating load conditions imposed by driven
- 15 equipment.
- 16 5. Size for altitude of Project.
- 17 6. Furnish with stainless steel nameplates which include all data required by NEC Article 430.
- 18 7. Use of manufacturer's standard motor will be permitted on integrally constructed motor
- 19 driven equipment specified by model number in which a redesign of the complete unit would
- 20 be required in order to provide a motor with features specified.
- 21 8. AC electric motors less than 1/3 HP:
- 22 a. Single phase, 60 Hz, designed for the supply voltage shown on the Drawings.
- 23 b. Permanently lubricated sealed bearings conforming to ABMA standards.
- 24 c. Built-in manual reset thermal protector or integrally mounted manual motor starter with
- 25 thermal overload element with stainless steel enclosure.
- 26 9. AC electric motors 1/3 to 1 HP:
- 27 a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
- 28 b. Permanently lubricated sealed bearings conforming to ABMA standards.
- 29 1) For single phase motors, provide built-in manual reset thermal protector or integrally
- 30 mounted manual motor starter with thermal overload element.
- 31 10. AC electric motors 1-1/2 to 10 HP:
- 32 a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
- 33 b. Permanently lubricated sealed bearings conforming to ABMA standards.
- 34 c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA
- 35 standards.
- 36 11. AC electric motors greater than 10 HP:
- 37 a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
- 38 b. Oil or grease lubricated antifriction bearings conforming to ABMA standards.
- 39 1) Design bearing life for 90 percent survival rating at 50,000 HRS of operation for
- 40 motors up to and including 100 HP.
- 41 2) For motors greater than 100 HP, design bearing life for 90 percent survival rating at
- 42 100,000 HRS of operation.
- 43 c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA
- 44 standards.
- 45 12. Severe duty motor to have the following minimum features:
- 46 a. All cast iron construction.
- 47 b. Gasketed conduit box.
- 48 c. Epoxy finish for corrosion protection.
- 49 d. Hydrosopic varnish on windings for corrosion protection.
- 50 e. Drain plug and breather.
- 51 G. NEMA Design Squirrel Cage Induction Motors:
- 52 1. Provide motors designed and applied in compliance with NEMA and IEEE for the specific
- 53 duty imposed by the driven equipment.
- 54 2. Motors to meet NEMA MG 1 (NEMA Premium) efficiencies.
- 55 3. Do not provide motors having a locked rotor kVA per HP exceeding the NEMA standard for
- 56 the assigned NEMA code letter.
- 57 4. For use on variable frequency type adjustable speed drives, provide:
- 58 a. Induction motors that are in compliance with NEMA MG 1, Part 31.
- 59 b. Nameplate identification meeting NEMA MG 1 Part 31 requirements.
- 60 c. Insulated drive end bearing on all motors.

- 1 d. Shaft grounding ring on all motors:
- 2 1) Factory installed, maintenance free, circumferential, bearing protection ring with
- 3 conductive microfiber shaft contacting material.
- 4 2) Electro Static Technology AEGIS SGR Bearing Protection Ring or approved equal.
- 5 5. Design motor insulation in accordance with NEMA standards for Class F insulation with
- 6 Class B temperature rise above a 40 DegC ambient.
- 7 6. Design motors for continuous duty.
- 8 7. Size motors having a 1.0 service factor so that nameplate HP is a minimum of 15 percent
- 9 greater than the maximum HP requirements of the driven equipment over its entire operating
- 10 range.
- 11 a. As an alternative, furnish motors with a 1.15 service factor and size so that nameplate
- 12 HP is at least equal to the maximum HP requirements of the driven equipment over its
- 13 entire operating range.
- 14 8. Motor enclosure and winding insulation application:
- 15 a. The following shall apply unless modified by specific Specification Sections:
- 16

MOTOR LOCATION	MOTOR ENCLOSURE / WINDING INSULATION
Wet indoor Areas	TEFC, Standard Insulation
Wet outdoor Areas	TEFC, Extra Dip and Bake for Moisture
Corrosive Areas	TEFC, Severe/ Chemical Duty

17  
18 NOTE: Provide TENV motors in the smaller horsepower ratings where TEFC is not available.

- 19
- 20 9. Provide oversize conduit box complete with clamp type grounding terminals inside the
- 21 conduit box.

22 **2.3 ACCESSORIES**

- 23 A. Guards:
- 24 1. Provide each piece of equipment having exposed moving parts with full length, easily
- 25 removable guards, meeting OSHA requirements.
- 26 2. Interior applications:
- 27 a. Construct from expanded galvanized steel rolled to conform to shaft or coupling surface.
- 28 b. Utilize non-flattened type 16 GA galvanized steel with nominal 1/2 IN spacing.
- 29 c. Connect to equipment frame with hot-dip galvanized bolts and wing nuts.
- 30 3. Exterior applications:
- 31 a. Construct from 16 GA stainless steel or aluminum.
- 32 b. Construct to preclude entrance of rain, snow, or moisture.
- 33 c. Roll to conform to shaft or coupling surface.
- 34 d. Connect to equipment frame with stainless steel bolts and wing nuts.
- 35 B. Anchorage:
- 36 1. Cast-in-place anchorage:
- 37 a. Provide ASTM F593, Type 316 stainless steel anchorage for all equipment.
- 38 b. Configuration and number of anchor bolts shall be per manufacturer's
- 39 recommendations.
- 40 c. Provide two (2) nuts for each bolt.
- 41 2. Drilled anchorage:
- 42 a. Adhesive anchors per Specification Section 05505.
- 43 b. Epoxy grout per Specification Section 03308.
- 44 c. Threaded rods same as cast-in-place.
- 45 C. Data Plate:
- 46 1. Attach a stainless steel data plate to each piece of rotary or reciprocating equipment.
- 47 2. Permanently stamp information on data plate including manufacturer's name, equipment
- 48 operating parameters, serial number and speed.
- 49 D. Gages:
- 50 1. Provide gages in accordance with Specification Section 13442.

- 1                   2. Provide at the following locations:
- 2                   a. Inlet and outlet of all reciprocating, centrifugal and positive displacement mechanical and
- 3                   process equipment.
- 4                   b. At locations identified on Drawings.
- 5                   3. Utilize tapping sleeves for mounting per Specification Section 15060.
- 6                   E. Lifting Eye Bolts or Lugs:
- 7                   1. Provide on all equipment 50 LBS or greater.
- 8                   2. Provide on other equipment or products as specified in the narrow-scope Specification
- 9                   Sections.
- 10                  F. Platforms and Ladders:
- 11                  1. Design and fabricate in accordance with OSHA Standards.
- 12                  2. Fabricate components from materials as required in:
- 13                  a. Section 05505 and Section 06610.
- 14                  3. Provide platform surface: Non-skid grating, unless specified in narrow-scope Specification
- 15                  Sections.

## 16   **2.4 FABRICATION**

- 17                  A. Design, fabricate, and assemble equipment in accordance with modern engineering and shop
- 18                  practices.
- 19                  B. Manufacture individual parts to standard sizes and gages so that repair parts, furnished at any
- 20                  time, can be installed in field.
- 21                  C. Furnish like parts of duplicate units to be interchangeable.
- 22                  D. Ensure that equipment has not been in service at any time prior to delivery, except as required by
- 23                  tests.
- 24                  E. Furnish equipment which requires periodic internal inspection or adjustment with access panels
- 25                  which will not require disassembly of guards, dismantling of piping or equipment or similar major
- 26                  efforts.
- 27                  1. Quick opening but sound, securable access ports or windows shall be provided for inspection
- 28                  of chains, belts, or similar items.
- 29                  F. Provide common, lipped base plate mounting for equipment and equipment motor where said
- 30                  mounting is a manufacturer's standard option.
- 31                  1. Provide drain connection for 3/4 IN PVC tubing.
- 32                  G. Machine the mounting feet of rotating equipment.
- 33                  H. Critical Speed:
- 34                  1. All rotating parts accurately machined and in as near perfect rotational balance as
- 35                  practicable.
- 36                  2. Excessive vibration is sufficient cause for equipment rejection.
- 37                  3. Ratio of all rotative speeds to critical speed of a unit or components: Greater than 1.2.
- 38                  I. Control Panels Engineered and Provided with the Equipment by the Manufacturer:
- 39                  1. Manufacturer's standard design for components and control logic unless specific
- 40                  requirements are specified in the specific equipment Specification Section.
- 41                  2. NEMA or IEC rated components are acceptable, whichever is used in the manufacturer's
- 42                  standard engineered design, unless specific requirements are required in the specific
- 43                  equipment Specification Section.
- 44                  3. Affix entire assembly with a UL 508A label "Listed Enclosed Industrial Control Panel" prior to
- 45                  delivery.
- 46                  a. Control panels without an affixed UL 508A label shall be rejected.

## 47   **2.5 SHOP OR FACTORY PAINT FINISHES**

- 48                  A. Electrical Equipment:
- 49                  1. Provide factory-applied paint coating system(s) for all electrical equipment components
- 50                  except those specified in Specification Section 09960 to receive field painting.
- 51                  a. Field painted equipment: See Specification Section 09960 for factory applied
- 52                  primer/field paint compatibility requirements.

- 1 B. Field paint other equipment in accordance with Specification Section 09960.  
2 1. See Specification Section 09960 for factory applied primer/field paint compatibility  
3 requirements.

## 4 2.6 SOURCE QUALITY CONTROL

- 5 A. Motor Tests:  
6 1. Test motors in accordance with NEMA and IEEE standards.  
7 2. Provide routine test for all motors.

## 8 PART 3 - EXECUTION

### 9 3.1 INSTALLATION

- 10 A. Install equipment as shown on Drawings and in accordance with manufacturer's directions.  
11 B. Utilize templates for anchorage placement for slab-mounted equipment.  
12 C. For equipment having drainage requirements such as seal water, provide 3/4 IN PVC or clear  
13 plastic tubing from equipment base to nearest floor or equipment drain.  
14 1. Route clear of major traffic areas and as approved by Engineer.  
15 D. DO NOT construct foundations until major equipment supports are approved.  
16 E. Extend all non-accessible grease fittings using stainless steel tubing to a location which allows  
17 easy access of fittings from closest operating floor level.  
18 F. Equipment Base:  
19 1. Construct level in both directions.  
20 2. Take particular care at anchor bolt locations so these areas are flat and level.  
21 G. Machine Base:  
22 1. Mount machine base of rotating equipment on equipment base.  
23 a. Level in both directions, using a machinist level, according to machined surfaces on  
24 base.  
25 2. Level machine base on equipment base and align couplings between driver and driven unit  
26 using steel blocks and shims.  
27 a. Size blocks and shims to provide solid support at each mounting bolt location.  
28 1) Provide area size of blocks and shims approximately 1-1/2 times area support  
29 surface at each mounting bolt point.  
30 b. Provide blocks and shims at each mounting bolt.  
31 1) Furnish blocks and shims that are square shape with "U" cut out to allow blocks and  
32 shims to be centered on mounting bolts.  
33 c. After all leveling and alignment has been completed and before grouting, tighten  
34 mounting bolts to proper torque value.  
35 H. Couplings:  
36 1. Align in the annular and parallel positions.  
37 a. For equipment rotating at 1200 rpm or less, align both annular and parallel within 0.001  
38 IN tolerance for couplings 4 IN size and smaller.  
39 1) Couplings larger than 4 IN size: Increase tolerance 0.0005 IN per inches of  
40 coupling diameter, i.e., allow 6 IN coupling 0.002 IN tolerance, and allow a 10 IN  
41 coupling 0.004 IN tolerance.  
42 b. For equipment rotating at speeds greater than 1200 rpm allow both annular and parallel  
43 positions within a tolerance rate of 0.00025 IN per inch coupling diameter.  
44 2. If equipment is delivered as a mounted unit from factory, verify factory alignment on site after  
45 installation and realigned if necessary.  
46 3. Check surfaces for runout before attempting to trim or align units.  
47 I. Grouting:  
48 1. After machine base has been shimmed, leveled onto equipment base, couplings aligned and  
49 mounting bolts tightened to correct torque value, place a dam or formwork around base to  
50 contain grouting between equipment base and equipment support pad.  
51 a. Extend dam or formwork to cover leveling shims and blocks.  
52 b. Do not use nuts below the machine base to level the unit.

- 1 2. Saturate top of roughened concrete subbase with water before grouting.
- 2 a. Add grout until entire space under machine base is filled to the top of the base
- 3 underside.
- 4 b. Puddle grout by working a stiff wire through the grout and vent holes to work grout in
- 5 place and release any entrained air in the grout or base cavity.
- 6 3. When the grout has sufficiently hardened, remove dam or formwork and finish the exposed
- 7 grout surface to fine, smooth surface.
- 8 a. Cover exposed grout surfaces with wet burlap and keep covering sufficiently wet to
- 9 prevent too rapid evaporation of water from the grout.
- 10 b. When the grout has fully hardened (after a minimum of seven (7) days) tighten all
- 11 anchor bolts to engage equipment base to grout, shims, and equipment support pad.
- 12 c. Recheck driver-driven unit for proper alignment.

### 13 3.2 INSTALLATION CHECKS

- 14 A. For all equipment specifically required in detailed specifications, secure services of experienced,
- 15 competent, and authorized representative(s) of equipment manufacturer to visit site of work and
- 16 inspect, check, adjust and approve equipment installation.
- 17 1. In each case, representative(s) shall be present during placement and start-up of equipment
- 18 and as often as necessary to resolve any operational issues which may arise.
- 19 B. Secure from equipment manufacturer's representative(s) a written report certifying that
- 20 equipment:
- 21 1. Has been properly installed and lubricated.
- 22 2. Is in accurate alignment.
- 23 3. Is free from any undue stress imposed by connecting piping or anchor bolts.
- 24 4. Has been operated under full load conditions and that it operated satisfactorily.
- 25 a. Secure and deliver a field written report to Owner immediately prior to leaving jobsite.
- 26 C. No separate payment shall be made for installation checks.
- 27 1. All or any time expended during installation check does not qualify as Operation and
- 28 Maintenance training or instruction time when specified.

### 29 3.3 IDENTIFICATION OF EQUIPMENT AND HAZARD WARNING SIGNS

- 30 A. Identify equipment and install hazard warning signs in accordance with Specification Section
- 31 10400.

### 32 3.4 FIELD PAINTING AND PROTECTIVE COATINGS

- 33 A. For required field painting and protective coatings, comply with Specification Section 09960.

### 34 3.5 WIRING CONNECTIONS AND TERMINATION

- 35 A. Clean wires before installing lugs and connectors.
- 36 B. Terminate motor circuit conductors with copper lugs bolted to motor leads.
- 37 C. Tape stripped ends of conductors and associated connectors with electrical tape.
- 38 1. Wrapping thickness shall be 150 percent of the conductor insulation thickness.
- 39 D. Connections to carry full ampacity of conductors without temperature rise.
- 40 E. Terminate spare conductors with electrical tape.

### 41 3.6 FIELD QUALITY CONTROL

- 42 A. Furnish equipment manufacturer services as specified in the individual equipment Specifications.
- 43 B. Inspect wire and connections for physical damage and proper connection.
- 44 C. Bump motor to check for correct rotation:
- 45 1. Ensure motor has been lubricated.
- 46 2. Check prior to connection to driven equipment.



- 1 D. Subbase that supports the equipment base and that is made in the form of a cast iron or steel  
2 structure that has supporting beams, legs and cross member that are cast welded or bolted, shall  
3 be tested for a natural frequency of vibration after equipment is mounted.  
4 1. Keep the ratio of the natural frequency of the structure to the frequency of the disturbing  
5 force out of the range from 0.5 to 1.5.

6 **3.7 DEMONSTRATION**

- 7 A. Demonstrate equipment in accordance with Specification Section 01650.

8 **END OF SECTION**

9



1 2014/09/10

2

## SECTION 11060

3

### PUMPING EQUIPMENT: BASIC REQUIREMENTS

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

A. Section Includes: Pumping equipment.

7

B. Related Specification Sections include but are not necessarily limited to:

8

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

9

2. Division 01 - General Requirements.

10

3. Section 09960 - High Performance Industrial Coatings.

11

4. Section 11005 - Equipment: Basic Requirements.

12

##### 1.2 QUALITY ASSURANCE

13

A. Referenced Standards:

14

1. Hydraulic Institute (HI):

15

a. 14.6, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

16

B. Fully coordinate all mechanical seal systems specified to ensure pump and seal compatibility.

17

C. Pump/motor and VFD coordination: See Specification Section 11005.

18

##### 1.3 DEFINITIONS

19

A. The abbreviations are defined as follows:

20

1. IPS: Iron Pipe Size.

21

2. NPSHR: Net Positive Suction Head Required.

22

3. TDH: Total Dynamic Head.

23

4. TEFC: Totally Enclosed Fan Cooled.

24

5. VFD: Variable Frequency Drive.

25

B. Pump Service Category: Pump or pumps having identical names (not tag numbers) used for specific pumping service.

26

27

##### 1.4 SUBMITTALS

28

A. Shop Drawings:

29

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

30

2. See Specification Section 11005.

31

3. Product technical data including:

32

a. Performance data and curves with flow (gpm), head (FT), horsepower, efficiency, NPSH requirements, submergence requirement.

33

b. Pump accessory data.

34

c. Bearing supports, shafting details and lubrication provisions.

35

1) Bearing life calculations.

36

2) Critical speed calculations.

37

d. Solids passage information.

38

4. Certifications:

39

a. Certified pump performance curves as described in the SOURCE QUALITY CONTROL Article.

40

5. Test reports: Factory hydrostatic test.

41

42

43

44

B. Operation and Maintenance Manuals:

45

1. See Specification Section 01342 for requirements for:

46

a. The mechanics and administration of the submittal process.

47

b. The content of Operation and Maintenance Manuals.

- 1 C. Informational Submittals:  
2 1. Certifications:  
3 a. Provide a written statement that manufacturer's equipment has been installed properly,  
4 started up and is ready for operation by Owner's personnel.

## 5 **PART 2 - PRODUCTS**

### 6 **2.1 ACCEPTABLE MANUFACTURERS**

- 7 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:  
8 1. Pumps: See individual pump Specification Sections.  
9 B. Submit request for substitution in accordance with Specification Section 01640.

### 10 **2.2 CENTRIFUGAL PUMP DESIGN**

- 11 A. Provide units with increasing head characteristics from the end run out portion of the curve to  
12 shut-off condition.

### 13 **2.3 ACCESSORIES**

- 14 A. See Specification Section 11005.  
15 B. Each Unit:  
16 1. Lifting eye bolts or lugs.  
17 2. Plugged gage cock connection at suction and discharge nozzles.  
18 3. Tapped and plugged openings for casing and bearing housing vents and drains.  
19 4. Fittings for properly adding flushing lubricant.  
20 5. Pressure relief fittings for grease lubrication.

### 21 **2.4 FABRICATION**

- 22 A. Pump Support:  
23 1. Design base to support weight of drive, shafting and pump.  
24 2. Comply with HI vibration limitations.  
25 3. Mount horizontal pump, motor and coupling on single piece drip lip type baseplate.  
26 4. Fabricate to withstand all operating loads transmitted from the pump and drive.

### 27 **2.5 SOURCE QUALITY CONTROL**

- 28 A. Statically and dynamically balance each pump per HI standards.

## 29 **PART 3 - EXECUTION**

### 30 **3.1 INSTALLATION**

- 31 A. See Specification Section 11005.  
32 B. Floor or Pad-Mounted Units (Non-Submersible):  
33 1. Align vertically and horizontally level, wedge and plumb units to match piping interfaces.  
34 2. Assure no unnecessary stresses are transmitted to equipment flanges.  
35 3. Tighten flange bolts at uniform rate and manufacturer's recommended torque for uniform  
36 gasket compression.  
37 4. Support and match flange faces to uniform contact over entire face area prior to bolting pipe  
38 flange and equipment.  
39 5. Permit piping connecting to equipment to freely move in directions parallel to longitudinal  
40 centerline when and while bolts in connection flange are tightened.  
41 6. Grout equipment into place prior to final bolting of piping but not before initial fitting and  
42 alignment.  
43 7. Assemble connecting piping with gaskets in place and minimum of four (4) bolts per joint  
44 installed and tightened.  
45 a. Test alignment by loosening flange bolts to see if there is any change in relationship of  
46 piping flange with equipment connecting flange.

- 1 b. Realign as necessary, install flange bolts and make equipment connection.
- 2 8. Field paint units as defined in Specification Section 09960.
- 3 9. Provide pressure gage on discharge of all pumps and on suction and discharge of all non-
- 4 submersible units.

5 **3.2 FIELD QUALITY CONTROL**

- 6 A. Provide services of equipment manufacturer's field service representative(s) to:
- 7 1. Inspect equipment covered by this Specification Section.
- 8 2. Supervise pre-start adjustments and installation checks.
- 9 3. Conduct initial startup of equipment and perform operational checks.
- 10 4. Instruct Owner's personnel for the specified minimum number of hours at jobsite per
- 11 Specification Section 01060 on operation and maintenance of each of following pumping
- 12 equipment:

13 **END OF SECTION**

14



1 2014/09/05

2

## SECTION 11652

3

### MATERIALS HANDLING EQUIPMENT

#### 4 PART 1 - GENERAL

##### 5 1.1 SUMMARY

6 A. Section Includes:

- 7 1. Materials handling equipment:  
8 a. Pallet load leveler.

9 B. Related Sections include but are not necessarily limited to:

- 10 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.  
11 2. Division 01 - General Requirements.  
12 3. Section 10400 - Identification Devices.  
13 4. Section 11005 - Equipment: Basic Requirements.

##### 14 1.2 QUALITY ASSURANCE

15 A. Standards:

- 16 1. Suppliers' catalog numbers listed establish the minimum fabrication quality and functional  
17 features required.

##### 18 1.3 SYSTEM DESCRIPTION

19 A. Provide single source coordination responsibility.

- 20 1. System shall include but not necessarily be limited to the following:  
21 a. Materials handling equipment.

##### 22 1.4 SUBMITTALS

23 A. Shop Drawings:

- 24 1. See Specification Section 01340 for requirements for the mechanics and administration of  
25 the submittal process.  
26 2. Product technical data including:  
27 a. Acknowledgement that products submitted meet requirements of standards referenced.  
28 b. Manufacturer's installation instructions.  
29 c. Technical information covering the equipment furnished.

30 B. Warranties: Provide copies of equipment warranties and list of service sources.

31 C. Certifications:

- 32 1. Where weight or volume capacities are specified, submit certification that equipment  
33 provided meets those capacity requirements.  
34 2. Statement concerning proper startup of equipment.

35 D. Operation and Maintenance Manuals:

- 36 1. See Specification Section 01342 for requirements for:  
37 a. The mechanics and administration of the submittal process.  
38 b. The content of Operation and Maintenance Manuals.

#### 39 PART 2 - PRODUCTS

##### 40 2.1 MINIMUM DESIGN CRITERIA

41 A. Pallet Load Leveler:

- 42 1. Tag Number: FC-SHPL-01.  
43 2. Furnish Southworth Products Pallet Pal 360 Spring Level Loader.

- 1
  - 2
  - 3
  - 4
  - 5
  - 6
  - 7
  - 8
  - 9
  - 10
  - 11
3. Provide unit designed and constructed to:
    - a. Lower and raise pallet as bags of chemical are added or removed from pallet by means of a system of springs and shock absorbers.
    - b. Provide nearside unloading by means of 360 degree turntable.
  4. Provide unit complying with the following:
    - a. Capacity: 2000 LBS.
    - b. Compressed height: 9-1/2 IN.
    - c. Extended height: 28 IN.
    - d. Base dimension: 36 IN x 36 IN.
    - e. Turntable diameter: 43-5/8 IN.
  5. Shall require no power supply or air supply.

12 **PART 3 - EXECUTION**

13 **3.1 INSTALLATION**

- 14 A. Comply with Section 10400 for identification and tagging.

15 **END OF SECTION**



1 2014/09/05

2

## SECTION 11926

3

### CHEMICAL FEED: LIQUID SYSTEMS

#### 4 PART 1 - GENERAL

##### 5 1.1 SUMMARY

###### 6 A. Section Includes:

- 7 1. Chemical metering pumps.
- 8 2. Chemical transfer pumps.
- 9 3. System accessories.
- 10 4. Liquid chemical tanks:
  - 11 a. Storage tanks.
  - 12 b. Day tanks.

###### 13 B. Related Specification Sections include but are not necessarily limited to:

- 14 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 15 2. Division 01 - General Requirements.
- 16 3. Section 11005 - Equipment: Basic Requirements.
- 17 4. Section 11060 - Pumping Equipment: Basic Requirements.
- 18 5. Section 13441 - Control Loop Descriptions.
- 19 6. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.
- 20 7. Section 15100 - Valves: Basic Requirements.
- 21 8. Section 15104 - Ball Valves.

##### 22 1.2 QUALITY ASSURANCE

###### 23 A. Referenced Standards:

- 24 1. ASTM International (ASTM):
- 25 2. D1998, Standard Specification for Polyethylene Upright Storage Tanks.
- 26 3. National Electrical Manufacturers Association (NEMA):
  - 27 a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

###### 28 B. Secure and coordinate entire system including but not necessarily limited to metering pumps, 29 electric equipment, controls, hardware, valving, and piping through the metering pump 30 manufacturer.

##### 31 1.3 SYSTEM DESCRIPTION

- 32 A. System shall be supplied through a single source and include all components specified herein.

##### 33 1.4 SUBMITTALS

###### 34 A. Shop Drawings:

- 35 1. See Specification Section 01340 for requirements for the mechanics and administration of  
36 the submittal process.
- 37 2. See Specification Section 11005.
- 38 3. Drawings and product data:
  - 39 a. See Specification Section 11060.
  - 40 b. Pump:
    - 41 1) Chemical resistance data for materials used.
    - 42 2) Complete performance information:
      - 43 a) Capacity, operating range.
      - 44 b) Pressure rating.
      - 45 c) NPSH required.
      - 46 d) Stroke speed, length.
      - 47 e) Horsepower required.
      - 48 f) Plunger diameter.

- 1 c. Valves: See Specification Section 15100.
- 2 d. Piping: See Specification Section 15060.
- 3 e. Control modes.
- 4 B. Operation and Maintenance Manuals:
- 5 1. See Specification Section 01342 for requirements for:
- 6 a. The mechanics and administration of the submittal process.
- 7 b. The content of Operation and Maintenance Manuals.

8 **1.5 PROJECT CONDITIONS**

9 A. Pumped Liquid:

10

LIQUID	CONCENTRATION	SPECIFIC GRAVITY	TEMP DEGF	pH
Hydrofluosilicic Acid	23%	1.23	50 - 85	<2
Polymer	Proprietary	1.04	50 - 85	5 - 7
Sodium Hexametaphosphate	1% (approximately)	1.00	50 - 85	7

11

12 **PART 2 - PRODUCTS**

13 **2.1 ACCEPTABLE MANUFACTURERS**

- 14 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 15 1. Metering pumps and accessories:
- 16 a. Prominent Sigma 2b.
- 17 b. UGSI Encore 700.
- 18 2. Tanks:
- 19 a. Storage tanks and hydrofluosilicic acid (fluoride) day tanks:
- 20 1) Design Tanks.
- 21 2) Owens-Corning.
- 22 3) Polycorr, Inc.
- 23 b. Polymer day tank:
- 24 1) Nalgene Industrial Products.
- 25 2) Snyder Industries.
- 26 B. No substitutions "or-equals" will be considered.

27 **2.2 METERING PUMPS**

- 28 A. Materials:
- 29 1. Mechanical Diaphragm Type - Motor-Driven:
- 30

	HYDROFLUOSILICIC ACID (FLUORIDE)
Liquid Ends	PVDF
Pump Head	PVC
Valve Balls	TFE
Valve Seals	Hypalon or PTFE
Diaphragm	TFE
Case	Epoxy coated cast aluminum

31 <sup>(1)</sup> Stainless steel spring-loaded ball checks for neat polymer.

32

- 33 B. Pump Performance and Design Requirements:
- 34 1. Hydrofluosilicic Acid (Fluoride):
- 35 a. Tag number(s): FC-FLFP-01, FC-FLFP-02.
- 36 b. Chemical: Hydrofluosilicic Acid.
- 37 c. Heads/unit: 1.
- 38 d. Capacity/head (gph): 10
- 39 e. Discharge pressure (psi): 15.

- 1 f. Maximum stroke rate (SPM):
- 2 1) Prominent – 90 SPM.
- 3 2) Encore 700 – 72 SPM.
- 4 g. Drive:
- 5 1) Motor minimum HP: 0.5.
- 6 a) Adjustable speed drive, integral to the pump.
- 7 2) 120 V, single phase, cord and plug connected.
- 8 C. Pump Fabrication:
- 9 1. Pump:
- 10 a. Ball-check inlet and outlet valves.
- 11 b. Moving parts totally enclosed and self-lubricating.
- 12 c. Complete external control with 10:1 minimum manual stroke adjustment, adjustable
- 13 while operating.
- 14 d. Capable of operating dry without damage to any component.
- 15 e. Repeatable accuracy: 1 percent of maximum output or better.
- 16 f. Nameplate with chemical, capacity (gph) and pressure (psi) ratings.
- 17 g. Pumps shall be skid mounted with metering pump accessories listed in Paragraph 2.4.
- 18 h. Four-step pulley and belt driven mechanism, where applicable.
- 19 2. Drive:
- 20 a. Motors:
- 21 1) TENV chemical service class motor.
- 22 2) Inverter duty rated (if Variable Frequency Drive utilized).
- 23 3) See Specification Section 11005.
- 24 b. Speed reducers permanently lubricated.
- 25 3. Controls:
- 26 a. Motor drive:
- 27 1) LOCAL/REMOTE control selection.
- 28 2) Input/output signals to/from Plant SCADA System:
- 29 a) Analog input: 4-20 mA pump speed control signal.
- 30 b) Analog output: 4-20 mA pump speed indication signal.
- 31 c) Discrete outputs:
- 32 (1) Pump in REMOTE control mode (dry contact).
- 33 (2) Pump run status (dry contact).
- 34 (3) Pump FAIL alarm (dry contact).
- 35 d) Discrete input: start/stop command from SCADA.
- 36 3) See Specification Section 13441.
- 37 4) Provide separate skid mounted junction boxes with terminal strips for termination of
- 38 analog and discrete signal and control wiring.
- 39 D. Spare Parts:
- 40 1. Provide the following spare parts for each metering pump:
- 41 a. One (1) set "O" rings and gaskets.
- 42 b. One (1) each diaphragm.
- 43 c. One (1) set ball checks and seats.
- 44 d. One (1) can hydraulic fluid (1 quart minimum).

45 **2.3 TRANSFER PUMPS**

- 46 A. Pump Type: Magnetic-Drive Sealless Centrifugal Pumps.
- 47 B. Acceptable Manufacturer's:
- 48 1. Finnish Thompson Inc.
- 49 2. Or equal.
- 50 C. Pump Tag Numbers:
- 51 1. Hydrofluosilic Acid (Fluoride): FC-FLTP-01, FC-FLTP-02.
- 52 D. Materials:
- 53 1. Pump housing and wetted components: Carbon reinforced PVDF.
- 54 2. Bearing: carbon.
- 55 3. Shaft: High purity alumina ceramic.

- 1 E. Performance and Design Requirements:
- 2 1. Delivery capacity: 12 gpm.
- 3 2. Total Differential head: 58 FT.
- 4 3. Pump Speed: 3450 rpm maximum.
- 5 4. Driver: 1.0 HP minimum, 480 V, 3 ph.
- 6 5. Single speed.
- 7 6. Magnet drive.
- 8 F. Fabrication:
- 9 1. Pumps shall be made from non-metallic construction. All parts exposed to chemical shall be
- 10 made from non-metallic compounds.
- 11 2. Pumps shall be capable to run dry for an infinite amount of time without damage.
- 12 3. Flanges shall have reusable/replaceable Teflon inserts to ensure a proper seal.
- 13 4. Pumps shall have repair kits to allow for complete rebuild to as new hydraulic performances.
- 14 G. Plastic Swing Check Valve:
- 15 1. Acceptable manufacturers:
- 16 a. Asahi America.
- 17 2. Materials:
- 18 a. Body: PVC.
- 19 3. Single disc design suitable for either horizontal or vertical installation.
- 20 4. Top entry access for cleaning.
- 21 5. Seats and seals shall be compatible with fluid being conveyed.
- 22 6. Flanged end connections.

23 **2.4 METERING PUMP ACCESSORIES**

- 24 A. Provide each accessory on metering pump skid, as shown on Drawings:
- 25 1. Calibration chamber:
- 26 a. PVC, graduated in ml.
- 27 b. Size:
- 28 1) Metering pumps up to 20 gph: 500 ml.
- 29 c. Include isolation ball valve.
- 30 2. Pressure relief valve:
- 31 a. PVC or Kynar with TFE or hypalon with TFE facing diaphragm.
- 32 b. External pressure setting.
- 33 c. Sized for pump capacity.
- 34 d. Pipe discharge to supply tank.
- 35 3. Back pressure/Anti-siphon valves:
- 36 a. Install pump discharge.
- 37 b. PVC or Kynar with TFE or hypalon with TFE facing diaphragm.
- 38 c. Manufacturer: Plast – O-matic or equal.
- 39 d. External pressure setting.
- 40 e. Sized for pump capacity.
- 41 4. Pulsation dampener:
- 42 a. Wetted components: PVC.
- 43 b. Sized for 5 percent variation from average pressure.
- 44 c. Provide stainless steel pressure gage, 2.5 IN DIA dial, glycerine-filled and gas fill valve.
- 45 5. Pressure gauge:
- 46 a. Stainless steel.
- 47 b. PVDF/PTFE diaphragm.
- 48 c. 0-160 psig.
- 49 6. Ball valves:
- 50 a. Refer to Specification Section 15104.
- 51 7. Wye Strainer:
- 52 a. PVDF.
- 53 B. Miscellaneous Skid Accessories:
- 54 1. Metering Pump skid stand:
- 55 a. Provide one for each pump skid.
- 56 b. Stand shall be sized to fit skid size and weight.
- 57 c. Materials: Polypropylene.

1 **2.5 TANKS**

- 2 A. General:
  - 3 1. Seismic requirements: See General Structural Notes on Contract Drawing Sheet S-001.
  - 4 2. Concentrated top load: Compute at 100 psf plus dead load.
  - 5 3. Tank materials and resins to be resistant to chemicals.
  
- 6 B. Storage Tanks:
  - 7 1. General:
    - 8 a. Shape:
      - 9 1) Sodium hexametaphosphate:
        - 10 a) Vertical, flat bottom on concrete pad, flat top.
      - 11 2) Polymer:
        - 12 a) Vertical, dished bottom with leg ring, flat top.
    - 13 b. Ambient temperature: 0-110 DegF.
    - 14 c. Insulated with 2 IN polyurethane, weather protected and with heat tape.
    - 15 d. Material: Fiberglass reinforced plastic (FRP).
  - 16 2. Sodium Hexametaphosphate tanks:
    - 17 a. Tag number(s): FC-SHST-01, FC-SHST-02.
    - 18 b. Nominal capacity: 500 GAL each.
    - 19 c. Approximate dimensions:
      - 20 1) Diameter: 60 IN.
      - 21 2) Height: 45 IN.
  - 22 3. Polymer :
    - 23 a. Tag number(s): FC-POST-01.
    - 24 b. Nominal capacity: 350 GAL.
    - 25 c. Approximate dimensions:
      - 26 1) Diameter: 48 IN.
      - 27 2) Height: 52 IN, plus leg ring to provide clearance distance required on Drawings.
    - 28 d. Provide tank on steel legs to provide gravity flow to Polymer day tank.
  
- 29 C. Day Tanks:
  - 30 1. Hydrofluorosilicic Acid (Fluoride):
    - 31 a. Tag number(s): FC-FLDT-01.
    - 32 b. Nominal capacity: 116 GAL.
    - 33 c. Approximate dimensions:
      - 34 1) Diameter: 30 IN.
      - 35 2) Height: 42 IN.
    - 36 d. Shape: Vertical, circular, flat bottom, sealed and closed top with fill and vent piping
    - 37 penetrations.
    - 38 e. Molded in calibration.
    - 39 f. Ambient temperature: 45-90 DegF.
    - 40 g. Material: Fiberglassed reinforced plastic (FRP).
  - 41 2. Polymer:
    - 42 a. Tag number(s): FC-PODT-01.
    - 43 b. Nominal capacity: 30 GAL.
    - 44 c. Approximate dimensions:
      - 45 1) Diameter: 18.5 IN.
      - 46 2) Height: 32 IN.
    - 47 d. Shape: Vertical, circular, flat bottom, sealed and closed top with fill and vent piping.
    - 48 e. Material: HDPE.
  
- 49 D. Overflow Vent Protection Container:
  - 50 1. Shape: Vertical, circular, flat bottom, removable cover with opening 1 IN greater in diameter
  - 51 than the overflow pipe.
  - 52 2. See Drawings for size.
  - 53 3. Material: HDPE.
  
- 54 E. Fabrication (Fiberglass Reinforced Plastic):
  - 55 1. Conform to referenced standards or specified requirements if more stringent.
  - 56 2. Helical filament-wound side walls and contact molded top and base construction.
  - 57 3. Minimum design safety factors and wall thickness per governing standard but not less than
  - 58 the following:
    - 59 a. Internal pressure: 10:1.

- 1 b. External pressure: 5:1.
- 2 c. Seismic loads: 3:1.
- 3 4. Sufficient resin on all surfaces to prevent fiber exposure.
- 4 5. Ends fabricated integrally with shell, or separately and laminated to shell.
- 5 6. Joints made with heavy reinforced lay-ups for structural stability and to prevent leakage.
- 6 7. Inner surface layer: 10-20 mils thick.
- 7 a. Inner layer followed by laminate 80-90 mils thick, reinforced with noncontinuous
- 8 chopped strand fiberglass.
- 9 b. Laminate layer resin content:
- 10 1) 70-80 percent.
- 11 2) Total thickness of two (2) layers at least 100 mils.
- 12 8. Structurally reinforce walls with helical filament winding of continuous strands, tops, and
- 13 bases with fiberglass mat and/or woven roving.
- 14 a. Thickness and glass content per tensile and flexural requirements.
- 15 9. Reinforcing ribs per manufacturer's recommendations.
- 16 10. Lifting lugs provided on tank.
- 17 11. Coated with protective gel coat, color as selected by Engineer.
- 18 12. Minimum wall thickness: 1/4 IN.
- 19 F. Fabrication (HDPE):
- 20 1. Construct using the rotational molding process.
- 21 2. Provide knuckle radius at bottom of wall minimum of 1 IN.
- 22 3. Wall thickness:
- 23 a. Design in accordance with ASTM D1998.
- 24 b. Design using a hoop stress no greater than 600 psi.
- 25 c. Provide minimum wall thickness sufficient enough to support its own weight in an upright
- 26 position without external support but shall not be less than 0.187 IN thick.
- 27 4. Trim all edges cut to have smooth edges.
- 28 G. Tank Accessories:
- 29 1. General:
- 30 a. Location and size of piping connections as shown on Drawings.
- 31 b. Penetrations to be factory installed in accordance with referenced standards.
- 32 c. Pipe connections to be flange type.
- 33 2. Storage tanks:
- 34 a. The following minimum trim features to be included:
- 35 1) Fill port.
- 36 2) Overflow port.
- 37 3) Drain connection.
- 38 4) Suction port, side bottom type.
- 39 5) 24 IN DIA top manhole, quick-access type.
- 40 6) Vent connection.
- 41 7) Sight glass connections.
- 42 8) Air connections for SH.
- 43 9) Level transmitter connections for SH storage tanks.
- 44 10) Service water connections for SH storage tanks.
- 45 11) Side ladder attached to tank - polymer tank only.
- 46 12) Fill pipe and conduit support attachment lugs.
- 47 13) All tank ports to be flange type.
- 48 3. Day tanks:
- 49 a. The following minimum trim features to be included:
- 50 1) Fill port.
- 51 2) Overflow port.
- 52 3) Drain connection.
- 53 4) Suction port.
- 54 5) Vent connection.
- 55 6) Sealed tank cover.

1 **PART 3 - EXECUTION**

2 **3.1 INSTALLATION**

3 A. See Specification Section 11005.

4 **3.2 DEMONSTRATION**

5 A. See Specification Section 01650.

6 **END OF SECTION**

7





1 2014/09/10

2

## SECTION 11983

3

### PUMPING EQUIPMENT: SAMPLE PUMPS

#### 4 PART 1 - GENERAL

##### 5 1.1 SUMMARY

6

###### A. Section Includes:

7

1. Sample pumps (FP-SMPP 01, 02, 03, 04).

8

###### B. Related Sections include but are not necessarily limited to:

9

1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

10

2. Division 1 - General Requirements.

11

3. Section 09960 - High Performance Industrial Coatings (HPIC).

12

4. Section 11005 - Equipment: Basic Requirements.

13

##### 1.2 QUALITY ASSURANCE

14

###### A. Referenced Standards:

15

1. ASTM International (ASTM):

16

- a. A48, Standard Specification for Gray Iron Castings.

17

##### 1.3 SUBMITTALS

18

###### A. Shop Drawings:

19

1. See Section 01340 for submittal mechanics.

20

2. Product technical data including:

21

- a. Performance curve with flow (gpm), head (ft), efficiency, and NPSH requirements.

22

- b. Technical data on mechanical seals.

23

- B. Operation and Maintenance Manuals: See Section 01342.

24

#### PART 2 - PRODUCTS

25

##### 2.1 ACCEPTABLE MANUFACTURERS

26

- A. Subject to compliance with the Contract Documents, the following manufacturers and products are acceptable:

27

1. Dayton, Self-Priming Cast Iron Centrifugal Pump, Model 4UA67A.

28

2. No like, equivalent or "or-equal" item or no substitution is permitted.

29

30

##### 2.2 MATERIALS

31

- A. Pump Casing, Volute, Base Plate: Cast Iron, ASTM A48.

32

- B. Mechanical Seal and O-Ring:

33

1. Viton.

34

##### 2.3 EQUIPMENT PERFORMANCE AND DESIGN REQUIREMENTS

35

- A. Sample Pumps (FP-SMPP01, FP-SMPP02, FP-SMPP03, FP-SMPP04):

36

1. Design condition: 33 gpm at 46 FT TDH.

37

2. Secondary condition: 54 gpm at 10 FT TDH.

38

3. Shutoff condition: 0 gpm at 78 FT TDH.

39

4. Pump configuration: Close coupled end suction.

40

5. Pump speed: 3450 RPM.

41

6. Minimum nameplate driver horsepower: 1/2 HP, 115 V/ 230 V, 1 PH, TEFC.

42

7. Drive type: Constant speed.

43

8. Automatic, self-priming to 20 FT. A single pump must be provided for this service. Systems requiring two pumps (one for priming and one for duty) will not be allowed.

44





**DIVISION 13**  
SPECIAL CONSTRUCTION





1 2014/09/08

2

3

**SECTION 13101**  
**LIGHTNING PROTECTION SYSTEM**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6 A. Section Includes:

- 7 1. Material, design and installation requirements for:  
8 a. Lightning protection system.

9 B. Related Specification Sections include but are not necessarily limited to:

- 10 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.  
11 2. Division 01 - General Requirements.  
12 3. Section 01800 – Openings and Penetrations in Construction.  
13 4. Section 07541 - PVC Membrane Roofing – Fully Adhered.  
14 5. Section 16060 - Grounding.  
15 6. Section 16130 - Raceways and Boxes.

16 **1.2 QUALITY ASSURANCE**

17 A. Referenced Standards:

- 18 1. Lightning Protection Institute (LPI):  
19 a. 175, Standard of Practice for the Design - Installation - Inspection of Lightning Protection  
20 Systems.  
21 2. National Fire Protection Association (NFPA):  
22 a. 780, Standard for the Installation of Lightning Protection Systems.  
23 3. Underwriters Laboratories, Inc. (UL):  
24 a. 96A, Standard for Installation Requirements for Lightning Protection Systems.

25 **1.3 DEFINITIONS**

26 A. Classification of Buildings per NFPA 780:

- 27 1. Class I: Any commercial, industrial, or residential building less than 75 FT in height.  
28 2. Class II: Any commercial, industrial, or residential building 75 FT or taller.  
29 3. Heavy-duty stacks: Any smoke or vent stack with a flue cross-section area greater than 500  
30 SQ IN and a stack height greater than 75 FT.

31 **1.4 SYSTEM DESCRIPTION**

32 A. Modify and existing Filter Plant Building rework of existing lightning protection system as required  
33 to accommodate renovation work to exterior of building.

- 34 1. Reuse portions of existing lightning protection where practical.  
35 2. Provide new components as necessary for a complete working lightning protection system.  
36 3. Extend existing lightning protection system to Filter Building Chemical Addition.

37 **1.5 SUBMITTALS**

38 A. Shop Drawings:

- 39 1. See Specification Section 01340 for requirements for the mechanics and administration of  
40 the submittal process.  
41 2. Product technical data:  
42 a. Provide submittal data for all products specified in PART 2 of this Specification Section.  
43 b. Provide manufacturer's technical information on products to be used, including product  
44 descriptive bulletin.  
45 c. Include data sheets that include manufacturer's name and product model number.  
46 Clearly identify all optional accessories.  
47 d. Acknowledgement that products submitted are in compliance with LPI or UL.  
48 e. Manufacturer's delivery, storage, handling and installation instructions.  
49 f. Equipment installation details.

- 1           3. Fabrication and/or layout Drawings:
  - 2           a. Plan drawing showing type, size, and locations of all lightning protection hardware. Roof
  - 3           penetration details.
  - 4           b. Verification that the installation shall comply with the requirements of, and shall qualify
  - 5           for the UL Master Label Certificate.
- 6           B. Operation and Maintenance Manuals:
  - 7           1. See Specification Section 01342 for requirements for:
    - 8           a. The mechanics and administration of submittal process.
    - 9           b. The content of Operation and Maintenance Manuals.
  - 10          2. Product data and as-built layout Drawings.
  - 11          3. Requirements for, and frequency of, periodic inspections.
- 12          C. Informational Submittals: UL Master Label Certificate.

## 13   **PART 2 - PRODUCTS**

### 14   **2.1 ACCEPTABLE MANUFACTURERS**

- 15          A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 16          1. A/C Lightning Protection, Inc.
  - 17          2. Harger Lightning Protection.
  - 18          3. Heary Brothers.
  - 19          4. National Lightning Protection (NLP).
  - 20          5. Robbins Lightning Protection Company.
  - 21          6. Thompson Lightning Protection, Inc.
  - 22          7. VFC Lightning Protection.
- 23          B. Submit request for substitution in accordance with Specification Section 01640.

### 24   **2.2 MATERIALS**

- 25          A. Standards: NFPA 780, UL 96A.
- 26          B. Material for air terminals, main conductors and bonding conductors: Copper or aluminum.
- 27          C. Size of air terminals, main conductors and bonding conductors: In accordance with Tables 3-
- 28          1.1(a) and 3-1.1(b) of NFPA 780.
- 29          D. Ground rods: In accordance with Specification Section 16060.
- 30          E. Material for conductor fasteners, connector fittings, bonding fittings, conductor splicers and thru-
- 31          wall or thru-roof assemblies: Cast bronze, brass or copper with bolt pressure connectors.
- 32          F. Material for bolts, nuts, and screws: Stainless steel.
- 33          G. Raceways: In accordance with Specification Section 16130.

## 34   **PART 3 - EXECUTION**

### 35   **3.1 INSTALLATION**

- 36          A. General:
  - 37          1. Design and installation standards: LPI 175, NFPA 780, UL 96A.
  - 38          2. Lightning protection material selected shall be compatible with the material of construction for
  - 39          the structure being protected.
  - 40          3. Components shall be adhesively fastened to the roof system or top of parapet wall unless
  - 41          specifically noted otherwise.
    - 42          a. Do not mechanically fasten to parapet walls or wall panels without written consent of the
    - 43          Owner and the Engineer.
    - 44          b. Seal all penetrations in accordance with Section 01800 and Section 07541.
- 45          B. Structures and/or Buildings:
  - 46          1. The protection system shall utilize Class I or Class II materials as defined by NFPA 780.

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- 2. The system shall include:
  - a. Roof mounted air terminals.
  - b. Interconnecting conductors.
  - c. Downleads:
    - 1) Conductors encased in rigid nonmetallic conduit concealed within the exterior wall.
    - 2) For existing areas where prefabricated wall panels are provided, route the conductors exposed on the interior side of the filter gallery walls in rigid nonmetallic conduit.
  - d. Ground terminations.
  - e. Bonding of other grounded structure/building systems.
- 3. Connect down leads to individual ground rods and connect the lightning protection system to the modified building grounding system.
- 4. Connection to grounding electrode system shall be made in accordance with Specification Section 16060.
- 5. Connect down leads to individual ground rod sand connect to modified building grounding system.
- 6. Lightning protection components to have a corrosion protection coating of lead.

**3.2 FIELD QUALITY CONTROL**

- A. Installation shall be performed in accordance with UL and NFPA.
- B. The completed installation shall qualify for and receive the UL Master Label Certificate.
- C. Provide a nameplate, attached to the structure, which includes the name and address of the Contractor responsible for the installation of the lightning protection system.

**END OF SECTION**





1 2014/09/05

2

## SECTION 13102

3

### FIBERGLASS REINFORCED PLASTIC STOP LOGS

#### 4 PART 1 - GENERAL

##### 5 1.1 SUMMARY

6

A. Specification Section Includes:

7

1. Frames for existing FRP stop log planks.

8

B. Related Specification Sections include but are not necessarily limited to:

9

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

10

2. Division 01 - General Requirements.

11

3. Section 01340 - Submittals.

12

4. Section 11005 - Equipment: Basic Requirements.

13

##### 1.2 QUALITY ASSURANCE

14

A. Referenced Standards:

15

1. ASTM International (ASTM):

16

- a. C582, Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.

17

2. National Bureau of Standards (NBS):

18

- a. PS15-69, Custom Contact-Molded Reinforced-Polyester Product Standard Chemical-Resistant Process Equipment.

19

20

##### 21 1.3 SUBMITTALS

22

A. Shop Drawings:

23

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

24

2. Submit for Engineer's approval Shop Drawings, including:

25

- a. Manufacturer's literature, data sheets, fabrication, assembly and mounting drawings of the associated components showing materials and significant dimensions in sufficient detail to demonstrate compliance with specified requirements.

26

27

28

29

B. Manufacturer's recommended spare parts.

30

##### 31 1.4 DELIVERY, STORAGE, AND HANDLING

32

A. All materials and equipment shall be shipped, stored, handled and installed in accordance with manufacturer's requirements in such a manner as not to degrade quality, serviceability or appearance.

33

34

B. Conditions of storage shall be in accordance with Section 01600 - Product Delivery, Storage and Handling.

35

36

#### 37 PART 2 - PRODUCTS

38

##### 39 2.1 ACCEPTABLE MANUFACTURERS

40

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

41

1. FRP Stop Log Frames:

42

- a. Plasti-Fab, Inc.

43

B. No like, equivalent or "or-equal" item is permitted.

44

##### 45 2.2 EQUIPMENT AND ACCESSORIES

46

A. FRP Stop Log appurtenances shall conform to the requirements of NBS 15-69 and ASTM C582.

47

B. Maximum allowable leakage of installed existing Stop Log planks shall not exceed 0.20 gpm/ft wetted perimeter.

48

49

- 1 C. Stop Log frames shall be provided with elastomeric seals:  
2 1. Guide frames shall be manufactured of 316-SS.  
3 2. Guides and all necessary attaching bolts and anchor bolts shall be provided by the existing  
4 Stop Log plank manufacturer.
- 5 D. In-channel seals shall be molded of EPDM.
- 6 E. Contractor shall field check all stop log openings and confirm Stop Log frame dimensions for  
7 openings:  
8 1. Stop Log frames shall conform to the following service conditions:  
9 a. Influent flume:  
10 1) Flume dimensions: 8 FT x 8 FT x 6 IN nominally.  
11 a) Field measure prior to fabrication.  
12 2) Maximum Seating / Unseating Head:  
13 a) 9 FT.  
14 3) Existing Plank Dimensions: Coordinate with district.  
15 4) Number of new frame locations: 3.  
16 5) Number of existing Planks per Location: Coordinate with district.
- 17 F. Anchorage Devices and Fasteners:  
18 1. Furnish anchor bolts of Type 316 stainless steel with Nitronic 60 nuts, of ample size and  
19 strength for the purpose intended, sized by the equipment manufacturer. Anchor bolts shall  
20 be installed into existing concrete channel.

## 21 **PART 3 - EXECUTION**

### 22 **3.1 INSTALLATION**

- 23 A. Install equipment in accordance with the manufacturer's printed instructions.  
24 B. Do not install damaged items.

### 25 **3.2 FIELD QUALITY CONTROL**

- 26 A. Inspection and Field Tests:  
27 1. Inspect and test installed Stop Log planks and Y-wall Composite cover units in accordance  
28 with as described in this section to demonstrate that each unit and its controls function  
29 correctly.
- 30 B. Preliminary Field Tests:  
31 1. The Contractor shall demonstrate the ease of installation, removal, and the proper fit of the  
32 existing Stop Log planks at their locations of use in the presence of and to the satisfaction of  
33 the Owner.

### 34 **3.3 MANUFACTURER'S FIELD SERVICES**

- 35 A. A manufacturer's factory-trained representative shall check and approve the installation of  
36 specified equipment before operation:  
37 1. The representative shall operate and test system in the presence of the Owner and verify  
38 that the equipment conforms to requirements, and instruct plant personnel on care and  
39 maintenance.
- 40 B. Testing, checkout and start-up of the equipment shall be performed under the technical direction  
41 of the manufacturer's factory-trained representative.

42 **END OF SECTION**

1 2014/08/19

2

## SECTION 13283

3

### LEAD-BASED PAINT ABATEMENT

#### 4 PART 1 - GENERAL

##### 5 1.1 SUMMARY

6

###### A. General

7

1. According to AMI Environmental Limited Lead-Based Paint Survey, lead-based paint is present on the existing stair railings in the Filter Plant lower level galleries.

8

9

###### B. Section Includes:

10

1. Furnishing all labor, materials, tools, facilities, equipment, training, packaging, testing and permits for the abatement design and removal of lead-based paint. This specification has not been prepared by a Certified Project Designer. Contractor shall retain a Certified Project Designer, who meets State of Nebraska and US EPA accreditation requirements, to prepare a Site-Specific Lead Abatement Plan (Work Plan) which at a minimum meets the regulatory requirements provided in the Referenced Standards listed in Section 1.2.

11

12

13

14

15

16

###### C. Related Sections include but are not necessarily limited to:

17

1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 1 - General Requirements.

18

19

##### 1.2 QUALITY ASSURANCE

20

###### A. Referenced Standards:

21

###### 1. U.S. Environmental Protection Agency (EPA):

22

- a. 40 CFR 260, Hazardous Waste Management Systems: General.

23

- b. 40 CFR 261, Identification and Listing of Hazardous Waste.

24

- c. 40 CFR 262, Standards Applicable to Generators of Hazardous Waste.

25

- d. 40 CFR 263, Standards Applicable to Transporters of Hazardous Waste.

26

- e. 40 CFR 264, Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.

27

- f. 40 CFR 265, Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.

28

- g. 40 CFR 268, Land Disposal Restrictions.

29

- h. 40 CFR 745, Lead-Based Paint Poisoning Prevention in Certain Residential Structures.

30

###### 2. U. S. Department of Labor, Occupational Safety and Health Administration (OSHA):

31

- a. 29 CFR 1910.134, Respiratory Protection Standard.

32

- b. 29 CFR 1910.1200, Hazard Communication Standard.

33

- c. 29 CFR 1926, Safety and Health Regulations for Construction.

34

- d. 29 CFR 1926.62, Lead in Construction Standard.

35

- e. 29 CFR 1926.1118, Inorganic Arsenic in Construction Standard.

36

- f. 29 CFR 1926.1126, Hexavalent Chromium in Construction Standard.

37

- g. 29 CFR 1926.1127, Cadmium in Construction Standard.

38

###### 3. Nebraska Department of Health and Human Services:

39

- a. Title 178, Chapter 23 Lead-Based Paint Activities.

40

###### 4. U.S. Department of Transportation:

41

- a. Transportation, Title 49, CFR, Parts 171 and 172.

42

###### 5. American Society for Testing and Materials (ASTM):

43

- a. E1553, Standard Practice for Collection of Airborne Particulate Lead during Abatement and Construction Activities.

44

###### 6. Society for Protective Coatings (SSPC):

45

- a. Guide 6, Guide for Containing Debris Generated During Paint Removal Operations.

46

- b. Guide 7, Guide for the Disposal of Lead-Contaminated Surface Preparation Debris.

47

- c. SP COM, Surface Preparation Commentary for Steel and Concrete Substrates.

48

- d. SP 1, Solvent Cleaning.

49

- e. SP 2, Hand Tool Cleaning.

50

51

52

- 1 f. SP 3, Power Tool Cleaning.
- 2 g. SP 13/NACE No. 6, Surface Preparation of Concrete.
- 3 h. SP 15, Commercial Grade Power Tool Cleaning.
- 4 7. Underwriters Laboratories, Inc. (UL):
- 5 a. 586, Standard for Safety High-Efficiency, Particulate, Air Filter Units.

6 **1.3 SYSTEM DESCRIPTION**

- 7 A. Retain a State of Nebraska Certified Project Designer to prepare a Site-Specific Lead Abatement
- 8 Plan for the removal of the lead-based paint identified on the Drawings.
- 9 B. Provide for and incur cost of all permits, licenses and certifications.
- 10 C. Provide required regulatory agency notifications.
- 11 D. Sample and analyze lead containing waste materials to determine appropriate disposal method.
- 12 E. Package, label and load lead containing waste materials removed from the site onto Owner
- 13 provided vehicles. The Owner shall transport and dispose of these waste materials.
- 14 F. Obtain a third party to conduct clearance air sampling and certify to the Owner lead based paint
- 15 has been removed and final clearance air sampling has been completed successfully. Clearance
- 16 sampling shall be conducted under the supervision of and signed by a Certified Industrial
- 17 Hygienist.

18 **1.4 BASIS OF PAYMENT**

- 19 A. Payment for lead abatement of the paint identified in the drawings and in the report "Limited
- 20 Lead-Based Paint Survey" shall be as provided on Bid Form. Limited Lead-Based Paint Survey
- 21 is available as indicated in Supplementary Conditions.

22 **1.5 SUBMITTALS**

- 23 A. See Section 01340.
- 24 B. Pre-Work Submittals:
  - 25 1. A detailed Lead Abatement Work Plan prepared by a Nebraska Department of Health and
  - 26 Human Services Certified Project Designer. The plan shall include the location and layout of
  - 27 decontamination areas, the sequencing of work and methods to be used to assure the safety
  - 28 of building occupants, workers, and visitors to the site. The plan shall also include methods
  - 29 for controlling visible emissions in the work area and the containerization of debris.
  - 30 2. Documentation that Contractor is currently certified by the Nebraska Department of Health
  - 31 and Human Services to perform lead activities.
- 32 C. Additional Submittals:
  - 33 1. Daily logs of testing, monitoring and removal on a weekly basis.
  - 34 2. Daily logs of testing, monitoring and removal as a final report.
  - 35 3. Manifests of lead containing waste materials loaded for transport.

36 **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

37 **PART 3 - EXECUTION**

38 **3.1 WORK PLAN**

- 39 A. Develop site specific Work Plan for lead paint abatement activities.

40 **3.2 UTILITIES**

- 41 A. Provide all necessary utilities and connections for temporary utilities in the workplace during
- 42 abatement work.
  - 43 1. Any temporary electrical power shall comply with applicable codes and standards.

44 **3.3 LEAD REMOVAL**

- 45 A. Remove lead-based paint in accordance with the Work Plan prepared for Article 3.1.





1 2014/08/18

2

## SECTION 13440

3

### INSTRUMENTATION FOR PROCESS CONTROL: BASIC REQUIREMENTS

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

###### A. Section Includes:

7

1. Basic requirements for complete instrumentation system for process control.

8

###### B. Related Specification Sections include but are not necessarily limited to:

9

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

10

2. Division 01 - General Requirements.

11

3. Section 10400 - Identification Devices.

12

4. Section 13448 - Control Panels and Enclosures.

13

5. Division 16 - Electrical.

14

6. Section 16120 - Wire and Cable - 600 Volt and Below.

15

###### C. Pre-Negotiated Pricing:

16

1. The Owner has negotiated a price for procuring most of the equipment and manufacturer's services associated with Specification Sections 13440 through 13504. The pricing is listed in the Bid Form. In addition to this cost, the Contractor shall include in its Bid additional costs for unloading, storage, provision, installation, startup, demonstration and other appurtenant costs associated with the control system as required to meet all requirements of these Contract Documents.

17

18 the Bid Form. In addition to this cost, the Contractor shall include in its Bid additional costs  
19 for unloading, storage, provision, installation, startup, demonstration and other appurtenant  
20 costs associated with the control system as required to meet all requirements of these  
21 Contract Documents.

18

2. The proposal defining materials and services provided for the pricing shown in the Bid Form is attached at the end of this Specification Section. In addition, the Contractor shall include in its Bid any and all requirements of these Specification Sections that are not included in Huffman Engineering's proposal.

19

20

21

22

23

24

25

26

##### 1.2 QUALITY ASSURANCE

27

###### A. Referenced Standards:

28

1. Canadian Standards Association (CSA).

29

2. FM Global (FM).

30

3. The Instrumentation, Systems, and Automation Society (ISA):

31

- a. 7.0.01, Quality Standard for Instrument Air.

32

- b. S5.1, Instrumentation Symbols and Identification.

33

- c. S5.3, Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems.

34

35

- d. S20, Standard Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.

36

37

4. National Electrical Manufacturers Association (NEMA):

38

- a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

39

5. National Fire Protection Association (NFPA):

40

- a. 70, National Electrical Code (NEC).

41

6. National Institute of Standards and Technology (NIST).

42

###### A. Pre-Approved Instrumentation and Control System Integrator:

43

1. Huffman Engineering Inc.

44

5301 North 57<sup>th</sup> Street

45

Lincoln, Nebraska 68057

46

(402)-464-6823

47

###### B. Miscellaneous:

48

1. Comply with electrical classifications and NEMA enclosure types shown on Drawings.

49

##### 1.3 DEFINITIONS

- 1 A. Architecturally finished area: Offices, laboratories, conference rooms, restrooms, corridors and  
2 other similar occupied spaces.
- 3 B. Non-architecturally Finished Area: Pump, chemical, mechanical, electrical rooms and other  
4 similar process type rooms.
- 5 C. Hazardous Areas: Class I, II or III areas as defined in NFPA 70.
- 6 D. Highly Corrosive and Corrosive Areas: Rooms or areas identified on the Drawings where there is  
7 a varying degree of spillage or splashing of corrosive materials such as water, wastewater or  
8 chemical solutions; or chronic exposure to corrosive, caustic or acidic agents, chemicals,  
9 chemical fumes or chemical mixtures.
- 10 E. Outdoor Area: Exterior locations where the equipment is normally exposed to the weather and  
11 including below grade structures, such as vaults, manholes, handholes and in-ground pump  
12 stations.
- 13 F. Instrument Air Header: The segment of air supply piping and tubing which transports air from the  
14 compressed instrument air source through the branch isolation valve of any takeoff (branch) line.
- 15 G. Branch Line: The segment of air supply piping and tubing which transports air from the outlet of  
16 the air header branch isolation valve through an air user's isolation valve.
- 17 H. Intrinsically Safe Circuit: A circuit in which any spark or thermal effect is incapable of causing  
18 ignition of a mixture of flammable or combustible material in air under test conditions as  
19 prescribed in UL 913.
- 20 I. Calibrate: To standardize a device so that it provides a specified response to known inputs.

#### 21 **1.4 SYSTEM DESCRIPTION**

- 22 A. Control System Requirements:
  - 23 1. This Specification Section provides the general requirements for the instrument and control  
24 system.
  - 25 2. The instrument and control system consists of all primary elements, transmitters, switches,  
26 controllers, computers, recorders, indicators, panels, signal converters, signal boosters,  
27 amplifiers, special power supplies, special or shielded cable, special grounding or isolation,  
28 auxiliaries, software, wiring, and other devices required to provide complete control of the  
29 plant as specified in the Contract Documents.
  - 30 3. Ensure coordination of instrumentation with other work to ensure that necessary wiring,  
31 conduits, contacts, relays, converters, and incidentals are provided in order to transmit,  
32 receive, and control necessary signals to other control elements, to control panels, and to  
33 receiving stations.

#### 34 **1.5 SUBMITTALS**

- 35 A. Shop Drawings:
  - 36 1. See Specification Section 01340 for requirements for the mechanics and administration of  
37 the submittal process.
  - 38 2. Submittals shall be original printed material or clear unblemished photocopies of original  
39 printed material.
    - 40 a. Facsimile information is not acceptable.
  - 41 3. Limit the scope of each submittal to one (1) Specification Section.
    - 42 a. Each submittal must be submitted under the Specification Section containing  
43 requirements of submittal contents.
    - 44 b. Do not provide any submittals for Specification Section 13440.
  - 45 4. Product technical data including:
    - 46 a. Equipment catalog cut sheets.
    - 47 b. Instrument data sheets:
      - 48 1) ISA S20 or approved equal.
      - 49 2) Separate data sheet for each instrument.
    - 50 c. Materials of construction.
    - 51 d. Minimum and maximum flow ranges.
    - 52 e. Pressure loss curves.
    - 53 f. Physical limits of components including temperature and pressure limits.
    - 54 g. Size and weight.



- 1 h. Electrical power requirements and wiring diagrams.
- 2 i. NEMA rating of housings.
- 3 j. Submittals shall be marked with arrows to show exact features to be provided.
- 4 5. Comprehensive set of wiring diagrams as specified in Specification Section 13448.
- 5 6. Panel fabrication drawings as specified in Specification Section 13448.
- 6 7. PLC equipment Drawings.
- 7 8. HMI graphics.
- 8 9. Nameplate layout Drawings.
- 9 10. Drawings, systems, and other elements are represented schematically in accordance with
- 10 ISA S5.1 and ISA S5.3.
- 11 a. The nomenclature, tag numbers, equipment numbers, panel numbers, and related
- 12 series identification contained in the Contract Documents shall be employed exclusively
- 13 throughout submittals.
- 14 11. All panel and wiring drawings shall be provided in both hardcopy and softcopy.
- 15 a. Furnish electronic files on CD-ROM or DVD-ROM media.
- 16 b. Drawings in MicroStation format.
- 17 12. Certifications:
- 18 a. Documentation verifying that calibration equipment is certified with NIST traceability.
- 19 b. Approvals from independent testing laboratories or approval agencies, such as UL, FM
- 20 or CSA.
- 21 1) Certification documentation is required for all equipment for which the specifications
- 22 require independent agency approval.
- 23 13. Testing reports: Source quality control reports.
- 24 B. Operation and Maintenance Manuals:
- 25 1. See Specification Section 01342 for requirements for:
- 26 a. The mechanics and administration of the submittal process.
- 27 b. The content of Operation and Maintenance Manuals.
- 28 2. All final O&M Manuals shall be updated to provide as-built information/corrections.
- 29 3. Warranties: Provide copies of warranties and list of factory authorized service agents.

### 30 1.6 DELIVERY, STORAGE, AND HANDLING

- 31 A. Do not remove shipping blocks, plugs, caps, and desiccant dryers installed to protect the
- 32 instrumentation during shipment until the instruments are installed and permanent connections
- 33 are made.

### 34 1.7 SITE CONDITIONS

- 35 A. Unless designated otherwise on the Drawings, area designations are as follows:
- 36 1. Outdoor area:
- 37 a. Wet.
- 38 b. Corrosive and/or hazardous when specifically designated on the Drawings or in the
- 39 Specifications.
- 40 c. Below grade vaults and manholes:
- 41 1) Subject to temporary submergence when specifically designated on the Drawings or
- 42 Specifications.
- 43 2. Architecturally finished area:
- 44 a. Dry.
- 45 b. Noncorrosive unless designated otherwise on the Drawings or in the Specifications.
- 46 c. Nonhazardous unless designated otherwise on the Drawings or in the Specifications.
- 47 3. Non-architecturally finished area: As designated elsewhere on the Drawings or in the
- 48 Specifications.

## 49 PART 2 - PRODUCTS

### 50 2.1 NEMA TYPE REQUIREMENTS

- 51 A. Provide enclosures/housing for control system components in accordance with the following:
- 52 1. Areas designated as wet: NEMA Type 4.
- 53 2. Areas designated as wet and/or corrosive: NEMA Type 4X.

3. Either architecturally or non-architecturally finished areas designated as dry, noncorrosive, and nonhazardous: NEMA Type 12.
4. Areas designated to be subject to temporary submersion: NEMA 6P.

## 2.2 PERFORMANCE AND DESIGN REQUIREMENTS

### A. System Operating Criteria:

1. Stability: After controls have taken corrective action, as result of a change in the controlled variable or a change in setpoint, oscillation of final control element shall not exceed two (2) cycles per minute or a magnitude of movement of 0.5 percent full travel.
2. Response: Any change in setpoint or change in controlled variable shall produce a corresponding corrective change in position of final control element and become stabilized within 30 seconds.
3. Agreement: Setpoint indication of controlled variable and measured indication of controlled variable shall agree within 3 percent of full scale over a 6:1 operating range.
4. Repeatability: For any repeated magnitude of control signal, from either an increasing or decreasing direction, the final control element shall take a repeated position within 0.5 percent of full travel regardless of force required to position final element.
5. Sensitivity: Controls shall respond to setpoint deviations and measured variable deviations within 1.0 percent of full scale.
6. Performance: All instruments and control devices shall perform in accordance with manufacturer's specifications.

## 2.3 ACCESSORIES

- A. Provide identification devices for instrumentation system components in accordance with Specification Section 10400.
- B. Provide corrosion resistant spacers to maintain 1/4 IN separation between equipment and mounting surface in wet areas, on below grade walls and on walls of liquid containment or processing areas such as Clarifiers, Digesters, Reservoirs, etc.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Wherever feasible, use bottom entry for all conduit entry to instruments and junction boxes.
- B. Install electrical components per Division 16.
- C. Panel-Mounted Instruments:
  1. Mount and wire so removal or replacement may be accomplished without interruption of service to adjacent devices.
  2. Locate all devices mounted inside enclosures so terminals and adjustment devices are readily accessible without use of special tools and with terminal markings clearly visible.
- D. See Specification Section 16120.

### 3.2 FIELD QUALITY CONTROL

- A. See Specification Section 01650.
- B. Maintain accurate daily log of all startup activities, calibration functions, and final setpoint adjustments.
  1. Documentation requirements include the utilization of the forms located at the end of this Specification Section.
    - a. Loop Check-out Sheet.
    - b. Instrument Certification Sheet.
- C. In the event that instrument air is not available during calibration and testing, supply either filtered, dry, instrument quality air from a portable compressor or bottled, dry, instrument quality air.
  1. Do not, under any circumstances, apply hydrostatic test to any part of the air supply system or pneumatic control system.

- 1 D. Pneumatic Signal Tubing Testing:
  - 2 1. Before the leak test is begun, blow clean with dry air.
  - 3 2. Test signal tubing per ISA 7.0.01, except for tubing runs of less than 10 FT where simple
  - 4 soap bubble testing will suffice.
  - 5 3. If a leak is detected, repair the leak and repeat the leak test.
  - 6 4. After completion of the leak test, check each signal line for obstructions.
  - 7 a. If any are indicated, remove and retest.
  
- 8 E. Instrumentation Calibration:
  - 9 1. Verify that all instruments and control devices are calibrated to provide the performance
  - 10 required by the Contract Documents.
  - 11 2. Calibrate all field-mounted instruments, other than local pressure and temperature gages,
  - 12 after the device is mounted in place to assure proper installed operation.
  - 13 3. Calibrate in accordance with the manufacturer's specifications.
  - 14 4. Bench calibrate pressure and temperature gages.
  - 15 a. Field mount gage within seven (7) days of calibration.
  - 16 5. Check the calibration of each transmitter and gage across its specified range at 0, 25, 50, 75,
  - 17 and 100 percent.
  - 18 a. Check for both increasing and decreasing input signals to detect hysteresis.
  - 19 6. Replace any instrument which cannot be properly adjusted.
  - 20 7. Stroke control valves with clean dry air to verify control action, positioner settings, and
  - 21 solenoid functions.
  - 22 8. Calibration equipment shall be certified by an independent agency with traceability to NIST.
  - 23 a. Certification shall be up-to-date.
  - 24 b. Use of equipment with expired certifications shall not be permitted.
  - 25 9. Calibration equipment shall be at least three (3) times more accurate as the device being
  - 26 calibrated.
  
- 27 F. Loop check-out requirements are as follows:
  - 28 1. Check control signal generation, transmission, reception and response for all control loops
  - 29 under simulated operating conditions by imposing a signal on the loop at the instrument
  - 30 connections.
  - 31 a. Use actual signals where available.
  - 32 b. Closely observe controllers, indicators, transmitters, HMI displays, recorders, alarm and
  - 33 trip units, remote setpoints, ratio systems, and other control components.
  - 34 1) Verify that readings at all loop components are in agreement.
  - 35 2) Make corrections as required.
  - 36 a) Following any corrections, retest the loop as before.
  - 37 2. Stroke all control valves, cylinders, drives and connecting linkages from the local control
  - 38 station and from the control room operator interface.
  - 39 3. Check all interlocks to the maximum extent possible.
  - 40 4. In addition to any other as-recorded documents, record all setpoint and calibration changes
  - 41 on all affected Contract Documents and turn over to the Owner.
  
- 42 G. Provide verification of system assembly, power, ground, and I/O tests.
- 43 H. Verify existence and measure adequacy of all grounds required for instrumentation and controls.

**END OF SECTION**



# MUD Florence Water Treatment Plant Phase II - Filter Improvements Project

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**PROPOSAL NUMBER MU160 REV 1**

**SEPTEMBER 8, 2014**



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Lincoln, NE 68507  
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## REVISION HISTORY

- Initial Issue – August 19, 2014 based on 90% information from HDR
- Revised – Sept 8, 2014 – removed Filter flow rate and head loss displays, added HART communications to instruments, changed Honeywell STD730 to STD720 transmitters, added Entch Echo Smart Interface Analyzer for filter media level and expansion, revised type of DP manifold from 3 valve to 5 valve from PGI, removed four (4) pump discharge pressure gauges.

## PROJECT OBJECTIVES

This proposal outlines the services and equipment Huffman Engineering Inc. (HEI) will provide for the Filter Improvement Project at the MUD Florence Water Treatment Plant. This proposal is based upon information provided from information sent by HDR on July 17, August 8, August 14, August 15, and August 18 and e-mails from HDR on Sept 4 and Sept 5, 2014. The P&ID's used in this proposal are: FCY601- Polymer Feed, FCY602- Sodium Hexametaphosphate Feed, FCY603 Flouride Feed, FPY601- Filter 1-18 and FPY602 – Filter 19-24.

## PROJECT DESCRIPTION

### Project Summary

The scope of the work to be performed by Huffman Engineering is based on information listed in the following specification sections:

- 13440 Instrumentation For Process Controls - Basic Requirements
- 13441 Control Loop Descriptions
- 13442 Primary Elements and Transmitters
  - Note: HEI is not including items in Section 2.6, 2.7, 2.8, and 3.1 of 13442
- 13445 Recorders and Indicators
- 13446 Control Auxiliaries
- 13448 Control Panels and Enclosures
- 13500 Programmable Logic Controller (PLC) Control System

This proposal includes submittals, engineering time, new primary elements, instrumentation, and field mounted displays. This proposal also includes PLC programming, HMI programming, training and onsite startup. Full documentation will be provided in the form of system architecture, panel layout, wiring, and schematic drawings. Operation and maintenance manuals will also be provided.

### Assumptions

This proposal is based upon the following assumptions:

- Equipment and labor **not** furnished under this proposal includes any equipment or labor not specifically described in this proposal.
- Reasonable Plant access will be granted to approved HEI personnel to allow for design, installation, and testing functions.
- All equipment specified in Division 11 of the specifications will be supplied by others.

- All HEI supplied instruments and displays will be installed and wired by others.
- HEI must receive a contract or purchase order in a timely manner in order to get started quickly and meet the completion date of the work.

### **HEI Supplied Labor for Base Bid**

- Engineering and technician time for submittals.
- Engineering and technician time for preconstruction, design and progress meetings.
- Engineering design time for system layout, PLC I/O requirements, and software requirements.
- Drafting time to create or modify schematics, layout drawings, and single line diagrams.
- Technician time to assemble the new Fluoride Transfer Pump control panel.
- Engineering time for PLC configuration and scaling for the new instruments.
- Engineering time for HMI programming.
- Engineering time to modify the existing reports to include data from the new instruments.
- Engineering time to create Loop Checkout forms.
- Engineering time to create Operation and Maintenance Manuals.
- Engineering and technician time for onsite I/O checkout, and system start-up.
- Technician time for instrument calibration, startup and training.
- Engineering time for HMI and Control System training for plant operators and maintenance personnel.

### **HEI Supplied Control Panel Equipment**

Equipment required per specification sections 13446, 13448, 13500 and the specification drawings.

1	Modifications to Quad 1 control panel including I/O cards, terminal blocks, and surge suppressors, wire and wire labels.
2	Fluoride Transfer Pump Control Control Panel with control switches, pilot lights and relays for hardwired control of the fluoride transfer pumps

### **HEI Supplied Instrumentation**

Instruments listed in specification sections 13342 and the contract drawings

1	Qty (24) – Honeywell STD720 Flow Transmitter with five-valve manifold (FP-F01-FIT, FP-F02-FIT, FP-F03-FIT, FP-F04-FIT, FP-F05-FIT, FP-F06-FIT, FP-F07-FIT, FP-F08-FIT, FP-F09-FIT, FP-F10-FIT, FP-F11-FIT, FP-F12-FIT, FP-F13-FIT, FP-F14-FIT, FP-F15-FIT, FP-F16-FIT, FP-F17-FIT, FP-F18-FIT, FP-F19-FIT, FP-F20-FIT, FP-F21-
---	--

	FIT, FP-F22-FIT, FP-F23-FIT, FP-F24-FIT)
2	Qty (24) – Honeywell STD720 Pressure Transmitter with five-valve manifold (FP-F01-PDIT, FP-F02-PDIT, FP-F03-PDIT, FP-F04-PDIT, FP-F05-PDIT, FP-F06-PDIT, FP-F07-PDIT, FP-F08-PDIT, FP-F09-PDIT, FP-F10-PDIT, FP-F11-PDIT, FP-F12-PDIT, FP-F13-PDIT, FP-F14-PDIT, FP-F15-PDIT, FP-F16-PDIT, FP-F17-PDIT, FP-F18-PDIT, FP-F19-PDIT, FP-F20-PDIT, FP-F21-PDIT, FP-F22-PDIT, FP-F23-PDIT, FP-F24-PDIT)
3	Qty (2) – Ashcroft Pressure Gage (FC-FLTP01-PI, FC-FLTP02-PI,)
4	Qty(3) – Siemens Radar Level Transmitter (FC-POST01-LIT, FC-SHST01-LIT, FC-SHST02-LIT)
5	Qty (4) – Anchor Scientific. Float-Tilt Level Switches (FC-SHST-LSH, FC-FLTP-LSH, FC-SUMP-LSH, FC-FLDT-LSH).
6	Qty (2) – Force Flow Tank Scale (FC-FLDT01-WE, FC-PODT01-WE)
7	Qty (27) Hack Turbidity Analyzer (FP-F01-AE/AIT, FP-F02-AE/AIT, FP-F03-AE/AIT, FP-F04-AE/AIT, FP-F05-AE/AIT, FP-F06-AE/AIT, FP-F07-AE/AIT, FP-F08-AE/AIT, FP-F09-AE/AIT, FP-F10-AE/AIT, FP-F11-AE/AIT, FP-F12-AE/AIT, FP-F13-AE/AIT, FP-F14-AE/AIT, FP-F15-AE/AIT, FP-F16-AE/AIT, FP-F17-AE/AIT, FP-F18-AE/AIT, FP-F19-AE/AIT, FP-F20-AE/AIT, FP-F21-AE/AIT, FP-F22-AE/AIT, FP-F23-AE/AIT, FP-F24-AE/AIT, FP-FEFF-AE/AIT, 2 Spare Analyzers)
8	Qty (1) Mill Ram Fluoride Gas Detector (FC-ROOM-AIT)
9	Qty (2) Entech – Echo Smart Interface Level Analyzer power cord and temporary mounting brackets.
10	Qty (1) Precision Digital PD6000 Display (FC-POST01-LI2) in SS Enclosure
11	Qty (15) – Phoenix field mounted surge suppressors for signals

### HEI Supplied Documentation

- Product Information Submittals. All submittals will be in electronic form only. Additional copies or extra submissions will be at extra cost.
- Panel Layout and Schematic Drawings. Electronic copies only.
- Operation and Maintenance Manuals. Preliminary and final O&M manuals will be in electronic format.
- Final HMI Project File on CD-ROM.
- PLC Programs and Drawings on CD-ROM.

### Labor Supplied by Others

- Installation of field conduit and wiring.
- Fabrication and installation of instrumentation and display mounting brackets.
- Installation of Instruments.
- Wiring terminations.
- Installation and wiring of field mounted surge suppressors for instruments.
- Mechanical Piping.
- Installation of valves, pumps, and all other mechanical equipment.
- Installation direct supervision.



**Equipment Supplied by Others**

All	Equipment specified in Div 11, 15 and 16, unless specifically listed as included in this proposal.
All	Pressure Taps, and Valves
All	Field Instrument device mounting accessories
All	Instrument Valves, tubing, piping, and fittings
All	Mechanical Piping
All	Pumps
All	Panelboards
All	Motor Control Centers
All	Variable Frequency Drives
All	Field Conduit and Wire

**Documentation Supplied by Others**

Huffman Engineering will be supplied with all applicable documentation including:

- Final design documents
- Submittal information for equipment supplied by others

**Schedule**

The schedule will be negotiated at the time of contract award and meet contract requirements.

**PRICING INFORMATION**

**Base Proposal Price:** \$

**Note: This price does not include sales tax.**

**Option #1:**

This proposal does not include the cost of a performance bond. If a performance bond is required, there will be an additional charge of 2% of the Total Proposal Price listed above.

- The amounts specified do not include sales tax. The contractor must provide a Form 13 or additional taxes will apply. This price is valid for 60 days. Past due accounts are subject to a service charge of 1.5% per month or the maximum permitted by law.
- All change requests after the acceptance of this proposal will be evaluated for impact to project cost and schedule, and may consequently result in change orders.

- Time spent on-site due to equipment not ready, errors in fabrication or field wiring, or any other circumstance beyond our control will be invoiced at the appropriate rate plus expenses.

### Payment Terms

90%	Billed monthly based on percent of completion
10%	Upon final completion.

### PROPOSAL ACCEPTANCE

To accept this proposal please either fill in the purchase order number, initial next to the base proposal and all options to purchase, sign, and return it to HEI, or return a written contract, written purchase order or written notice to proceed.

Purchase order number: \_\_\_\_\_

Initial \_\_\_\_\_

\_\_\_\_\_ Base Proposal  
 \_\_\_\_\_ Option #1- Performance Bond  
 \_\_\_\_\_

Prepared By: Huffman Engineering Inc.



Howard Huffman P.E.  
 President

September 8, 2014

Date

Accepted by:

\_\_\_\_\_

Date



# Loop Check-out Sheet

Project Name: BIG PROJECT	Owner's Project No. (if applicable):	Page 1 of 2
Project Owner: ABC Company	Regulatory Agency Project No. (if applicable):	
HDR Project No.: 10050-211-134	Date: 12/19/98	
Control Loop No. 107		

## LEAK AND TERMINATION/CONTINUITY CHECKS

DESCRIPTION	FIELD			CONTROL CAB			
	LEAK CHECK <sub>(1)</sub>			TERM/CONT CHECK <sub>(2)</sub>		TERM/CONT CHECK <sub>(2)</sub>	
	Device Tag No.	Process Conn.	Signal Tube	Device Tag No.	Termination Ident.	Device Tag No.	Termination Ident.
P201 Start Sig				VFD-107	21, 22	PLC Cab	103, 104
P201, Speed inp				VFD-107	27, 28	PLC Cab	67, 68, 69
P201 Start out				VFD-107	31, 32	PLC Cab	72, 73, 74
Press transmit	PIT-107	JS	--	PIT-107	+ / -	PLC Cab	98, 99, 100

- Leak check for pneumatic signal tubing to be per ISA-PR7.1.
- Termination/continuity check includes check at terminated equipment for: (a) correct polarity, (b) appropriate signal generation, transmission and reception, and (c) correct shield & ground terminations.

## OPERATOR INTERFACE CHECK-OUT MONITORING POINTS OBSERVED

PARAMETER TYPE	TAG NO.	TAG NO.	TAG NO.	TAG NO.	TAG NO.	TAG NO.
PROCESS VAR	PI-107A	SI-107				
EQUIP STATUS	P201 ON	P201 OFF	V-107 open	V-107 close		
ALARM POINT	PAH-107					

## OPERATOR CONTROL FUNCTIONS CHECKED

FUNCTION TYPE	TAG NO.	LOCATION	TAG NO.	LOCATION	TAG NO.	LOCATION
H-O-A sel sw	HS-107A	VFD-107				
L-O-R sel sw	HS-107B	@ P201				
S/S switch	HS-107C	MCC	HS-107D	MCC		

## AS LEFT SETTINGS

TAG NO.	SWITCH & ALARM SP	CONTROLLERS			
		Gain	Reset, rpm	Deriv. (rate), min	PV Set Point
PAH-107	120 psi				
SC-107		2.0	5.0	0.2	80 psi

Describe all interlocks checked, equipment started/stopped, valves/operators stroked. Describe modes of operation checked, and location of operator interface (local/remote).

(1) HS-107B in Local: (a) start/stop operation via HS-107A and HS-107C. (b) Manual/auto operation via HS-107A. In auto, pump stopped on hi press, started on lo press. (2) HS-107B in Remote: Observed operation from PLC-pump stopped on hi press, started on lo press. (3) Observed V-107 open/close automatically in accord with pump run condition. (4) Observed all indications and terminations shown above. (5) Tuned SC-107

I certify that the control loop referenced on this page has been completely checked and functions in accordance with applicable drawings and specifications.

Certified by: \_\_\_\_\_ Joe Smith  
(Work Performed By)

Date: 12/19/98



# Loop Check-out Sheet

Project Name: BIG PROJECT	Owner's Project No. (if applicable):	Page 2 of 2
Project Owner: ABC Company	Regulatory Agency Project No. (if applicable):	
HDR Project No.: 10050-211-134	Date: 12/19/98	
Control Loop No. 107		

## LEAK AND TERMINATION/CONTINUITY CHECKS

DESCRIPTION	FIELD				CONTROL CAB		
	LEAK CHECK <sub>(1)</sub>			TERM/CONT CHECK <sub>(2)</sub>		TERM/CONT CHECK <sub>(2)</sub>	
	Device Tag No.	Process Conn.	Signal Tube	Device Tag No.	Termination Ident.	Device Tag No.	Termination Ident.
V-107 open ZS				ZSO-107	+ / -	PLC Cab	112, 113
V-107 close ZS				ZSC-107	+ / -	PLC Cab	114, 115

- Leak check for pneumatic signal tubing to be per ISA-PR7.1.
- Termination/continuity check includes check at terminated equipment for: (a) correct polarity, (b) appropriate signal generation, transmission and reception, and (c) correct shield & ground terminations.

## OPERATOR INTERFACE CHECK-OUT MONITORING POINTS OBSERVED

PARAMETER TYPE	TAG NO.	TAG NO.	TAG NO.	TAG NO.	TAG NO.	TAG NO.
PROCESS VAR						
EQUIP STATUS	ZOI-107	ZCI-107				
ALARM POINT						

## OPERATOR CONTROL FUNCTIONS CHECKED

FUNCTION TYPE	TAG NO.	LOCATION	TAG NO.	LOCATION	TAG NO.	LOCATION

## AS LEFT SETTINGS

TAG NO.	SWITCH & ALARM SP	CONTROLLERS			
		Gain	Reset, rpm	Deriv. (rate), min	PV Set Point

Describe all interlocks checked, equipment started/stopped, valves/operators stroked. Describe modes of operation checked, and location of operator interface (local/remote).

Checked terminations and verified indications shown above.

I certify that the control loop referenced on this page has been completely checked and functions in accordance with applicable drawings and specifications.

Certified by: Joe Smith  
(Work Performed By)

Date: 12/19/98



# Loop Check-out Sheet

Project Name:	Owner's Project No. (if applicable):	Page of
Project Owner:	Regulatory Agency Project No. (if applicable):	
HDR Project No.:	Date:	

## LEAK AND TERMINATION/CONTINUITY CHECKS

DESCRIPTION	FIELD					CONTROL CAB	
	LEAK CHECK <sub>(1)</sub>			TERM/CONT CHECK <sub>(2)</sub>		TERM/CONT CHECK <sub>(2)</sub>	
	Device Tag No.	Process Conn.	Signal Tube	Device Tag No.	Termination Ident.	Device Tag No.	Termination Ident.

1. Leak check for pneumatic signal tubing to be per ISA-PR7.1.
2. Termination/continuity check includes check at terminated equipment for: (a) correct polarity, (b) appropriate signal generation, transmission and reception, and (c) correct shield & ground terminations.

## OPERATOR INTERFACE CHECK-OUT

### MONITORING POINTS OBSERVED

PARAMETER TYPE	TAG NO.	TAG NO.	TAG NO.	TAG NO.	TAG NO.	TAG NO.
PROCESS VAR						
EQUIP STATUS						
ALARM POINT						

## OPERATOR CONTROL FUNCTIONS CHECKED

FUNCTION TYPE	TAG NO.	LOCATION	TAG NO.	LOCATION	TAG NO.	LOCATION

## AS LEFT SETTINGS

TAG NO.	SWITCH & ALARM SP	CONTROLLERS			
		Gain	Reset, rpm	Deriv. (rate), min	PV Set Point

Describe all interlocks checked, equipment started/stopped, valves/operators stroked. Describe modes of operation checked, and location of operator interface (local/remote).

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I certify that the control loop referenced on this page has been completely checked and functions in accordance with applicable drawings and specifications.

Certified by: \_\_\_\_\_  
(Work Performed By)

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





# Instrument Certification Sheet

Project Name:	BIG PROJECT	Owner's Project No. (if applicable):	
Project Owner:	ABC Company	Regulatory Agency Project No. (if applicable):	
HDR Project No.	10050-211-134	Date:	12/19/98
Control Loop No.:	222		
Instrument Tag No.	TSH-222	Transmitter/gauge span:	
Manufacturer:	ACE, Inc.	Switch set-point:	50 F
Model No.	TL-2983-SH5	Switch dead band:	5 F
Serial No.	10293583	Switch range:	32-200 F

## TRANSMITTERS AND INDICATORS

% OF SPAN	INCREASING INPUT			DECREASING INPUT		
	INPUT	OUTPUT	ERROR (% of span)	INPUT	OUTPUT	ERROR (% of span)
0%						
25%						
50%						
75%						
100%						
Other (if applicable)						
Other (if applicable)						

## SWITCHES

ACTUATION POINT	INCREASING INPUT			DECREASING INPUT		
	INPUT	OUTPUT	ERROR (% of range)	INPUT	OUTPUT	ERROR (% of range)
High (Increasing input)	49.8 F	Contact Close	0.1%	45.1 F	Contact Open	0.2%
Low (Decreasing input)						

Maximum allowable error (per Contract Documents): 1.0% Switch Range

Remarks: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

## CALIBRATION EQUIPMENT UTILIZED

DEVICE TYPE	MFR/MODEL NO.	ACCURACY	NIST TRACEABILITY?
Temperature (dry block) calibrator	Hart Scientific XL5897T	0.1 F	Yes

Certified by: Joe Smith

Date Certified: 12/19/98



# Instrument Certification Sheet

Project Name:	BIG PROJECT	Owner's Project No. (if applicable):	
Project Owner:	ABC Company	Regulatory Agency Project No. (if applicable):	
HDR Project No.	10050-211-134	Date:	12/19/98
Control Loop No.:	106		
Instrument Tag No.	PIT-106A	Transmitter/gauge span:	0-200 psi
Manufacturer:	ACE, Inc.	Switch set-point:	
Model No.	1275-X	Switch dead band:	
Serial No.	3049569TSH	Switch range:	

## TRANSMITTERS AND INDICATORS

% OF SPAN	INCREASING INPUT			DECREASING INPUT		
	INPUT	OUTPUT	ERROR (% of span)	INPUT	OUTPUT	ERROR (% of span)
0%	0.00 psi	4.02 mA	0.13	0.00 psi	4.00 mA	0.00
25%	50.00 psi	8.00 mA	0.00	50.00 psi	8.01 mA	0.06
50%	100.00 psi	12.01 mA	0.06	100.00 psi	12.00 mA	0.00
75%	150.00 psi	16.00 mA	0.00	150.00 psi	16.01 mA	0.06
100%	200.00 psi	20.00 mA	0.00	200.00 psi	19.99 mA	0.06
Other (if applicable)						
Other (if applicable)						

## SWITCHES

ACTUATION POINT	INCREASING INPUT			DECREASING INPUT		
	INPUT	OUTPUT	ERROR (% of range)	INPUT	OUTPUT	ERROR (% of range)
High (Increasing input)						
Low (Decreasing input)						

Maximum allowable error (per Contract Documents): 0.15% span

Remarks: Adjusted zero-otherwise no adjustments required

## CALIBRATION EQUIPMENT UTILIZED

DEVICE TYPE	MFR/MODEL NO.	ACCURACY	NIST TRACEABILITY?
Pressure calibrator	Hathaway/Beta XL5946P	0.025% full scale	Yes
Pressure module	Hathaway/Beta XL5948P-6:0-150 psi	0.025% full scale	Yes

Certified by: Joe Smith Date Certified: 12/19/98





# Instrument Certification Sheet

Project Name:	Owner's Project No. (if applicable):
Project Owner:	Regulatory Agency Project No. (if applicable):
HDR Project No.	Date:
Control Loop No.:	
Instrument Tag No.	Transmitter/gauge span:
Manufacturer:	Switch set-point:
Model No.	Switch dead band:
Serial No.	Switch range:

## TRANSMITTERS AND INDICATORS

% OF SPAN	INCREASING INPUT			DECREASING INPUT		
	INPUT	OUTPUT	ERROR (% of span)	INPUT	OUTPUT	ERROR (% of span)
0%						
25%						
50%						
75%						
100%						
Other (if applicable)						
Other (if applicable)						

## SWITCHES

ACTUATION POINT	INCREASING INPUT			DECREASING INPUT		
	INPUT	OUTPUT	ERROR (% of range)	INPUT	OUTPUT	ERROR (% of range)
High (Increasing input)						
Low (Decreasing input)						

Maximum allowable error (per Contract Documents): \_\_\_\_\_

Remarks: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

## CALIBRATION EQUIPMENT UTILIZED

DEVICE TYPE	MFR/MODEL NO.	ACCURACY	NIST TRACEABILITY?

Certified by: \_\_\_\_\_

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





# Final Control Element Certification Sheet

Project Name:	BIG PROJECT	Owner's Project No. (if applicable):
Project Owner:	ABC Company	Regulatory Agency Project No. (if applicable):
HDR Project No.:	10050-211-134	Date: 12/19/98
Control Loop No.:	056	

Tag No. LCV-056A	Actuator: Pneumatic: <input checked="" type="checkbox"/> Electric: _____
Description: Control Valve	Positioner: Direct: <input checked="" type="checkbox"/> Reverse: _____
Manufacturer: ACE, Inc.	Positioner: Input: <u>9-15 psi</u> Output: <u>0-100%</u>
Model No. XYZ-123	I/P Converter: Input: <u>4-20 mA</u> Output: <u>3-15 psi</u>
Serial No. 748569AP2	Valve to <u>Open</u> on air failure
	Valve to <u>Open</u> on power failure

### I/P CONVERTER

% OF SPAN	INCREASING INPUT			DECREASING INPUT		
	INPUT	OUTPUT	ERROR (% of span)	INPUT	OUTPUT	ERROR (% of span)
0%	4.00 mA	3.01 psi	0.08	4.00 mA	3.02 psi	0.17
25%	8.00 mA	6.04 psi	0.33	8.00 mA	6.05 psi	0.42
50%	12.00 mA	9.00 psi	0.00	12.00 mA	9.01 psi	0.08
75%	16.00 mA	11.97 psi	0.25	16.00 mA	12.03 psi	0.25
100%	20.00 mA	14.99 psi	0.08	20.00 mA	14.99 psi	0.08

Specified I/P converter accuracy: 0.50% % of span.

### FINAL CONTROL ELEMENT

% OF SPAN	INCREASING INPUT			DECREASING INPUT		
	INPUT	TRAVEL	ERROR (% of full travel)	INPUT	TRAVEL	ERROR (% of full travel)
0%	9.00 psi	0%	-	9.00 psi	0%	-
25%	10.50 psi	25%	-	10.50 psi	25%	-
50%	12.00 psi	50%	-	12.00 psi	50%	-
75%	13.50 psi	75%	-	13.50 psi	75%	-
100%	15.00 psi	100%	-	15.00 psi	100%	-

Remarks: LCV-056A is not furnished with position transmitter, so travel checks were visual.

### CALIBRATION EQUIPMENT UTILIZED

DEVICE TYPE	MFR/MODEL NO.	ACCURACY	NIST TRACEABILITY?
Multi-fct calibrator	Fluke-XL743B	0.01% Rdg + 0.015% FS	Yes
Pressure Module	Fluke-XL700POS (0-30")	0.05% FS	Yes

Certified by: Joe Smith

Date Certified: 12/19/98

**EXAMPLE**



# Final Control Element Certification Sheet

Project Name:	Owner's Project No. (if applicable):
Project Owner:	Regulatory Agency Project No. (if applicable):
HDR Project No.	Date:
Control Loop No.:	
Tag No.	Actuator: Pneumatic: _____ Electric: _____
Description:	Positioner: Direct: _____ Reverse: _____
Manufacturer:	Positioner: Input: _____ Output: _____
Model No.	I/P Converter: Input: _____ Output: _____
Serial No.	Valve to _____ on air failure
	Valve to _____ on power failure

## I/P CONVERTER

% OF SPAN	INCREASING INPUT			DECREASING INPUT		
	INPUT	OUTPUT	ERROR (% of span)	INPUT	OUTPUT	ERROR (% of span)
0%						
25%						
50%						
75%						
100%						

Specified I/P converter accuracy: \_\_\_\_\_ % of span.

## FINAL CONTROL ELEMENT

% OF SPAN	INCREASING INPUT			DECREASING INPUT		
	INPUT	TRAVEL	ERROR (% of full travel)	INPUT	TRAVEL	ERROR (% of full travel)
0%						
25%						
50%						
75%						
100%						

Remarks: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

## CALIBRATION EQUIPMENT UTILIZED

DEVICE TYPE	MFR/MODEL NO.	ACCURACY	NIST TRACEABILITY?

Certified by: \_\_\_\_\_

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



1 2014/09/08

2

3

**SECTION 13441**  
**CONTROL LOOP DESCRIPTIONS**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes: Instrumentation control loops.
- 7 B. Related Specification Sections include but are not necessarily limited to:
  - 8 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
  - 9 2. Division 01 - General Requirements.
  - 10 3. Section 13440 - Instrumentation for Process Control: Basic Requirements.

11 **1.2 QUALITY ASSURANCE**

- 12 A. See Specification Section 13440.

13 **1.3 SYSTEM DESCRIPTION**

- 14 A. The control loop descriptions provide the functional requirements of the control loops represented  
15 in the Contract Documents.
  - 16 1. Descriptions are provided as follows:
    - 17 a. Control system overview and general description.
    - 18 b. Major equipment to be controlled.
    - 19 c. Major field mounted instruments (does not include local gages).
    - 20 d. Manual control functions.
    - 21 e. Automatic control functions/interlocks.
    - 22 f. Remote indications and alarms.
  - 23 B. Provide instrumentation hardware and software as necessary to perform control functions  
24 specified herein and shown on Drawings.
  - 25 C. Update all existing HMI screens to incorporate District standards.
  - 26 D. Purpose and use of control loop descriptions:
    - 27 1. The control loop descriptions are not intended to be an inclusive listing of all elements and  
28 appurtenances required to execute loop functions, but are rather intended to supplement and  
29 complement the Drawings and other Specification Sections.
    - 30 2. The control loop descriptions contain minimum requirements to be utilized for PLC and HMI  
31 programming and configuration.
      - 32 a. The Contractor shall review existing PLC programming logic diagrams to ascertain  
33 existing details of PLC programming.
      - 34 b. Except where directed otherwise in these Contract Documents, the Contractor shall  
35 maintain existing control logic and existing indications of alarms, equipment status and  
36 process variables.

37 **1.4 GENERAL REQUIREMENTS**

- 38 A. In addition to the requirements specifically stated within the control loop descriptions, all control  
39 software and hardware shall be provided to ensure the safe and reliable operation of all controlled  
40 equipment.
- 41 B. All analog inputs shall be scaled to engineering units in the PLC rather than in Citect software as  
42 many are now.
- 43 C. Alarm Requirements:
  - 44 1. A "Transmitter Trouble" alarm shall be generated upon loss of transmitter signal or if the  
45 signal is out of range (outside the 4 to 20 mA signal).
  - 46 2. All alarm set points shall be adjustable through the HMI with appropriate security.
    - 47 a. All high-high and low-low set points are to be set via Supervisor level only.
  - 48 3. Alarms shall be configured with a delay timer in the PLC to remove nuisance alarms.

- 1           4. Alarm Categories are to be as indicated below; coordinate with the District to assign the
- 2           appropriate alarm level to each alarm condition.
- 3           a. Level 1: Red alarm text; sound building alarm horn, sound HMI alarm noise.
- 4           b. Level 2: Red alarm text; do not sound building alarm horn, sound HMI alarm noise.
- 5           c. Level 3: Yellow alarm text; do not sound building alarm horn, sound HMI alarm noise.
- 6           d. Level 4: Notification only; do not sound building alarm horn, do not sound HMI alarm
- 7           noise.
- 8           D. A "failsafe" design shall be incorporated in the logic so that loss of any signal or loss of power
- 9           shall not endanger personnel or result in equipment damage.
- 10          E. Any restart of the PLC processor shall not restart the plant equipment. An operator initiated,
- 11          controlled re-start of the plant equipment shall be implemented in the PLC logic.
- 12          F. All trip time delays shall be operator adjustable from the HMI system with appropriate security.
- 13          G. All process values, ranges, and setpoints described herein shall be considered "Initial Values"
- 14          and may be changed during installation and startup.
- 15          H. The PLC and HMI system shall validate all operator entered setpoint values before
- 16          implementation. All alarm setpoint changes can be made by an operator level password unless
- 17          otherwise noted and all trip setpoint changes can be made by supervisory level password.
- 18          I. All PID loops shall be programmed for "bumpless transfer" between auto and manual modes from
- 19          the HMI system.
- 20          J. To obtain synchronized time, all computers shall look to domain controller which in turn will look
- 21          to firewall for current time. PLCs shall look to the firewall for the time.

## 22   1.5   **SUBMITTALS**

- 23          A. See Specification Section 01340 for requirements for the mechanics and administration of the
- 24          submittal process.
- 25          B. See Specification Section 13440.
- 26          C. Operation and Maintenance Manuals:
- 27            1. See Specification Section 01342 for requirements for:
- 28            a. The mechanics and administration of the submittal process.
- 29            b. The content of Operation and Maintenance Manuals.
- 30          D. Control Strategy for Record Documents:
- 31            1. Obtain this Specification Section 13441 in electronic format (Microsoft Word) from Engineer
- 32            at beginning of Project.
- 33            2. Revise and update the file monthly during construction and start-up to reflect all changes that
- 34            occur due to specific equipment and systems supplied on the Project.
- 35            a. Show all revisions in 'track change' mode.
- 36            b. Change Specification Section Title to read "Control Loop Descriptions - Contractor
- 37            Record Document."
- 38            c. Reference all changes by Request for Information (RFI) number or Change Proposal
- 39            Request (CPR) number.
- 40            d. Submit revised file monthly to Engineer for review.
- 41            3. Deliver the revised and updated file as a final control loop description Record Document in
- 42            the Operation and Maintenance Manual described in Specification Section 01342.
- 43            4. Provide both paper copy and electronic copy (on CD-ROM) of the Record Document control
- 44            loop descriptions in the Operation and Maintenance Manual described in Specification
- 45            Section 01342.



1 **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

2 **PART 3 - EXECUTION**

3 **3.1 CONTROL LOOPS**

4 A. Polymer Feed.

- 5 1. Major equipment:
- 6 a. Polymer Dilution Blender: FC-PODB-1F001.
  - 7 b. Quad 1 PLC.
  - 8 c. Quad 2 PLC.
  - 9 d. Quad 3 PLC.
  - 10 e. Quad 4 PLC.
  - 11 f. Polymer Day Tank: FC-PODT-01.
  - 12 g. Polymer Storage Tank: FC-POST-01.
- 13 2. Major field instruments:
- 14 a. Existing filter bed effluent flow venturis and new associated differential pressure type
  - 15 flow transmitters (24 total; one per filter).
  - 16 b. Polymer Day Tank Scale: FC-PODT01-WE.
  - 17 c. Polymer Storage Tank Scale: FC-POST01-WE.
  - 18 d. Chemical Tank Scale Indicating Transmitter: FC-TANK-WIT (shared transmitter
  - 19 receives inputs from both the Polymer and Fluoride Day Tanks).
- 20 3. Control logic:
- 21 a. When the Polymer Dilution Blender FC-PODB-1F001 has been placed in the REMOTE
  - 22 control mode, the operator will be able to remotely start and stop the Polymer Dilution
  - 23 Blender via START-STOP selection at any SCADA System HMI.
  - 24 b. When speed controller function FC-PODB01-SC is placed in the MANUAL mode at any
  - 25 SCADA HMI, the operator will be able to manually adjust the Polymer Dilution Blender
  - 26 speed via the HMI.
  - 27 c. When the speed controller function is placed in the AUTO mode (at SCADA HMI), the
  - 28 polymer dilution blender will feed polymer in proportion to the total filter effluent flow rate.
  - 29 Total filter flow rate is calculated within the four filter PLCs by summing together each
  - 30 filter's flow rate as measured by each filter's effluent flow meter. The polymer dose
  - 31 setting (pounds polymer/MG filter effluent) is input by the operator via SCADA HMI.
  - 32 d. When the Polymer Dilution Blender FC-PODB-1F001 has been placed in the LOCAL
  - 33 control mode, the operator will be able to locally start and stop the Polymer Dilution
  - 34 Blender via START-STOP selection at the polymer dilution blender. In LOCAL mode,
  - 35 the operator can also make local manual adjustments to the polymer dilution blender
  - 36 speed and stroke length.
- 37 4. Indications at Plant SCADA System HMIs:
- 38 a. Polymer Dilution Blender in REMOTE control mode: FC-PODB01-ZI.
  - 39 b. Polymer Dilution Blender run status: FC-PODB01-YI.
  - 40 c. Polymer Dilution Blender trouble alarm: FC-PODB01-XA1.
  - 41 d. Polymer Dilution Blender fail to run alarm (not running within 6 seconds (operator
  - 42 adjustable) of PLC run command): FC-PODB01-XA2.
  - 43 e. Polymer Day Tank weight indication: FC-PODT01-WI.
  - 44 f. Polymer Day Tank weight low alarm: FC-PODT01-WAL.
  - 45 g. Polymer Day Tank weight high alarm: FC-PODT01-WAH.
  - 46 h. Polymer Day Tank weight low-low alarm: FC-PODT01-WALL.
  - 47 i. Polymer Storage Tank level indication: FC-POST01-LI1.
  - 48 j. Polymer Storage Tank low level alarm: FC-POST01-LAL.
  - 49 k. Polymer Storage Tank low-low level alarm: FC-POST01-LALL.
  - 50 l. Total filter effluent flow rate: FP-FEF-FQI.

51 B. Sodium Hexametaphosphate Feed.

- 52 1. Major equipment:
- 53 a. Sodium Hexametaphosphate Feed Pump: FC-SHFP-01.
  - 54 b. Sodium Hexametaphosphate Feed Pump: FC-SHFP-02.
  - 55 c. Sodium Hexametaphosphate Storage Tank: FC-SHST-01.
  - 56 d. Sodium Hexametaphosphate Storage Tank: FC-SHST-02.

- 1 e. Quad 1 PLC.
- 2 2. Major field instruments:
- 3 a. FC-SHST-01 Tank level transmitter: FC-SHST01-LIT.
- 4 b. FC-SHST-02 Tank level transmitter: FC-SHST02-LIT.
- 5 c. Sodium Hexametaphosphate Storage Tank spill containment level detection float switch:
- 6 FC-SHST-LSH.
- 7 3. Control logic:
- 8 a. Each sodium hexametaphosphate feed pump is controlled in accordance with LOCAL-OFF-
- 9 REMOTE selection made at the pump.
- 10 1) When in the LOCAL control mode, each pump may be started and stopped via local
- 11 ON-OFF switch at the pump.
- 12 2) When in the REMOTE control mode, each pump will be started and stopped in
- 13 accordance with control logic resident within the Quad 1 PLC and in accordance
- 14 with MANUAL-AUTO selection made by the operator via any Plant SCADA HMI.
- 15 a) In MANUAL mode, the operator may be manually start and stop each pump via
- 16 START and STOP pushbutton functions at the HMI.
- 17 b) In AUTO mode, each pump will automatically start and stop in accordance with
- 18 PLC logic as described below. Normally only one pump will be placed into the
- 19 REMOTE and AUTO mode at a time.
- 20 (1) Quad 1 PLC presently controls sodium hexametaphosphate feed to the
- 21 suction side of the Filter Backwash Pumps following the air wash portion of
- 22 the filter backwash sequence.
- 23 (a) When the air wash is complete, and the main wash valve and cell
- 24 valves are confirmed open, the lead backwash pump is
- 25 commanded to start. The PLC also commands the sodium
- 26 hexametaphosphate feed pump (if in REMOTE and AUTO control mode) to
- 27 start at this time.
- 28 (b) Following completion of the wash cycle, the backwash pump is
- 29 commanded to stop when the filter bed being backwashed has
- 30 reached the normal level setpoint. The PLC commands the sodium
- 31 hexametaphosphate pump to stop at this time also.
- 32 b. Note that current PLC logic does not differentiate between pump 1 and pump 2; only one
- 33 pump control output and one pump run status input exist. PLC logic to be revised to
- 34 control and monitor each Sodium Hexametaphosphate pump individually.
- 35 4. Indications at Plant SCADA System HMIs:
- 36 a. FC-SHFP-01 run status: FC-SHFP01-YI.
- 37 b. FC-SHFP-01 total run time (since last reset): FC-SHFP01-KQI.
- 38 c. FC-SHFP-01 fail alarm (pump is not running within 6 seconds (adjustable) of PLC
- 39 command run): FC-SHFP01-XA.
- 40 d. FC-SHFP-02 run status: FC-SHFP02-YI.
- 41 e. FC-SHFP-02 total run time (since last reset): FC-SHFP02-KQI.
- 42 f. FC-SHFP-02 fail alarm (pump is not running within 6 seconds (adjustable) of PLC
- 43 command run): FC-SHFP02-XA.
- 44 g. FC-SHST-01 level indication: FC-SHST01-LI.
- 45 h. FC-SHST-01 low level alarm: FC-SHST01-LAL.
- 46 i. FC-SHST-01 low-low level alarm: FC-SHST01-LALL.
- 47 j. FC-SHST-02 level indication: FC-SHST02-LI.
- 48 k. FC-SHST-02 low level alarm: FC-SHST02-LAL.
- 49 l. FC-SHST-02 low-low level alarm: FC-SHST02-LALL.
- 50 m. Sodium hexametaphosphate storage tank spill containment level detection alarm: FC-
- 51 SHST-LAH.
- 52 C. Fluoride Feed.
- 53 1. Major equipment:
- 54 a. Fluoride Feed Pump: FC-FLFP-01.
- 55 b. Fluoride Feed Pump: FC-FLFP-02.
- 56 c. Fluoride Day Tank: FC-FLDT-01.
- 57 d. Fluoride Transfer Pump: FC-FLTP-01.
- 58 e. Fluoride Transfer Pump: FC-FLTP-02.
- 59 f. Fluoride Transfer Pump Control Panel: FC-FLTP-CP.
- 60 g. Quad 1 PLC.
- 61 h. Quad 2 PLC.

- 1 i. Quad 3 PLC.
- 2 j. Quad 4 PLC.
- 3 2. Major field instruments:
- 4 a. Existing filter bed effluent flow venturis and new associated differential pressure type
- 5 flow transmitters (24 total; one per filter).
- 6 b. FC-FLDT-01 Scale: FC-FLDT01-WE.
- 7 c. Chemical Tank Scale Indicating Transmitter/relay output: FC-TANK-WIT/WSH
- 8 (transmitter is dual channel servicing both the Fluoride and Polymer Day Tanks).
- 9 d. Fluoride Transfer Pump Containment Structure level detection float switch: FC-FLTP-
- 10 LSH.
- 11 e. Fluoride Day Tank FC-FLDT-01 spill containment level detection float switch: FC-
- 12 FLDT01-LSH.
- 13 f. Fluoride Room Sump Drain high level float switch: FC-SUMP-LSH.
- 14 g. Fluoride Room fluoride leak sensor/transmitter: FC-ROOM-AE/AIT.
- 15 3. Control logic:
- 16 a. Fluoride Transfer Pumps FC-FLTP-01 & 02 are manually controlled via PUMP 1-2
- 17 selector switch and START and STOP pushbuttons on the Fluoride Transfer Pump
- 18 Control Panel located near the Fluoride Day Tank. See Control Diagrams in the
- 19 drawings for details of hardwired control logic.
- 20 1) A hardwired interlock stops the transfer pumps when the level in the Fluoride Day
- 21 Tank is high as detected by FC-FLDT01-WE/FC-TANK-WSH.
- 22 b. The Fluoride Feed Pumps provide fluoride to either Basin #1 Effluent or to Basin #7
- 23 Influent. Each fluoride feed pump is controlled in accordance with LOCAL-OFF-REMOTE
- 24 selection made locally at the pump.
- 25 1) When in the LOCAL control mode, each pump's START/STOP control and speed
- 26 control is via manual operator selection made at the pump.
- 27 2) When in the REMOTE control mode, each pump will be started and stopped in
- 28 accordance with control logic resident within the Quad 1 PLC and in accordance
- 29 with MANUAL-AUTO selection made by the operator via any Plant SCADA HMI.
- 30 a) In MANUAL mode, the operator may manually start and stop the pump via
- 31 START and STOP pushbutton functions at the HMI.
- 32 b) In AUTO mode, each pump will automatically start and stop in accordance with
- 33 Quad 1 PLC logic as described below.
- 34 (1) Pump is commanded to run whenever filter effluent flow is detected.
- 35 (2) When the pump's speed controller function is placed in the MANUAL mode
- 36 (at any SCADA HMI), the operator will be able to manually adjust the feed
- 37 pump's speed at the HMI.
- 38 (3) When the pump's speed controller function is placed in the AUTO mode (at
- 39 SCADA HMI), the fluoride feed pump will feed fluoride in proportion to the
- 40 total filter effluent flow rate. Total filter flow rate is calculated within the
- 41 four filter PLCs by summing together each filter's flow rate as measured by
- 42 each filter's effluent flow meter. The fluoride dose setting (mg fluoride/Liter
- 43 filter effluent) is input by the operator via SCADA HMI.
- 44 4. Indications at Plant SCADA System HMIs:
- 45 a. FC-FLFP-01 speed indication: FC-FLFP01-SI.
- 46 b. FC-FLFP-01 run status: FC-FLFP01-YI.
- 47 c. FC-FLFP-01 total run time (since last reset): FC-FLFP01-KQI.
- 48 d. FC-FLFP-01 in REMOTE control mode: FC-FLFP01-ZI.
- 49 e. FC-FLFP-01 fail alarm (pump is not running within 6 seconds (adjustable) of PLC
- 50 command run): FC-FLFP01-XA1.
- 51 f. FC-FLFP-01 pump fail alarm (input from pump): FC-FLFP01-XA2.
- 52 g. FC-FLFP-02 speed indication: FC-FLFP02-SI.
- 53 h. FC-FLFP-02 run status: FC-FLFP02-YI.
- 54 i. FC-FLFP-02 total run time (since last reset): FC-FLFP02-KQI.
- 55 j. FC-FLFP-02 in REMOTE control mode: FC-FLFP02-ZI.
- 56 k. FC-FLFP-02 fail alarm (pump is not running within 6 seconds (adjustable) of PLC
- 57 command run): FC-FLFP02-XA1.
- 58 l. FC-FLFP-01 pump fail alarm (input from pump): FC-FLFP01-XA2.
- 59 m. FC-FLDT-01 weight indication: FC-FLDT01-WI.
- 60 n. FC-FLDT-01 low weight alarm: FC-FLDT01-WAL.
- 61 o. FC-FLDT-01 low-low weight alarm: FC-FLDT01-WALL.
- 62 p. FC-FLDT-01 spill containment level detected: FC-FLDT01-LAH.

- 1 q. Fluoride Transfer Pump Containment Structure level detected: FC-FLTP-LAH.
  - 2 r. Fluoride Room Sump Drain high level alarm: FC-SUMP-LAH.
  - 3 s. Fluoride Transfer Pump Containment Structure heat trace failure alarm: FC-FLTP-TAL.
  - 4 t. Fluoride Room fluoride level indication: FC-ROOM-AI.
  - 5 u. Fluoride Room fluoride leak detected: FC-ROOM-AAH (high fluoride set point resides in
  - 6 PLC).
  - 7 v. Fluoride Room emergency shower/eye wash flow detected: FC-ROOM-FAH.
- 8 D. Influent Flume Drain Valve:
- 9 1. Major equipment:
  - 10 a. Motor actuated drain valve FPIFCV-01.
  - 11 b. Quad 1 PLC.
  - 12 2. Control Logic:
  - 13 a. The valve is controlled in accordance with selections made via the LOCAL-OFF-
  - 14 REMOTE selector switch on the valve actuator.
  - 15 1) When LOCAL mode is selected, the valve may be opened, closed, or positioned in
  - 16 an intermediate position by use of the local OPEN, CLOSE, and STOP pushbuttons
  - 17 furnished with the valve actuator.
  - 18 2) When OFF is selected, the valve remains in place.
  - 19 3) When REMOTE is selected, the valve is controlled in accordance with Operator
  - 20 input made via any HMI. In this mode, the PLC commands the valve to go to
  - 21 whatever position (0 to 100 percent) the Operator inputs at the HMI.
  - 22 3. Indications at Plant SCADA System HMIs:
  - 23 a. Valve in REMOTE control mode: FP- FPIFCV01-ZI1.
  - 24 b. Valve position: FP- FPIFCV01-ZI2.
- 25 E. Programming for the following new filter control valves is provided under a separate Contract
- 26 (SCADA Upgrade Project).
- 27 1. Filter influent control valves.
  - 28 2. Filter drain control valves.
  - 29 3. Filter wash water control valves.
  - 30 4. Filter left cell wash water control valves.
  - 31 5. Filter right cell wash water control valves.
  - 32 6. Filter effluent control valves.
  - 33 7. Filter to waste control valves.

34

**END OF SECTION**

1 2014/09/08

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## SECTION 13442

3

### PRIMARY METERS AND TRANSMITTERS

4

#### PART 1 - GENERAL

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##### 1.1 SUMMARY

6

###### A. Section Includes:

7

1. Flow components.

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2. Pressure components.

9

3. Level components.

10

4. Analytical components.

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5. Pipe, tubing and fittings.

12

6. Instrument valves.

13

###### B. Related Specification Sections include but are not necessarily limited to:

14

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

15

2. Division 01 - General Requirements.

16

3. Section 13440 - Instrumentation for Process Control: Basic Requirements.

17

4. Section 13441 - Control Loop Descriptions.

18

##### 1.2 QUALITY ASSURANCE

19

###### A. Referenced Standards:

20

1. American Gas Association (AGA):

21

a. Gas Measurement Committee Report #3.

22

2. American Iron and Steel Institute (AISI).

23

3. American National Standards Institute (ANSI).

24

4. American Society of Mechanical Engineers (ASME):

25

a. B31.1, Power Piping.

26

b. Section II, Part A SA-182, Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.

27

c. Section II, Part A SA-479, Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.

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29

5. ASTM International (ASTM):

30

a. A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.

31

32

b. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

33

34

c. A276, Standard Specification for Stainless Steel Bars and Shapes.

35

36

d. A479, Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.

37

38

e. B16, Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.

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f. B75, Standard Specification for Seamless Copper Tube.

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42

g. B124, Standard Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes.

43

44

h. B283, Standard Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed).

45

46

i. B453, Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Rod, Bar, and Shapes.

47

6. National Electrical Manufacturers Association (NEMA):

a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

1 **1.3 SYSTEM DESCRIPTION**

- 2 A. The instruments specified in this Specification Section are the primary element components for  
3 the control loops shown on the "Y" series Drawings and specified in Specification Section 13441.  
4 1. These instruments are integrated with other control system components specified under  
5 Specification Section 13440 series to produce the functional control defined in the Contract  
6 Documents.

7 **1.4 SUBMITTALS**

- 8 A. Shop Drawings:  
9 1. See Specification Section 01340 for requirements for the mechanics and administration of  
10 the submittal process.  
11 2. See Specification Section 13440.
- 12 B. Operation and Maintenance Manuals:  
13 1. See Specification Section 01342 for requirements for:  
14 a. The mechanics and administration of the submittal process.  
15 b. The content of Operation and Maintenance Manuals.

16 **PART 2 - PRODUCTS**

17 **2.1 ACCEPTABLE MANUFACTURERS**

- 18 A. Subject to compliance with the Contract Documents, the manufacturers listed in the Articles  
19 describing the elements are acceptable.
- 20 B. Submit request for substitution in accordance with Specification Section 01640.

21 **2.2 FLOW COMPONENTS**

- 22 A. Differential Pressure Type Flow Transmitters:  
23 1. Acceptable manufacturers:  
24 a. Honeywell STD720.  
25 b. No "or equals" accepted.  
26 2. Design and fabrication:  
27 a. Smart transmitter utilizing microprocessor based electronics.  
28 b. Output: 4-20 mA DC proportional to square root of the differential pressure (i.e. to flow  
29 rate).  
30 1) Capable of HART communication.  
31 c. Nonvolatile EEPROM memory.  
32 d. Local digital display of flow rate.  
33 e. Power supply: 24 Vdc.  
34 f. Adjustable zero and span.  
35 g. Temperature limits: -20 to 180 DegF.  
36 1) -4 to 175 DegF for LCD indicators.  
37 h. Overpressure limits:  
38 1) Withstand body rated pressure on either side without damage or loss of calibration.  
39 2) Withstand 150 percent of stated maximum service pressure without damage.  
40 i. Humidity limits: 0 to 100 percent relative humidity.  
41 j. Damping: Adjustable between 0 and 32 seconds.  
42 k. Inaccuracy (includes effects of linearity, repeatability and hysteresis): +/-0.05 percent of  
43 calibrated span for 10:1 rangeability.  
44 l. Stability: +/-0.05 percent of upper range limit for 12 months.  
45 m. Temperature effect:  
46 1) Total effect including span and zero errors: +/-0.2 percent of upper range limit per  
47 100 DegF for minimum 15:1 rangeability.  
48 n. Minimum 1/2 IN pressure connection.  
49 o. Equip with test jacks or accessible terminals for testing output.  
50 p. 316 SS Body, nuts, bolts.  
51 q. Viton gaskets.

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- r. Equip with five-valve manifold as follows:
    - 1) PGI International M3-675-5-5 (no "or equals" accepted).
      - a) Two (2) transmitter isolating valves.
      - b) One (1) transmitter equalizing valve.
      - c) Two (2) test connection valves.
  - s. Provide with test connections with isolation valves and/or plugs.
3. Schedule:

TAG NUMBER	SERVICE	SPAN	
		Diff Press (IN)	MGD
FP-F01-FIT	Filter Bed 1 Effluent Flow	0-147.49	0-10
FP-F02-FIT	Filter Bed 2 Effluent Flow	0-147.49	0-10
FP-F03-FIT	Filter Bed 3 Effluent Flow	0-147.49	0-10
FP-F04-FIT	Filter Bed 4 Effluent Flow	0-147.49	0-10
FP-F05-FIT	Filter Bed 5 Effluent Flow	0-147.49	0-10
FP-F06-FIT	Filter Bed 6 Effluent Flow	0-147.49	0-10
FP-F07-FIT	Filter Bed 7 Effluent Flow	0-147.49	0-10
FP-F08-FIT	Filter Bed 8 Effluent Flow	0-147.49	0-10
FP-F09-FIT	Filter Bed 9 Effluent Flow	0-147.49	0-10
FP-F10-FIT	Filter Bed 10 Effluent Flow	0-147.49	0-10
FP-F11-FIT	Filter Bed 11 Effluent Flow	0-147.49	0-10
FP-F12-FIT	Filter Bed 12 Effluent Flow	0-147.49	0-10
FP-F13-FIT	Filter Bed 13 Effluent Flow	0-162.25	0-10
FP-F14-FIT	Filter Bed 14 Effluent Flow	0-162.25	0-10
FP-F15-FIT	Filter Bed 15 Effluent Flow	0-162.25	0-10
FP-F16-FIT	Filter Bed 16 Effluent Flow	0-162.25	0-10
FP-F17-FIT	Filter Bed 17 Effluent Flow	0-162.25	0-10
FP-F18-FIT	Filter Bed 18 Effluent Flow	0-162.25	0-10
FP-F19-FIT	Filter Bed 19 Effluent Flow	0-54.25	0-10
FP-F20-FIT	Filter Bed 20 Effluent Flow	0-54.25	0-10
FP-F21-FIT	Filter Bed 21 Effluent Flow	0-54.25	0-10
FP-F22-FIT	Filter Bed 22 Effluent Flow	0-54.25	0-10
FP-F23-FIT	Filter Bed 23 Effluent Flow	0-54.25	0-10
FP-F24-FIT	Filter Bed 24 Effluent Flow	0-54.25	0-10

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### 2.3 PRESSURE COMPONENTS

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- A. Differential Pressure Transmitters:
  - 1. Acceptable manufacturers:
    - a. Honeywell STD720.
    - b. No "or equals" accepted.
  - 2. Design and fabrication:
    - a. Smart transmitter utilizing microprocessor based electronics.
    - b. Output: 4-20 mA DC proportional to: Differential pressure.
      - 1) Capable of HART communication.
    - c. Nonvolatile EEPROM memory.
    - d. Local digital display of differential pressure.
    - e. Power supply: 24 Vdc.
    - f. Adjustable zero and span.
    - g. Temperature limits: -20 to 180 DegF.
      - 1) -4 to 175 DegF for LCD indicators.
    - h. Overpressure limits:
      - 1) Withstand body rated pressure on either side without damage or loss of calibration.
      - 2) Withstand 150 percent of stated maximum service pressure without damage.
    - i. Humidity limits: 0 to 100 percent relative humidity.
    - j. Damping: Adjustable between 0 and 32 seconds.
    - k. Inaccuracy (includes effects of linearity, repeatability and hysteresis): +/-0.05 percent of calibrated span for 10:1 rangeability.
    - l. Stability: +/-0.05 percent of upper range limit for 12 months.

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- m. Temperature effect:
    - 1) Total effect including span and zero errors: +/-0.2 percent of upper range limit per 100 DegF for minimum 15:1 rangeability.
  - n. Minimum 1/2 IN pressure connection.
  - o. 316 Stainless steel body, nuts, bolts.
  - p. Viton gaskets.
  - q. Equip with test jacks or accessible terminals for testing output.
  - r. Equip with five-valve manifold as follows:
    - 1) PGI International M3-675-5-5 (no "or equals" accepted).
      - a) Two (2) transmitter isolating valves.
      - b) One (1) transmitter equalizing valve.
      - c) Two (2) test connection valves.
  - s. Provide with test connections with isolation valves and/or plugs.
3. Schedule:

TAG NUMBER	SERVICE	SPAN (FT)
FP-F01-PDIT	Filter Bed 1 Head Loss	0-10
FP-F02-PDIT	Filter Bed 2 Head Loss	0-10
FP-F03-PDIT	Filter Bed 3 Head Loss	0-10
FP-F04-PDIT	Filter Bed 4 Head Loss	0-10
FP-F05-PDIT	Filter Bed 5 Head Loss	0-10
FP-F06-PDIT	Filter Bed 6 Head Loss	0-10
FP-F07-PDIT	Filter Bed 7 Head Loss	0-10
FP-F08-PDIT	Filter Bed 8 Head Loss	0-10
FP-F09-PDIT	Filter Bed 9 Head Loss	0-10
FP-F10-PDIT	Filter Bed 10 Head Loss	0-10
FP-F11-PDIT	Filter Bed 11 Head Loss	0-10
FP-F12-PDIT	Filter Bed 12 Head Loss	0-10
FP-F13-PDIT	Filter Bed 13 Head Loss	0-10
FP-F14-PDIT	Filter Bed 14 Head Loss	0-10
FP-F15-PDIT	Filter Bed 15 Head Loss	0-10
FP-F16-PDIT	Filter Bed 16 Head Loss	0-10
FP-F17-PDIT	Filter Bed 17 Head Loss	0-10
FP-F18-PDIT	Filter Bed 18 Head Loss	0-10
FP-F19-PDIT	Filter Bed 19 Head Loss	0-10
FP-F20-PDIT	Filter Bed 20 Head Loss	0-10
FP-F21-PDIT	Filter Bed 21 Head Loss	0-10
FP-F22-PDIT	Filter Bed 22 Head Loss	0-10
FP-F23-PDIT	Filter Bed 23 Head Loss	0-10
FP-F24-PDIT	Filter Bed 24 Head Loss	0-10

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- B. Pressure Gage:
  - 1. Acceptable manufacturers:
    - a. Ashcroft.
    - b. Ametek.
  - 2. Materials:
    - a. Bourdon tube, socket, connecting tube: 316 stainless steel.
    - b. Case: Phenolic.
  - 3. Accessories:
    - a. Provide valve at point of connection to equipment and at panel if panel mounted.
    - b. Utilize pressure snubbers with porous metal discs to provide pulsation dampening on gage applications as shown on schedule.
    - c. Provide 1/2 IN stainless steel antisiphon pigtail inlet connection for hot water and steam applications.
  - 4. Design and fabrication:
    - a. Provide viewer protection from element rupture.
    - b. Calibrate gages at jobsite for pressure and temperature in accordance with manufacturer's instructions.



- 1 c. Unless otherwise required by codes, provide stem mounted or flush mounted, as  
 2 required, with dial diameter as follows:  
 3

PIPE SIZE	DIAL SIZE	GAGE CONNECTION
1-1/2 IN or less	2-1/2 IN	1/4 IN
Larger than 1-1/2 IN	4-1/2 IN	1/2 IN

- 4  
 5 d. Equip with white faces, black numerals and black pointers.  
 6 e. Gage tapping position to be clear of equipment functions and movements, and protected  
 7 from maintenance and operation of equipment.  
 8 1) Gage to be readable from an accessible standing position.  
 9 f. Gage accuracy: 1 percent of full range.  
 10 g. Select gage range so that:  
 11 1) The normal operating value is in the middle third of the dial.  
 12 2) Maximum operating pressure does not exceed 75 percent of the full scale range.

13 C. Schedule:  
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TAG NUMBER	APPLICATION	PRESSURE RANGE (PSI)	DIAL SIZE (IN)	PROTECTOR REQUIREMENTS	LIQUID FILLED
FC-FLTP01-PI	Pump discharge	TBD	2 1/2	Diaphragm Seal	Yes
FC-FLTP02-PI	Pump discharge	TBD	2 1/2	Diaphragm Seal	Yes

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 16 D. Diaphragm Seal:

- 17 1. Acceptable manufacturers:  
 18 a. Ashcroft.  
 19 b. Ametek.  
 20 2. Materials:  
 21 a. Lower housing: 316 stainless steel.  
 22 b. Diaphragm material: 316 stainless steel.  
 23 3. Design and fabrication:  
 24 a. Isolates instrument from process fluids which are corrosive or contain solids.  
 25 b. Upper housing with bleed screw.  
 26 c. Fill fluid:  
 27 1) Utilize halocarbon fill for process applications involving strong oxidizing agents.  
 28 a) Agents include but are not limited to: Cl<sub>2</sub>, KMNO<sub>4</sub>, FeCl, NaOH, and NaOCl.  
 29 2) Utilize manufacturer's standard fill for other applications.  
 30 a) Ensure fill is suitable for application temperatures.  
 31 d. Process connections:  
 32 1) Instrument: 1/2 IN NPT.  
 33 2) Process: 0.5 IN female NPT.  
 34 3) PVC pipe applications: Use a socket weld connection.  
 35 4. Installed where specified or shown on Drawings.

36 **2.4 LEVEL ELEMENTS**

37 A. Non-Contact Type Radar Level Transmitters:

- 38 1. Acceptable manufacturers:  
 39 a. Siemens SITRANS LR 200.  
 40 b. No "or equals" acceptable.  
 41 2. Materials:  
 42 a. Antenna:  
 43 1) Dielectric rod: teflon.  
 44 b. Housing: Aluminum.  
 45 c. O-rings: Viton, EPDM, or Buna-N.  
 46 3. Design and fabrication:  
 47 a. Transmit and receive radar signal.  
 48 b. Comply with FCC 47 CFR 15.  
 49 c. Two-wire, 24 Vdc loop-powered.

- 1 d. Output signal: 4-20 mA.
- 2 1) Capable of HART communication.
- 3 e. False target rejection.
- 4 f. Gain adjustments to maximize performance.
- 5 g. Operating temperature:
- 6 1) -40 to 175 DegF.
- 7 2) Display operating temperature: -5 to 160 DegF.
- 8 h. Humidity: 0-99 percent, non-condensing.
- 9 i. Linearity: +/-0.4 IN or 0.1 percent of tank height (whichever is greater).
- 10 j. Measured error: +/-0.4 IN or 0.1 percent of tank height (whichever is greater;
- 11 performance will degrade slightly within 60 IN of antenna).
- 12 k. Resolution: 0.1 IN.
- 13 l. Repeatability: +/-0.2 IN or 0.05 percent of tank height.
- 14 m. Response time: Less than 1 second.
- 15 n. Display with keypad.
- 16 o. Configuration capability: Provide with either pushbuttons and display or handheld
- 17 communicator.
- 18 4. Schedule:
- 19

TAG NUMBER	SERVICE	SPAN	MOUNT TYPE and SIZE
FC-POST01-LIT	Polymer Storage Storage Tank	0-52 IN	4-IN blind flange
FC-SHST01-LIT	Sodium Hexametaphosphate Storage Tank #1	0-45 IN	4-IN blind flange
FC-SHST02-LIT	Sodium Hexametaphosphate Storage Tank #2	0-45 IN	4-IN blind flange

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- 22 B. Float-Tilt Type Level Switches:
- 23 1. Acceptable manufacturers:
- 24 a. Anchor Scientific Inc.
- 25 b. Siemens.
- 26 2. Materials:
- 27 a. Float material: Polypropylene or Teflon coated type 316 stainless steel.
- 28 b. Cable jacket: PVC, neoprene.
- 29 c. Cable clamp: Polypropylene or 316 stainless steel.
- 30 3. Design and fabrication:
- 31 a. Sealed non-mercury switch in float.
- 32 b. Provide switch complete with flexible electrical cables.
- 33 c. Switch contacts rated at 4.5 amp at 120 Vac.
- 34 d. Direct acting float switch:
- 35 1) Switch actuates on rising level.
- 36 2) Switch deactuates when liquid falls 1 IN below actuation level.
- 37 e. Terminate cables in junction box.
- 38 f. Install floats per Drawing details.
- 39 4. Schedule:
- 40

TAG NUMBER	SERVICE	CONTACT NO/NC	MOUNTING ELEVATION
FC-SHST-LSH	Sodium Hexametaphosphate Storage Tank spill containment	NC	1 IN above floor
FC-FLTP-LSH	Fluoride Transfer Pump Containment Structure	NC	1 IN above floor
FC-SUMP-LSH	Fluoride sump drain	NC	1 IN above floor
FC-FLDT-LSH	Fluoride Day Tank spill containment	NC	1 IN above floor

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- 1 C. Tank Scale:
- 2 1. Acceptable manufacturers:
- 3 a. Force Flow Equipment, Electronic Chem-Scale with Wizard Electronic
- 4 Indicator/Transmitter.
- 5 2. Design and fabrication:
- 6 a. Digital readout/electronic load cell type.
- 7 b. Sized to accept the totes and barrels as indicated below and on the Drawings.
- 8 c. Scale platform shall have minimum dry thickness of 80 mils and be resistant to moisture,
- 9 chemicals, abrasion, and impact.
- 10 d. Provide four (4) adjustable hold down lugs on the platform to increase lateral stability
- 11 and to allow the use of hold down straps for securing the vessel to the platform.
- 12 e. Flexible cable shall connect load cell to indicator to allow easy remote installation of the
- 13 readout. Cable length shall be as required to reach from the load cell to the indicator.
- 14 f. Weight Indicators/Transmitter:
- 15 1) Wall-mounted panel with tare adjustment.
- 16 2) Indicating transmitter housed in a NEMA 4X, UL approved enclosure.
- 17 3) Digital display: LCD display with backlighting.
- 18 g. Accuracy: 1/4 of 1 percent (min.).
- 19 h. Each scale channel shall have an independent, adjustable 4-20 ma signal (net weight or
- 20 volume as indicated in schedule below).
- 21 3. Schedule:
- 22

TAG NUMBER	SERVICE	TANK DIAMETER	RANGE
FC-PODT01-WE	Polymer Day Tank	18.5 IN	0-300 LB
FC-FLDT01-WE	Fluoride Day Tank	30 IN	0-1300 LB
FC-TANK-WIT	Shared 2 channel indicating transmitter for all scales listed above		

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24 **2.5 ANALYTICAL ELEMENTS**

- 25 A. Turbidity Analyzers:
- 26 1. Acceptable manufacturers:
- 27 a. Hach 1720E.
- 28 b. No substitutions or "or equals" accepted.
- 29 2. Design and fabrication:
- 30 a. Provide with power cord and plug.
- 31 b. Accuracy:  $\pm 2\%$  of reading or  $\pm 0.015$  NTU (whichever is greater) from 0 to 40 NTU, and
- 32  $\pm 5\%$  of reading from 40 to 100 NTU.
- 33 c. Repeatability: Better than  $\pm 1.0\%$  of reading or  $\pm 0.002$  NTU, whichever is greater.
- 34 d. Flow through system using scattered light principle.
- 35 e. Power supply: 120 Vac.
- 36 f. Operating temperature limits: 32 DegF to 122 DegF.
- 37 g. Relative humidity limits: Up to 95 percent non-condensing.
- 38 h. Output signal: 4-20 mA.
- 39 1) Capable of HART communication.

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3. Schedule:

TAG NUMBER	SERVICE	SPAN (NTU)
FP-F01-AE/AIT	Filter Bed 1 Effluent Turbidity	0-2
FP-F02-AE/AIT	Filter Bed 2 Effluent Turbidity	0-2
FP-F03-AE/AIT	Filter Bed 3 Effluent Turbidity	0-2
FP-F04-AE/AIT	Filter Bed 4 Effluent Turbidity	0-2
FP-F05-AE/AIT	Filter Bed 5 Effluent Turbidity	0-2
FP-F06-AE/AIT	Filter Bed 6 Effluent Turbidity	0-2
FP-F07-AE/AIT	Filter Bed 7 Effluent Turbidity	0-2
FP-F08-AE/AIT	Filter Bed 8 Effluent Turbidity	0-2
FP-F09-AE/AIT	Filter Bed 9 Effluent Turbidity	0-2
FP-F10-AE/AIT	Filter Bed 10 Effluent Turbidity	0-2
FP-F11-AE/AIT	Filter Bed 11 Effluent Turbidity	0-2
FP-F12-AE/AIT	Filter Bed 12 Effluent Turbidity	0-2
FP-F13-AE/AIT	Filter Bed 13 Effluent Turbidity	0-2
FP-F14-AE/AIT	Filter Bed 14 Effluent Turbidity	0-2
FP-F15-AE/AIT	Filter Bed 15 Effluent Turbidity	0-2
FP-F16-AE/AIT	Filter Bed 16 Effluent Turbidity	0-2
FP-F17-AE/AIT	Filter Bed 17 Effluent Turbidity	0-2
FP-F18-AE/AIT	Filter Bed 18 Effluent Turbidity	0-2
FP-F19-AE/AIT	Filter Bed 19 Effluent Turbidity	0-2
FP-F20-AE/AIT	Filter Bed 20 Effluent Turbidity	0-2
FP-F21-AE/AIT	Filter Bed 21 Effluent Turbidity	0-2
FP-F22-AE/AIT	Filter Bed 22 Effluent Turbidity	0-2
FP-F23-AE/AIT	Filter Bed 23 Effluent Turbidity	0-2
FP-F24-AE/AIT	Filter Bed 24 Effluent Turbidity	0-2
FP-FEFF-AE/AIT	Filter Effluent (Lab)	0-2
Spare AE/AIT	Spare (turn over to District)	
Spare AE/AIT	Spare (turn over to District)	

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Note: Filter Bed 1 has an existing Hach 1720E turbidity analyzer which will be removed by the District prior to installation of new turbidity analyzer.

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B. Fluoride Gas Detector:

1. Acceptable manufacturers:
  - a. MilRam TA 2100 F2 (no "or equals" accepted).
2. Design and fabrication:
  - a. Gas monitoring system shall measure and display gas concentration and provide alarms when reset limits are exceeded.
  - b. Gas monitoring system shall consist of gas sensor, transmitter, sensor calibration kit and transmitting cable (where applicable).
  - c. Gas sensor shall be the electrochemical type and shall not require the periodic addition of reagents.
  - d. Interconnect wiring from sensor to transmitter (if not integral) shall be 3 wire shielded cable.
  - e. Sensing element shall have minimum useful life of one (1) year.
  - f. Transmitter output: 4-20 mA signal proportional to measured gas level.
    - 1) Capable of driving 600 ohm load at 24 Vdc supply voltage.
  - g. Powered by 24 VDC.
  - h. Housing: In accordance with the area classification shown on Drawings.
  - i. Local displays:
    - 1) 3-1/2 digit LCD or LED display of measured gas level.
    - 2) Fault indication.
  - j. Stand alone sensors and transmitters (without central control unit):
    - 1) Provide relay contacts rated at 1/2 amps at 120 Vac for each of the following conditions:
      - a) High gas level (warning level).
      - b) High high gas level (alarm level).
      - c) Sensor fault condition.

- 1 k. Relay contacts shall be normally energized (normally closed); contacts shall open in the
- 2 event of a warning, alarm or trouble condition.
- 3 l. Store calibration data in nonvolatile memory or back up with battery.
- 4 3. Provide one (1) calibration kit for each type of gas monitored.
- 5 a. Calibration kits shall be furnished complete with all tubing, regulators, fittings,
- 6 communication devices, and accessories required to calibrate sensors.
- 7 b. Calibration kit shall utilize nonintrusive means of calibrating sensors/transmitters.
- 8 4. Provide two (2) full cylinders of each type of calibration check gas.
- 9 a. Cylinder size: 17 liters.
- 10 5. Provide the same quantity of zero air cylinders as the total required number of calibration
- 11 check gas cylinders (of all types).
- 12 6. Schedule:
- 13

TAG NO	SERVICE	GAS	RANGE
FC-ROOM-AIT	Fluoride Room	Fluoride	0-10 PPM

- 14 C. Filter Bed Media Expansion Analyzer:
- 15 1. Acceptable manufacturers:
- 16 a. Entech Design, Inc. Echo Smart Interface Level Analyzer.
- 17 b. No "or equals" accepted.
- 18 2. Design and fabrication:
- 19 a. Provide two (2) new analyzers for monitoring filter media level and expansion and
- 20 turbidity during backwash.
- 21 b. Provide all required brackets for temporary mounting of analyzer to handrail and sensor
- 22 above filter media. Brackets to enable easy movement of analyzers from one filter bed
- 23 to another.
- 24 c. Provide with cord and plug to 120 VAC power source. No connections to SCADA
- 25 required.

26 **2.6 PIPE, TUBING, AND FITTINGS**

- 27 A. Acceptable Manufacturers:
- 28 1. Tube fittings:
- 29 a. Parker CPI.
- 30 b. Swagelok.
- 31 B. Instrument Tubing and Fittings:
- 32 1. Material:
- 33 a. Tubing: ASTM A269, Grade TP 316 stainless steel.
- 34 b. Straight fittings: 316 stainless steel per ASME SA-479 or ASTM A276.
- 35 c. Shaped bodies: ASME SA-182 F316 stainless steel.
- 36 2. Design and fabrication:
- 37 a. Tubing:
- 38 1) Seamless.
- 39 2) Fully annealed.
- 40 3) Maximum hardness: 80 Rb.
- 41 4) Free from surface scratches and imperfections.
- 42 5) Diameter:
- 43 a) Process sensing tubes: 1/2 IN OD unless specified otherwise.
- 44 b) Pneumatic signal tubing: 1/4 IN or 3/8 IN as specified or required.
- 45 6) Wall thickness:
- 46 a) Meet requirements of ASME B31.1, Paragraph 122.3.
- 47 b) Minimum 0.049 IN for 1/2 IN OD tubing.
- 48 b. Fittings:
- 49 1) Flareless.
- 50 2) Compression type.
- 51 C. Instrument Piping:
- 52 1. For applications where the instrument is supported solely by the sensing line, ( e.g., pressure
- 53 gauge directly mounted to process line) utilize piping as specified below.
- 54 a. Diameter: 1/2 IN unless specified otherwise.
- 55 b. Schedule 80.
- 56 c. Match process pipe material.

1 **2.7 INSTRUMENT VALVES**

- 2 A. Provide isolation ball valve in each instrument sensing line between the process connection and  
3 the 5-valve manifold.  
4 1. Acceptable manufacturers:  
5 a. PGI International.  
6 2. Materials:  
7 a. Packing: Graphite or Teflon.  
8 b. Body: 316 stainless steel per ASTM A479.  
9 c. Stem: 316 stainless steel per ASTM A276.  
10 d. Ball: 316 stainless steel per ASTM A276.  
11 e. Support rings: 316 stainless steel per ASTM A276.  
12 f. Seats:  
13 1) Metal:  
14 a) 316 stainless steel per ASTM A276.  
15 2) Soft:  
16 a) Teflon, Delrin.  
17 b) Only utilized on applications where manufacturer's temperature and pressure  
18 ratings exceed process design conditions.  
19 3. Design and fabrication:  
20 a. Provide body wall thickness sufficient for process design conditions per ASME B31.1.
- 21 B. Isolation Valves in Copper Instrument Air Tubing:  
22 1. Acceptable manufacturer:  
23 a. Whitey Co.  
24 2. Materials:  
25 a. Packing: Graphite or Teflon.  
26 b. Body: Brass per ASTM B16.  
27 c. Stem: 316 stainless steel per ASTM A276.  
28 d. Ball: 316 stainless steel per ASTM A276.  
29 e. Support rings: 316 stainless steel per ASTM A276.  
30 f. Seats:  
31 1) Metal: 316 stainless steel per ASTM A276.  
32 2) Soft:  
33 a) Teflon, Delrin.  
34 b) Only utilized on applications where manufacturer's temperature and pressure  
35 ratings exceed process design conditions.  
36 3. Design and fabrication:  
37 a. Ball valve with 1/4 turn activation.  
38 b. Provide body wall thickness sufficient for process design conditions per ASME B31.1.

39 **2.8 ACCESSORIES**

- 40 A. Furnish all mounting brackets, hardware and appurtenances required for mounting primary  
41 elements and transmitters.  
42 1. Materials, unless otherwise specified, shall be as follows:  
43 a. Bolts, nuts, washers, expansion anchors: 316 stainless steel.  
44 b. Mounting brackets:  
45 1) Standard: 316 stainless steel.  
46 2) Highly corrosive areas: Aluminum.  
47 c. Mounting plates, angles:  
48 1) Standard: Carbon steel.  
49 2) Corrosive areas: 316 stainless steel.  
50 d. Instrument pipe stands:  
51 1) Standard: Hot-dip galvanized 2 IN schedule 40, ASTM A106, Grade B carbon steel.  
52 2) Corrosive areas: Aluminum or 316 stainless steel.
- 53 B. Tubing Support Angles and Brackets:  
54 1. Any of the following materials are acceptable:  
55 a. Aluminum support with dielectric material between support and tubing.  
56 b. Type 316 stainless steel.  
57 c. Fiberglass.

- 1 C. Tubing Tray or Channel:
- 2 1. Aluminum.
- 3 2. Provide dielectric material between tray or channel and tubing.
- 4 D. Provide two HART 475 (or latest) field communicators.
- 5 E. Cable lengths between sensors and transmitters shall be continuous (without splices) and as
- 6 required to accommodate locations as shown on Drawings.

## 7 **PART 3 - EXECUTION**

### 8 **3.1 INSTALLATION**

- 9 A. Install products in accordance with manufacturer's instructions.
- 10 B. Install instrument mounting pipe stands level and plumb.
- 11 C. Instrument Valves:
- 12 1. Orient stems for proper operation.
- 13 2. Install arrays orderly and neat in appearance with true horizontal and vertical lines.
- 14 3. Provide a minimum of 2 IN clearance between valve handle turning radii where there are
- 15 multiple valve handles appearing in a straight line.
- 16 4. Valves shall have bonnets and any soft seals removed during welding or soldering into the
- 17 line.
- 18 a. When cool, reassemble the valves.
- 19 5. Support each valve individually.
- 20 a. The tubing system does not qualify as support for the valve.
- 21 D. Locate instrument piping and tubing so as to be free of vibration and interference with other
- 22 piping, conduit, or equipment.
- 23 E. Keep foreign matter out of the system.
- 24 F. Remove all oil on piping and tubing with solvent before piping and tubing installation.
- 25 G. Plug all open ends and connections to keep out contaminants.
- 26 H. Tubing Installation:
- 27 1. General:
- 28 a. Install such that tube shows no sign of crumpling, bends of too short a radius, or
- 29 flattening, etc.
- 30 b. Make tube runs straight and parallel or perpendicular to the floor, equipment and piping
- 31 runs.
- 32 c. For liquid and steam applications, slope continuously from the process to the instrument
- 33 with a minimum slope of 0.50 IN/FT.
- 34 d. For gas and air applications, slope continuously from the instrument to the process with
- 35 a minimum slope of 0.50 IN/FT.
- 36 e. If the sensing line cannot be continuously sloped, install high point vents and low point
- 37 drains.
- 38 f. Keep instrument tubing clean during all phases of work.
- 39 g. Blow out with clean, dry, oil-free air immediately before final assembly.
- 40 h. Cut by sawing only and debur.
- 41 2. Bending:
- 42 a. Make each bend with tube bender of the correct size for the tube.
- 43 b. Make all bends smooth and continuous.
- 44 c. Rebending is not permitted.
- 45 d. Make bends true to angle and radius.
- 46 e. Maintain a true circular cross section of tubing without buckling or undue stretch of tube
- 47 wall.
- 48 f. Allowable tolerance for flattening out of tubing bends: Maximum of 8 percent of the OD
- 49 for stainless steel tubing.

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g. Minimum bending radius for stainless steel tubing:

TUBE OD, INCHES	MINIMUM BENDING RADIUS, INCHES
1/4	9/16
3/8	15/16
1/2	1-1/2

h. Minimum bending radius for type L, hard (drawn) copper:

TUBE OD, INCHES	MINIMUM BENDING RADIUS, INCHES
3/8	1-3/4
1/2	2-1/2

- 3. Tubing support:
  - a. Intermittently support by clamping to support angle.
  - b. Install supports to be self-draining, supported by hangers, or cantilevered from walls or structural beams.
  - c. Support at 5 FT-0 IN maximum spans for horizontal or vertical runs.
  - d. Use tubing trays in areas where spans between supports are greater than 5 FT and for all signal tubing support.
  - e. Support each tubing tray at 10 FT maximum spans.
  - f. Align tubing in orderly rows and retain in the tray by bolted clips.
    - 1) The use of spring or speed clips is not acceptable.
  - g. Maintain order of the tubing throughout the length of the tray.
  - h. Locate angle, channel and tray installation to protect tubing from spills and mechanical damage.
  - i. Locate support members to clear all piping, conduit, equipment, hatchways, monorails, and personnel access ways and allow access for equipment operation and maintenance.
  - j. Support trays to prevent torsion, sway or sag.
  - k. Permanently attach supports to building steel or other permanent structural members.
  - l. Arrange supports and trays so that they do not become a trough or trap.
- 4. Routing and orientation:
  - a. Route to maintain a minimum headroom clearance of 8 FT.
  - b. Locate and orient valves and specialties so that they are accessible for operation and maintenance from the operating floor.
    - 1) Do not route through or over equipment removal areas, below monorails or cranes nor above or below hatches.
- 5. Expansion and vibration provisions:
  - a. Provide horizontal expansion loops at the process connections.
  - b. Route tubing parallel to relative motion through sleeved supports that allow linear tube movement.
  - c. Cold springing of tubing to compensate for thermal expansion is prohibited.
  - d. Utilize flexible hoses to connect pneumatic tubing to air users which may move or vibrate.
- I. Air Supply:
  - 1. Connect all instruments requiring air to air supply piping and tubing.
  - 2. Provide connections as follows:
    - a. Terminate branch supply line not more than 36 IN from the device with a 1/2 IN isolation valve.
    - b. For remaining line, use 1/4 or 3/8 IN tubing of a length to allow for normal equipment movement and vibration.
    - c. Use flexible hoses to connect pneumatic tubing to air users which may experience significant movement or vibration.
    - d. Make branch connections to individual instruments from the top of the supply header.
    - e. Purge instrument air piping of extraneous material by blowing clean, dry, oil-free air through the system prior to final connection.



- 1 J. Threaded Connection Seals:
- 2 1. Use Tite-Seal or acceptable alternate.
- 3 2. Use of lead base pipe dope or Teflon tape is not acceptable.
- 4 3. Do not apply Tite-Seal to tubing threads of compression fittings.
- 5 K. Instrument Mounting:
- 6 1. Mount all instruments where they will be accessible from fixed ladders, platforms, or grade.
- 7 2. Mount all local indicating instruments with face forward toward the normal operating area,
- 8 within reading distance, and in the line of sight.
- 9 3. Mount instruments level, plumb, and support rigidly.
- 10 4. Mount to provide:
- 11 a. Protection from heat, shock, and vibrations.
- 12 b. Accessibility for maintenance.
- 13 c. Freedom from interference with piping, conduit and equipment.

14 **3.2 TRAINING**

- 15 A. Provide on-site training in accordance with Specification Section 01650.

16 **END OF SECTION**

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**SECTION 13445**  
**RECORDERS AND INDICATORS**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6 A. Section Includes: Large Display Process Meter.

7 B. Related Sections include but are not necessarily limited to:

8 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

9 2. Division 01 - General Requirements.

10 3. Section 13440 - Instrumentation for Process Control: Basic Requirements.

11 **1.2 QUALITY ASSURANCE**

12 A. Referenced Standards:

13 1. National Electrical Manufacturers Association (NEMA).

14 B. Miscellaneous:

15 1. Ensure units comply with electrical area classifications and NEMA enclosure type shown on  
16 Drawings.

17 **1.3 SUBMITTALS**

18 A. Shop Drawings:

19 1. See Specification Section 01340 for requirements for the mechanics and administration of  
20 the submittal process.

21 2. See Specification Section 13440.

22 3. Product technical data including:

23 a. Acknowledgement that products submitted meet requirements of standards referenced.

24 b. Manufacturer's installation instructions.

25 B. Operation and Maintenance Manuals:

26 1. See Specification Section 01342 for requirements for:

27 a. The mechanics and administration of the submittal process.

28 b. The content of Operation and Maintenance Manuals.

29 **PART 2 - PRODUCTS**

30 **2.1 ACCEPTABLE MANUFACTURERS**

31 A. Subject to compliance with the Contract Documents, the manufacturers listed in the paragraphs  
32 describing the devices are acceptable.

33 B. Submit request for substitution in accordance with Specification Section 01640.

34 **2.2 INDICATORS**

35 A. Process Display Meters - Panel Mounted.

36 1. Acceptable manufacturers:

37 a. Precision Digital, PD6000 series.

38 2. Materials:

39 a. Case: Polycarbonate.

40 3. Design and fabrication:

41 a. Accuracy: +/-0.03 percent of calibrated span, +/- 1 count.

42 b. Display:

43 1) Sunbright display model.

44 2) 0.6 IN high LED digits.

45 3) Display update rate: 5/second.



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**SECTION 13446**  
**CONTROL AUXILIARIES**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6 A. Section Includes:

- 7 1. Signal modules: Loop isolator.  
8 2. Pilot devices:  
9 a. Selector switches.  
10 b. Pushbuttons.  
11 c. Indicating lights.  
12 3. Relays:  
13 a. Control and isolation relays.  
14 b. Terminal Block Relays.  
15 4. Termination equipment:  
16 a. Terminal blocks.  
17 b. Fuse holders.  
18 5. Power supplies: DC power supplies.  
19 6. Alarm strobe lights.

20 B. Related Specification Sections include but are not necessarily limited to:

- 21 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.  
22 2. Division 01 - General Requirements.  
23 3. Section 13440 - Instrumentation for Process Control: Basic Requirements.

24 **1.2 QUALITY ASSURANCE**

25 A. Referenced Standards:

- 26 1. The Instrumentation, Systems, and Automation Society (ISA):  
27 a. S18.1, Annunciator Sequences and Specifications.  
28 2. National Electrical Manufacturers Association (NEMA):  
29 a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).  
30 b. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays  
31 Rated 600 Volts.  
32 3. Underwriters Laboratories, Inc. (UL).

33 B. Miscellaneous:

- 34 1. Assure units comply with electrical area classifications and NEMA enclosure type shown on  
35 Drawings.

36 **1.3 SUBMITTALS**

37 A. Shop Drawings:

- 38 1. See Specification Section 01340 for requirements for the mechanics and administration of  
39 the submittal process.  
40 2. See Specification Section 13440.

41 B. Operation and Maintenance Manuals:

- 42 1. See Specification Section 01342 for requirements for:  
43 a. The mechanics and administration of the submittal process.  
44 b. The content of Operation and Maintenance Manuals.

1 **PART 2 - PRODUCTS**

2 **2.1 ACCEPTABLE MANUFACTURERS**

- 3 A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable  
4 Articles below are acceptable.
- 5 B. Provide similar components from the same manufacturer for uniformity of appearance,  
6 operations, and maintenance.
- 7 C. Submit request for substitution in accordance with Specification Section 01640.

8 **2.2 SIGNAL MODULE**

- 9 A. Analog Isolators:
- 10 1. Acceptable manufacturers:
- 11 a. Phoenix Contact MINI MCR-SL-I-I-2864406.
- 12 2. Design and fabrication:
- 13 a. Solid state electronics.
- 14 b. Transmit analog output signal directly proportional to measured input signal.
- 15 c. Power source: 24 Vdc.
- 16 d. Analog input: 4-20 mA DC or 1-5 Vdc.
- 17 e. Output signal: 4-20 mA DC into 1400 ohms.
- 18 f. Impedance:
- 19 1) Current input: 50 ohms.
- 20 2) Current output: 1650 ohms.
- 21 g. Accuracy: Better than  $\pm 0.10$  percent of span.
- 22 h. Isolation: Up to 500 V rms (input, output and case).
- 23 i. Temperature effect:  $\pm 0.0025$  percent of span per DegF.
- 24 j. Ambient temperature range: 0-140 DegF.
- 25 k. Factory calibrated.

26 **2.3 PILOT DEVICES**

- 27 A. Selector Switches:
- 28 1. Acceptable manufacturers:
- 29 a. Eaton.
- 30 b. Allen-Bradley.
- 31 2. Design and fabrication:
- 32 a. Heavy-duty type.
- 33 b. Rotary cam units conforming to NEMA ICS 2-216.22.
- 34 c. Mounting hole: 30.5 mm.
- 35 d. Supply switches having number of positions required with contact blocks to fulfill  
36 functions shown and specified.
- 37 e. UL listed.
- 38 f. Maintained contact type.
- 39 g. Black colored operators.
- 40 h. Designed with cam and contact block with approximate area of 2 IN SQ.
- 41 i. Legend plate marked per Contract Documents.
- 42 B. Pushbuttons:
- 43 1. Acceptable manufacturers:
- 44 a. Eaton.
- 45 b. Allen-Bradley.
- 46 2. Materials:
- 47 a. Backing diaphragm: Buna-N.
- 48 3. Design and fabrication:
- 49 a. Heavy-duty type.
- 50 b. Conforming to NEMA ICS 2-216.22.
- 51 c. Mounting hole: 30.5 mm.
- 52 d. Diaphragm backed.
- 53 e. UL listed.
- 54 f. Emergency stop pushbuttons to have mushroom head operator and maintained contact.

- 1 g. Non-illuminated type:
- 2 1) Momentary contact with necessary contact blocks.
- 3 2) Molded, solid color melamine buttons.
- 4 3) Appropriate contact blocks to fulfill functions shown or specified.
- 5 C. Indicating Lights:
- 6 1. Acceptable manufacturers:
- 7 a. Eaton.
- 8 b. Allen-Bradley.
- 9 2. Design and fabrication:
- 10 a. Heavy duty.
- 11 b. Type allowing replacement of bulb without removal from control panel.
- 12 c. LED type.
- 13 d. UL listed.
- 14 e. Legends marked per Contract Documents.
- 15 f. Nominal 2 IN SQ face.
- 16 g. Mounting hole: 30.5 mm.
- 17 h. Push-to-test indicating lights.
- 18 i. Glass lens.
- 19 j. Color code lights as follows:
- 20 1) Green: ON or running; valve open.
- 21 2) Red: OFF or stopped; valve close, alarm condition.
- 22 k. Legend plate engraved for each light.

## 23 2.4 RELAYS

- 24 A. Control Relays:
- 25 1. Acceptable manufacturers:
- 26 a. Phoenix Contact model number 2961312.
- 27 b. Siemens.
- 28 c. Allen-Bradley.
- 29 2. Design and fabrication:
- 30 a. Plug-in general purpose relay.
- 31 b. Blade connector type.
- 32 c. Contact current: 10 A.
- 33 d. Contact material: Silver cadmium oxide.
- 34 e. Coil voltage: 120 Vac or 24 Vdc.
- 35 f. Relay sockets are DIN rail mounted.
- 36 g. Internal neon or LED indicator is lit when coil is energized.
- 37 h. Clear polycarbonate dust cover with clip fastener.
- 38 i. Check button.
- 39 j. Temperature rise:
- 40 1) Coil: 85 DegF maximum.
- 41 2) Contact: 65 DegF maximum.
- 42 k. Insulation resistance: 100 Meg minimum.
- 43 l. Frequency response: 1800 operations/hour.
- 44 m. Operating temperature: -20 to +150 DegF.
- 45 n. UL listed or recognized.
- 46 B. Terminal Block Relays – Utilized as Required Due to Panel Space Considerations:
- 47 1. Acceptable manufacturers:
- 48 a. Allen-Bradley 700-HLT1U24.
- 49 b. Or equal Phoenix Contact relay.

## 50 2.5 TERMINATION EQUIPMENT

- 51 A. Terminal Blocks:
- 52 1. Acceptable manufacturers:
- 53 a. Entrelec.
- 54 b. Phoenix Contact.
- 55 2. Design and fabrication:
- 56 a. Modular type with screw compression clamp.
- 57 b. Screws: Stainless steel.
- 58 c. Current bar: Nickel-plated copper allow.

- 1 d. Thermoplastic insulation rated for -40 to +90 DegC.
- 2 e. Wire insertion area: Funnel-shaped to guide all conductor strands into terminal.
- 3 f. Install end sections and end stops at each end of terminal strip.
- 4 g. Install machine-printed terminal markers on both sides of block.
- 5 h. Spacing: 6 mm.
- 6 i. Wire size: 22-12 AWG.
- 7 j. Rated voltage: 600 V.
- 8 k. Din rail mounting.
- 9 l. UL listed.
- 10 3. Standard-type block:
- 11 a. Rated current: 30 A.
- 12 b. Color: Gray body.
- 13 4. Bladed-type block:
- 14 a. Terminal block with knife blade disconnect which connects or isolated the two (2) sides
- 15 of the block.
- 16 b. Rated current: 10 A.
- 17 c. Color:
- 18 1) Panel control voltage leaves enclosure - normal: Gray body, orange switch.
- 19 2) Foreign voltage entering enclosure: Orange body, orange switch.
- 20 5. Grounded-type block:
- 21 a. Electrically grounded to mounting rail.
- 22 b. Use to terminal ground wires and analog cable shields.
- 23 c. Color: Green and yellow body.
- 24 B. Fuse Holders:
- 25 1. Acceptable manufacturers:
- 26 a. Entrelec.
- 27 b. Phoenix Contact.
- 28 2. Design and fabrication:
- 29 a. Modular-type with screw compression clamp.
- 30 b. Screws: Stainless steel.
- 31 c. Current bar: Nickel-plated copper alloy.
- 32 d. Thermoplastic insulation rated for -40 to +105 DegC.
- 33 e. Wire insertion area: Funnel-shaped to guide all conductor strands into terminal.
- 34 f. Blocks can be ganged for multi-pole operation.
- 35 g. Install end sections and end stops at each end of terminal strip.
- 36 h. Install machine-printed terminal markers on both sides of block.
- 37 i. Spacing: 9.1 mm.
- 38 j. Wire size: 30-12 AWG.
- 39 k. Rated voltage: 300 V.
- 40 l. Rated current: 12 A.
- 41 m. Fuse size: 1/4 x 1-1/4.
- 42 n. Blown fuse indication.
- 43 o. DIN rail mounting.
- 44 p. UL listed.

## 45 2.6 POWER SUPPLIES

- 46 A. DC Power Supplies:
- 47 1. Acceptable manufacturers:
- 48 a. Sola HD.
- 49 b. Siemens.
- 50 2. Design and fabrication:
- 51 a. Converts 120 Vac input to DC power at required voltage.
- 52 b. DIN rail mount with enclosure (i.e., not open frame).
- 53 c. Switching type.
- 54 d. AC input: 120 Vac +/-15 percent, nominal 60 Hz.
- 55 e. Efficiency: Minimum 86 percent.
- 56 f. Rated mean time between failure (MTBF): 500,000 HRS.
- 57 g. Voltage regulation:
- 58 1) Static: Less than 1.0 percent  $V_{out}$ .
- 59 2) Dynamic: +/-2 percent  $V_{out}$  overall.
- 60 h. Output ripple/noise: Less than 100 mV peak to peak (20 MHz).



- 1 i. Overload, short circuit and open circuit protection.
- 2 j. Temperature rating: 0 to 60 DegC full rated, derated linearly to 50 percent at 70 DegC.
- 3 k. Humidity rating: Up to 90 percent, non-condensing.
- 4 l. LED status indication for DC power.

5 **2.7 ALARM STROBE LIGHTS**

- 6 A. Acceptable manufacturers:
  - 7 1. Edwards Signaling, 125 Class Strobe Beacon.
  - 8 2. Federal Signal Corporation Streamline LP3 Series.
- 9 B. Design and Fabrication:
  - 10 1. NEMA 4X rated.
  - 11 2. Gasketed surface mount to Polymer Fill Panel.
  - 12 3. UL listed.
  - 13 4. Color as indicated in Drawings.
  - 14 5. Candlepower: 175,000 peak.
  - 15 6. Power: Either 120 VAC or 24 VDC.

16 **PART 3 - EXECUTION**

17 **3.1 INSTALLATION**

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

19 **END OF SECTION**

20



1 2014/09/15

2

3

**SECTION 13448**  
**CONTROL PANELS AND ENCLOSURES**

4

**PART 1 - GENERAL**

5

**1.1 SUMMARY**

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A. Section Includes:

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1. Requirements for control panels and enclosures utilized as follows:

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- a. Unless noted otherwise, all control panels and enclosures housing control components that are specified in Specification Section 13442, Specification Section 13446 or Specification Section 13500.

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11

- B. This Specification Section is only applicable to panels furnished with Division 11 equipment packages when so stated in the applicable Division 11 Specification Section.

12

13

- C. This Section is only applicable to panels housing Division 16 specified equipment (e.g., motor starters, lighting controls, etc.) when so stated in the applicable Division 16 Specification Section.

14

15

D. Related Sections include but are not necessarily limited to:

16

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

17

2. Division 01 - General Requirements.

18

3. Section 10400 - Identification Devices.

19

4. Division 11 - Equipment.

20

5. Section 13440 - Instrumentation for Process Control: Basic Requirements.

21

6. Section 13442 - Primary Elements and Transmitters.

22

7. Section 13446 - Control Auxiliaries.

23

8. Section 13500 - Programmable Logic Controller (PLC) Control System.

24

9. Division 16 - Electrical.

25

**1.2 QUALITY ASSURANCE**

26

A. Referenced Standards:

27

1. American National Standards Institute (ANSI).

28

2. ASTM International (ASTM):

29

- a. B75, Standard Specification for Seamless Copper Tube.

30

3. National Electrical Manufacturers Association (NEMA):

31

- a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

32

- b. ICS 4, Industrial Control and Systems: Terminal Blocks.

33

4. National Fire Protection Association (NFPA):

34

- a. 70, National Electrical Code (NEC):

35

- 1) Article 409, Industrial Control Panels.

36

5. Underwriters Laboratories, Inc. (UL):

37

- a. 508A, Standard for Safety Industrial Control Panels.

38

B. Miscellaneous:

39

1. Approved supplier of Industrial Control Panels under provisions of UL 508A.

40

- a. Entire assembly shall be affixed with a UL 508A label "Listed Enclosed Industrial Control Panel" prior to shipment to the jobsite.

41

- b. Control panel(s) without an affixed UL 508A label shall be rejected and sent back to the Contractor's factory.

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**1.3 DEFINITIONS**

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- A. The term "panel" refers to control panels or enclosures listed in the schedule included in this Specification Section.

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- B. Foreign Voltages: Voltages that may be present in circuits when the panel main power is disconnected.

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- 1 C. Intrinsically Safe:
- 2 1. A device, instrument or component that will not produce sparks or thermal effects under
- 3 normal or abnormal conditions that will ignite a specified gas mixture.
- 4 2. Designed such that electrical and thermal energy limits inherently are at levels incapable of
- 5 causing ignition.
- 6 D. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or
- 7 instrumentation wire.
- 8 E. Instrumentation Cable:
- 9 1. Multiple conductor, insulated, twisted or untwisted, with outer sheath.
- 10 2. Instrumentation cable is typically either TSP (twisted-shielded pair) or TST (twisted-shielded
- 11 triad), and is used for the transmission of low current or low voltage signals.
- 12 F. Ground Fault Circuit Interrupter (GFCI): A type of device (e.g., circuit breaker or receptacle)
- 13 which detects an abnormal current flow to ground and opens the circuit preventing a hazardous
- 14 situation.
- 15 G. Programmable Logic Controller (PLC): A specialized industrial computer using programmed,
- 16 custom instructions to provide automated monitoring and control functions by interfacing software
- 17 control strategies to input/output devices.
- 18 H. Remote Terminal Unit (RTU): An industrial data collection device designed for location at a
- 19 remote site, that communicates data to a host system by using telemetry such as radio, dial-up
- 20 telephone, or leased lines.
- 21 I. Input/Output (I/O): Hardware for the moving of control signals into and/or out of a PLC or RTU.
- 22 J. Supervisory Control and Data Acquisition (SCADA): Used in process control applications, where
- 23 programmable logic controllers (PLCs) perform control functions but are monitored and
- 24 supervised by computer workstations.
- 25 K. Highway Addressable Remote Transducer (HART): An open, master-slave protocol for bus
- 26 addressable field instruments.
- 27 L. Digital Signal Cable: Used for the transmission of digital communication signals between
- 28 computers, PLCs, RTUs, etc.
- 29 M. Uninterruptible Power Supply (UPS): A backup power unit that provides continuous power when
- 30 the normal power supply is interrupted.
- 31 N. Loop Calibrator: Portable testing and measurement tool capable of accurately generating and
- 32 measuring 4-20ma DC analog signals.

33 **1.4 SUBMITTALS**

- 34 A. Shop Drawings:
- 35 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 36 the submittal process.
- 37 2. See Specification Section 13440.
- 38 3. Prepared with computer aided design (CAD) software.
- 39 4. Printed on 11 by 17 IN sheets.
- 40 5. Drawings shall include a title block containing the following:
- 41 a. Plant or facility name where panel(s) are to be installed.
- 42 b. Drawing title.
- 43 c. Drawing number.
- 44 d. Revision list with revision number and date
- 45 e. Drawing date.
- 46 f. Drawing scale.
- 47 g. Manufacturer name, address, and telephone number.
- 48 6. Cover sheet for each drawing set shall indicate the following:
- 49 a. Plant or facility name.
- 50 b. Project name.
- 51 c. Submittal description.
- 52 d. Revision number.
- 53 e. Issue date.

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7. Table of contents sheet(s) shall indicate the following for each Drawing in the set:
    - a. Drawing number.
    - b. Drawing title.
    - c. Sheet number.
  8. Legend and abbreviation sheet shall indicate the following:
    - a. Description of symbols and abbreviations used.
    - b. Panel construction notes including enclosure NEMA rating, finish type and color, wire type, wire color strategy, conductor sizes, and wire labeling strategy.
    - c. Confirmation that the panel(s) are to be affixed with a UL 508A label prior to shipment from the factory.
  9. Bill of Material for each panel shall include the following component information:
    - a. Instrument tag number.
    - b. Quantity.
    - c. Functional name or description.
    - d. Manufacturer.
    - e. Complete model number.
    - f. Size or rating.
  10. Panel exterior layout Drawings to scale and shall indicate the following:
    - a. Panel materials of construction, dimensions, and total assembled weight.
    - b. Panel access openings.
    - c. Conduit access locations.
    - d. Front panel device layout.
    - e. Nameplate schedule:
      - 1) Nameplate location.
      - 2) Legend which indicates text, letter height and color, and background color.
    - f. Alarm annunciator window engraving schedule.
    - g. Layouts of graphic panels or mosaic displays.
  11. Panel interior layout Drawings shall be drawn to scale and shall indicate the following:
    - a. Sub-panel or mounting pan dimensions.
    - b. Interior device layouts.
    - c. PLC general arrangement layouts.
    - d. Wire-way locations, purpose, and dimensions.
    - e. Terminal strip designations.
    - f. Location of external wiring and/or piping connections.
    - g. Location of lighting fixtures, switches and receptacles.
  12. Wiring diagrams shall consist of the following:
    - a. Panel power distribution diagrams.
    - b. Control and instrumentation wiring diagrams.
    - c. PLC I/O information:
      - 1) Model number of I/O module.
      - 2) Description of I/O module type and function.
      - 3) Rack and slot number.
      - 4) Terminal number on module.
      - 5) Point or channel number.
      - 6) Programmed point addresses.
      - 7) Signal function and type.
    - d. Wiring diagrams shall identify each wire as it is to be labeled.
- B. Manufacturer catalog cut sheets for enclosure, finish, panel devices, control auxiliaries, and accessories.
  - C. Electrical load calculations for each panel:
    1. Total connected load.
    2. Peak electrical demand for each panel.
  - D. Climate control calculations for each panel.
    1. Verify that sufficient dissipation and/or generation of heat is provided to maintain interior panel temperatures within the rated operating temperatures of panel components.
  - E. Operation and Maintenance Manuals:
    1. See Specification Section 01342 for requirements for:
      - a. The mechanics and administration of the submittal process.
      - b. The content of Operation and Maintenance Manuals.

- 1           2. See Specification Section 13440.
- 2           F. Informational Submittals:
- 3           1. Record Drawings:
- 4           a. Updated Panel Drawings delivered with the panel(s) from the Contractor's factory.
- 5           b. Drawings shall be enclosed in transparent plastic and firmly secured within each panel.

6           **PART 2 - PRODUCTS**

7           **2.1 ACCEPTABLE MANUFACTURERS**

- 8           A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 9           1. Enclosures:
- 10           a. Hoffman Engineering Co.
- 11           b. Rittal.
- 12           c. Hammond Manufacturing.
- 13           d. Millbank Mfg. Co.
- 14           2. Panel heaters:
- 15           a. Hoffman Enclosures, Inc.
- 16           b. Rittal.
- 17           c. Hammond Manufacturing.
- 18           3. Heat exchangers and air conditioners:
- 19           a. Hoffman Enclosures, Inc.
- 20           b. Rittal.
- 21           c. Hammond Manufacturing.
- 22           4. Cooling fans and exhaust packages:
- 23           a. Hoffman Enclosures, Inc.
- 24           b. Rittal.
- 25           5. Internal corrosion inhibitors:
- 26           a. Hoffman Enclosures, Inc.; Model A-HCI.
- 27           b. Northern Technologies International Corporation (NTIC); Model Zerust VC.
- 28           c. Cortec Corporation; Model VpCI Emitting Systems.
- 29           B. Submit request for substitution in accordance with Specification Section 01640.

30           **2.2 ACCESSORIES**

- 31           A. Panel Nameplates and Identification: See Section 10400.

32           **2.3 FABRICATION**

- 33           A. General:
- 34           1. Fabricate panels with instrument arrangements and dimensions identified in the Contract
- 35           Documents.
- 36           2. Provide panel(s) with the required enclosure rating per NEMA 250 to meet classifications
- 37           identified in the Contract Documents.
- 38           3. Devices installed in panel openings shall have a NEMA enclosure rating at least equal to the
- 39           panel enclosure rating.
- 40           a. Devices that cannot be obtained with an adequate NEMA rating shall be installed behind
- 41           a transparent viewing window.
- 42           b. The window shall maintain the required NEMA rating of the enclosure.
- 43           4. Panel(s) shall be completely assembled at the Contractor's factory.
- 44           a. No fabrication other than correction of minor defects or minor transit damage shall be
- 45           performed on panels at the jobsite.
- 46           5. Painting:
- 47           a. Panels fabricated from steel shall have their internal and external surfaces prepared,
- 48           cleaned, primed, and painted.
- 49           1) Mechanically abrade all surfaces to remove rust, scale, and surface imperfections.
- 50           2) Provide final surface treatment with 120 grit abrasives or finer, followed by spot
- 51           putty to fill all voids.
- 52           3) Utilize solvent or chemical methods to clean panel surfaces.
- 53           4) Apply surface conversion of zinc phosphate prior to painting to improve paint
- 54           adhesion and to increase corrosion resistance.

- 1 5) Electrostatically apply polyester urethane powder coating to all inside and outside
- 2 surfaces.
- 3 6) Bake powder coating at high temperatures to bond coating to enclosure surface.
- 4 a) Panel interior shall be white with semi-gloss finish.
- 5 b) Panel exterior shall be ANSI #61 gray with flat finish.
- 6 7) Application of alkyd liquid enamel coating shall be allowed in lieu of polyester
- 7 urethane powder for wall mounted NEMA 1 or NEMA 12 rated panels.
- 8 b. Panels fabricated from stainless steel, aluminum, or fiberglass shall not be painted.
- 9 6. Finish opening edges of panel cutouts to smooth and true surface conditions.
- 10 a. Panels fabricated from steel shall have the opening edges finished with the panel
- 11 exterior paint.
- 12 7. Panel shall meet all requirements of UL 508A.
- 13 a. If more than one (1) disconnect switch is required to disconnect all power within a panel
- 14 or enclosure, provide a cautionary marking with the word "CAUTION" and the following
- 15 or equivalent, "Risk of Electric Shock-More than one (1) disconnect switch required to
- 16 de-energize the equipment before servicing."
- 17 8. Provide control panel in accordance with NFPA 70, Article 409.
- 18 a. In the event of any conflict between NFPA 70, Article 409 and UL 508A, the more
- 19 stringent requirement shall apply.
- 20 B. Wall Mounted Panels:
- 21 1. Seams continuously welded and ground smooth.
- 22 2. Rolled lip around all sides of enclosure door opening.
- 23 3. Gasketed dust tight.
- 24 4. Door clamps and hasp/staple for padlocking.
- 25 5. Continuous heavy GA hinge pin on doors.
- 26 a. Hinges rated for 1.5 times door plus instrument weight.
- 27 6. Front full opening door.
- 28 7. Brackets for wall mounting.
- 29 C. Internal Panel Wiring:
- 30 1. Panel wire duct shall be installed between each row of components, and adjacent to each
- 31 terminal strip.
- 32 a. Route wiring within the panel in wire-duct neatly tied and bundled with tie wraps.
- 33 b. Follow wire-duct manufacturer's recommended fill limits.
- 34 c. Wire-duct shall have removable snap-on covers and perforated walls for easy wire
- 35 entrance.
- 36 d. Wire-duct shall be constructed of nonmetallic materials with rating in excess of the
- 37 maximum voltage carried therein.
- 38 2. Wiring shall be installed such that if wires are removed from one (1) device, source of power
- 39 will not be disrupted to other devices.
- 40 3. Splicing and tapping of wires permitted only at terminal blocks.
- 41 4. Wire bunches to doors shall be secured at each end so that bending or twisting will be
- 42 around longitudinal axis of wire.
- 43 a. Protect bend area with sleeve.
- 44 5. Arrange wiring neatly, cut to proper length, with surplus wire removed.
- 45 a. Arrange wiring with sufficient clearance.
- 46 b. Provide abrasion protection for wire bundles that pass through openings or across
- 47 edges of sheet metal.
- 48 6. AC circuits shall be routed separate from analog signal cables and digital signal cables.
- 49 a. Separate by at least 6 IN, except at unavoidable crossover points and at device
- 50 terminations.
- 51 7. Provide at least 6 IN of separation between intrinsically safe devices and circuits and non-
- 52 intrinsically safe devices and circuits.
- 53 8. Wiring to pilot devices or rotary switches shall be individually bundled and installed with a
- 54 "flexible loop" of sufficient length to permit the component to be removed from panel for
- 55 maintenance without removing terminations.
- 56 9. Conductors for AC and DC circuits shall be type MTW stranded copper listed for operation
- 57 with 600 V at 90 DegC.
- 58 a. Conductor size shall be as required for load and 16 AWG minimum.
- 59 b. Internal panel wiring color code shall be as follows:
- 60 1) Line power: Black.
- 61 2) Neutral: White.

- 1 3) Ground: Green.
- 2 4) +24 VDC: Brown.
- 3 5) 24 VDC Common: Brown/white stripe.
- 4 6) Inputs: Blue.
- 5 7) Outputs: Yellow.
- 6 8) Analog (+): Clear/white.
- 7 9) Analog (-): Black.
- 8 10. Analog signal cables shall be of 600 V insulation, stranded copper, twisted-shielded pairs.
- 9 a. Conductor size: 18 AWG minimum.
- 10 b. Terminate shield drain conductors to ground only at one (1) end of the cable.
- 11 11. High precision 250 ohm resistors with 0.25 percent accuracy shall be used where 4-20 mA
- 12 DC analog signals are converted to 1-5 Vdc signals.
- 13 a. Resistors located at terminal strips.
- 14 b. Resistors terminated using individual terminal blocks and with no other conductors.
- 15 c. Resistor leads shall be un-insulated and of sufficient length to allow test or calibration
- 16 equipment (e.g., HART communicator, loop calibrator) to be properly attached to the
- 17 circuit with clamped test leads.
- 18 12. Loop isolators shall be used if required to avoid signal noise problems where analog signals
- 19 are transmitted between control enclosures.
- 20 13. Wire and cable identification:
- 21 a. Wire and cables numbered and tagged at each termination.
- 22 b. Wire tags:
- 23 1) Slip-on, PVC wire sleeves with legible, machine-printed markings.
- 24 2) Adhesive, snap-on, or adhesive type labels are not acceptable.
- 25 c. Markings as identified in the Shop Drawings.
- 26 D. Grounding Requirements:
- 27 1. Equipment grounding conductors shall be separated from incoming power conductors at the
- 28 point of entry.
- 29 2. Minimize grounding conductor length within the enclosure by locating the ground reference
- 30 point as close as practical to the incoming power point of entry.
- 31 3. Bond electrical racks, chassis and machine elements to a central ground bus.
- 32 a. Nonconductive materials, such as paint, shall be removed from the area where the
- 33 equipment contacts the enclosure.
- 34 4. Bond the enclosure to the ground bus.
- 35 a. It is imperative that good electrical connections are made at the point of contact between
- 36 the ground bus and enclosure.
- 37 5. Panel-mounted devices shall be bonded to the panel enclosure or the panel grounding
- 38 system by means of locknuts or pressure mounting methods.
- 39 6. Sub-panels and doors shall be bonded to ground.
- 40 E. Termination Requirements:
- 41 1. Wiring to circuits external to the panel connected to interposing terminal blocks.
- 42 2. Terminal blocks rigidly mounted on DIN rail mounting channels.
- 43 3. Terminal strips located to provide adequate space for entrance and termination of the field
- 44 conductors.
- 45 4. One (1) side of each strip of terminal blocks reserved exclusively for the termination of field
- 46 conductors.
- 47 5. Terminal block markings:
- 48 a. Marking shall be the same as associated wire marking.
- 49 b. Legible, machine-printed markings.
- 50 c. Markings as identified in the shop drawings.
- 51 6. Terminal block mechanical characteristics, and electrical characteristics shall be in
- 52 accordance with NEMA ICS 4.
- 53 7. Terminal blocks with continuous marking strips.
- 54 a. Each terminal block shall be identified with machine printed labels.
- 55 8. Terminals shall facilitate wire sizes as follows:
- 56 a. 120 Vac applications: Conductor size 12 AWG minimum.
- 57 b. Other: Conductor size 14 AWG minimum..
- 58 9. Analog signal cable shield drain conductors shall be individually terminated.
- 59 10. Install minimum of 20 percent spare terminals.
- 60 11. Bladed, knife switch, isolating type terminal blocks where control voltages enter or leave the
- 61 panel.



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12. Fused terminal blocks shall be used in the following circuits:
    - a. Control voltage is used to energize a solenoid valve.
    - b. DC power is connected to 2-wire, loop-powered instruments.
  13. Fused terminal blocks shall be provided with blown fuse indicators.
  14. When control circuits require more than one (1) field conductor connected to a single wiring point, a sufficient number of terminal points shall be connected internally to allow termination of only one (1) field conductor per terminal block.
  15. DIN rail mounting channels shall be installed along full length of the terminal strip areas to facilitate future expansion.
  16. Connections to devices with screw type terminals shall be made using spade-tongue, insulated, compression terminators.

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- F. Component Mounting and Placement:
1. Components shall be installed per manufacturer instructions.
  2. Control relays and other control auxiliaries shall be mounted on DIN rail mounting channels where practical.
  3. Front panel devices shall be mounted within a range of 40 to 70 IN above the finished floor, unless otherwise shown in the Contract Documents.
  4. PLC and I/O rack installation:
    - a. Located such that the LED indicators and switches are readily visible with the panel door open.
    - b. Located such that repair and/or replacement of component can be accomplished without the need to remove wire terminations or other installed components.
  5. Locate power supplies with sufficient spacing for circulation of air.
  6. Where components such as magnetic starters, contactors, relays, and other electromagnetic devices are installed within the same enclosure as the PLC system components, provide a barrier of at least 6 IN of separation between the "power area containing the electromagnetic devices" and the "control area".
  7. Components mounted in the panel interior shall be fastened to an interior sub-panel using machine screws.
    - a. Fastening devices shall not project through the outer surface of the panel enclosure.
  8. Excess mounting space of at least 20 percent for component types listed below to facilitate future expansion:
    - a. Fuse holders.
    - b. Circuit breakers.
    - c. Control relays.
    - d. Time delay relays.
    - e. Intrinsically safe barriers and relays.
  9. Components installed on sub-panels shall be provides with a minimum spacing between component and wire duct of 1 IN.
    - a. Minimum of 2 IN separation between terminal strips and wire ducts.
  10. Pneumatic tubes and appurtenances:
    - a. Connect panel air piping and tubing penetrations with bulkhead fittings.
    - b. Pneumatic control tubing shall be 1/4 IN OD.
      - 1) Tubing material: Either soft annealed ASTM B75 copper or flame-resistant polyethylene.
    - c. Main headers within panels shall be minimum 1 IN.
    - d. Compression-type pressure fittings.
    - e. Equip panel instrument leads with ball type isolation valve.
    - f. Route tubing neatly and mount securely.
    - g. Do not route tubing in front of or in wire ducting.
    - h. Code terminal plates.
    - i. Pneumatic devices shall be served by a dual function filter regulator.

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- G. Power Distribution:
1. Main incoming power circuits shall be protected with a thermal magnetic circuit breaker.
    - a. Limit load to maximum of 80 percent of circuit breaker rating.
  2. Component types listed below shall be individually fused so that they may be individually de-energized for maintenance:
    - a. PLC power supply modules.
    - b. Single-loop controllers.
    - c. Recorders.
    - d. Alarm annunciators.

- 1                   3. Equip each panel with necessary power supplies with ratings required for installed equipment
- 2                   and with minimum 25 percent spare capacity.
- 3                   4. Constant voltage transformers, balancing potentiometers, and rectifiers as necessary for
- 4                   specific instrument requirements.
- 5                   H. Internal Panel Lighting and Service Receptacles:
- 6                   1. Panels less than or equal to 4 FT wide:
- 7                   a. One (1) electrical GFCI duplex receptacle.
- 8                   b. One (1) compact fluorescent light fixture with manual switch(es).
- 9                   2. Panels or panel faces greater than 4 FT wide:
- 10                  a. One (1) duplex electrical GFCI receptacle per 6 FT of length.
- 11                  b. Continuous fluorescent lighting strip with manual switches.
- 12                  I. Environmental Controls:
- 13                  1. Outdoor panels:
- 14                  a. Outdoor temperature range of -20 DegF through 120 DegF.
- 15                  b. Thermostat controlled heaters to maintain temperature approximately 10 DegF above
- 16                  ambient for condensation prevention inside the panels.
- 17                  c. Internal corrosion inhibitors.
- 18                  2. Environmental control components:
- 19                  a. Panel heaters:
- 20                    1) Thermostat controlled.
- 21                    2) Designed for sub-panel mounting.
- 22                    3) Powered from 120 Vac and protected with a dedicated circuit breaker.
- 23                  b. Cooling fans (if required to keep temperatures within the panel from exceeding
- 24                  component temperature ratings).
- 25                    1) Designed to be mounted within a panel to preclude hot spots within the panel.
- 26                    2) Cooling fan controlled with a separately mounted thermostat with bi-metal sensor
- 27                    and adjustable dial for temperature setting.
- 28                    3) Powered from 120 Vac and protected with a dedicated circuit breaker.
- 29                  c. Internal corrosion inhibitors:
- 30                    1) Contains chemical which vaporizes and condenses on surfaces in the enclosure.
- 31                    2) Inhibitor shall be applied in accordance with manufacturer instructions for the
- 32                    enclosure volume.
- 33                    3) Inhibitor shall be applied in the panel(s) prior to shipment from the Contractor's
- 34                    factory.

35                   **2.4 MAINTENANCE MATERIALS**

- 36                   A. Extra Materials:
- 37                   1. One (1) quart of exterior finish touch-up paint.
- 38                   2. One (1) complete set of replacement corrosion inhibitors in sealed packages for each panel.

39                   **PART 3 - EXECUTION**

40                   **3.1 FACTORY TESTING**

- 41                   A. Scope: Inspect and test entire panel assembly to verify readiness for shipment.
- 42                   B. Location: Contractor's factory.
- 43                   C. Factory Tests:
- 44                   1. Tests shall be fully documented and signed by the Contractor's factory supervisor.
- 45                   2. The panel shop shall fully test the control panel for correct wiring.
- 46                   a. Each I/O point shall be checked by measuring or connecting circuits at the field terminal
- 47                   blocks.
- 48                   3. The following functions shall be tested as a minimum:
- 49                   a. Demonstrate all functions of the panel(s).
- 50                   b. Correctness of wiring from all panel field terminals to all I/O points and to all panel
- 51                   components.
- 52                   c. The Contractor shall notify the Engineer in writing a minimum of 15 calendar days prior
- 53                   to the Factory Tests.
- 54                   1) Engineer has the option to witness all required tests.

- 1           4. Make following documentation available to the Engineer at test site during the tests:
- 2           a. Contract Documents.
- 3           b. Factory Demonstration Testing procedures.
- 4           c. List of equipment to be testing including make, model, and serial number.
- 5           d. Shop Drawing submittal data for equipment being tested.
- 6           5. Deficiencies shall be corrected prior to shipment from the Contractor's factory.

7   **3.2 INSTALLATION**

- 8           A. Obtain approved panel layouts prior to installation of conduits.
- 9           B. Install products in accordance with manufacturer's instructions.

10   **3.3 SCHEDULE**

- 11          A. Schedule:

SERVICE	TYPE	MATERIAL	NEMA RATNG
Polymer Fill Panel	Wall Mount	Stainless Steel	NEMA 4X
Fluoride Transfer Pump Control Panel	Wall Mount	Stainless Steel	NEMA 4X

13

**END OF SECTION**

14

15



1 2014/09/08

2

## SECTION 13500

3

### PROGRAMMABLE LOGIC CONTROLLER (PLC) CONTROL SYSTEM

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

###### A. Section Includes:

7

1. Programmable logic controller (PLC) control system(s), including software, programming, and training.

8

9

###### B. Related Sections include but are not necessarily limited to:

10

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

11

2. Division 01 - General Requirements.

12

3. Section 10400 Identification Devices.

13

4. Section 11005 - Equipment: Basic Requirements.

14

5. Section 13440 - Instrumentation for Process Control: Basic Requirements.

15

6. Section 13441 - Control Loop Descriptions.

16

7. Section 13448 - Control Panels and Enclosures.

17

##### 1.2 QUALITY ASSURANCE

18

###### A. Qualifications:

19

1. Installation supervisor shall have had experience in overseeing installation and startup of at least three (3) similar installations.

20

2. Programmer(s) shall have had experience in programming PLCs for at least two (2) projects of similar size and complexity.

21

22

##### 1.3 SYSTEM DESCRIPTION

23

- A. See Network Drawing 00Y601 for depiction of existing PLC processors to be utilized. No new PLC processors are required as part of this project.

24

25

##### 1.4 SUBMITTALS

26

###### A. Shop Drawings:

27

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

28

2. See Specification Section 13440.

29

3. Product technical data including:

30

- a. Annotated hard copies of PLC software programs.

31

- 1) Submit program for logic in ladder diagram format as used for the specific PLC system.

32

- 2) Annotate program listing to include the following:

33

- a) Written description of each rung's function.

34

- b) Reference to control loop number for each rung where applicable.

35

- c) Reference to instrumentation tag number of I/O devices for each rung where applicable.

36

- 3) Provide written descriptions completely defining all function blocks used in program.

37

- 4) Provide list of all addresses referenced in logic diagram with description of data associated with each address.

38

39

- b. Drawings containing the following information:

40

- 1) Arrangement Drawings for PLC system components.

41

- 2) Panel and enclosure plans, sections and details.

42

- 3) Enclosure internal wiring and terminal blocks.

43

- c. Catalog cut sheets containing information on PLC components to be submitted as part of this Specification Section submittals.

44

45

4. Certifications:

46

- a. Qualifications of installation supervisor.

47

- b. Qualifications of programmer(s).

48

49

50

51

134-225510-006

- 1 B. Operation and Maintenance Manuals:
- 2 1. See Specification Section 01342 for requirements for:
- 3 a. The mechanics and administration of the submittal process.
- 4 b. The content of Operation and Maintenance Manuals.
- 5 2. Submit maintenance procedures available to Owner.
- 6 a. Include the location and phone numbers of service centers (including 24 HR "hot lines").
- 7 b. Provide specific information including operation and maintenance requirements,
- 8 programming assistance, troubleshooting guide, parts ordering, field service personnel
- 9 requests, and service contracts.

## 10 PART 2 - PRODUCTS

### 11 2.1 ACCEPTABLE MANUFACTURERS

- 12 A. Siemens S7 300 family.

### 13 2.2 PERFORMANCE AND DESIGN REQUIREMENTS

- 14 A. See Section 13440.
- 15 B. The PLC system shall accomplish the control requirements of the loop descriptions, Drawings,
- 16 and Specifications.
- 17 C. PLC programming shall be documented and factory tested.
- 18 D. Where the PLC is utilized to control multiple trains of equipment and where the equipment in each
- 19 train operates as a unit relatively independent of other equipment trains (e.g., facility with multiple
- 20 boiler units or filter trains), the PLC components (I/O modules, power supplies, etc.) shall be
- 21 assigned so that the failure of any one (1) component does not affect equipment on all trains.
- 22 1. I/O modules shall be segregated on a train basis unless required otherwise for safety
- 23 reasons.
- 24 2. Where several equipment units operate in parallel, but are not considered assigned to a
- 25 particular equipment train (e.g., multiple raw water pumps or chemical feed pumps all
- 26 discharging into a common system), the PLC I/O modules associated with each equipment
- 27 unit shall be assigned so that the failure of any one (1) I/O module does not affect all of the
- 28 parallel operating equipment units.
- 29 E. Safety Function Wiring: Emergency shutdown switches shall not be wired into the controller.
- 30 F. Safe Wiring:
- 31 1. Equipment failure mode shall be selected so that the loss of power or control signal to the
- 32 equipment will result in the equipment either shutting down or operating safely.
- 33 2. Unless otherwise specified, activation of alarms and stopping of equipment shall result from
- 34 the de-energization of control circuits, rather than the energization of control circuits.
- 35 3. Low voltage control signal wires:
- 36 a. Place in conduit segregated for that purpose only.
- 37 b. Twisted shielded wire pair.
- 38 c. Not located in the same conduit or bundle with power wiring.
- 39 G. Initial Safety Conditions:
- 40 1. Utilize program module to dictate output states in a known and safe manner prior to running
- 41 of control program.
- 42 2. Utilize program each time PLC is re-initiated and the control program activated.

### 43 2.3 COMPONENTS

- 44 A. PLC System Central Processor Unit (CPU):
- 45 1. Program existing PLC processor(s) to provide control functionality required by the Contract
- 46 Documents.
- 47 a. Existing processor(s): Siemens S7 300 family.
- 48 2. CPU shall provide communications with other control systems and man-machine interfaces
- 49 as specified.

- 1 B. Input/Output (I/O) Modules:
- 2 1. Utilize existing or provide new I/O modules as described below:
- 3 a. Analog input modules: Siemens 6ES7331-1KF02-0AB0 (8 channel, 13 bit).
- 4 b. Analog output modules: Siemens 6ES7332-5HF00-0AB0 (8 channel, 11/12 bit).
- 5 c. Discrete input modules: Siemens 6ES7321-1FH00-0AA0 (16 DI, 120 VAC) or Siemens
- 6 6ES7321-1BH02-0AA0 (16 DI, 24 VDC), as applicable.
- 7 d. Discrete output modules: Siemens 6ES7322-1BH01-0AA0 (16 DO, 24 VDC).
- 8 2. Provide I/O system with:
- 9 a. Electric isolation between logic and field device.
- 10 b. Incorporate noise suppression design.
- 11 c. Install 20 percent spare I/O points.
- 12 3. Input/output connection requirements:
- 13 a. Make connections to I/O subsystem by terminating all field wiring on terminal blocks
- 14 within the I/O enclosure.
- 15 b. Prewire I/O modules to terminal blocks.
- 16 c. Provide terminal blocks with continuous marking strip.
- 17 d. Size terminals to accommodate all active data base points and spares.
- 18 e. Provide terminals for individual termination of each signal shield.
- 19 f. Field wiring shall not be disturbed when removing or replacing an I/O module.
- 20 4. Discrete I/O modules:
- 21 a. Interface to ON/OFF devices.
- 22 b. Isolated modules for applications where one (1) module interfaces with devices utilizing
- 23 different sources of power.
- 24 5. Discrete outputs shall be fused:
- 25 a. Provide one (1) fuse per common or per isolated output.
- 26 b. Provide blown fuse indication.
- 27 c. External fusing shall be provided if output module does not possess internal fusing.
- 28 d. Fuses provided external to output module shall:
- 29 1) Be in accordance with module manufacturer's specifications.
- 30 2) Be installed at terminal block.
- 31 6. Analog I/O modules:
- 32 a. Input modules to accept signals indicated on Drawings or Specifications.
- 33 b. Provide output signals as indicated on Drawings and Specifications.
- 34 C. PLC System Enclosure:
- 35 1. Wiring and grounding to be in accordance with Section 13448.
- 36 2. Termination requirements:
- 37 a. In accordance with Section 13448.
- 38 b. Make connections to I/O subsystem by terminating all field wiring on terminal blocks
- 39 within the enclosure.
- 40 c. Prewire I/O modules to terminal blocks.
- 41 d. Size terminals to accommodate all active database points and spares.
- 42 e. Provide terminals for individual termination of each signal shield.
- 43 f. Field wiring shall not be disturbed when removing or replacing an I/O module.
- 44 D. PLC System Software and Programming:
- 45 1. Provide all hardware and programming required to provide communication between the PLC
- 46 and the man-machine interface.
- 47 2. Provide programming to accomplish all control and monitoring requirements of the Drawings
- 48 and Specifications.
- 49 3. Provide two (2) copies of control logic program on 3-1/2 IN disks or on CD.
- 50 4. IBM compatible software.
- 51 5. Full documentation capability.
- 52 a. Provide description for each rung.
- 53 6. On/off line programming.
- 54 7. Offline simulation prior to download.
- 55 8. Two-step commands requiring operator verification prior to deletion of any programming.

## 56 2.4 ACCESSORIES

- 57 A. Provide all accessories required to furnish a complete PLC control system to accomplish the
- 58 requirements of the Drawings and Specifications.

1 **2.5 SOURCE QUALITY CONTROL**

- 2 A. Provide a performance test after factory completion and prior to shipment.
- 3 1. Conduct a test where the system is operated continuously and checked for correct operation
- 4 including loop controls, displays, printing, keyboard functions, alarm responses, and on/off
- 5 sequencing control.
- 6 2. Conduct testing with dummy I/Os to verify each control loop operation.
- 7 3. Allow for Owner and Engineer representatives to witness testing program.
- 8 a. Provide minimum of 15 days notice prior to testing.
- 9 4. Do not ship prior to successful completion of this testing program.

10 **PART 3 - EXECUTION**

11 **3.1 INSTALLATION**

- 12 A. Install PLC control system in accordance with manufacturer's written instructions.

13 **3.2 FIELD QUALITY CONTROL**

- 14 A. Employ and pay for services of equipment manufacturer's field service representative(s) to:
- 15 1. Inspect equipment covered by these Specifications.
- 16 2. Supervise adjustments and installation checks.
- 17 3. Maintain and submit an accurate daily or weekly log of all commissioning functions.
- 18 a. All commissioning functions may be witnessed by the Engineer.
- 19 b. All reports shall be cosigned by the Contractor and the Engineer if witnessed.
- 20 4. Conduct startup of equipment and perform operational checks.
- 21 5. Provide Owner with a written statement that manufacturer's equipment has been installed
- 22 properly, started up, and is ready for operation by Owner's personnel.

23 **3.3 DEMONSTRATION**

- 24 A. Demonstrate system in accordance with Section 01650.

25 **3.4 PLC POINTS LIST**

26

<b>Analog Inputs – Quad 1 PLC</b>			
<b>No.</b>	<b>Tag Name</b>	<b>Description</b>	<b>Comment</b>
1.	FC-FLDT01-WI	Fluoride Weight	Move this input to Quad 1 PLC from CP-0306
2.	FC-FLROOM-AI	Fluoride Room Leak Alarm	Move this input to Quad 1 PLC from CP-0306
3.	FC-FLTP-XA	Fluoride Transfer Pump Leak Alarm	Move this input to Quad 1 PLC from CP-0306
4.	FC-POST01-LI1	Polymer Storage Tank Level	
5.	FC-PODT01-WI	Polymer Day Tank Weight	This input already exists in Quad 1 PLC from existing polymer day tank scale; input is now to be from new scale
6.	FC-SHST01-LI	Sodium Hex Storage Tank 1 Level	
7.	FC-SHST02-LI	Sodium Hex Storage Tank 2 Level	
8.	FP-IFCV01-ZI2	Influent Flume Drain Valve FPIFCV-01 position	

27

<b>Analog Outputs – Quad 1 PLC</b>			
<b>No.</b>	<b>Tag Name</b>	<b>Description</b>	<b>Comment</b>
1.	FC-PODB01-SIC	Polymer Dilution Blender/Feeder Speed Control	



<b>Analog Outputs – Quad 1 PLC</b>			
<b>No.</b>	<b>Tag Name</b>	<b>Description</b>	<b>Comment</b>
2.	FC-FLFP01-SIC	Fluoride Feed Pump 1 Speed Control	
3.	FC-FLFP02-SIC	Fluoride Feed Pump 2 Speed Control	
4.	FP-IFCV01-HIC	Influent Flume Drain Valve FPIFCV-01 Position Control	

1

<b>Discrete Inputs – Quad 1 PLC</b>			
	<b>Tag Name</b>	<b>Description</b>	<b>Comments</b>
1.	FC-FLFP01-YI	Fluoride Feed Pump 1 Run Status	Move this input to Quad 1 PLC from CP-0306
2.	FC-FLFP01-ZI	Fluoride Feed Pump 1 in Remote	
3.	FC-FLFP01-XA2	Fluoride Feed Pump 1 VFD Fault	
4.	FC-FLFP02-YI	Fluoride Feed Pump 2 Run Status	
5.	FC-FLFP02-ZI	Fluoride Feed Pump 2 in Remote	
6.	FC-FLFP02-XA2	Fluoride Feed Pump 2 VFD Fault	
7.	FL_ALM1	Fluoride Alarm # 1	This is existing point that was moved in SCADA Upgrade Project to CP-0306 from PLC in Main Control Room Console. Monitoring panel which provides this signal is being relocated under this contract.
8.	FL_ALM2	Fluoride Alarm # 2	Existing point - same comment as for FL_ALM1 above
9.	FC-FLTP-LAH	Fluoride Transfer Pump vault flood	From level float switch
10.	FC-FLTP-TAL	Fluoride Transfer Pump vault heat trace alarm	
11.	FC-FL-FAH	Fluoride eye wash flow alarm	
12.	FC-FLSUMP-LAH	Fluoride sump drain hi level	From level float switch
13.	FC-FLDT01-LAH	Fluoride Day Tank spill containment level sensed	From level float switch
14.	FC-PODB01-YI	Polymer Dilution Blender/Feeder Run Status	From Polyblend skid
15.	FC-PODB01-XA2	Polymer Dilution Blender/Feeder Trouble Alarm	From Polyblend skid
16.	FC-PODB01-ZI	Polymer Dilution Blender/Feeder in Remote Mode	From Polyblend skid
17.	FC-SHFP01-YI	Sodium Hex Pump 1 Run Status	This input already exists in Quad 1 PLC for existing sodium hex pump status; input is now to be for new sodium hex pump #1
18.	FC-SHFP02-YI	Sodium Hex Pump 2 Run Status	
19.	FC-SHST-LAH	Sodium Hex Tank Spill Alarm	
20.	FP-IFCV01-ZI1	Influent Flume Drain Valve FPIFCV-01 In REMOTE Control Mode	

2

<b>Discrete Outputs</b>			
-------------------------	--	--	--

	Tag Name	Description	
1.		Fluoride Above 760 Pounds	Move this output to Quad 1 PLC from CP-0306? Need to verify where this output goes
2.	FC-FLFP01-HS2	Fluoride Feed Pump 1 Start/Stop Command	
3.	FC-FLFP02-HS2	Fluoride Feed Pump 2 Start/Stop Command	
4.	FC-PODB01-HS2	Polymer Dilution Blender/Feeder Start/Stop Command	
5.	FC-SHFP01-HS2	Sodium Hexametaphosphate Feed Pump 1 Start/Stop Command	This output already exists in Quad 1 PLC for existing sodium hex pump start; output is now to be for new sodium hex pump #1
6.	FC-SHFP02-HS2	Sodium Hexametaphosphate Feed Pump 2 Start/Stop Command	

1  
2  
3

CP-0306 Remote I/O Panel			
Analog Inputs			
No.	Existing Tag Name	Description	Comment
20	E_FL_LV	East Fluoride Storage Tank Level	See note 1 below
21	W_FL_LV	West Fluoride Storage Tank Level	See note 1 below

4 Note 1: These points are existing inputs to CP-0306. The Fluoride Tank Management System Panel that  
5 provides these PLC inputs is being relocated under this Contract. Contractor to provide loop checks for this  
6 inputs after relocation of the Fluoride Tank Management System Panel. See Electrical Drawings for details.  
7  
8

Discrete Inputs – CP-0306			
	Tag Name	Description	Comments
1.	FL_ALM1	Fluoride Alarm # 1	See note 1 below
2.	FL_ALM2	Fluoride Alarm # 2	See note 1 below
3.	FL_ALM1	Fluoride Alarm #1	See note 1 below
4.	FL_ALM2	Fluoride Alarm #2	See note 1 below
5.	EFL_VAL	East Fluoride Tank Vault Leak Alarm	See note 1 below
6.	EFL_TAL	East Fluoride Tank Leak Alarm	See note 1 below
7.	WFL_VAL	West Fluoride Tank Vault Leak Alarm	See note 1 below
8.	WFL_TAL	West Fluoride Tank Leak Alarm	See note 1 below

9 Note 1: These points are existing inputs to CP-0306. The Fluoride Tank Management System Panel that  
10 provides these PLC inputs is being relocated under this Contract. Contractor to provide loop checks for this  
11 inputs after relocation of the Fluoride Tank Management System Panel. See Electrical Drawings for details.

12

## END OF SECTION

1 2014/08/19

2

## SECTION 13504

3

# CONFIGURATION REQUIREMENTS: HUMAN MACHINE INTERFACE (HMI) AND REPORTS

4

## 5 PART 1 - GENERAL

### 6 1.1 SUMMARY

7

#### A. Section Includes:

8

1. Configuration requirements for HMI and reports which includes but is not necessarily limited to.

9

10

- a. Specific software functional descriptions.

11

- b. Graphics requirements.

12

- c. HMI functionality requirements.

13

- d. Plant overview screens.

14

- e. Process overview screens.

15

- f. Detail displays.

16

- g. Trend displays.

17

- h. PLC hardware/HMI status screen.

18

- i. Alarm monitoring.

19

- j. Report generation.

20

- k. Configuration standards and conventions.

21

- l. Screen configuration review meetings.

22

- m. Report configuration review meetings.

23

- n. Coordination.

24

#### B. Related Specification Sections include but are not necessarily limited to:

25

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

26

2. Division 01 - General Requirements.

27

3. Section 13440 - Instrumentation for Process Control: Basic Requirements.

28

### 1.2 QUALITY ASSURANCE

29

#### A. Qualifications:

30

1. Programmer(s) shall have had experience in software configuration and installation for at least two (2) projects of similar size and complexity.

31

32

### 1.3 DEFINITIONS

33

#### A. HMI: Human Machine Interface.

34

#### B. I/O: Input/Output.

35

#### C. OLE: Object Linking and Embedding, a document standard developed by Microsoft that enables the creation of an object with one application and the linking or embedding of the object in a second application.

36

37

38

#### D. OPC: "OLE for Process Control"; a software standard utilizing a client/server model that makes interoperability possible between automation/control applications and field systems/devices.

39

40

#### E. PC: Personal Computer.

41

#### F. PLC: Programmable Logic Controller.

42

### 1.4 SUBMITTALS

43

#### A. Shop Drawings:

44

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

45

2. See Specification Section 13440.

46

3. Graphic screen displays; provide in actual colors utilized.

47

- 1 B. Operation and Maintenance Manuals:
- 2 1. See Specification Section 01342 for requirements for:
- 3 a. The mechanics and administration of the submittal process.
- 4 b. The content of Operation and Maintenance Manuals.
- 5 C. Informational Submittals:
- 6 1. Results of factory testing procedures.
- 7 2. Proposed training agendas and schedule.

## 8 **1.5 GENERAL FUNCTIONAL REQUIREMENTS**

- 9 A. Software Functional Requirements:
- 10 1. General functional requirements for system configuration are indicated on the Drawings and
- 11 described in the Specifications.
- 12 2. The information presented herein and indicated on the Drawings illustrates the general
- 13 functional intent of the system and may not be sufficient to fully configure the system.
- 14 3. The Contractor is responsible for determining what additional information may be required to
- 15 complete the configuration tasks, and for obtaining this information from the Owner.
- 16 B. Available Process Values:
- 17 1. All process alarm, equipment status, and process variable values shall be available at any
- 18 HMI.
- 19 2. If communications to a particular I/O point has failed for any reason, then wherever that data
- 20 is displayed, the software shall post a visual indication that the point is not valid.
- 21 C. All process related functions, calculations, timers, and numeric manipulations, shall be
- 22 accomplished in the PLC hardware and not in the HMI.
- 23 1. The HMI shall function as a monitoring system, not as a process controller.
- 24 2. The HMI shall transfer data to the PLC system and the PLC system shall perform all control
- 25 algorithms.

## 26 **PART 2 - PRODUCTS**

### 27 **2.1 SPECIFIC SOFTWARE FUNCTIONAL DESCRIPTIONS**

- 28 A. The existing SCADA System utilizes Schneider Electric's Citect Version 7.3 HMI software.
- 29 1. Contractor shall add new and/or revised HMI functionality utilizing the existing Citect
- 30 software.
- 31 B. Specific functional requirements for various software control blocks within the computer system
- 32 are as follows.
- 33 1. Descriptions are general and are not intended to fully indicate the complete functionality of
- 34 the system.
- 35 2. Monitoring of process values:
- 36 a. Process values derived from analog process variable signals must be historically
- 37 archived.
- 38 1) Store all historical data with time and date of occurrence.
- 39 2) Make values available for use in reports.
- 40 3) Assign high and low alarms to process values as defined below and otherwise
- 41 deemed appropriate.
- 42 b. Provide capability for computer server(s) to retrieve real-time values from the PLC
- 43 system at adjustable time periods.
- 44 c. Alarm limits:
- 45 1) Set per direction from the Owner.
- 46 2) An operator having proper security authorization must be able to enable, disable,
- 47 and adjust the setpoint of any individual alarm.
- 48 C. Utilize graphic screen displays at the HMI(s) to provide monitoring and control functionality.
- 49 1. Hierarchy of HMI screens is in descending order as follows:
- 50 a. Plant overview screen(s).
- 51 b. Process overview screens.
- 52 c. Process screens.
- 53 d. Pop-up/control screens.

- 1 D. HMI operator interface functionality shall include:
- 2 1. Indication of process variables.
- 3 2. Configuration of control loop parameters (e.g., setpoints, gains, etc.).
- 4 3. Adjustment of controller output.
- 5 4. Display of real time and historical process trends.
- 6 5. Selector switch and pushbutton station controls.
- 7 6. System and process status indicators.
- 8 7. Graphic representation of plant operations with interactive status and measurement symbols.
- 9 8. Annunciation.
- 10 E. Graphics:
- 11 1. Provide new graphics with the same functionality and format as the existing graphics.
- 12 F. Process Overview Screens:
- 13 1. At a process overview screen, the operator shall be able to select a specific process screen
- 14 for monitoring/control purposes.
- 15 a. Monitoring and control functions available at the selected process screen include but are
- 16 not limited to the following:
- 17 1) Select individual equipment items for monitoring and control.
- 18 2) Select a control loop or point for control action.
- 19 3) Change control mode of loop selected (manual, automatic, cascade).
- 20 4) Change setpoint.
- 21 5) Issue commands to start/stop and open/close two-state equipment.
- 22 6) For manual loading output stations, the operator shall be able to manipulate analog
- 23 output values.
- 24 7) Select a loop and initiate further display, such as the detail display, trend, or hourly
- 25 averaging.
- 26 8) Display and change ratio and bias values.
- 27 9) Control field equipment such as motor-operated valves and switches.
- 28 G. Trend Displays:
- 29 1. Real time on-line and historical trend displays.
- 30 2. Capable of displaying multiple points per display.
- 31 3. Operator shall be able to select any desired sample time interval.
- 32 4. Utilize Historical Data Server(s) to collect and manage data.
- 33 H. Alarm Monitoring:
- 34 1. Provide standard alarm screen functionality to ensure flexibility and quick access to live
- 35 alarms, alarm history and alarm grouping parameters.
- 36 2. Audible alarming capability for user selected alarms.

## 37 **PART 3 - EXECUTION**

### 38 **3.1 CONFIGURATION REQUIREMENTS**

- 39 A. Provide all programming and configuration required for all HMIs furnished under this Contract:

### 40 **3.2 SCREEN CONFIGURATION REVIEW MEETINGS**

- 41 A. Conduct a minimum of one configuration conference with the Owner to review and discuss
- 42 system configuration programming and related topics.
- 43 1. The purpose of the conference will be to discuss, in detail, how each I/O point will be handled
- 44 and the types, quantities, hierarchies, and functioning of display screens.
- 45 2. Review of the Owner's existing systems, standards, conventions, file and tag naming
- 46 requirements, font type and size requirements, and reporting requirements must be part of
- 47 each conference.
- 48 3. Conference will be held in the Minne Lusa Conference Room at the Florence Water
- 49 Treatment Plant.
- 50 4. Each screen will be reviewed at each conference.
- 51 a. If required, to review all screens, each conference will occur on multiple days.
- 52 5. Submit 10 color copies of printed screens via shop drawing submittal process 10 calendar
- 53 days before each conference.

- 1           6. Bring equipment to project screens on wall or provide multiple monitors for viewing by  
2           attendees.
- 3           B. Proposed graphic screens and report formats must be reviewed with the Owner throughout the  
4           configuration process.

5   **3.3 COORDINATION**

- 6           A. Coordinate as required with other contractors and vendors to seamlessly integrate all HMI  
7           monitoring and control functions.

8   **3.4 DEMONSTRATION**

- 9           A. Demonstrate system in accordance with Specification Section 01650.

10

**END OF SECTION**



**DIVISION 14**  
**CONVEYING SYSTEMS**







1 2014/08/19

2

## SECTION 14301

3

### HOISTS, TROLLEYS, AND MONORAILS

#### 4 PART 1 - GENERAL

##### 5 1.1 SUMMARY

6

A. Section Includes: Hoists, trolleys, and monorails.

7

B. Related Specification Sections include but are not necessarily limited to:

8

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

9

2. Division 01 - General Requirements.

10

3. Section 11005 - Equipment: Basic Requirements.

11

##### 1.2 QUALITY ASSURANCE

12

A. Referenced Standards:

13

1. American Bearing Manufacturers Association (ABMA).

14

2. American Society of Mechanical Engineers (ASME):

15

a. B30.11, Safety Code for Underhung Cranes and Monorail Systems.

16

b. B30.16, Safety Code for Overhead Hoists.

17

3. ASTM International (ASTM):

18

a. A36, Standard Specification for Carbon Structural Steel.

19

4. National Fire Protection Association (NFPA):

20

a. 70, National Electrical Code (NEC).

21

B. Comply with ASME B30.11 and ASME B30.16.

22

##### 1.3 DEFINITIONS

23

A. Hook Height: The minimum acceptable distance in feet from bottom of hook in full raised position to the nearest floor surface.

24

25

B. Lift Height: The distance in feet from the bottom of the hook in full raised position to the surface of the lowest floor from which items may be hoisted.

26

27

C. Total Trolley Capacity: The ultimate load-carrying capacity of the trolley based on the ultimate strength of the material used (with a 5:1 safety factor) and the bearing life.

28

29

D. Ultimate Load-Carrying Capacity: Live load, weights of all equipment and an allowance for impact.

30

31

##### 1.4 SUBMITTALS

32

A. Shop Drawings:

33

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

34

2. See Specification Section 11005.

35

3. Product technical data including:

36

a. Acknowledgement that products submitted meet requirements of standards referenced.

37

4. Fabrication and/or layout Drawings.

38

a. Track layout including supports, splices, connections, switches, and end trucks.

39

5. Test reports verifying strength of inserts and rail.

40

6. Load test results.

41

42

B. Operation and Maintenance Manuals:

43

1. See Specification Section 01342 for requirements for:

44

a. The mechanics and administration of the submittal process.

45

b. The content of Operation and Maintenance Manuals.

1 **PART 2 - PRODUCTS**

2 **2.1 ACCEPTABLE MANUFACTURERS**

3 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

- 4 1. Hoists:  
5 a. Yale.  
6 b. Acco.  
7 c. Robbins and Myers.  
8 d. Wright.  
9 e. Or approved equal.  
10 2. Trolleys:  
11 a. Yale.  
12 b. Acco.  
13 c. Wright.  
14 d. Or approved equal.  
15 3. Monorails:  
16 a. Spanmaster.  
17 b. Twin City Monorail.  
18 c. Or approved equal.

19 B. Submit request for substitution in accordance with Specification Section 01640.

20 **2.2 MANUFACTURED UNITS**

- 21 A. Trolleys:  
22 1. Push-type.  
23 2. Completely compatible with hoists, cranes, and monorails specified.  
24 3. Meet NEC standards according to classifications shown on Drawings.  
25 4. Capable of maneuvering curves without binding or scraping the track.  
26 5. Minimum ABMA L-10 bearing life of 5000 HRS based on 75 percent of the wheel load,  
27 excluding impact.  
28 6. Plain trolleys:  
29 a. Frame consisting of thick rolled steel sections extending beyond wheel flanges to protect  
30 wheels.  
31 b. Alloy steel hardened axles, ball-bearings and pressed steel wheels.  
32 1) Carburized and hardened ball tread wheels.  
33 2) Factory lubricated requiring no additional lubrication.
- 34 B. Hoists:  
35 1. Electric chain hoists:  
36 a. Low headroom models.  
37 b. Hoist frames of welded heavy steel plate construction.  
38 c. Oiltight gear casing for oil bath lubrication of gears.  
39 d. Load chain and wheels:  
40 1) Close link coil or roller-type chain.  
41 2) Links of uniform size and shape and free from scale.  
42 3) Manufacture load chain wheels from steel, pearlitic malleable iron or modular cat-  
43 iron.  
44 a) Form load and idler sheaves to fit chain.  
45 e. Double revving for hoists with total lift height greater than hook height.  
46 f. Provide running sheaves with means for lubrication.  
47 g. Bearings:  
48 1) Antifriction type.  
49 h. Mechanical load brake.  
50 i. Lower limit switch to stop hoist when hook reaches its lower limit.  
51 j. Motor:  
52 1) Motor brake.  
53 a) Internal disc magnetic type.  
54 b) Rated for 150 percent of motor torque.  
55 c) Delivers rapidly with no hook drift.  
56 2) TENV motors operable on 460 V, 3 PH, 60 cycle power.  
57 3) Meet specified area classification.

- 1 4) Permanently lubricate and seal motor ball-bearings.
- 2 5) Provide an upper limit switch to stop the hoist motor and apply the holding brake
- 3 when the hook reaches its upper limit.
- 4 6) Furnish with 40 FT of power cord (3 wire plus ground) to be terminated with male
- 5 plug by the contractor.
- 6 k. Controls:
- 7 1) Motor starters, electric conduit, control stations, magnetic reversing contactors and
- 8 low-voltage transformer, necessary for a complete and totally functional conveying
- 9 system. Include control power transformer. Controls shall be listed by Nationally
- 10 Recognized Testing Laboratory (NRTL).
- 11 l. Mark the hoist with the following information:
- 12 1) Name and address of manufacturer.
- 13 2) Manufacturer's unit identification number.
- 14 3) Rated load.
- 15 4) Voltage of AC or DC power supply and phase and frequency of AC power supply.
- 16 5) Rated amperage.
- 17 2. Hand chain hoists:
- 18 a. Spur-gearred.
- 19 b. Design load-carrying parts so that the calculated static stress in the material, based on
- 20 rated capacity, does not exceed 25 percent of the average ultimate strength of the
- 21 material.
- 22 c. Hand chain and wheels:
- 23 1) Hand chain of the endless coil-type with a drop that is about 2 FT less than the
- 24 specified lift of the hoist.
- 25 2) Chain yield point at least three (3) times the required hand chain pull for rated load.
- 26 3) Manufacture hand chain wheels from steel, malleable iron, high strength cast iron,
- 27 or aluminum alloy.
- 28 4) Equip handwheel with suitable chain guard to prevent the hand chain from slipping
- 29 or jumping the wheel rim.
- 30 d. Automatic mechanical load brake which will prevent lowering of the load unless manual
- 31 power is applied to the hand chain.
- 32 e. Sleeve or antifriction type bearings.
- 33 f. Enclose gearing in sealed construction and provide life-time lubrication.
- 34 g. Load limit clutch to automatically prevent hoist from lifting loads greater than rated
- 35 capacity.
- 36 h. Mark each hoist with the following information:
- 37 1) Name and address of manufacturer.
- 38 2) Manufacturer's unit identification number.
- 39 3) Rated load.
- 40 3. Hooks:
- 41 1) Forged steel.
- 42 2) Bottom hook free to swivel in the loaded condition without twisting the chain.
- 43 3) Gate or swing type latch hooks.
- 44 4. Mark each hoist with the following information:
- 45 a. Name and address of manufacturer.
- 46 b. Manufacturer's unit identification number.
- 47 c. Rated load.
- 48 C. Monorails:
- 49 1. Straight track: ASTM A36 steel I beams.
- 50 2. Where track curves are required, supply straight track and curves which are standard items
- 51 of monorail manufacturer.
- 52 3. Design track to support hoist capacity plus 25 percent for impact load plus the weight of hoist
- 53 and accessories without exceeding allowable working stress of track material with maximum
- 54 deflection of 1/450 of span.
- 55 4. Brace track to prevent sideways movement under full load conditions.
- 56 5. Provide end stops at all track ends.
- 57 6. Assure that track splices have been designed by track supplier and are located at support
- 58 points.

## 59 2.3 ACCESSORIES

- 60 A. Trolley stops design to engage the trolley frame rather than trolley wheels.

- 1 B. Furnish chain containers for hand hoists.
- 2 C. Electrification and Controls:
- 3 1. Provide electrical power to the motor-driven hoists and trolleys using one (1) of the following
- 4 methods as scheduled:
- 5 a. Cable reel system:
- 6 1) 360-degree swivel base.
- 7 2) Full working length of cable plus 25 percent.
- 8 3) Include all components needed for a complete and operable system.
- 9 2. Controls:
- 10 a. Pendant pushbutton control stations with reversing type contactors for electric hoists
- 11 and/or trolleys.
- 12 b. Single station if hoist and trolley are both motor-driven.
- 13 c. Suspend control stations from trolleys.
- 14 d. Clearly mark function of each button.
- 15 e. Suspend station in a manner that will protect the electrical conductors against strain.
- 16 f. Control station: Operable from 115 V power supply.
- 17 g. Ground control station to hoist.
- 18 h. Provide control cable lengths of 1 FT less than distance to nearest floor.
- 19 3. Switches:
- 20 a. Manual switches.
- 21 b. Completely compatible with hoists, trolleys, and monorails specified.
- 22 c. Provide switch chain to within 6 FT of floor.

## 23 PART 3 - EXECUTION

### 24 3.1 INSTALLATION

- 25 A. Support track as shown on Drawings.
- 26 B. Arrange supports for easy removal of track for repair or replacement.
- 27 C. Align track true and level.
- 28 D. Warning Signs:
- 29 1. Affix to the hoist or the lower load block or the controls in a readable position a durable label
- 30 or labels displaying the following information concerning safe operating procedures:
- 31 a. The word WARNING or other legend designed to bring the label to the attention of an
- 32 operator.
- 33 b. Cautionary language against:
- 34 1) Lifting more than rated load.
- 35 2) Operating hoist when hook is not centered under hoist.
- 36 3) Operating hoist with twisted, kinked or damaged rope or chain.
- 37 4) Operating damaged or malfunctioning hoist.
- 38 5) Operating hoist with a rope that is not properly seated in its groove (if applicable).
- 39 6) Lifting people or lifting loads over people.
- 40 7) Removing or obscuring warning label.

### 41 3.2 FIELD QUALITY CONTROL

- 42 A. Test each hoist, trolley, and monorail using 110 percent rated load.
- 43 B. Employ and pay for services of equipment manufacturer's field service representative(s) to:
- 44 1. Inspect equipment covered by this Specification Section.
- 45 2. Supervise pre-start-up adjustments, installation checks and all field tests.
- 46 3. Conduct initial start-up of equipment and perform operational checks.
- 47 4. Provide a written statement that manufacturer's equipment has been installed properly,
- 48 started up and is ready for operation by Owner's personnel.
- 49 5. Instruct Owner's personnel for 8 HRS at jobsite on operation and maintenance of the hoist,
- 50 trolley, monorail and crane equipment.

1 **3.3 SCHEDULE**

2 A. Hoist, trolley, and monorail systems include but are not necessarily limited to the following:  
3

TAG NUMBER	LOADING (TONS)	HOIST	TROLLEY	HOOK HEIGHT (FT)*	LIFTING HEIGHT (FT)*	HP	OPERATING SPEED FPM	LOCATION	MR	COMMENT
FP-HST-01	2	HC	Push	10	10	NA	NA	Lower Level	Yes	
FP-HST-02	2	HC	Push	8	8	NA	NA	Lower Level	Yes	
FP-HST-03	2	EC	Push	10	18	3	21	Operating Level	No	Provide new hoist/trolley on existing crane. Hoist shall be provided with power cord. Salvage existing hoist/trolley to Owner.

4 \* Distances listed are approximate as they will vary depending on hoist and trolley selection.

- 5
- 6 HC = Hand Chain
- 7 EC = Electric Chain
- 8 MR = Monorail
- 9 NA = Not Applicable

10 **END OF SECTION**





DIVISION 15  
MECHANICAL







1 2014/09/05

2

## SECTION 15060

3

### PIPE AND PIPE FITTINGS: BASIC REQUIREMENTS

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

###### A. Section Includes:

7

1. Process piping systems.

8

2. Utility piping systems.

9

3. Plumbing piping systems.

10

###### B. Related Specification Sections include but are not necessarily limited to:

11

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

12

2. Division 01 - General Requirements.

13

3. Section 02221 - Trenching, Backfilling, and Compacting for Utilities.

14

4. Section 09960 - High Performance Industrial Coatings.

15

5. Section 11005 - Equipment: Basic Requirements.

16

6. Section 13442 - Primary Elements and Transmitters.

17

7. Section 15090 - Pipe Support Systems.

18

8. Section 15100 - Valves: Basic Requirements.

19

9. Section 15183 - Pipe, Duct and Equipment Insulation.

20

##### 1.2 QUALITY ASSURANCE

21

###### A. Referenced Standards:

22

1. American Society of Mechanical Engineers (ASME):

23

a. B16.22, Wrought Copper and Bronze Solder - Joint Pressure Fittings.

24

b. B40.100, Pressure Gauges and Gauge Attachments.

25

2. ASTM International (ASTM):

26

a. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

27

b. A74, Standard Specification for Cast Iron Soil Pipe and Fittings.

28

c. A760, Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains.

29

d. B88, Standard Specification for Seamless Copper Water Tube.

30

e. C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

31

f. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules

32

40, 80, and 120.

33

g. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

34

h. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

35

i. D3034, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

36

j. D3139, Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

37

k. D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

38

l. D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

39

m. F1417, Standard Specification for Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air.

40

3. American Water Works Association (AWWA):

41

a. B300, Standard for Hypochlorites.

42

b. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.

43

c. C606, Standard for Grooved and Shouldered Joints.

44

d. C651, Standard for Disinfecting Water Mains.

45

4. American Water Works Association/American National Standards Institute (AWWA/ANSI):

46

a. C110/A21.10, Standard for Ductile-Iron and Gray-Iron Fittings.

47

48

49

50

51

52

53

54

55

- 1                   b. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and
- 2                   Fittings.
- 3                   c. C115/A21.15, Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron
- 4                   Threaded Flanges.
- 5                   d. C151/A21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
- 6                   e. C153/A21.53, Standard for Ductile-Iron Compact Fittings for Water Service.
- 7                   5. Chlorine Institute, Inc. (CI):
- 8                   a. Pamphlet 6, Piping Systems for Dry Chlorine.
- 9                   6. Cast Iron Soil Pipe Institute (CISPI):
- 10                  a. 301, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and
- 11                  Storm Drain, Waste, and Vent Piping Applications.
- 12                  7. International Plumbing Code (IPC).
- 13                  8. Underwriters Laboratories, Inc. (UL).
- 14                  B. Coordinate flange dimensions and drillings between piping, valves, and equipment.

15   **1.3 SYSTEM DESCRIPTION**

- 16   A. Piping Systems Organization and Definition:
- 17    1. Piping services are grouped into designated systems according to the chemical and physical
- 18    properties of the fluid conveyed, system pressure, piping size and system materials of
- 19    construction.
- 20    2. See PIPING SPECIFICATION SCHEDULES in PART 3.
- 21    3. The table below identifies each service classification, its symbol, and the designated system
- 22    classification for each service:
- 23

<u>SERVICE</u>	<u>SYMBOL</u>	<u>SYSTEM NO.</u>
Ammonia (Solution)	AMS	7
Backwash Drain	BDR	2
Chlorine (Solution)	CLS	7
Chlorine Gas (Vacuum)	CLGV	7
Compressed Air	A	11
Drain	DR	2
Filter Air Backwash	FAB	11
Filter Backwash Supply	FBS	26
Filter Drain	FDR	2
Filter Effluent	FEF	2
Filter Influent	FIN	2
Filter to Waste	FTW	2
Fluoride	FL	7
Natural Gas	NG	5
Polymer (Cationic)	POC	7
Potable Water Cold	PWC	10
Potable Water Hot	PWH	10
Pump Prime System	PS	4
Sanitary Sewer	SAN	21
Sample	SMP	27
Service Water	SVW	10
Sodium Hexametaphosphate	SH	7
Soft Water	SOW	10
Steam Supply	ST	5
Steam Condensate	SC	5

24

25   **1.4 SUBMITTALS**

- 26   A. Shop Drawings:
- 27    1. See Specification Section 01340 for requirements for the mechanics and administration of
- 28    the submittal process.
- 29    2. Product technical data including:
- 30    a. Acknowledgement that products submitted meet requirements of standards referenced.

- 1                   b. Copies of manufacturer's written directions regarding material handling, delivery, storage
- 2                   and installation.
- 3                   c. Separate schedule sheet for each piping system scheduled in this Specification Section
- 4                   showing compliance of all system components.
- 5                   1) Attach technical product data on gaskets, pipe, fittings, and other components.
- 6            B. Operation and Maintenance Manuals:
- 7            1. See Specification Section 01342 for requirements for:
- 8            a. The mechanics and administration of the submittal process.
- 9            b. The content of Operation and Maintenance Manuals.
- 10           C. Informational Submittals:
- 11           1. Qualifications of lab performing disinfection analysis on water systems.
- 12           2. Test reports:
- 13           a. Copies of pressure test results on all piping systems.
- 14           b. Disinfection test report.
- 15           c. Notification of time and date of piping pressure tests.

16           **PART 2 - PRODUCTS**

17           **2.1 ACCEPTABLE MANUFACTURERS**

- 18           A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 19           1. Insulating unions:
- 20           a. "Dielectric" by Epco.
- 21           2. Dirt strainers (Y type):
- 22           a. Mueller (#351).
- 23           b. Sarco.
- 24           c. Armstrong.
- 25           3. Chemical strainers (Y type):
- 26           a. Chemtrol.
- 27           b. Asahi.
- 28           4. Dry disconnect couplings:
- 29           a. Kamlock.
- 30           5. Dielectric flange kit:
- 31           a. PSI.
- 32           b. Maloney.
- 33           c. Central Plastics.
- 34           6. Pipe saddles (for gage installation):
- 35           a. Dresser Style 91 (steel and ductile iron systems).
- 36           b. Dresser Style 194 (nonmetallic systems).
- 37           7. Expansion joint at FRP and poly tanks:
- 38           a. PROCO.
- 39           B. Submit request for substitution in accordance with Specification Section 01640.

40           **2.2 PIPING SPECIFICATION SCHEDULES**

- 41           A. Piping system materials, fittings and appurtenances are subject to requirements of specific piping
- 42           specification schedules located at the end of PART 3 of this Specification Section.

43           **2.3 COMPONENTS AND ACCESSORIES**

- 44           A. Insulating Components:
- 45           1. Dielectric flange kits:
- 46           a. Flat faced.
- 47           b. 1/8 IN thick dielectric gasket, phenolic, non-asbestos.
- 48           c. Suitable for 175 psi, 210 DegF.
- 49           d. 1/32 IN wall thickness bolt sleeves.
- 50           e. 1/8 IN thick phenolic insulating washers.
- 51           2. Dielectric unions:
- 52           a. Screwed end connections.
- 53           b. Rated at 175 psi, 210 DegF.
- 54           c. Provide dielectric gaskets suitable for continuous operation at union rated temperature
- 55           and pressure.

- 1 B. Dirt Strainers:
- 2 1. Y-type.
- 3 2. Composition bronze.
- 4 3. Rated for test pressure and temperature of system in which they are installed.
- 5 4. 20 mesh Monel screen.
- 6 5. Threaded bronze plug in the blowoff outlet.
- 7 6. Threaded NPT end connections.
- 8 C. Strainers for Chemical Applications:
- 9 1. Y-type.
- 10 2. Strainers of same material, test pressure, and temperature rating as system in which strainer
- 11 is placed.
- 12 D. Reducers:
- 13 1. Furnish appropriate size reducers and reducing fittings to mate pipe to equipment
- 14 connections.
- 15 2. Connection size requirements may change from those shown on Drawings depending on
- 16 equipment furnished.
- 17 E. Protective Coating and Lining:
- 18 1. Include pipe, fittings, and appurtenances where coatings, linings, paint, tests and other items
- 19 are specified.
- 20 2. Field paint pipe in accordance with Specification Section 09960.
- 21 F. Pressure Gages: See Section 11005 and Section 13442.
- 22 G. Dry Disconnect Couplings:
- 23 1. Adapters:
- 24 a. Male adapters: Size shown on Drawings.
- 25 b. Adapters:
- 26 1) Female NPT end connection for sludge and flush applications.
- 27 2) Male NPT end connection for chemical applications.
- 28 c. Construct adapters for sludge applications from cast iron or steel.
- 29 d. Construct adapters for chemical and PVC system applications 3 IN and below from
- 30 polypropylene.
- 31 2. Couplers:
- 32 a. Built-in valve and spring loaded poppet which close automatically when disconnected.
- 33 b. Designed to remain with only one (1) arm locked in closed position.
- 34 c. Construct couplers for chemical and PVC system applications 3 IN and less from
- 35 polypropylene with stainless steel arms and pins.
- 36 1) Above 3 IN, provide stainless steel units.
- 37 d. Gasket: Compatible with conveyed liquid.
- 38 3. Dust caps: For all adapters.
- 39 H. Valves:
- 40 1. See schematics and details for definition of manual valves used in each system under 4 IN in
- 41 size.
- 42 a. See Specification Section 15100 schedule for valve types 4 IN and above and for
- 43 automatic valves used in each system.
- 44 2. See Specification Section 15100.
- 45 I. Expansion Joints at FRP and Poly Tanks:
- 46 1. Materials:
- 47 a. Bellows: PTFE-62.
- 48 b. Flanges: PVC.
- 49 c. Limit bolts and nuts: 316 stainless steel.
- 50 d. Reinforcing rings: Stainless steel.
- 51 2. Pressure rating at 70 DegF: 70 psig.
- 52 3. Minimum axial movement: 3/8 IN.

1 **PART 3 - EXECUTION**

2 **3.1 EXTERIOR BURIED PIPING INSTALLATION**

- 3 A. Unless otherwise shown on the Drawings, provide a minimum of 4 FT and maximum of 8 FT  
4 earth cover over exterior buried piping systems and appurtenances conveying water, fluids, or  
5 solutions subject to freezing.
- 6 B. Enter and exit through structure walls, floors, and ceilings by using penetrations and seals  
7 specified in Specification Section 01800 and as shown on Drawings.
- 8 C. When entering or leaving structures with buried mechanical joint piping, install joint within 2 FT of  
9 point where pipe enters or leaves structure.  
10 1. Install second joint not more than 6 FT nor less than 4 FT from first joint.
- 11 D. Install expansion devices as necessary to allow expansion and contraction movement.
- 12 E. Laying Pipe In Trench:  
13 1. Excavate and backfill trench in accordance with Specification Section.  
14 2. Clean each pipe length thoroughly and inspect for compliance to Specifications.  
15 3. Grade trench bottom and excavate for pipe bell and lay pipe on trench bottom.  
16 4. Install gasket or joint material according to manufacturer's directions after joints have been  
17 thoroughly cleaned and examined.  
18 5. Except for first two (2) joints, before making final connections of joints, install two (2) full  
19 sections of pipe with earth tamped along side of pipe or final with bedding material placed.  
20 6. Lay pipe in only suitable weather with good trench conditions.  
21 a. Never lay pipe in water except where approved by Engineer.  
22 7. Seal open end of line with watertight plug if pipe laying stopped.  
23 8. Remove water in trench before removal of plug.
- 24 F. Lining Up Push-On Joint Piping:  
25 1. Lay piping on route lines shown on Drawings.  
26 2. Deflect from straight alignments or grades by vertical or horizontal curves or offsets.  
27 3. Observe maximum deflection values stated in manufacturer's written literature.  
28 4. Provide special bends when specified or where required alignment exceeds allowable  
29 deflections stipulated.  
30 5. Install shorter lengths of pipe in such length and number that angular deflection of any joint,  
31 as represented by specified maximum deflection, is not exceeded.
- 32 G. Anchorage and Blocking:  
33 1. Provide reaction blocking, anchors, joint harnesses, or other acceptable means for  
34 preventing movement of piping caused by forces in or on buried piping tees, wye branches,  
35 plugs, or bends.  
36 2. Place concrete blocking so that it extends from fitting into solid undisturbed earth wall.  
37 a. Concrete blocks shall not cover pipe joints.  
38 3. Provide bearing area of concrete in accordance with drawing detail.
- 39 H. Install insulating components where dissimilar metals are joined together.
- 40 I. Install underground hazard warning tape and tracer wire per Specification Section 10400 on all  
41 buried pipelines.

42 **3.2 INTERIOR AND EXPOSED EXTERIOR PIPING INSTALLATION**

- 43 A. Install piping in vertical and horizontal alignment as shown on Drawings.
- 44 B. Alignment of piping smaller than 4 IN may not be shown; however, install according to Drawing  
45 intent and with clearance and allowance for:  
46 1. Expansion and contraction.  
47 2. Operation and access to equipment, doors, windows, hoists, moving equipment.  
48 3. Headroom and walking space for working areas and aisles.  
49 4. System drainage and air removal.
- 50 C. Enter and exit through structure walls, floor and ceilings using penetrations and seals specified in  
51 Specification Section 01800 and as shown on the Drawings.
- 52 D. Install vertical piping runs plumb and horizontal piping runs parallel with structure walls.

- 1 E. Pipe Support:
- 2 1. Use methods of piping support as shown on Drawings and as required in Specification
- 3 Section 15090.
- 4 2. Piping support systems for piping 12 IN and greater are shown on the Drawings.
- 5 a. Support systems for piping smaller than 12 IN DIA are not shown on the Drawings.
- 6 b. Contractor is responsible for design of these support systems per Specification Section
- 7 15090.
- 8 3. Where pipes run parallel and at same elevation or grade, they may be grouped and
- 9 supported from common trapeze-type hanger, provided hanger rods are increased in size as
- 10 specified for total supported weight.
- 11 a. The pipe in the group requiring the least maximum distance between supports shall set
- 12 the distance between trapeze hangers.
- 13 4. Size pipe supports with consideration to specific gravity of liquid being piped.
- 14 F. Locate and size sleeves and castings required for piping system.
- 15 1. Arrange for chases, recesses, inserts or anchors at proper elevation and location.
- 16 G. Use reducing fittings throughout piping systems.
- 17 1. Bushings will not be allowed unless specifically approved.
- 18 H. Equipment Drainage and Miscellaneous Piping:
- 19 1. Provide drip pans and piping at equipment where condensation may occur.
- 20 2. Hard pipe stuffing box leakage to nearest floor drain.
- 21 3. Avoid piping over electrical components such as motor control centers, panelboards, etc.
- 22 a. If piping must be so routed, utilize 16 GA, 316 stainless steel drip pan under piping and
- 23 over full length of electrical equipment.
- 24 b. Hard pipe drainage to nearest floor drain.
- 25 4. Collect system condensate at drip pockets, traps and blowoff valves.
- 26 5. Provide drainage for process piping at locations shown on Drawings in accordance with
- 27 Drawing details.
- 28 6. For applications defined above and for other miscellaneous piping which is not addressed by
- 29 a specific piping service category in PART 1, provide 304 stainless steel piping and fittings.
- 30 a. Size to handle application with 3/4 IN being minimum size provided.
- 31 I. Unions:
- 32 1. Install in position which will permit valve or equipment to be removed without dismantling
- 33 adjacent piping.
- 34 2. Mechanical type couplings may serve as unions.
- 35 3. Additional flange unions are not required at flanged connections.
- 36 J. Install expansion devices as necessary to allow expansion/contraction movement.
- 37 K. Provide full face gaskets on all systems.
- 38 L. Anchorage and Blocking:
- 39 1. Block, anchor, or harness exposed piping subjected to forces in which joints are installed to
- 40 prevent separation of joints and transmission of stress into equipment or structural
- 41 components not designed to resist those stresses.
- 42 M. Equipment Pipe Connections:
- 43 1. Equipment - General:
- 44 a. Exercise care in bolting flanged joints so that there is no restraint on the opposite end of
- 45 pipe or fitting which would prevent uniform gasket pressure at connection or would
- 46 cause unnecessary stresses to be transmitted to equipment flanges.
- 47 b. Where push-on joints are used in conjunction with flanged joints, final positioning of
- 48 push-on joints shall not be made until flange joints have been tightened without strain.
- 49 c. Tighten flange bolts at uniform rate which will result in uniform gasket compression over
- 50 entire area of joint.
- 51 1) Provide tightening torque in accordance with manufacturer's recommendations.
- 52 d. Support and match flange faces to uniform contact over their entire face area prior to
- 53 installation of any bolt between the piping flange and equipment connecting flange.
- 54 e. Permit piping connected to equipment to freely move in directions parallel to longitudinal
- 55 centerline when and while bolts in connection flange are tightened.
- 56 f. Align, level, and wedge equipment into place during fitting and alignment of connecting
- 57 piping.

- 1 g. Grout equipment into place prior to final bolting of piping but not before initial fitting and
- 2 alignment.
- 3 h. To provide maximum flexibility and ease of alignment, assemble connecting piping with
- 4 gaskets in place and minimum of four (4) bolts per joint installed and tightened.
- 5 1) Test alignment by loosening flange bolts to see if there is any change in relationship
- 6 of piping flange with equipment connecting flange.
- 7 2) Realign as necessary, install flange bolts and make equipment connection.
- 8 i. Provide utility connections to equipment shown on Drawings, scheduled or specified.
- 9 2. Plumbing and HVAC equipment:
- 10 a. Make piping connections to plumbing and HVAC equipment, including but not limited to
- 11 installation of fittings, strainers, pressure reducing valves, flow control valves and relief
- 12 valves provided with or as integral part of equipment.
- 13 b. Furnish and install sinks, fittings, strainers, pressure reducing valves, flow control valves,
- 14 pressure relief valves, and shock absorbers which are not specified to be provided with
- 15 or as integral part of equipment.
- 16 c. For each water supply piping connection to equipment, furnish and install union and gate
- 17 or angle valve.
- 18 1) Provide wheel handle stop valve at each laboratory sink water supply.
- 19 2) Minimum size: 1/2 IN.
- 20 d. Furnish and install "P" trap for each waste piping connection to equipment if waste is
- 21 connected directly to building sewer system.
- 22 1) Size trap as required by IPC.
- 23 e. Stub piping for equipment, sinks, lavatories, supply and drain fittings, key stops, "P"
- 24 traps, miscellaneous traps and miscellaneous brass through wall or floor and cap and
- 25 protect until such time when later installation is performed.
- 26 N. Provide insulating components where dissimilar metals are joined together.
- 27 O. Instrument Connections: See Drawing details.

28 **3.3 CONNECTIONS WITH EXISTING PIPING**

- 29 A. Where connection between new work and existing work is made, use suitable and proper fittings
- 30 to suit conditions encountered.
- 31 B. Perform connections with existing piping at time and under conditions which will least interfere
- 32 with the operation of the facility.
- 33 C. Undertake connections in fashion which will disturb system as little as possible.
- 34 D. Provide suitable equipment and facilities to dewater, drain, and dispose of liquid removed without
- 35 damage to facility.
- 36 E. Where connections to existing systems necessitate employment of past installation methods not
- 37 currently part of trade practice, utilize necessary special piping components.
- 38 F. Where connection involves potable water systems, provide disinfection methods as prescribed in
- 39 this Specification Section.
- 40 G. Once tie-in to each existing system is initiated, continue work continuously until tie-in is made and
- 41 tested.

42 **3.4 ACCESS PROVISIONS**

- 43 A. Provide access doors or panels in walls, floors, and ceilings to permit access to valves, piping
- 44 and piping appurtenances requiring service.
- 45 B. Size of access panels to allow inspection and removal of items served, minimum 10 x 14 IN size.
- 46 C. Fabricate door and frame of minimum 14 GA, stretcher leveled stock, cadmium plated or
- 47 galvanized after fabrication and fitted with screw driver lock of cam type.
- 48 D. Provide with key locks, keyed alike, in public use areas.
- 49 E. Furnish panels with prime coat of paint.
- 50 F. Style and type as required for material in which door installed.

1 G. Where door is installed in fire-rated construction, provide door bearing UL label required for  
2 condition.

3 **3.5 HEAT TRACING**

4 A. See Specification Section 16125 - Heat Tracing Cable.

5 **3.6 PRESSURE GAGES**

6 A. Provide at locations shown on the Drawings and specified.

7 B. See Specification Section 11005.

8 **3.7 FIELD QUALITY CONTROL**

9 A. Pipe Testing - General:

- 10 1. Test piping systems as follows:
- 11 a. Test exposed, non-insulated piping systems upon completion of system.
  - 12 b. Test exposed, insulated piping systems upon completion of system but prior to
  - 13 application of insulation.
  - 14 c. Test concealed interior piping systems prior to concealment and, if system is insulated,
  - 15 prior to application of insulation.
  - 16 d. Test buried piping after backfilling has been complete.
- 17 2. Utilize pressures, media and pressure test durations as specified in the PIPING
- 18 SPECIFICATION SCHEDULES.
- 19 3. Isolate equipment which may be damaged by the specified pressure test conditions.
- 20 4. Perform pressure test using calibrated pressure gages and calibrated volumetric measuring
- 21 equipment to determine leakage rates.
- 22 a. Select each gage so that the specified test pressure falls within the upper half of the
  - 23 gage's range.
  - 24 b. Notify the Owner's Construction Representative 24 HRS prior to each test.
- 25 5. Completely assemble and test new piping systems prior to connection to existing pipe
- 26 systems.
- 27 6. Acknowledge satisfactory performance of tests and inspections in writing to Engineer prior to
- 28 final acceptance.
- 29 7. Bear the cost of all testing and inspecting, locating and remedying of leaks and any
- 30 necessary retesting and re-examination.

31 B. Pressure Testing:

- 32 1. Testing medium: Unless otherwise specified in the PIPING SPECIFICATION SCHEDULES,
- 33 utilize the following test media.
- 34 a. Process and plant air systems:

PIPE LINE SIZE	SPECIFIED TEST PRESSURE	TESTING MEDIUM
2 IN and smaller	Greater than 75 psi	Water
Greater than 2 IN	3 psi or less	Air or water
Greater than 2 IN	Greater than 3 psi	Water

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b. Liquid systems:

PIPE LINE SIZE (DIA)	GRAVITY OR PUMPED	SPECIFIED TEST PRESSURE	TESTING MEDIUM
Up to and including 48 IN	Gravity	25 psig or less	Air
All sizes	Pumped	250 psig or less	Water

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2. Allowable leakage rates:

- 41 a. Hazardous gas systems, all exposed piping systems, all pressure piping systems and all
- 42 buried, insulated piping systems which are hydrostatically pressure tested shall have
- 43 zero leakage at the specified test pressure throughout the duration of the test.
- 44 b. Large diameter (above 48 IN) gravity plant piping systems shall have a maximum
- 45 exfiltration of 25 gpd per inch-mile.
- 46 c. Non-hazardous gas and air systems which are tested with air shall have a maximum
- 47 pressure drop of 5 percent of the specified test pressure throughout the duration of the
- 48 test.



- 1                    3. Hydrostatic pressure testing methodology:  
2                    a. General:  
3                    1) All joints, including welds, are to be left exposed for examination during the test.  
4                    2) Provide additional temporary supports for piping systems designed for vapor or gas  
5                    to support the weight of the test water.  
6                    3) Provide temporary restraints for expansion joints for additional pressure load under  
7                    test.  
8                    4) Isolate equipment in piping system with rated pressure lower than pipe test  
9                    pressure.  
10                    5) Do not paint or insulate exposed piping until successful performance of pressure  
11                    test.  
12                    b. Soil, waste, drain and vent systems:  
13                    1) Test at completion of installation of each stack or section of piping by filling system  
14                    with water and checking joints and fittings for leaks.  
15                    2) Eliminate leaks before proceeding with work or concealing piping.  
16                    3) Minimum test heights shall be 10 FT above highest stack inlet.  
17                    c. Larger diameter (above 36 IN) gravity plant piping:  
18                    1) Plug downstream end of segment to be tested.  
19                        a) Provide bracing as required.  
20                    2) Fill segment and upstream structure to normal operating level as per hydraulic  
21                    profile.  
22                    3) Allow 24 HRS for absorption losses.  
23                        a) Refill to original level.  
24                    4) Provide reservoir to maintain constant head over duration of test.  
25                    5) Record reservoir water volume at beginning and end of test.  
26                    4. Natural gas systems - testing methodology:  
27                    a. Maintain specified test pressure until each joint has been thoroughly examined for leaks  
28                    by means of soap suds and glycerine.  
29                    b. Wipe joints clean after test.  
30                    5. Air testing methodology:  
31                    a. General:  
32                    1) Assure air is ambient temperature.  
33                    b. Low pressure air testing:  
34                    1) Low pressure air test shall be conducted in accordance with ASTM F1417 for plastic  
35                    pipe.  
36                    2) Plug the ends of the section to be tested with airtight plugs. Brace plugs to prevent  
37                    slippage due to internal pressure.  
38                        a) One plug must have provisions for connecting an air hose.  
39                    3) Connect air hose to plug and to portable air control equipment consisting of valves  
40                    and pressure gages to control rate of air flow into the test section and monitor air  
41                    pressure inside the pipe.  
42                    4) Supply air to test section such that internal pressure in the pipe section does not  
43                    exceed 5 psig. When pressure reaches 4.0 psig, throttle air supply to maintain  
44                    internal pressure between 3.5 and 4.0 psig for minimum of two minutes.  
45                    5) Disconnect air supply and allow pressure to drop 3.5 psig. At 3.5 psig start stop  
46                    watch and determine the time required for the pressure to drop to 2.5 psig.  
47                    6) Minimum holding times depending on length and size of mains.  
48

Pipe Line Size (DIA)	Minimum Time min:s	SPECIFIED TIME FOR LENGTH SHOWN, min:s							
		100 FT	150 FT	200 FT	250 FT	300 FT	350 FT	400 FT	450 FT
6	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24

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50 **3.8 CLEANING, DISINFECTION AND PURGING**

- 51                    A. Cleaning:  
52                    1. Clean interior of piping systems thoroughly before installing.  
53                    2. Maintain pipe in clean condition during installation.  
54                    3. Before jointing piping, thoroughly clean and wipe joint contact surfaces and then properly  
55                    dress and make joint.  
56                    4. Immediately prior to pressure testing, clean and remove grease, metal cuttings, dirt, or other  
57                    foreign materials which may have entered the system.

- 1 5. At completion of work and prior to Final Acceptance, thoroughly clean work installed under
- 2 these Specifications.
- 3 a. Clean equipment, fixtures, pipe, valves, and fittings of grease and metal cuttings which
- 4 may have accumulated by operation of system, from testing, or from other causes.
- 5 b. Repair any stoppage or discoloration or other damage to parts of building, its finish, or
- 6 furnishings, due to failure to properly clean piping system, without cost to Owner.
- 7 6. Clean chlorine piping in accordance with CI Pamphlet 6.
- 8 7. Purge all neat liquid polymer tubing or piping between the neat polymer storage tank and the
- 9 polymer blending units with mineral oil to remove residual water prior to introducing neat
- 10 polymer. Following purging, drain as much of the mineral oil out of the system as possible.
- 11 Dispose of purged fluids and waste mineral oil in accordance with local environmental
- 12 regulations.
- 13 B. Disinfection of Potable Water Systems:
- 14 1. After favorable performance of pressure test and prior to Final Acceptance, thoroughly flush
- 15 entire potable water piping system including supply, source and any appurtenant devices and
- 16 perform disinfection as prescribed.
- 17 2. Perform work, including preventative measures during construction, in full compliance with
- 18 AWWA C651.
- 19 3. Perform disinfection using sodium hypochlorite complying with AWWA B300.
- 20 4. Flush each segment of system to provide flushing velocity of not less than 2.5 FT per
- 21 second.
- 22 5. Drain flushing water to sanitary sewer.
- 23 a. Do not drain flushing water to receiving stream.
- 24 6. Use continuous feed method of application.
- 25 a. Tag system during disinfection procedure to prevent use.
- 26 7. After required contact period, flush system to remove traces of heavily chlorinated water.
- 27 8. After final flushing and before placing water in service, obtain an independent laboratory
- 28 approved by the Owner to collect samples and test for bacteriological quality.
- 29 a. Repeat entire disinfection procedures until satisfactory results are obtained.
- 30 9. Secure and deliver to Owner, satisfactory bacteriological reports on samples taken from
- 31 system.
- 32 a. Ensure sampling and testing procedures are in full compliance to AWWA C651, local
- 33 water purveyor and applicable requirements of State of Nebraska.

### 34 **3.9 LOCATION OF BURIED OBSTACLES**

- 35 A. Furnish exact location and description of buried utilities encountered and thrust block placement.
- 36 B. Reference items to definitive reference point locations such as found property corners, entrances
- 37 to buildings, existing structure lines, fire hydrants and related fixed structures.
- 38 C. Include such information as location, elevation, coverage, supports and additional pertinent
- 39 information.
- 40 D. Incorporate information on "As-Recorded" Drawings.

### 41 **3.10 PIPE INSULATION**

- 42 A. Insulate pipe and pipe fittings in accordance with Specification Section 15183.

### 43 **3.11 SCHEDULES**

44

- 1 A. SPECIFICATION SCHEDULE - SYSTEM 2  
2 1. General:  
3 a. Piping symbol and service:  
4 1) DR – Drain.  
5 2) FDR – Filter Drain.  
6 3) FEF – Filter Effluent.  
7 4) FIN – Filter Influent.  
8 5) FTW – Filter to Waste.  
9 6) BDR – Backwash Drain.  
10 b. Test requirements:  
11 1) Test medium: Water.  
12 2) Pressure: 25 psig.  
13 3) Duration: 6 HRS.  
14 c. Gaskets:  
15 1) Flanged, push-on, and mechanical joints (ductile iron): Rubber,  
16 AWWA/ANSI C111/A21.11.  
17 2. System components:  
18 a. Pipe size 3 IN through 30 IN:  
19 1) Exposed service:  
20 a) Material:  
21 (1) Flanged: Ductile iron, Class 53.  
22 b) Reference: AWWA/ANSI C115/A21.15.  
23 c) Lining: Cement.  
24 d) Coating: Paint.  
25 e) Fittings: Either AWWA/ANSI C110/A21.10 ductile or gray iron.  
26 f) Joints: AWWA/ANSI C115/A21.15 flanged joints with flanges at valves and  
27 structure penetrations.  
28

- 1 B. SPECIFICATION SCHEDULE – SYSTEM 4  
2  
3 1. General:  
4 a. Piping symbol and service:  
5 1) PS – Priming System.  
6 b. Test requirements:  
7 1) Test medium: Water.  
8 2) Pressure: 125 psig.  
9 3) Duration: 6 HRS.  
10 2. System components:  
11 a. Pipe size through 2 IN:  
12 1) Exposed service:  
13 a) Material: Steel, Grade B, black, Schedule 40.  
14 b) Reference: ASTM A53.  
15 c) Lining: None.  
16 d) Coating: Paint.  
17 e) Fittings: Malleable iron meeting ASTM A197, ANSI B16.3 and steel meeting  
18 ANSI B16.3, ASTM A234.  
19 f) Joints: Threaded.  
20

1 C. SPECIFICATION SCHEDULE - SYSTEM 5

- 2 1. General:
- 3 a. Piping symbol and service:
- 4 1) ST – Steam Supply.
- 5 2) SC – Steam Condensate.
- 6 3) NG – Natural gas.
- 7 b. Test requirements:
- 8 a) Natural gas:
- 9 (1) Test medium: Cylinder Nitrogen.
- 10 (2) Pressure: 10 psig.
- 11 (3) Duration: 12 HRS.
- 12 b) Steam:
- 13 (1) Test medium: Compressed air.
- 14 (2) Pressure: 50 psig.
- 15 (3) Duration: 12 HRS.
- 16 2. System components:
- 17 a. Pipe size through 10 IN:
- 18 1) Exposed service:
- 19 a) Material: Steel, Grade B, black, Schedule 40.
- 20 b) Reference: ASTM A53.
- 21 c) Lining: None.
- 22 d) Coating: Paint.
- 23 e) Fittings: Malleable iron meeting ASTM A197, ASME B16.3, Class 150.
- 24 f) Joints: Threaded, ASME B16.9 steel butt- or socket-welded joints.
- 25 2) Buried service:
- 26 a) Materials: Steel, Grade B, black, Schedule 40.
- 27 b) Reference: ASTM A53.
- 28 c) Linings: None.
- 29 d) Coatings: Factory coating-mill wrapped with 3-M "Scotchkote," or Energy
- 30 Coating Company "Encoat" with fittings and uncoated portions fully wrapped
- 31 after testing with 3-M "Scotchkote" tape.
- 32 e) Fittings: Malleable iron meeting ASTM A197, ASME B16.3, Class 150.
- 33 f) Joints: Threaded, ASME B16.9 steel butt- or socket-welded joints.
- 34

35 Natural Gas Piping Installation:

- 36 1. Install piping in accordance with NFPA, local gas company regulations, codes and local
- 37 ordinances, complete with necessary appurtenances.
- 38 2. Install buried pipe at approximately 30 IN deep.
- 39 3. Gas cocks:
- 40 a. Install before gas utilization equipment connected to system, at each branch main and at
- 41 connection to meter.
- 42 b. Design to operate safely under pressures indicated.
- 43 c. Install ground joint unions at intervals to facilitate repairs.
- 44 d. Cocks shall be of type and lubricant recommended by manufacturer for this class of
- 45 service, and as approved by local gas company.
- 46 4. Pipe drainage:
- 47 a. Drain horizontal piping to risers.
- 48 b. Locate drains where required for system drainage.
- 49 c. Install tee fitting with bottom outlet plugged or provide with threaded, capped nipple at
- 50 bottom of risers or in accordance with applicable codes.
- 51 5. Make piping connections with shellacked joints or ground joint unions.
- 52 6. Provide vents from gas regulators, pressure reducing valves, and other vented devices to the
- 53 outdoors and terminate in accordance with applicable codes.
- 54 7. Connect piping to pressure reducing valve outside each building as shown on drawings and
- 55 schedule.
- 56 8. Provide flexible connections to vibration isolated equipment suitable for pressures, local and
- 57 national codes and intended application.
- 58 9. Remove cutting and threading burrs.
- 59 10. Plug each gas outlet (including valves) with threaded plugs or caps immediately after
- 60 installation and retain until the piping or equipment connections are completed.
- 61 11. Continuously ground gas piping electrically, bond tightly to the grounding connection.
- 62

1 D. SPECIFICATION SCHEDULE - SYSTEM 7

2 1. General:

- 3 a. Piping symbol and service:
- 4 1) AMS - Ammonia Solution.
  - 5 2) CLGV - Chlorine Gas (Vacuum).
  - 6 3) CLS - Chlorine Solution.
  - 7 4) FL - Fluoride.
  - 8 5) POC - Polymer (Cationic).
  - 9 6) SH – Sodium Hexametaphosphate.
- 10 b. Test requirements pressure lines:
- 11 1) Test medium: Water.
  - 12 2) Pressure: 125 psig.
  - 13 3) Duration: 6 HRS.
- 14 c. Test requirements vacuum lines:
- 15 1) Test medium: Air.
  - 16 2) Pressure: -27 IN HG.
  - 17 3) Duration: 6 HRS.
- 18 d. Gaskets and O-rings:
- 19 1) Viton for CLS, FL, POC, SH.
  - 20 2) EPDM for AMS.
  - 21 3) CI standard for CLGV.

22 2. System components:

- 23 a. Hard piping at chemical storage and feed equipment:
- 24 1) Exposed service within Fluoride Transfer Pump Enclosure and in Filter Chemical
  - 25 Addition building between tanks, metering pumps, chemical feeders, and
  - 26 downstream of pumps/feeders to locations identified on Drawings.
  - 27 a) Material: PVC, Type 1, Grade 1, Schedule 80.
  - 28 b) Reference: ASTM D1785.
  - 29 c) Lining: None.
  - 30 d) Coating: None.
  - 31 e) Fittings: Solvent welded socket type complying with ASTM D2467.
  - 32 f) Joints:
  - 33 (1) Pipe 2 IN or les:
  - 34 (a) Solvent welded with unions at valves and penetrations through
  - 35 structures. Solvent shall be compatible with liquid being conveyed.
  - 36 (b) Flanges where required for connections to equipment and
  - 37 instruments.
- 38 b. Carrier pipe size 2 IN and smaller - double containment (not prefabricated):
- 39 1) Exposed service:
  - 40 a) Carrier tubing:
  - 41 (1) Material: HDPE flexible tubing.
  - 42 (a) CenCore HDPE CTS or Equal.
  - 43 (2) Tensile strength:
  - 44 (a) At yield (2 IN/min.): 3300 psi.
  - 45 (b) At break (2 IN/min.): 4500 psi.
  - 46 (3) Elongation: At break (2 IN/min.): 800 percent.
  - 47 (4) Minimum wall thickness dimension ratio: SDR 9.
  - 48 (5) Minimum working pressure: 200 psi.
  - 49 (6) Joints: CTS compression fittings.
  - 50 b) Casing pipe:
  - 51 (1) Material: PVC, Type 1, Grade 1, Schedule 80.
  - 52 (2) Reference: ASTM D1785.
  - 53 (3) Linings: None.
  - 54 (4) Coating: None.
  - 55 (5) Fittings: None. Carrier tubing exposed at changes in direction.
  - 56 (6) Joints: Solvent welded.
- 57 2) Buried service:
- 58 a) Carrier tubing:
  - 59 (1) Material: HDPE flexible tubing.
  - 60 (a) CenCore HDPE CTS or Equal.

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- (2) Tensile strength:
  - (a) At yield (2 IN/min.): 3300 psi.
  - (b) At break (2 IN/min.): 4500 psi.
- (3) Elongation: At break (2 IN/min.): 800 percent.
- (4) Minimum wall thickness dimension ratio: SDR 9.
- (5) Minimum working pressure: 200 psi.
- (6) Joints: CTS compression fittings.
- b) Casing pipe:
  - (1) Material: PVC, Type 1, Grade 1, Schedule 40.
  - (2) Reference: ASTM D1785.
  - (3) Linings: None.
  - (4) Coating: None.
  - (5) Fittings: Solvent welded socket type complying with ASTM D2466.
  - (6) Joints: Solvent welded.
- c. Carrier pipe size – 4 IN (single containment):
  - 1) Buried service:
    - a) Material: Propriety polyethylene – Asahi America Chem Proline single wall piping system or Equal.
    - b) Cell classification: PE445584C.
    - c) Reference: PAS 1075.
    - d) Linings: None.
    - e) Coating: None.
    - f) Fittings: Socket fittings.
    - g) Joints: Socket fusing welding.
    - h) Valves: PVC or CPVC joined to piping system be either Chem Proline PE end connector or ANSI 150 LB flanged connection.

1 E. SPECIFICATION SCHEDULE - SYSTEM 10

- 2 1. General:
- 3 a. Piping symbol and service:
- 4 1) PWC - Potable Water Cold.
- 5 2) PWH - Potable Water Hot.
- 6 3) SOW - Soft Water.
- 7 4) SVW – Service Water.
- 8 b. Test requirements:
- 9 1) Test medium: Water.
- 10 2) Pressure: 125 psig.
- 11 3) Duration: 6 HRS.
- 12 c. Gaskets and O-rings:
- 13 1) O-rings: Neoprene or rubber.
- 14 2) Flanged, push-on and mechanical joints (ductile iron): Rubber,  
15 AWWA/ANSI C111/A21.11.
- 16 2. System components:
- 17 a. Pipe size to 3 IN:
- 18 1) Exposed service:
- 19 a) Material: Copper tubing, Type L.
- 20 b) Solder: Cadmium and lead-free solder compatible with tubing and fittings  
21 materials.
- 22 c) Reference: ASTM B88.
- 23 d) Lining: None.
- 24 e) Coating: None.
- 25 f) Fittings: Wrought copper or bronze fittings meeting ASME B16.22.
- 26 g) Joints: Soldered or brazed with unions at valves and equipment.
- 27 b. Pipe size 3 IN through 24 IN:
- 28 1) Exposed service:
- 29 a) Materials:
- 30 (1) Flanged: Ductile iron, Class 53.
- 31 b) Reference: AWWA/ANSI C115/A21.15.
- 32 c) Lining: Cement.
- 33 d) Coating: Paint.
- 34 e) Fittings: Either AWWA/ANSI C110/A21.10 ductile or gray iron.
- 35 f) Joints:
- 36 (1) Flanged joints.
- 37 (2) Provide screwed-on flanges at valves, equipment, and structure  
38 penetration.
- 39 2) Buried service:
- 40 a) Materials: Ductile iron, Class 52.
- 41 b) Reference: AWWA/ANSI C151/A21.51.
- 42 c) Lining: Cement.
- 43 d) Coating: Bituminous with double-wrapped layers of high density cross  
44 laminated polyethylene encasement.
- 45 e) Fittings:
- 46 (1) Either AWWA/ANSI C110/A21.10 ductile or gray iron.
- 47 (2) Optional: AWWA/ANSI C153/A21.53 ductile iron compact fittings for sizes  
48 3 to 6 IN.
- 49 f) Joints:
- 50 (1) Manufactured restrained joint system for entire length of buried PWC pipe  
51 installed beneath Filter Chemical Addition and in yard to connection point  
52 with existing water line.
- 53 (a) American (Flex-Ring or Lok-Ring).
- 54 (b) US Pipe (TR-Flex).
- 55 (2) Fabricated steel restraint coupling to connect new PWC pipe to existing  
56 water line.
- 57 (a) Smith Blair 471 Pipe Lock or equal.
- 58 3. Install drain tees with capped nipples of IPS brass 3 IN long at low points.
- 59 a. If low point occurs in concealed piping, provide approved flush access panel.
- 60 b. These drains are not shown on Drawings.
- 61 4. Slope water lines down to drain points not less than 1 IN in 60 FT.



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5. Install all threaded piping with clean-cut tapered threads and with ends thoroughly reamed after cutting to remove burrs.
    - a. Pipe joint cement permitted only on external threads.
  6. For screwed nipples for connections to flush valves, lavatory supplies, and other equipment with threaded connections use iron, copper, or brass pipe.
  7. Install ball, butterfly and plug valves where indicated or required to adequately service all parts of system and equipment.
    - a. Install valves on each branch serving restroom.
    - b. Install valves on inlet and outlet connections of heat exchangers and on other equipment connected to water lines.
  8. Install unions between valves and connections to each piece of equipment, and install sufficient number of unions throughout piping system to facilitate installation and servicing.
    - a. On copper pipe lines, install wrought, solder-joint, copper to copper unions for lines 2 IN and smaller and, for lines 2-1/2 IN and over install brass flange unions.
  9. Construct and equip plumbing fixtures and equipment with anti-siphon devices as to entirely eliminate any danger of siphoning waste material into potable water supply system.
  10. Where exposed pipes 6 IN in size and smaller pass through floors, finished walls, or finished ceilings, fit with nickel or chrome-plated plates large enough to completely close hole around pipes.
    - a. Secure plates to pipe by set screw in approved manner.
  11. Size supply branches to individual fixtures as scheduled or indicated on Drawings.
  12. Install piping so as to be free to expand with proper loops, anchors and joints without injury to system or structure.
  13. Provide branches to wall hydrants or hose bibbs in exterior locations with interior shutoff and drain valves.
  14. Provide approved type vacuum breaker and backflow preventer installations indicated or as required by Code.
  15. Install concealed in finished structures such as administration and office facilities and at locations shown on Drawings.

1 F. SPECIFICATION SCHEDULE - SYSTEM 11

- 2 1. General:
- 3 a. Piping symbol and service:
- 4 1) A - Compressed Air.
- 5 2) FAB – Filter Air Backwash.
- 6 b. Test requirements:
- 7 1) Test medium: See the FIELD QUALITY CONTROL Article in PART 3 of this
- 8 Specification Section.
- 9 2) Pressure: 150 psig.
- 10 3) Duration: 6 HRS.
- 11 c. Gaskets and O-rings:
- 12 1) O-ring and flanged joints: Rubber or neoprene, 250 DegF.
- 13 2) Grooved coupling joints (steel): AWWA C606, rubber, 250 DegF.
- 14 2. System components:
- 15 a. Pipe size up to 3 IN:
- 16 1) Exposed service:
- 17 a) Material: HDPE – Asahi America Air-Pro Compressed Air Piping System or
- 18 equal.
- 19 (1) SDR 11 or SDR 7.
- 20 (2) Pipe and resin complying with FDA CFR, Title 21, Chapter 1: Section
- 21 177.1520.
- 22 b) Reference: ASTM D3350, ISO 15494, ASTM 2837.
- 23 c) Lining: None.
- 24 d) Coating: None.
- 25 e) Fittings: Socket fittings.
- 26 f) Joints: Socket fusing welding.
- 27 b. Pipe size 10 IN and 16 IN:
- 28 1) Exposed service:
- 29 a) Materials: PVC, Type 1, Grade 1, Schedule 40.
- 30 b) Reference: ASTM D1785.
- 31 c) Linings: None.
- 32 d) Coating: None.
- 33 e) Fittings: Solvent welded socket type.
- 34 f) Joints: Solvent welded.
- 35 3. Slope all piping mains approximately 1:100 toward points of drainage.
- 36 4. Provide driplegs at low points:
- 37 a. Provide ball type isolation valve.
- 38 b. Route dripleg to nearest wall or column and terminate 4 FT above finished floor.
- 39 5. Provide hand held socket welding tool for thermofusion welding of HDPE pipe.
- 40

1 G. SPECIFICATION SCHEDULE - SYSTEM 21

- 2 1. General:
- 3 a. Piping symbol and service:
- 4 1) SAN – Sanitary Sewer.
- 5 b. Test requirements:
- 6 1) Test medium: Air.
- 7 2) Pressure:
- 8 a) Gravity Sewer Pipe: See Low Pressure Air Testing in Paragraph 3.7 B.4. of
- 9 this Specification Section.
- 10 3) Duration:
- 11 a) Gravity Sewer Pipe: See Low Pressure Air Testing in Paragraph 3.7 B.4. of
- 12 this Specification Section.
- 13 c. Gaskets: Elastomeric.
- 14 2. System components:
- 15 a. Pipe size 2 IN and larger:
- 16 1) Exposed service.
- 17 a) Material: Cast iron soil pipe.
- 18 b) Reference: ASTM A74, CISPI 301.
- 19 c) Lining: None.
- 20 d) Coating: Paint.
- 21 e) Fittings: ASTM A74.
- 22 f) Joints: No-hub with elastomeric sealing sleeve and stainless steel clamp
- 23 assembly conforming to CISPI 301.
- 24 2) Buried service from 2 FT outside Filter Plant wall and beyond (Gravity Sewer Pipe):
- 25 a) Material: PVC-SDR35.
- 26 b) Reference: ASTM D3034.
- 27 c) Lining: None.
- 28 d) Coating: none.
- 29 e) Fittings: ASTM D3034.
- 30 f) Joints: Compression joints meeting ASTM D3212.
- 31 3) Buried service (Pressure Sewer Pipe):
- 32 a) Material: AWWA C900, PVC SDR 25.
- 33 b) Reference: ASTM D3139.
- 34 c) Lining: None.
- 35 d) Coating: none.
- 36 e) Fittings: AWWA C900.
- 37 f) Joints: Integral bell and spigot joints, conforming to ASTM D3139.
- 38 g) Join Pressure Sewer Pipe to Gravity Sewer Pipe using Fernco couplings.
- 39

- 1 H. SPECIFICATION SCHEDULE - SYSTEM 26  
2  
3 1. General:  
4 a. Piping symbol and service:  
5 1) FBS – Filter Backwash Supply.  
6 b. Test requirements:  
7 1) Test medium: Water.  
8 2) Pressure: 200 psig.  
9 3) Duration: 6 HRS.  
10 c. Gaskets:  
11 1) Flanged, push-on and mechanical joints (ductile iron): Rubber,  
12 AWWA/ANSI C111/A21.11.  
13 2) Grooved coupling joints (ductile and steel): Rubber, AWWA C606.  
14 3) Flanged joints (steel): Rubber, AWWA C207.  
15 2. System components:  
16 a. Pipe size 3 IN through 24 IN:  
17 1) Exposed service:  
18 a) Material:  
19 (1) Flanged: Ductile iron, Class 53.  
20 (2) Grooved type joint system: Use pipe thickness per AWWA C606.  
21 b) Reference: AWWA/ANSI C115/A21.15.  
22 c) Lining: Cement.  
23 d) Coating: Paint.  
24 e) Fittings: AWWA/ANSI C110/A21.10 ductile iron fittings or  
25 AWWA/ANSI C110/A21.10, 250 psi rated gray iron fittings.  
26 f) Joints:  
27 (1) Flanged joints.  
28 (2) With both systems, provide screwed-on flanges at equipment, valves and  
29 structure penetrations.

1 I. SPECIFICATION SCHEDULE - SYSTEM 27

- 2 1. General:
- 3 a. Piping symbol and service:
- 4 1) SMP - Sample.
- 5 b. Test requirements pressure lines:
- 6 1) Test medium: Water.
- 7 2) Pressure: 100 psig.
- 8 3) Duration: 6 HRS.
- 9 c. Gaskets and O-rings:
- 10 1) O-rings and flanged joints: Neoprene or rubber.
- 11 2. System components:
- 12 a. Pipe size 1-1/2 IN and smaller:
- 13 1) Exposed service from Distribution System, North end of Lower Level Filter Gallery
- 14 to Laboratory:
- 15 a) Material: Copper tubing, Type L.
- 16 b) Solder: Cadmium and lead-free solder compatible with tubing and fitting
- 17 materials.
- 18 c) Reference ASTM B88.
- 19 d) Lining: None.
- 20 e) Coating: None.
- 21 f) Fittings: Wrought copper or bronze fitting meeting ASME B16.22.
- 22 g) Joints: Soldered or brazed with unions at valves and equipment.
- 23 2) Exposed service all other locations:
- 24 a) Material: PVC, Type 1, Grade 1, Schedule 80.
- 25 b) Reference: ASTM D1785.
- 26 c) Lining: None.
- 27 d) Coating: None.
- 28 e) Fittings: Solvent welded socket type complying with ASTM D2467.
- 29 f) Joints: Solvent welded with unions at valves, penetrations through structures
- 30 and equipment connections for pipe 2 IN and less and flanges at those
- 31 locations for pipe above 2 IN.
- 32 3) Buried service:
- 33 a) Material: PVC, Type 1, Grade 1, Schedule 80.
- 34 b) Reference: ASTM D1785.
- 35 c) Lining: None.
- 36 d) Coating: None.
- 37 e) Fittings: Solvent welded socket type complying with ASTM D2466.
- 38 f) Joints: Solvent welded.
- 39 b. Pipe size through 26 IN:
- 40 1) Exposed service:
- 41 a) Material:
- 42 (1) Threaded:
- 43 (a) Threaded: Steel, Grade B, black, Schedule 40.
- 44 (b) Grooved type joint system: Use pipe thickness per AWWA C606.
- 45 b) Reference: ASTM A53.
- 46 c) Lining: None.
- 47 d) Coating: Paint.
- 48 e) Fittings: Malleable iron or steel meeting ASME B16.3 and ASTM A234.
- 49 f) Joints:
- 50 (1) Threaded or grooved type mechanical coupling (AWWA C606) joints.
- 51 (2) With both systems, provide rigid flanges at equipment, valves and
- 52 structure penetrations above 2 IN and unions at those locations 2 IN and
- 53 below.

54 **END OF SECTION**

55



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**SECTION 15090**  
**PIPE SUPPORT SYSTEMS**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes: Pipe support and anchor systems.
- 7 B. Related Specification Sections include but are not necessarily limited to:
- 8 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 9 2. Division 01 - General Requirements.
- 10 3. Section 05505 - Metal Fabrications.
- 11 4. Section 09960 - High Performance Industrial Coatings.
- 12 5. Contractor is responsible for design of pipe support systems not specifically shown on the
- 13 Drawings, including thrust supports and anti-sway bracing for pressurized systems.

14 **1.2 QUALITY ASSURANCE**

- 15 A. Referenced Standards:
- 16 1. American Society of Mechanical Engineers (ASME):
- 17 a. B31.1, Power Piping.
- 18 b. B31.3, Process Piping.
- 19 2. ASTM International (ASTM):
- 20 a. A36, Standard Specification for Carbon Structural Steel.
- 21 b. A276, Standard Specification for Stainless Steel Bars and Shapes.
- 22 3. American Welding Society (AWS):
- 23 a. D1.1, Structural Welding Code - Steel.
- 24 4. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
- 25 a. SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.
- 26 b. SP-69, Pipe Hangers and Supports - Selection and Application.

27 **1.3 SUBMITTALS**

- 28 A. Shop Drawings:
- 29 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 30 the submittal process.
- 31 2. Product technical data including:
- 32 a. Acknowledgement that products submitted meet requirements of standards referenced.
- 33 b. Manufacturer's installation instructions.
- 34 c. Itemized list of wall sleeves, anchors, support devices and all other items related to pipe
- 35 support system.
- 36 d. Scale Drawings showing guides, hangers, supports, anchors, structural members and
- 37 appurtenances to describe the pipe support system.

38 **PART 2 - PRODUCTS**

39 **2.1 ACCEPTABLE MANUFACTURERS**

- 40 A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable
- 41 Articles below are acceptable.
- 42 B. Submit request for substitution in accordance with Specification Section 01640.

43 **2.2 MANUFACTURED UNITS**

- 44 A. Materials:
- 45 1. Stainless steel, except where called out otherwise.

1           2. Where standard manufactured items not available in stainless steel, fabricate item out of  
2           stainless steel, similar to figure listed.

3           B. Hanger Rods:

- 4           1. Material:  
5           a. ASTM A36.  
6           b. ASTM A276.  
7           2. Continuously threaded.  
8           3. Load limit:  
9

NOMINAL ROD DIAMETER	MAXIMUM SAFE LOAD, (LBS)
3/8 IN DIA (min)	610
1/2 IN DIA	1,130
5/8 IN DIA	1,810
3/4 IN DIA	2,710
7/8 IN DIA	3,770
1 IN DIA	4,960

10

11           C. Hangers:

- 12           1. Hanger type schedule:  
13

APPLICATION	PIPE SIZE	HANGER TYPE
All except noted	4 IN and less	ANVIL Figure 260SS
All except noted	Over 4 IN	ANVIL Figure 260SS
Steam, condensate and hot water	All	ANVIL Figure 181, Figure 82

14

15           D. Beam Clamps for Hanger Rods:

- 16           1. Heavy duty.  
17           2. ANVIL Figure 134.

18           E. Trapeze Hangers for Suspended Piping:

- 19           1. Angles, channels, or other structural shapes.  
20           2. Curved roller surfaces at support point corresponding with type of hanger required.

21           F. Vertical Pipe Supports:

- 22           1. At base of riser.  
23           2. Lateral movement:  
24           a. Clamps or brackets:  
25           1) ANVIL Figure 191.

26           G. Expanding Pipe Supports:

- 27           1. Spring hanger type.  
28           2. MSS SP-58.

29           H. Pipe Support Saddle:

- 30           1. For pipe located 3 FT or less from floor elevation, except as otherwise indicated on  
31           Drawings.  
32           2. ANVIL Figure 264.

33           I. Pipe Support Risers:

- 34           1. As recommended by saddle manufacturer.

35           J. Pipe Support Base Plate:

- 36           1. 4 IN larger than support.  
37           2. Collar 3/16 IN thickness, circular in shape, and sleeve type connection to pipe.  
38           3. Collar fitted over outside of support pipe and extended 2 IN from floor plate.  
39           4. Collar welded to floor plate.  
40           5. Edges ground smooth.

41           K. Pipe Covering Protection Saddle:

- 42           1. For insulated pipe at point of support.  
43           2. ANVIL Figure 167, Type B.



- 1 L. Wall Brackets:
- 2 1. For pipe located near walls and 8 FT or more above floor elevation or as otherwise indicated
- 3 on the Drawings.
- 4 2. ANVIL Figure 199.
- 5 M. Pipe Anchors:
- 6 1. For locations shown on the Drawings.
- 7 2. 1/4 IN steel plate construction.
- 8 3. Designed to prevent movement of pipe at point of attachment.
- 9 N. Pipe Guides:
- 10 1. For locations on both sides on each expansion joint or loop.
- 11 2. To ensure proper alignment of expanding or contracting pipe.
- 12 3. ANVIL Figure 256.
- 13 O. Concrete Anchors:
- 14 1. See Section 05505.
- 15 2. Adhesive anchors shall not be used in overhead applications.

### 16 2.3 DESIGN REQUIREMENTS

- 17 A. Supports capable of supporting the pipe for all service and testing conditions.
- 18 1. Provide 5 to 1 safety factor.
- 19 B. Allow free expansion and contraction of the piping to prevent excessive stress resulting from
- 20 service and testing conditions or from weight transferred from the piping or attached equipment.
- 21 C. Design supports and hangers to allow for proper pitch of pipes.
- 22 D. For chemical and waste piping, design, materials of construction and installation of pipe hangers,
- 23 supports, guides, restraints, and anchors:
- 24 1. ASME B31.3.
- 25 2. MSS SP-58 and MSS SP-69.
- 26 3. Except where modified by this Specification.
- 27 E. For steam and hot and cold water piping, design, materials of construction and installation of pipe
- 28 hangers, supports, guides, restraints, and anchors:
- 29 1. ASME B31.1.
- 30 2. MSS SP-58 and MSS SP-69.
- 31 F. Check all physical clearances between piping, support system and structure.
- 32 1. Provide for vertical adjustment after erection.
- 33 G. Support vertical pipe runs in pipe chases at base of riser.
- 34 1. Support pipes for lateral movement with clamps or brackets.
- 35 H. Place hangers on outside of pipe insulation.
- 36 1. Use a pipe covering protection saddle for insulated pipe at support point.
- 37 2. Insulated piping 1-1/2 IN and less: Provide a 9 IN length of 9 LB density fiberglass insulation
- 38 at saddle.
- 39 3. Insulated piping over 1-1/2 IN: Provide a 12 IN length of 9 LB density fiberglass insulation on
- 40 saddle.
- 41 I. For plastic pipe, provide a larger diameter plastic pipe of the same material as the process pipe
- 42 as a saddle to ensure a minimum contact width of 4 IN.
- 43 J. Pipe Support Spacing:
- 44 1. General:
- 45 a. Factor loads by specific weight of liquid conveyed if specific weight is greater than water.
- 46 b. Locate pipe supports at maximum spacing scheduled unless indicated otherwise on the
- 47 Drawings.
- 48 c. Provide at least one (1) support for each length of pipe at each change of direction and
- 49 at each valve.

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2. Steel, stainless steel, cast-iron pipe support schedule:

PIPE SIZES - IN	MAXIMUM SPAN - FT
1-1/2 and less	5
2 thru 4	10
5 thru 8	15
10 and greater	20

3. Copper pipe support schedule:

PIPE SIZES - IN	MAXIMUM SPAN - FT
2-1/2 and less	5
3 thru 6	10
8 and greater	15

4. PVC and HDPE pipe support schedule:

PIPE SIZES - IN	MAXIMUM SPAN - FT
1-1/4 and less	3
1-1/2 thru 3	4
4 and greater	5

\* Maximum fluid temperature of 120 DegF.

- 5. Support each length and every fitting:
  - a. Bell and spigot piping:
    - 1) At least one (1) hanger.
    - 2) Applied at bell.
  - b. Mechanical coupling joints:
    - 1) Place hanger within 2 FT of each side of fittings to keep pipes in alignment.
- 6. Space supports for soil and waste pipe and other piping systems not included above every 5 FT.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Provide piping systems exhibiting pulsation, vibration, swaying, or impact with suitable constraints to correct the condition.
  - 1. Included in this requirement are movements from:
    - a. Trap discharge.
    - b. Water hammer.
    - c. Similar internal forces.
- B. Weld Supports:
  - 1. AWS D1.1.
  - 2. Weld anchors to pipe in accordance with ASME B31.3.
- C. Locate piping and pipe supports as to not interfere with open accesses, walkways, platforms, and with maintenance or disassembly of equipment.
- D. Inspect hangers for:
  - 1. Design offset.
  - 2. Adequacy of clearance for piping and supports in the hot and cold positions.
  - 3. Guides to permit movement without binding.
  - 4. Adequacy of anchors.
- E. Inspect hangers after erection of piping systems and prior to pipe testing and flushing.
- F. Welding:
  - 1. Welding rods: ASTM and AWS standards.

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2. Integral attachments:
    - a. Include welded-on ears, shoes, plates and angle clips.
    - b. Ensure material for integral attachments is of good weldable quality.
  3. Preheating, welding and post heat treating: ASME B31.3, Chapter V.
- G. Field Painting: Comply with Specification Section 09960.

6 **END OF SECTION**

7



1 2014/09/10

2

## SECTION 15100

3

### VALVES: BASIC REQUIREMENTS

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

A. Section Includes: Valving, actuators, and valving appurtenances.

7

B. Related Specification Sections include but are not necessarily limited to:

8

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

9

2. Division 01 - General Requirements.

10

3. Section 09960 - High Performance Industrial Coatings (HPIC).

11

4. Section 11005 - Equipment: Basic Requirements.

12

5. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.

13

6. Section 15101 - Gate Valves.

14

7. Section 15102 - Plug Valves.

15

8. Section 15104 - Ball Valves.

16

9. Section 15114 - Miscellaneous Valves.

17

##### 1.2 QUALITY ASSURANCE

18

A. Referenced Standards:

19

1. American Society of Mechanical Engineers (ASME):

20

a. B1.20.1, Pipe Threads, General Purpose.

21

b. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

22

c. B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.

23

2. American Water Works Association (AWWA):

24

a. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.

25

b. C500, Standard for Metal-Seated Gate Valves for Water Supply Service.

26

c. C550, Standard for Protective Coatings for Valves and Hydrants.

27

3. National Electrical Manufacturers Association (NEMA):

28

a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

29

b. MG 1, Motors and Generators.

30

31

##### 1.3 DEFINITIONS

32

A. The following are definitions of abbreviations used in this Specification Section or one (1) of the individual valve sections:

33

1. CWP: Cold water working pressure.

34

2. SWP: Steam working pressure.

35

3. WOG: Water, oil, gas working pressure.

36

4. WWP: Water working pressure.

37

38

##### 1.4 SUBMITTALS

39

A. Shop Drawings:

40

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

41

2. Product technical data including:

42

a. Acknowledgement that products submitted meet requirements of standards referenced.

43

b. Manufacturer's installation instructions.

44

c. Valve pressure and temperature rating.

45

d. Valve material of construction.

46

e. Special linings.

47

f. Valve dimensions and weight.

48

g. Valve flow coefficient.

49

h. Wiring and control diagrams for electric or cylinder actuators.

50

3. Test reports.

51

- 1 B. Operation and Maintenance Manuals:  
2 1. See Specification Section 01342 for requirements for:  
3 a. The mechanics and administration of the submittal process.  
4 b. The content of Operation and Maintenance Manuals.  
5 C. Informational Submittals:  
6 1. Verification from valve actuator manufacturer that actuators have been installed properly,  
7 that all limit switches and position potentiometers have been properly adjusted, and that the  
8 valve actuator responds correctly to the valve position command.

9 **PART 2 - PRODUCTS**

10 **2.1 ACCEPTABLE MANUFACTURERS**

- 11 A. Subject to compliance with the Contract Documents, refer to individual valve Specification  
12 Sections for acceptable manufacturers.

13 **2.2 MATERIALS**

- 14 A. Refer to individual valve Specification Sections.

15 **2.3 VALVE ACTUATORS**

- 16 A. Valve Actuators - General:  
17 1. Provide actuators as shown on Drawings or specified.  
18 2. Counter clockwise opening as viewed from the top.  
19 3. Direction of opening and the word OPEN to be cast in handwheel or valve bonnet.  
20 4. Size actuator to produce required torque with a maximum pull of 80 LBS at the maximum  
21 pressure rating of the valve provided and withstand without damage a pull of 200 LBS on  
22 handwheel or chainwheel or 300 FT/LBS torque on the operating nut.  
23 5. Unless otherwise specified, actuators for valves to be buried, submerged or installed in  
24 vaults or manholes shall be sealed to withstand at least 20 FT of submergence.  
25 6. Extension stem:  
26 a. Install where shown or specified.  
27 b. Solid steel with actuator key and nut, diameter not less than stem of valve actuator shaft.  
28 c. Pin all stem connections.  
29 d. Center in valve box or grating opening band with guide bushing.  
30 B. Exposed Valve Manual Actuators:  
31 1. Provide for all exposed valves not having electric or cylinder actuators.  
32 2. Provide handwheels for gate valves.  
33 a. Size handwheels for valves in accordance with AWWA C500.  
34 3. Provide lever actuators for plug valves and ball valves 3 IN DIA and smaller.  
35 a. Provide at least two (2) levers for each type and size of valve furnished.  
36 4. Gear actuators required for plug valves and ball valves 4 IN DIA and larger.  
37 5. Gear actuators to be totally enclosed, permanently lubricated and with sealed bearings.  
38 6. Provide chain actuators for valves 6 FT or higher from finish floor to valve centerline.  
39 a. Cadmium-plated chain looped to within 3 FT of finish floor.  
40 b. Equip chain wheels with chain guides to permit rapid operation with reasonable side pull  
41 without "gagging" the wheel.  
42 7. For valves located in exterior structures:  
43 a. Provide 2 IN standard actuator nuts.  
44 b. Extension stem:  
45 1) Extend to within 6 IN of finish grade.  
46 C. Electric Actuators (480 V, 3 PH):  
47 1. Provide electric valve actuators with integral control devices and a remote pushbutton  
48 station.  
49 2. Furnish electric actuator integral with valve consisting of:  
50 a. Motor.  
51 b. Gearing.  
52 c. Handwheel.  
53 d. Limit and torque switches.

- 1 e. Lubricants.
- 2 f. Heating elements.
- 3 g. Wiring.
- 4 h. Terminals for motor power and controls.
- 5 i. Drive nut.
- 6 3. Housing/enclosure:
- 7 a. Provide cast iron gear housing and cast iron load bearing enclosure.
- 8 b. Non load bearing enclosure and housing: Aluminum or cast iron.
- 9 c. Rated for area classification shown on Drawings.
- 10 d. Provide O-ring seals for covers and entries.
- 11 e. Terminal and limit switch compartment covers are to be fastened to gear housing by
- 12 stainless steel fasteners with capture device to prevent loss.
- 13 4. Motors:
- 14 a. Provide motors that are totally enclosed, high torque design made expressly for valve
- 15 actuator service and capable of operating the valve under full differential pressure for
- 16 complete open-close and reverse cycle of travel at least twice in immediate succession
- 17 without overheating.
- 18 b. Design motors in accordance with NEMA MG 1 standards, with Class B insulation, and
- 19 to operate successfully at any voltage within 10 percent above or below rated voltage.
- 20 c. Provide positive method to ensure motor bearings are permanently lubricated.
- 21 d. Provide three (3) thermal switches imbedded in windings:
- 22 1) 120 degrees apart.
- 23 2) Provide motor shutdown at high temperature.
- 24 e. Motor housing:
- 25 1) Aluminum or cast iron.
- 26 2) Totally enclosed nonventilated with cooling fins.
- 27 f. Provide motor capable of operating in any position.
- 28 g. Provide motor sealed from gearcase to allow any mounting position.
- 29 h. Provide motors suitable for 480 V, 3 PH, 60 Hz.
- 30 5. Gearing:
- 31 a. Provide power gearing consisting of heat treated steel helical gears, carburized and
- 32 hardened alloy steel worm, and alloy bronze worm gear, all grease or oil bath lubricated,
- 33 designed for 100 percent overload, and effectively sealed against entrance of foreign
- 34 matter.
- 35 b. Provide gearing mechanism constructed to permit field changes of reduction gear ratio.
- 36 c. Design actuators so that motor comes up to speed before stem load is encountered in
- 37 either opening or closing operation.
- 38 d. Limit switch gearings and feedback device reduction gearing:
- 39 1) Steel or bronze.
- 40 e. Support rotating shafts with anti-friction bearings.
- 41 f. Provide separate drive nut/thrust bearing assembly:
- 42 1) Mounted to base of actuator.
- 43 2) High tensile bronze.
- 44 3) Quarter turn actuator: Provide 90 degree mounting intervals.
- 45 4) Provide grease fitting on drive assembly.
- 46 6. Handwheel:
- 47 a. Permanently attached for manual operation.
- 48 b. Positive declutch mechanism to engage and disengage handwheel.
- 49 c. Handwheel shall not rotate during motor operation.
- 50 d. Inoperable motor shall not prevent manual operation.
- 51 7. Limit torque and thrust loads in both closing and opening directions by torque limit switches.
- 52 a. Provide torque switches with micrometer adjustment and reference setting indicator.
- 53 1) Assure adjustment variation of approximately 40 percent in torque setting.
- 54 b. Provide switches having rating of not less than 6 A at 120 Vac and 2.2 A at 115 Vdc.
- 55 c. Limit and torque switches shall have totally sealed contacts.
- 56 8. Furnish electric actuator with two (2) geared limit switch assemblies with each switch
- 57 assembly having four (4) separate limit switches:
- 58 a. Assure each limit switch assembly is geared to driving mechanism and is independently
- 59 adjustable to trip at any point at and between the fully open and fully closed valve
- 60 position.
- 61 b. Provide minimum of two (2) normally open contacts and two (2) normally closed
- 62 contacts at each end of valve travel.

- 1 c. Provide switches with inductive contact rating of not less than 6 A at 120 Vac, 3 A at 240  
2 Vac, 1.5 A at 480 Vac, 2.2 A at 115 Vdc and 1.1 A at 230 Vdc.  
3 d. Limit switches shall be fully adjustable when power is applied to actuator.  
4 9. Provide space heating elements sized to prevent condensation in both motor and geared  
5 limit switch compartment(s).  
6 a. Furnish heating elements rated at 120 Vac with heaters continuously energized.  
7 10. Open-close actuator controls:  
8 a. Provide control assembly with necessary holding relays, reversing starter, control  
9 transformers of sufficient capacity to provide control power, space heating element  
10 power and valve position transmitter.  
11 b. Provide control assembly in an enclosure rated for the defined area classification.  
12 c. Controls for open/close actuator:  
13 1) Provide remote pushbutton station with enclosure rated for area classification  
14 shown on Drawings with:  
15 a) Open pushbutton.  
16 b) Close pushbutton.  
17 c) Stop pushbutton.  
18 d) Remote/local switch.  
19 e) Full open light.  
20 f) Full close light.  
21 g) Open and close relays as required.  
22 2) Provide control enclosure to accept:  
23 a) Remote open/close switches.  
24 3) Provide contacts in control enclosure:  
25 a) Remote/local contact.  
26 b) Full open contact.  
27 c) Full close contact.  
28 4) Wire all components to an internal terminal strip and include mounted wiring  
29 diagram inside enclosure.  
30 11. Additional requirements for modulating valve actuators:  
31 a. Proportional position servo-amplifier mounted integral with the actuator control  
32 compartment.  
33 b. Positioning of valve shall be proportional to a 4-20 mA signal input to the position servo-  
34 amplifier when remote control has been selected.  
35 c. Servo-amplifier adjustments shall include zero, span, gain, and dead-band.  
36 d. Provide 4-20 mA signal position control as shown on the Drawings that interfaces with  
37 the position control/position feedback instrumentation wiring to and from PLC.
- 38 D. Electric Actuators (120 V, 1 PH):  
39 1. General:  
40 a. Self contained including motor, gearing, torque switch, limit switches and cast housing.  
41 b. Electrical enclosure: NEMA 4 or NEMA 7 to comply with area rating classification shown  
42 on Drawings.  
43 c. Factory assembled requiring only field connection of power and control wires.  
44 d. Comply with Specification Section 11005.  
45 2. Motors:  
46 a. Produce 1.5 times the required torque.  
47 b. Sized for two (2) complete open-close cycles without overheating.  
48 c. One (1) fully closed to fully open cycle to occur within 60 SEC.  
49 d. Class F insulation.  
50 e. Operate at plus or minus 10 percent voltage.  
51 f. 120 Volt, single phase, 60 Hz.  
52 g. Provide thermal cutout switch and internal heater for actuator enclosure.  
53 h. Control wiring as shown on Drawing control diagrams.

54 **2.4 FABRICATION**

- 55 A. End Connections:  
56 1. Provide the type of end connections for valves as required in the Piping Schedules presented  
57 in Specification Section 15060 or as shown on the Drawings.  
58 2. Comply with the following standards:  
59 a. Threaded: ASME B1.20.1.  
60 b. Flanged: ASME B16.1, Class 125 unless otherwise noted or AWWA C207.



- 1                   c. Soldered: ASME B16.18.
- 2           B. Refer to individual valve Specification Sections for specifications of each type of valve used on
- 3           Project.
- 4           C. Nuts, Bolts, and Washers:
- 5           1. Wetted or internal to be bronze or stainless steel.
- 6           a. Exposed to be zinc or cadmium plated.
- 7           D. On Insulated Piping: Provide valves with extended stems to permit proper insulation application
- 8           without interference from handle.
- 9           E. Epoxy Interior Coating: Provide epoxy interior coating for all ferrous surfaces in accordance with
- 10           AWWA C550.

11           **PART 3 - EXECUTION**

12           **3.1 INSTALLATION**

- 13           A. Install products in accordance with manufacturer's instructions.
- 14           B. Painting Requirements: Comply with Specification Section 09960 for painting and protective
- 15           coatings.
- 16           C. Support exposed valves and piping adjacent to valves independently to eliminate pipe loads
- 17           being transferred to valve and valve loads being transferred to the piping.
- 18           D. Install electric actuators above or horizontally adjacent to valve and gear box to optimize access
- 19           to controls and external handwheel.
- 20           E. For threaded valves, provide union on one (1) side within 2 FT of valve to allow valve removal.
- 21           F. Install valves accessible for operation, inspection, and maintenance.

22           **3.2 ADJUSTMENT**

- 23           A. Adjust valves, actuators and appurtenant equipment to comply with Specification Section 01650.
- 24           1. Operate valve, open and close at system pressures.
- 25           B. For all 120 Vac and 480 Vac electric actuators, employ and pay for services of valve actuator
- 26           manufacturer's field service representative to:
- 27           1. Inspect valve actuators covered by this Specification Section.
- 28           2. Supervise adjustments and installation checks:
- 29           a. Open and close valves electrically under local manual and demonstrate that all limit
- 30           switches are properly adjusted and that switch contacts are functioning properly by
- 31           verifying the inputs are received at the remote input/output (RIO) panels or local control
- 32           panel as appropriate.
- 33           b. Position modulating valves electrically under local manual control and demonstrate that
- 34           the valve position feedback potentiometer is properly adjusted and that the feedback
- 35           signal is received at the RIO panels or local control panel as appropriate.
- 36           c. Simulate a valve position command signal at the RIO panel or local control panel as
- 37           appropriate and demonstrate that the valve is controlled to the desired position without
- 38           excessive hunting.
- 39           3. Provide Owner with a written statement that the valve actuator manufacturer has verified that
- 40           the actuators have been installed properly, that all limit switches and position potentiometers
- 41           have been properly adjusted and that the valve actuator responds correctly to the valve
- 42           position command.

1 **3.3 VALVE SCHEDULES**

2 A. Refer to Drawings for manual valves 4 IN and smaller. Valve schedule includes motorized valves and manual valves larger than 4 IN.  
3

PLUG VALVES

Location	Valve Description	Valve Tag	Size, IN	Valve Type	Valve Actuator Type	Type of Operation	Manual Override
Filter Plant Influent Flume	Drain Valve	FPIFCV-01	12	Plug	Motorized	Modulating	Handwheel

GATE VALVES

Location	Valve Description	Valve Tag	Size, IN	Valve Type	Valve Actuator Type	Type of Operation	Manual Override
Filter Plant Influent Flume	Drain Valve	FPIFV-02	12	Gate	Manual	----	----
Filter Plant Influent Flume	Drain Valve	FPIFV-03	12	Gate	Manual	----	----

BUTTERFLY VALVES

Location	Valve Description	Valve Tag	Size, IN	Valve Type	Valve Actuator Type	Type of Operation	Manual Override
Filter Plant Lower Level	PWC Isolation	FPLLV-04	6	Butterfly	Manual	----	----

AIR RELEASE / VACUUM RELIEF VALVES

Location	System	Quantity	Size, IN	Valve Type	Design Requirements
Type 1 Backwash Channel Rupture Disc Assembly	DR	3 EA	1	Air Release / Vacuum Relief	Refer to Section 15114

4

5

**END OF SECTION**

1 2014/08/07

2

## SECTION 15101

3

### GATE VALVES

#### 4 PART 1 - GENERAL

##### 5 1.1 SUMMARY

6

A. Section Includes:

7

1. Gate valves.

8

B. Related Specification Sections include but are not necessarily limited to:

9

1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

10

2. Division 1 - General Requirements.

11

3. Section 15100 - Valves: Basic Requirements.

12

##### 1.2 QUALITY ASSURANCE

13

A. Referenced Standards:

14

1. American Water Works Association (AWWA):

15

a. C504, Standard for Rubber-Seated Butterfly Valves.

16

b. C509, Standard for Resilient-Seated Gate Valves for Water Supply Service.

17

c. C550, Standard for Protective Epoxy Interior Coatings for Valves and Hydrants.

18

##### 1.3 DEFINITIONS

19

A. NRS: Non-rising Stem.

20

##### 1.4 SUBMITTALS

21

A. Shop Drawings:

22

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

23

2. See Specification Section 15100.

24

25

B. Operation and Maintenance Manuals:

26

1. See Specification Section 01340 for requirements for:

27

a. The mechanics and administration of the submittal process.

28

b. The content of Operation and Maintenance Manuals.

29

#### PART 2 - PRODUCTS

30

##### 2.1 ACCEPTABLE MANUFACTURERS

31

A. Subject to compliance with the Contract Documents, the manufacturers listed below are acceptable:

32

1. Clow.

33

2. Mueller.

34

3. American Flow Control.

35

4. M & H.

36

37

B. Submit request for substitution in accordance with Specification Section 01640.

38

##### 2.2 VALVES

39

A. Comply with AWWA C509.

40

B. Design requirements:

41

1. 200 psi working pressure.

42

2. Buried: NRS, O-ring stem seal, 2 IN operation nut.

43

3. Clockwise opening as viewed from top.

- 1 C. Fusion bonded epoxy coating interior and exterior, except stainless steel and bearing surfaces.
- 2 1. Comply with AWWA C550.
- 3 2. Wetted bronze parts in low zinc bronze.
- 4 3. Aluminum bronze components: Heat treated per AWWA C504.

5 **2.3 ACCESSORIES**

- 6 A. Refer to Specification Section 15100 for actuator requirements.

7 **2.4 FABRICATION**

- 8 A. General:
- 9 1. Provide valves with clear waterways the full diameter of the valve.

10 **PART 3 - EXECUTION**

11 **3.1 INSTALLATION**

- 12 A. See Specification Section 15100.
- 13 B. Gate valves are shown on Drawings to be installed inverted or with stems sloped more than
- 14 45 degrees from the upright shall be ordered and manufactured specifically for this orientation.

15 **END OF SECTION**

1 2014/08/15

2 **SECTION 15102**  
3 **PLUG VALVES**

4 **PART 1 - GENERAL**

- 5 A. Section Includes: Plug valves.
- 6 B. Related Specification Sections include but are not necessarily limited to:
- 7 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 8 2. Division 01 - General Requirements.
- 9 3. Section 15100 - Valves: Basic Requirements.

10 **1.2 QUALITY ASSURANCE**

- 11 A. Referenced Standards:
- 12 1. American Society of Mechanical Engineers (ASME):
- 13 a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125 and 250.
- 14 2. ASTM International (ASTM):
- 15 a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe
- 16 Fittings.
- 17 b. A536, Standard Specification for Ductile Iron Castings.
- 18 c. D2240, Standard Test Method for Rubber Property-Durometer Hardness.
- 19 3. American Water Works Association (AWWA):
- 20 a. C504, Standard for Rubber-Seated Butterfly Valves.

21 **1.3 SUBMITTALS**

- 22 A. Shop Drawings:
- 23 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 24 the submittal process.
- 25 2. See Specification Section 15100.
- 26 B. Operation and Maintenance Manuals:
- 27 1. See Specification Section 01342 for requirements for:
- 28 a. The mechanics and administration of the submittal process.
- 29 b. The content of Operation and Maintenance Manuals.
- 30 2. See Specification Section 15100.

31 **PART 2 - PRODUCTS**

32 **2.1 ACCEPTABLE MANUFACTURERS**

- 33 A. Subject to compliance with the Contract Documents, the manufacturers listed under the specific
- 34 valve types are acceptable.
- 35 B. Submit request for substitution in accordance with Specification Section 01640.

36 **2.2 NON-LUBRICATED ECCENTRIC PLUG VALVES**

- 37 A. Acceptable Manufacturers:
- 38 1. DeZurik.
- 39 2. Millikin.
- 40 3. ValMatic.
- 41 4. Victaulic.
- 42 B. Materials:
- 43 1. Body: Cast-iron ASTM A126, Class B.
- 44 2. Plug: One-piece construction ductile iron, ASTM A536 65-45-12 or cast iron, ASTM A126
- 45 Class B.

- 1 3. Plug facing: Grease and/or petroleum-resistant resilient Neoprene or Buna-N compound, 70
- 2 Type A durometer hardness per ASTM D2240.
- 3 4. Shaft bearing bushings: Permanently lubricated TFE or Delrin sleeve type stainless steel or
- 4 bronze.
- 5 5. Valve seats: Welded-in overlay of 90 percent nickel, minimum Brinell hardness of 200,
- 6 (minimum 1/8 IN thick).
- 7 6. Stem seal: Nitrile butadiene packing or Buna-N dual U-cups per AWWA C504, Section 3.7.

### 8 **2.3 ACCESSORIES**

- 9 A. Refer to Drawings and valve schedule for type of actuator.
- 10 1. Furnish actuator integral with valve.
- 11 B. Refer to Specification Section 15100 for actuator requirements.

### 12 **2.4 DESIGN REQUIREMENTS**

- 13 A. Non-Lubricated Eccentric Plug Valves:
- 14 1. Port area:
- 15 a. Valves 4 IN through 20 IN: Equal to or exceed 80 percent of full pipe area.
- 16 2. Valve body: Fitted with bolted bonnet.
- 17 3. End connections: See Specification Section 15100.
- 18 4. Stem seal: Adjustable and replaceable without disassembling valve or bonnet.
- 19 5. Designed for seating drip tight in any flow direction.
- 20 6. Rating:
- 21 a. 1/2 through 12 IN, 175 psi working pressure.
- 22 7. Actuator:
- 23 a. Actuator gearing in enclosure suitable for running in oil with seals on shaft to prevent
- 24 entry of dirt or water.
- 25 b. Positive identification on actuator indicating valve position.
- 26 c. Adjustable stop to set closing torque.

### 27 **2.5 FABRICATION**

- 28 A. See Specification Section 15100.

## 29 **PART 3 - EXECUTION**

### 30 **3.1 INSTALLATION**

- 31 A. See Specification Section 15100.

32 **END OF SECTION**

1 2014/09/05

2 **SECTION 15103**  
3 **BUTTERFLY VALVES**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:  
7 1. Butterfly valves.
- 8 B. Related Sections include but are not necessarily limited to:  
9 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.  
10 2. Division 01 - General Requirements.  
11 3. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.  
12 4. Section 15100 - Valves: Basic Requirements.

13 **1.2 QUALITY ASSURANCE**

- 14 A. Referenced Standards:  
15 1. American Society of Mechanical Engineers (ASME):  
16 a. B16.5, Pipe Flanges and Flanged Fittings - NPS 1/2 Through NPS 24.  
17 2. ASTM International (ASTM):  
18 a. A48, Standard Specification for Gray Iron Castings.  
19 b. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe  
20 Fittings.  
21 c. A276, Standard Specification for Stainless Steel Bars and Shapes.  
22 d. A436, Standard Specification for Austenitic Gray Iron Castings.  
23 e. A536, Standard Specification for Ductile Iron Castings.  
24 3. American Water Works Association (AWWA):  
25 a. C504, Standard for Rubber-Seated Butterfly Valves.

26 **1.3 SUBMITTALS**

- 27 A. Shop Drawings:  
28 1. See Specification Section 01340 for requirements for the mechanics and administration of  
29 the submittal process.  
30 2. See Specification Section 15100.
- 31 B. Operation and Maintenance Manuals:  
32 1. See Specification Section 01342 for requirements for:  
33 a. The mechanics and administration of the submittal process.  
34 b. The content of Operation and Maintenance Manuals.

35 **PART 2 - PRODUCTS**

36 **2.1 ACCEPTABLE MANUFACTURERS**

- 37 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:  
38 1. AWWA C504 butterfly valves:  
39 a. DeZurik.  
40 b. Clow.  
41 c. Mueller.  
42 d. Pratt.  
43 2. CLS application butterfly valves:  
44 a. Asahi.
- 45 B. Submit request for substitution in accordance with Specification Section 01640.

1 **2.2 BUTTERFLY VALVES (AWWA C504)**

- 2 A. Comply with AWWA C504.
- 3 B. Materials:
- 4 1. Valve bodies:
- 5 a. ASTM A126, Class B or ASTM A536 Grade 65-45-12 ductile iron.
- 6 b. Wafer valves may be constructed of ASTM A48, Class 40 cast iron.
- 7 2. Valve shafts:
- 8 a. Stainless steel, 18-8, Type 304 or 316.
- 9 3. Valve discs:
- 10 a. Potable and nonpotable water:
- 11 1) ASTM A48, Class 40 cast iron.
- 12 2) ASTM A536, Grade 65-45-12 ductile iron.
- 13 3) ASTM A436, Type 1 alloy cast iron.
- 14 4) Bronze in accordance with AWWA C504.
- 15 4. Valve seats:
- 16 a. Potable and nonpotable water below 150 DegF:
- 17 1) Natural rubber.
- 18 5. Mating surfaces:
- 19 a. Valves less than 30 IN: ASTM A276, 18-8, stainless steel or bronze.
- 20 C. Design Requirements:
- 21 1. Seat type:
- 22 a. Resilient.
- 23 b. Comply with AWWA C504.
- 24 2. Exposed valves 3 through 20 IN.
- 25 a. Body type: Wafer or short body flange (laying length may vary from AWWA C504).
- 26 b. Equip wafer type with fully tapped anchor lugs drilled per ASME B16.5.

27 **2.3 BUTTERFLY VALVES (CLS APPLICATION)**

- 28 A. Materials:
- 29 1. Valve bodies:
- 30 a. Epoxy powder coated ductile iron body.
- 31 2. Valve shaft or stem:
- 32 a. Stainless steel, Type 304.
- 33 3. Valve disc:
- 34 a. PTFE.
- 35 4. Valve seat:
- 36 a. Viton.
- 37 5. Valve extension stem:
- 38 a. Stainless steel, Type 304.
- 39 B. Design Requirements:
- 40 1. Exposed valves 3 IN through 4 IN.
- 41 a. Body type: Wafer.
- 42 b. Working pressure: Rated for 150 psi.
- 43 c. Only wetted parts are disc and seat.

44 **2.4 ACCESSORIES**

- 45 A. Furnish actuator integral with valve.
- 46 B. Refer to Section 15100 for actuator requirements.

47 **PART 3 - EXECUTION**

48 **3.1 INSTALLATION**

- 49 A. See Section 15100.

50 **END OF SECTION**



1 2014/09/05

2

## SECTION 15104

3

### BALL VALVES

#### 4 PART 1 - GENERAL

##### 5 1.1 SUMMARY

6 A. Section Includes:

7 1. Ball valves.

8 B. Related Specification Sections include but are not necessarily limited to:

9 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

10 2. Division 01 - General Requirements.

11 3. Section 15100 - Valves: Basic Requirements.

##### 12 1.2 QUALITY ASSURANCE

13 A. Referenced Standards:

14 1. ASTM International (ASTM):

15 a. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and  
16 Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

17 2. American Water Works Association (AWWA):

18 a. C507, Standard for Ball Valves, 6 IN through 48 IN.

19 3. Federal Specification (FS):

20 a. WW-V-35C, Valve, Ball.

##### 21 1.3 SUBMITTALS

22 A. Shop Drawings:

23 1. See Specification Section 01340 for requirements for the mechanics and administration of  
24 the submittal process.

25 2. See Specification Section 15100.

26 3. Test results for AWWA valves.

27 B. Operation and Maintenance Manuals:

28 1. See Specification Section 01342 for requirements for:

29 a. The mechanics and administration of the submittal process.

30 b. The content of Operation and Maintenance Manuals.

#### 31 PART 2 - PRODUCTS

##### 32 2.1 ACCEPTABLE MANUFACTURERS

33 A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable  
34 Articles below are acceptable.

35 B. Submit request for substitution in accordance with Specification Section 01640.

##### 36 2.2 METALLIC BALL VALVES 1/4 TO 3 IN DIA

37 A. Comply with FS WW-V-35C Type II, Class A.

38 B. Acceptable Manufacturers:

39 1. Apollo.

40 2. Jamesbury.

41 3. Watts.

42 4. Stockham.

43 5. Nibco.

44 6. Or approved equal.

- 1 C. Materials:
- 2 1. Body: Bronze.
- 3 2. Stem, stem gland nut: Brass.
- 4 3. Ball: Brass, chrome plated.
- 5 4. Seats, stuffing box ring, and thrust washer: Reinforced Teflon.
- 6 5. Handle: Vinyl coated or zinc- or cadmium-plated steel.
- 7 D. Design Requirements:
- 8 1. Rated for 400 psi and 250 DegF, WOG for threaded end applications and 285 psi WOG and
- 9 150 psi saturated steam service for flanged end applications.
- 10 2. Handles showing direction of opening.
- 11 3. Stuffing boxes capable of being repacked under pressure and adjustable for wear.
- 12 4. Stem with reinforced Teflon stuffing box ring and blowout-proof design.
- 13 5. Renewable reinforced Teflon seats.
- 14 6. Ball design which does not allow media contact with stem.
- 15 7. Balancing stop for all applications.
- 16 8. Bodies with mounting pad for applications requiring actuators.

17 **2.3 PLASTIC BALL VALVES: 1/2 IN TO 4 IN DIA (CHEMICAL SERVICE)**

- 18 A. Acceptable Manufacturers:
- 19 1. Chemtrol.
- 20 2. Spears.
- 21 3. ASAH/USA.
- 22 4. Or approved equal.
- 23 B. Materials:
- 24 1. Body, stem, ball, handle, end connectors:
- 25 a. PVC ASTM D1784-12454B.
- 26 2. Ball Seat: EPDM.
- 27 3. O-rings: EPDM.
- 28 C. Design Requirements:
- 29 1. Rated at 150 psi at 75 DegF.
- 30 2. Double or "true union" design.
- 31 3. Blocks both directions, upstream and downstream.
- 32 4. Union nut capable of compensating for seat wear.
- 33 5. Body with mounting pad for actuators where required.
- 34 6. Capable of being disconnected at downstream end under full line pressure.
- 35 7. Sodium hypochlorite service:
- 36 a. Provide "vented" ball valves for all service with greater than 5 percent concentrated
- 37 sodium hypochlorite.

38 **2.4 ACCESSORIES**

- 39 A. Refer to Drawings and valve schedule for type of actuators.
- 40 1. Furnish actuator integral with valve.
- 41 B. Refer to Specification Section 15100 for actuator requirements.

42 **2.5 SOURCE QUALITY CONTROL**

- 43 A. Shop test AWWA C507 ball valves in accordance with AWWA C507.
- 44 B. Furnish record of test.

45 **PART 3 - EXECUTION**

46 **3.1 INSTALLATION**

- 47 A. See Specification Section 15100.





1 2014/09/15

2

3

**SECTION 15109**  
**VALVES (STEAM AND CONDENSATE)**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6 A. Section Includes:

- 7 1. Steam and Condensate Gate Valves.  
8 2. Check valves.

9 B. Related Specification Sections include but are not necessarily limited to:

- 10 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.  
11 2. Division 01 - General Requirements.  
12 3. Section 15100 - Valves: Basic Requirements.

13 **1.2 QUALITY ASSURANCE**

14 A. Referenced Standards:

- 15 1. ASTM International (ASTM):  
16 a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe  
17 Fittings.  
18 2. American Water Works Association (AWWA):  
19 a. C500, Standard for Metal-Seated Gate Valves for Water Supply Service.  
20 b. C504, Standard for Rubber-Seated Butterfly Valves.  
21 c. C509, Standard for Resilient-Seated Gate Valves for Water Supply Service.  
22 d. C515, Standards for Reduced-Wall, Resilient-Seated Gate Valves for Water Supply  
23 Systems.  
24 e. C550, Standard for Protective Epoxy Interior Coatings for Valves and Hydrants.  
25 3. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):  
26 a. SP-9, Spot Facing for Bronze, Iron and Steel Flanges.  
27 b. SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.  
28 c. SP-80, Bronze Gate, Globe, Angle and Check Valves.

29 **1.3 DEFINITIONS**

30 A. OS&Y: Outside Screw and Yoke.

31 B. NRS: Non-rising Stem.

32 C. RS: Rising Stem.

33 **1.4 SUBMITTALS**

34 A. Shop Drawings:

- 35 1. See Specification Section 01340 for requirements for the mechanics and administration of  
36 the submittal process.  
37 2. See Specification Section 15100.

38 B. Operation and Maintenance Manuals:

- 39 1. See Specification Section 01342 for requirements for:  
40 a. The mechanics and administration of the submittal process.  
41 b. The content of Operation and Maintenance Manuals.

42 **PART 2 - PRODUCTS**

43 **2.1 ACCEPTABLE MANUFACTURERS**

44 A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable  
45 Articles below are acceptable.

46 B. Check valves:

- 47 1. Base:

- 1 a. Apco Valve & Primer.
- 2 b. Nibco.
- 3 c. Stockham Valves & Fittings.
- 4 d. Crane Valves.
- 5 e. Hammond Valve.
- 6 f. Kennedy Valve.
- 7 g. Milwaukee Valve.
- 8 h. Mueller Steam Specialty.
- 9 i. Powell.
- 10 j. Victaulic of America.
- 11 k. Viking.
- 12 l. Walworth.
- 13 C. Submit request for substitution in accordance with Specification Section 01640.
- 14 **2.2 VALVES: WATER, STEAM CONDENSATE, STEAM TO 125 PSI, AIR; 2-1/2 IN AND SMALLER**
- 15 A. Class 125 bronze gate valve.
- 16 B. Comply with MSS SP-80.
- 17 C. Materials:
- 18 1. Body, bonnet, wedge: Bronze.
- 19 2. Stem: Silicon bronze.
- 20 3. Packing: Aramid fibers with graphite (Kevlar®).
- 21 D. Design Requirements:
- 22 1. 125 psi steam, 200 psi nonshock WOG.
- 23 2. Screw in bonnet, non-rising stem, solid wedge.
- 24 E. Acceptable Manufacturers:
- 25 1. Nibco.
- 26 2. Stockham.
- 27 **2.3 VALVES: STEAM CONDENSATE, STEAM TO 125 PSI, AIR; 3 IN AND LARGER**
- 28 A. Class 125 iron body gate valve.
- 29 B. Comply with MSS SP-70.
- 30 C. Materials:
- 31 1. Body, bonnet, wedge: Cast iron, ASTM A126, Class B.
- 32 2. Stem: Brass, bronze, or copper silicon alloy.
- 33 D. Design Requirements:
- 34 1. 125 psi steam to 400 DegF, 200 psi WOG.
- 35 2. Bolted bonnet, OS&Y, solid wedge, bronze mounted.
- 36 E. Acceptable Manufacturers: Nibco.
- 37 **2.4 CHECK VALVE**
- 38 A. Y-pattern, horizontal swing, Class 125, bronze body, threaded cap, renewable Teflon (PTFE) disc
- 39 and seat, threaded. Example: Nibco T-413-Y.
- 40 **2.5 ACCESSORIES**
- 41 A. Refer to Drawings and valve schedule for type of actuators.
- 42 1. Furnish actuator integral with valve.
- 43 B. Refer to Specification Section 15100 for actuator requirements.
- 44 **2.6 FABRICATION**
- 45 A. General: Provide valves with clear waterways the full diameter of the valve.
- 46 B. Spot valves in accordance with MSS SP-9.

1 **PART 3 - EXECUTION**

2 **3.1 INSTALLATION**

- 3 A. See Specification Section 15100.
- 4 B. Where larger buried valves utilize smaller bypass valves, provide a second valve box installed  
5 over the bypass valve operating nut.
- 6 C. Do not install gate valves inverted or with the stems sloped more than 45 degrees from the  
7 upright unless the valve was ordered and manufactured specifically for this orientation.

8 **END OF SECTION**

9





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2

3

**SECTION 15114**  
**MISCELLANEOUS VALVES**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
- 7 1. Air release valves.
- 8 2. Rupture discs.
- 9 B. Related Specification Sections include but are not necessarily limited to:
- 10 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 11 2. Division 01 - General Requirements.
- 12 3. Section 11005 - Equipment: Basic Requirements.
- 13 4. Section 15100 - Valves: Basic Requirements.

14 **1.2 QUALITY ASSURANCE**

- 15 A. Referenced Standards:
- 16 1. American Water Works Association (AWWA):
- 17 a. C512, Standard for Air-Release, Air-Vacuum, and Combination Air Valves for
- 18 Waterworks Service.
- 19 b. C550, Standard for Protective Interior Coatings for Valves and Hydrants.

20 **1.3 SUBMITTALS**

- 21 A. Shop Drawings:
- 22 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 23 the submittal process.
- 24 2. See Specification Section 15100.
- 25 B. Operation and Maintenance Manuals:
- 26 1. See Specification Section 01342 for requirements for:
- 27 a. The mechanics and administration of the submittal process.
- 28 b. The content of Operation and Maintenance Manuals.

29 **PART 2 - PRODUCTS**

30 **2.1 ACCEPTABLE MANUFACTURERS**

- 31 A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable
- 32 Articles below are acceptable.
- 33 B. Submit request for substitution in accordance with Specification Section 01640.

34 **2.2 AIR RELEASE VALVES**

- 35 A. General: Conform to AWWA C512.
- 36 B. Combination Air Release and Vacuum Valve:
- 37 1. Acceptable manufacturers:
- 38 a. GA Industries, Figure 920.
- 39 b. APCO Series 200A.
- 40 2. Materials:
- 41 a. Body and cover: Cast iron.
- 42 b. Float, linkage and hardware: Stainless steel.
- 43 c. Seat: Buna-N.

- 1 3. Design requirements:
- 2 a. Size: 1 IN.
- 3 b. Working pressure: 10 psi.
- 4 c. Release 10 cfm at 10 psi differential at working pressure.
- 5 d. Air vacuum capacity: 10 scfm at 5 psi differential from atmospheric.
- 6 e. Provide isolation valve, type as shown.
- 7 f. Provide control for slow release of air through valve to prevent valve slamming shut from
- 8 excessive air or water velocity through the valve.

## 9 **2.3 RUPTURE DISCS**

- 10 A. Acceptable Manufacturers:
- 11 1. Forgy Process Instruments, Inc.
- 12 2. Or approved equal.
- 13 B. Materials:
- 14 1. HOV bolted flat seat.
- 15 2. Flange rating 150 ANSI.
- 16 3. Top ring/cover material: 316 stainless steel.
- 17 4. Seal material: Fluoropolymer.
- 18 5. Bottom ring/Vs material: 316 stainless steel.
- 19 6. Manufacturing range: Standard.
- 20 C. Design Requirements:
- 21 1. Size as shown on Drawings.
- 22 2. Burst pressure: 20 PSIG at 60 DegF.
- 23 3. Certification: Burst/material certification.
- 24 D. Spare Discs:
- 25 1. Provide one (1) spare disc for each size disc installed.

## 26 **2.4 ACCESSORIES**

- 27 A. Furnish any accessories required to provide a completely operable valve.

## 28 **2.5 FABRICATION**

- 29 A. Completely shop assemble unit including any interconnecting piping, speed control valves,
- 30 control isolation valves and electrical components.
- 31 B. Provide internal epoxy coating suitable for potable water for all iron body valves in accordance
- 32 with AWWA C550.

## 33 **2.6 SOURCE QUALITY CONTROL**

- 34 A. Shop hydrostatically test to unit test pressure.

## 35 **2.7 MAINTENANCE MATERIALS**

- 36 A. Provide one (1) set of any special tools or wrenches required for operation or maintenance for
- 37 each type valve.

## 38 **PART 3 - EXECUTION**

### 39 **3.1 INSTALLATION**

- 40 A. General: See Specification Section 11005 and Specification Section 15100.
- 41 B. Air Release:
- 42 1. Pipe exhaust to a suitable disposal point.
- 43 2. Where exhausted to a trapped floor drain, terminate exhaust line 6 IN minimum above floor.
- 44 C. Float-Operated Valves: Install baffle around float to minimize turbulence adjacent to float.





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## SECTION 15183

3

### PIPE, DUCT AND EQUIPMENT INSULATION

#### 4 PART 1 - GENERAL

##### 5 1.1 SUMMARY

6 A. Section Includes:

- 7 1. Insulation:  
8 a. Piping insulation.  
9 b. Duct insulation.

10 B. Related Specification Sections include but are not necessarily limited to:

- 11 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.  
12 2. Division 01 - General Requirements..

##### 13 1.2 QUALITY ASSURANCE

14 A. Referenced Standards:

- 15 1. ASTM International (ASTM):  
16 a. C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal  
17 Transmission Properties by Means of Guarded-Hot-Plate Apparatus.  
18 b. C411, Standard Test Method for Hot-Surface Performance of High-Temperature  
19 Thermal Insulation.  
20 c. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients  
21 by the Reverberation Room Method.  
22 d. C518, Standard Test Method for Steady-State Thermal Transmission Properties by  
23 Means of the Heat Flow Meter Apparatus.  
24 e. C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for  
25 Commercial and Industrial Applications.  
26 f. C665, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light  
27 Frame Construction and Manufactured Housing.  
28 g. C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and  
29 Sound Absorbing Material).  
30 h. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded  
31 Rubber.  
32 i. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.  
33 j. E96, Standard Test Methods for Water Vapor Transmission of Materials.  
34 k. F25, Standard Test Method for Sizing and Counting Airborne Particulate Contamination  
35 in Cleanrooms and Other Dust-Controlled Areas.  
36 2. National Fire Protection Association (NFPA):  
37 a. 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.  
38 3. Underwriters Laboratories, Inc. (UL):  
39 a. 723, Standard for Test for Surface Burning Characteristics of Building Materials.

##### 40 1.3 SUBMITTALS

41 A. Shop Drawings:

- 42 1. See Specification Section 01340 for requirements for the mechanics and administration of  
43 the submittal process.  
44 2. Product technical data including:  
45 a. Acknowledgement that products submitted meet requirements of standards referenced.  
46 b. Manufacturer's installation instructions.  
47 c. Submit complete specification of insulation materials, adhesives, cement, together with  
48 manufacturer's recommended methods of application and coverage for coatings and  
49 adhesives.  
50 3. Submit itemized schedule by building of proposed insulation systems showing density,  
51 thermal conductivity, thickness, adhesive, jackets and vapor barriers.  
52 4. Certifications: Products will meet the requirements of the Contract Documents.

1 **PART 2 - PRODUCTS**

2 **2.1 ACCEPTABLE MANUFACTURERS**

3 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

- 4 1. Elastomeric insulation:
  - 5 a. Rubatex.
  - 6 b. Armstrong.
- 7 2. Fiberglass insulation:
  - 8 a. Certainteed Corporation.
  - 9 b. Schuller (Manville).
  - 10 c. Owens Corning.
  - 11 d. Knauf.
- 12 3. PVC jacket:
  - 13 a. Ceel-Co.
  - 14 b. PIC Plastics.
- 15 4. Ductwork insulation:
  - 16 a. Certainteed.
  - 17 b. Schuller (Manville).
  - 18 c. Owens Corning.

19 B. Submit request for substitution in accordance with Specification Section 01640.

20 **2.2 PIPING INSULATION - ELASTOMERIC**

21 A. General:

- 22 1. Insulation fire and smoke hazard ratings for composite (insulation, jacket or facing, and  
23 adhesive used to adhere the facing or jacket to the insulation), as tested by procedure  
24 ASTM E84, NFPA 255 and UL 723, not exceeding:
  - 25 a. Flame spread: 25.
  - 26 b. Smoke developed: 50.
- 27 2. Accessories (adhesives, mastics, cements, and tapes: Same component ratings as listed  
28 above.
- 29 3. Indicate on product labels or their shipping cartons: Flame and smoke ratings do not exceed  
30 above requirements.
- 31 4. Permanent treatment of jackets or facings to impart flame and smoke safety is required.
  - 32 a. Water-soluble treatments are prohibited.
- 33 5. Insulated shields at pipe support points.

34 B. Pipe, Fitting, and Valve Insulation:

- 35 1. Flexible elastomeric closed cell pipe insulation.
  - 36 a. Average thermal conductivity not to exceed  $0.27 \text{ (Btu-IN)/(HR-FT}^2\text{-DegF)}$  at mean  
37 temperature of 75 DegF, temperature range -40 to 220 DegF; permeability not to exceed  
38 0.20 by ASTM E96; water absorption 3 percent by ASTM D1056 and ozone resistance.
- 39 2. Provide minimum insulation thickness conforming to schedules or as shown on the  
40 Drawings.

41 **2.3 PIPING INSULATION - FIBERGLASS**

42 A. Pipe and Fitting Insulation:

- 43 1. Preformed fiberglass pipe insulation:
  - 44 a. Density: 4 LBS/CF.
  - 45 b. Temperature rated: 650 DegF.
  - 46 c. Average thermal conductivity not to exceed  $0.22 \text{ (Btu-IN)/(HR-FT}^2\text{-DegF)}$  at mean  
47 temperature of 75 DegF.
  - 48 d. Fire hazard rating:
    - 49 1) UL 723, ASTM E84, NFPA 255.
    - 50 2) Flame spread not exceeding 25 and smoke developed not exceeding 50.
- 51 2. Moisture adsorption:
  - 52 a. ASTM C553.
  - 53 b. Not greater than 0.5 percent moisture by volume when exposed to moisture laden air at  
54 120 DegF and 96 percent RH.
- 55 3. Fungi and bacteria resistance:
  - 56 a. ASTM C665.
  - 57 b. Does not breed or promote growth.

- 1 c. Flame attenuated glass fibers bonded with thermosetting resin.
- 2 4. Piping jackets (general applications):
- 3 a. Aluminum: 16 mil embossed aluminum.
- 4 b. PVC: Preformed 0.028 IN thick PVC jackets fabricated from B.F. Goodrich PVC
- 5 sheeting V-66 with proven resistance to ultraviolet degradation when temperatures do
- 6 not exceed the limits of PVC.
- 7 5. Provide minimum insulation thickness conforming to schedules or as shown on the
- 8 Drawings.

9 **2.4 DUCTWORK INSULATION: FIBERGLASS**

- 10 A. Semi-Rigid Insulation for Indoor Installation:
- 11 1. Scheduled thickness Schuller (Manville) #814 SPIN-GLASS fiberglass duct insulation.
- 12 2. Factory applied vapor barrier facing-white scrim foil.
- 13 3. Average thermal conductivity not to exceed 0.23 (Btu-IN)/(HR-FT<sup>2</sup>-DegF) at a mean
- 14 temperature of 75 DegF.
- 15 4. Minimum density: 3.0 LB/CF.
- 16 5. Moisture adsorption:
- 17 a. ASTM C553.
- 18 b. Not greater than 0.5 percent moisture by volume when exposed to moisture laden air at
- 19 120 DegF and 96 percent RH.
- 20 B. Provide minimum insulation thickness conforming to Schedule, or as shown on Drawings.
- 21 C. Duct Interior Lining Board :
- 22 1. Acoustical performance: Minimum noise reduction coefficients (NRC) is 0.45 when tested in
- 23 accordance with ASTM C423 on ASTM F25 mounting.
- 24 2. Fire hazard classification:
- 25 a. UL 723, ASTM E84, NFPA 255.
- 26 b. Flame spread not exceeding 25 and smoke developed not exceeding 50.
- 27 3. Service temperature:
- 28 a. ASTM C411.
- 29 b. Cooling and heating ducts up to 200 DegF.
- 30 4. Velocity rating:
- 31 a. ASTM C1071.
- 32 b. Maximum average air velocity is rated at 600 fpm.
- 33 5. Moisture adsorption:
- 34 a. ASTM C553.
- 35 b. Not greater than 0.5 percent moisture by volume when exposed to moisture laden air at
- 36 120 DegF and 96 percent RH.
- 37 6. Fungi and bacteria resistance:
- 38 a. ASTM C665.
- 39 b. Does not breed or promote growth.
- 40 7. Size and performance:
- 41 a. ASTM C518 and ASTM C177.
- 42 b. 1 IN thickness, long textiled glass-type fibers firmly bonded by thermosetting resin.
- 43 c. At 75 DegF mean temperature, the k value, expressed as (Btu-IN)/(HR-FT<sup>2</sup>-DegF) does
- 44 not exceed 0.27.

45 **PART 3 - EXECUTION**

46 **3.1 INSTALLATION**

- 47 A. Install products in accordance with manufacturer's instructions.
- 48 B. General:
- 49 1. Piping below ground covered with earth will not be insulated
- 50 2. Provide release for insulation application after installation and testing is complete.
- 51 a. Apply insulation on clean, dry surfaces after inspection.
- 52 3. Provide insulation continuous through wall, roof and ceiling openings, pipe hangers, supports
- 53 and sleeves.
- 54 4. Provide insulation with vapor barrier for piping, ductwork and equipment where surfaces may
- 55 be cooler than surrounding air temperatures.
- 56 a. Provide vapor barrier (0.17 perm-IN; ASTM C553) continuous and unbroken.

- 1                   b. Hangers, supports, anchors, and related items that are secured directly to cold surfaces  
2                   must be adequately insulated and vapor-sealed to prevent condensation.
- 3                   5. Apply specified adhesives, mastics and coatings at the manufacturer's recommended  
4                   coverage per unit volume.
- 5                   C. Piping Insulation - Elastomeric:
- 6                   1. Slip insulation on pipe prior to connection.
- 7                   a. Whenever the slip-on technique is not possible provide insulation neatly slit and  
8                   snapped over the pipe.
- 9                   2. Fabricate and install fitting cover insulation according to manufacturer's recommendations.
- 10                  3. Seal joints, slits, miter-cuts and other exposed edges of insulation with adhesive,  
11                  recommended by the insulation manufacturer, to ensure complete vapor barrier.
- 12                  D. Piping Insulation - Fiberglass:
- 13                  1. Apply over clean dry pipe.
- 14                  a. Butt all joints together firmly.
- 15                  2. Seal joints, slits, miter-cuts and other exposed edges of insulation as recommended by the  
16                  insulation manufacturer.
- 17                  3. Insulate fittings, valves, and flanges with insulation thickness equal to adjacent pipe.
- 18                  4. PVC pipe jacket:
- 19                  a. Apply jacketing with a minimum of 1 IN overlap.
- 20                      1) Weld longitudinal and circumferential seams with adhesives as recommended by  
21                      manufacturer.
- 22                  b. Provide slip-joints every 30 FT and between fittings if distance exceeds 8 FT.
- 23                      1) Construct slip-joints by overlapping jacket sections 6 to 10 IN.
- 24                  c. Provide premolded PVC covers of same material and manufacturer as jacket for fittings,  
25                  valves, flanges, and related items in insulated piping systems.
- 26                  5. Aluminum pipe jacket:
- 27                  a. Field-applied aluminum jacket with vapor-sealed longitudinal and butt joints.
- 28                  b. Provide smooth and straight joint with a minimum 2 IN overlap.
- 29                  c. Secure joints with corrosion-resistant screws spaced 0.25 to 0.50 IN back from edge.
- 30                  d. Center spacing of screws 5 IN maximum or as required to provide smooth tight-fitted  
31                  joints.
- 32                  e. Place joints on least exposed side of piping to obtain neat appearance.
- 33                  E. Equipment: Install per manufacturer's instructions.
- 34                  F. Ductwork Insulation - Fiberglass:
- 35                  1. Flexible insulation:
- 36                  a. Butt edges tightly.
- 37                      1) Secure insulation with Benjamin Foster 85-20 adhesive applied in 6 IN strips on 12  
38                      IN centers and/or pins, applied on not more than 18 IN centers so that the insulation  
39                      conforms to the duct surfaces uniformly and firmly.
- 40                  b. Seal joints with facing overlap or 4 IN wide strips of like facing material adhered and  
41                  stapled in place.
- 42                  c. Properly seal any penetration in vapor barrier facing with Benjamin Foster 85-20.
- 43                  d. Cut insulation slightly longer than the perimeter of the duct to ensure full thickness at  
44                  corners.
- 45                  2. Semi-rigid insulation and duct interior lining board:
- 46                  a. Impaling over pins.
- 47                      1) Apply insulation with edges tightly butted.
- 48                      2) Apply insulation with mechanically welded fasteners to the duct and secured with  
49                      speed clips.
- 50                      3) Clip pins off close to clip.
- 51                      4) Space pins as required to hold insulation firmly against duct surface but not less  
52                      than one (1) pin per 1.5 SF.
- 53                      5) Seal joints and speed clips with 3 IN wide strip of facing adhered with Benjamin  
54                      Foster 85-20 adhesive.
- 55                  b. If the welded pin method is impossible, secure insulation to the duct with Benjamin  
56                  Foster 85-20 adhesive.
- 57                      1) Cover the entire surface of duct with adhesive.
- 58                      2) Use corner metal angle to protect edge of insulation.
- 59                      3) Protect edge of insulation.







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2

## SECTION 15440

3

### PLUMBING FIXTURES AND EQUIPMENT

#### 4 PART 1 - GENERAL

##### 5 1.1 SUMMARY

6

A. Section Includes: Plumbing fixtures, trim, and equipment.

7

B. Related Specification Sections include but are not necessarily limited to:

8

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

9

2. Division 01 - General Requirements.

10

3. Section 11005 - Equipment: Basic Requirements.

11

4. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.

12

##### 1.2 QUALITY ASSURANCE

13

A. Referenced Standards:

14

1. Americans with Disabilities Act (ADA):

15

a. Accessibility Guidelines for Buildings and Facilities (ADAAG).

16

2. American National Standards Institute (ANSI):

17

a. Z358.1, Emergency Eyewash and Shower Equipment.

18

3. American Society of Heating, Refrigerating and Air Conditioning Engineers/Illuminating Engineering Society of North America (ASHRAE/IESNA):

19

a. 90.1 IP Energy Standard for Buildings Except Low-Rise Residential Buildings.

20

4. American Society of Mechanical Engineers (ASME):

21

a. A112.19.3, Stainless Steel Plumbing Fixtures (Designed for Residential Use).

22

5. American Society of Sanitation Engineers (ASSE):

23

a. 1011, Performance Requirements for Hose Connection Vacuum Breaker.

24

6. Canadian Standards Association (CSA).

25

7. NSF International (NSF).

26

8. Underwriters Laboratories, Inc. (UL).

27

9. Building Code:

28

a. International Code Council (ICC):

29

1) International Building Code and associated standards, 2006 Edition including all amendments, referred to herein as Building Code.

30

b. Local Codes:

31

1) Chapter 49 Omaha Municipal Code.

32

33

##### 1.3 SUBMITTALS

34

A. Shop Drawings:

35

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

36

2. See Specification Section 11005 and Specification Section 15060.

37

3. Color selection charts for Owner color selection.

38

4. Fabrication and/or layout Drawings:

39

a. Layout plan(s) showing dimensions, elevations, etc.

40

b. Details showing connections, installation, rough-in locations, etc.

41

5. Product technical data including:

42

a. Acknowledgement that products submitted meet requirements of standards referenced.

43

b. Manufacturer's installation instructions.

44

c. Chemical-resistance data.

45

46

B. Operation and Maintenance Manuals:

47

1. See Specification Section 01342 for requirements for:

48

a. The mechanics and administration of the submittal process.

49

b. The content of Operation and Maintenance Manuals.

50

1 **PART 2 - PRODUCTS**

2 **2.1 ACCEPTABLE MANUFACTURERS**

3 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

- 4 1. Pre-molded mop sinks:
- 5 a. Powers - Fiat.
  - 6 b. Standard - Elsmar Granite Co.
  - 7 c. Williams.
  - 8 d. Florestone.
- 9 2. Mop sink fittings:
- 10 a. American Standard.
  - 11 b. Chicago Faucets.
  - 12 c. Kohler.
- 13 3. Sink fittings:
- 14 a. American Standard.
  - 15 b. Kohler.
  - 16 c. Just.
- 17 4. Emergency shower and eyewash:
- 18 a. Speakman.
  - 19 b. Haws.
  - 20 c. Guardian Equipment.
- 21 5. Drains:
- 22 a. Wade.
  - 23 b. Josam.
  - 24 c. Zurn.
  - 25 d. Smith.
- 26 6. Hose reels:
- 27 a. Hannay and Son, Inc.
  - 28 b. Aeromative Mfg Co.
- 29 7. Hose bibs:
- 30 a. Nibco.
  - 31 b. Woodford.
- 32 8. Domestic water heater:
- 33 a. A. O. Smith.
  - 34 b. Ruud.
  - 35 c. Rheem.
  - 36 d. State.
- 37 9. Reduced pressure backflow preventer:
- 38 a. Watts.
  - 39 b. Febco.
  - 40 c. Clayton.
- 41 10. Hose racks:
- 42 a. Strahman Valves, Inc., Model HR-100.
- 43 11. Hose valve:
- 44 a. Guardian Fire Equipment.
  - 45 b. Wilkins.

46 B. Submit request for substitution in accordance with Specification Section 01640.

47 **2.2 MANUFACTURED UNITS**

- 48 1. Mop sink (MS):
- 49 a. Precast terrazzo (marble chips cast in Portland cement, ground and polished with all air
  - 50 voids grouted).
  - 51 b. One-piece.
  - 52 c. Drop front.
  - 53 d. 2 IN wide shoulder.
  - 54 e. Stainless steel threshold.
  - 55 f. Integral drain body, removable strainer and 3 IN drain pipe.
  - 56 g. Type:
  - 57 1) MS-1 (square) 24 x 24 x 12 IN.

- 1 B. Mop Sink Fittings:
- 2 1. Type:
- 3 a. Mounted on wall with pipe chase behind American Standard 8344.112.
- 4 b. Mounted on wall without pipe chase behind Chicago Faucet #835.
- 5 C. Emergency Fixtures:
- 6 1. Emergency shower and eye/face wash (ESEW):
- 7 a. ANSI Z358.1.
- 8 b. Flow switch:
- 9 1) Rating: 125/250 V, 5 A.
- 10 2) Single pole, double throw.
- 11 3) UL listed.
- 12 c. Deluge shower head:
- 13 1) Stay-open ball valve.
- 14 2) Pull-chain.
- 15 d. Eye/face wash:
- 16 1) Aerated eye/face wash with stainless steel bowl.
- 17 2) Stay-open full port ball valve.
- 18 3) Push handle control for eye/face wash.
- 19 4) Supply line strainer for eye/face wash.
- 20 e. Type:
- 21 1) ESEW-1 (free standing, cast flange base and pull-chain for shower): Speakman
- 22 SE-603.
- 23 2. Emergency eye/face wash (EW):
- 24 a. ANSI Z358.1.
- 25 b. Aerated eye/face wash.
- 26 c. Stainless steel bowl.
- 27 d. 1/2 IN stay-open full port ball valve.
- 28 e. Push handle control.
- 29 f. Supply line strainer.
- 30 g. Flow switch.
- 31 h. Type:
- 32 1) EW-1 (wall-mounted, wall mounting brackets, 1-1/2 IN tailpiece): Speakman SE-
- 33 400.
- 34 D. Drains:
- 35 1. Floor drain (FD):
- 36 a. Bottom outlet.
- 37 b. Clamping seepage flange.
- 38 c. Seepage openings.
- 39 d. Size as shown on Drawings.
- 40 e. Type: Cast iron body.
- 41 1) FD-1 (unfinished area) sediment bucket, bucket shall support grate: Wade W-1200-
- 42 TD.
- 43 E. Cleanouts (CO):
- 44 1. Cleanouts for cast iron pipe:
- 45 a. Tapped extra heavy cast iron ferrule.
- 46 b. Calked into cast iron fittings.
- 47 c. Extra heavy brass neoprene seal screw plug with solid hexagonal nut.
- 48 2. Cleanouts for steel pipe: Extra heavy brass screw plug in drainage fittings.
- 49 3. Access housing with adjustable anchor flange and secured scoriated cast: Wade W-3800-
- 50 MF.
- 51 4. Cleanouts turning out through walls and up through floor shall be made by long sweep ells or
- 52 "y" and 1/8 bends with plugs and face or deck plates to conform to architectural finish in
- 53 room.
- 54 a. Where definite finish is not indicated, wall plates shall be chrome-plated cast-brass and
- 55 floor plates polished brass.
- 56 5. Code:
- 57 a. Provide cleanouts of same size as pipe up to 4 IN and not less than 4 IN for larger pipes.
- 58 b. Close access openings for concealed cleanouts with flush floor or flush wall cover plates
- 59 or flush ceiling access panels.

- 1 c. Provide wall plates with chrome plated cast-brass round cleanout cover with flanged
- 2 ring.
- 3 d. Provide screws which match cover plate material.
- 4 F. Hose Bibb (HB-1):
- 5 1. 3/4 IN boiler drain with attached vacuum breaker-backflow preventer.
- 6 2. Vacuum breaker: Non-removable, manual draining, meeting the requirements of the
- 7 ASSE 1011.
- 8 G. Hose Valve:
- 9 1. Cast brass.
- 10 2. Minimum pressure rating 150 psi.
- 11 3. Angle configuration.
- 12 4. Hose outlet connection 2-1/2 IN.
- 13 5. Pin lug protective hose thread cap with chain.
- 14 H. Hose Reel (HR):
- 15 1. HR-1:
- 16 a. Wall-mounted.
- 17 b. Capacity for 100 FT of 3/4 IN ID hose.
- 18 c. Direct crank rewind.
- 19 d. 1 IN IPT female swivel joint inlet and male garden hose thread outlet.
- 20 e. Isolation valve at inlet.
- 21 2. HR-2:
- 22 a. Capacity for 60 FT of 1/4 IN ID air hose.
- 23 b. Spring rewind with ratchet locking and hose stop.
- 24 c. Roller position VR.
- 25 d. 1/2 IN female IPT swivel joint inlet and 1/2 IN female IPT outlet.
- 26 e. Isolation valve at inlet.
- 27 I. Hose Racks:
- 28 1. Stainless steel.
- 29 2. 3/4 IN hose capacity: 50 FT.
- 30 J. Emergency Shower and Eyewash Water Heater:
- 31 1. Electric tankless type:
- 32 a. Size and capacity as scheduled.
- 33 b. UL listed.
- 34 c. Nema 4 enclosure.
- 35 1) Hinged cover.
- 36 2) Power coated finish.
- 37 d. Replaceable cartridge elements.
- 38 e. Meets ANSI Z358.1 Tepid Water Requirements..
- 39 f. Microprocessor Control.
- 40 g. Provided as scheduled on drawings.
- 41 K. Thermostatic Mixing Valve:
- 42 1. Flow rate: 1 to 30 gpm.
- 43 2. Provide minimum 20 gpm cold water bypass.
- 44 3. Provide temperature gauge.
- 45 4. Brass Body.
- 46 5. Check stops.
- 47 6. High temperature setting: 65 to 85 DegF.
- 48 7. Inlet temperature hot 120 to 180 DegF.
- 49 8. Stainless steel surface mount enclosure.
- 50 9. Haws 9201E with 9200 SUR enclosure, Speakman SE-362 with SE-366 enclosure or equal.
- 51 L. Reduced Pressure Backflow Preventer:
- 52 1. Backflow preventers consist of two (2) check valves, test cocks and relief valve, all
- 53 assembled as an integral unit.
- 54 2. Reduced pressure backflow preventers Watts 909.
- 55 3. Backflow preventer to have threaded ends in sizes through 2 IN, flanged 2-1/2 IN and larger.
- 56 4. Pressure loss through backflow preventer not exceeding 14 psi at design flow.
- 57 5. Provide air gap and pipe discharge to equipment drain

1 **PART 3 - EXECUTION**

2 **3.1 INSTALLATION**

- 3 A. Cross Connection: Do not install any plumbing components that will provide a cross connection  
4 between potable and non-potable or drainage systems.
- 5 B. Fixtures:
- 6 1. Install fixtures at locations indicated on Drawings and in compliance with local Codes.  
7 2. Connect plumbing supply, drain and vent line sizes as shown on Drawings.  
8 3. Set proper grounds to form secure base for each fixture and rigid setting.  
9 4. Seal fixture joints abutting walls and floors with silicone sealant.  
10 5. Connect exposed traps and supply pipes for fixtures and equipment to rough piping systems  
11 at wall, unless otherwise specified.  
12 6. Install emergency fixtures in accordance with ANSI Z358.1.
- 13 C. Hose Racks:
- 14 1. Adjacent to hose bibbs, top of rack 36 IN above finished floor or grade.  
15 2. Concrete or masonry walls: Mount with 5/8 IN x 2-1/2 IN stainless steel expansion anchors.  
16 3. Handrail:
- 17 a. Bolt hose rack to 24 IN x 24 IN x 1/4 IN aluminum plate with 5/8 IN stainless steel bolts.  
18 b. Attach to handrail with 3/8 IN stainless steel through bolt at each corner of the plate.  
19 4. Pedestal:
- 20 a. Bolt hose rack to 24 IN to 24 IN x 1/4 IN aluminum plate with 5/8 IN stainless steel bolts.  
21 b. Attach to pedestal with two (2) 1/2 IN stainless steel bolts through handrail.
- 22 D. Hose Bibbs:
- 23 1. Install 36 IN above finished floor.  
24 2. In exterior locations, provide interior isolation valve.
- 25 E. Shock Absorbers:
- 26 1. Install on hot and cold water lines adjacent to each battery of fixtures or other equipment  
27 where indicated on Drawings.  
28 2. Size as recommended by manufacturer for length of pipe served.  
29 3. Locations having two (2) fixtures or less, install capped air chamber 12 IN long on hot and  
30 cold water runouts to each fixture, same size as runout.  
31 4. Runouts to hose bibbs and wall hydrants do not require air chambers.  
32 5. Install units vertically on top of pipe or as detailed on the Drawings.
- 33 F. Cleanouts:
- 34 1. Install cleanouts:
- 35 a. Above floor in each vertical riser that connects to horizontal branch below floor.  
36 b. At test tee to receive proper test plugs in each vertical riser at least every other floor.  
37 c. As required by local Code.
- 38 G. Wall Plates and Escutcheons: Install as specified in Specification Section 15060 or this  
39 Specification Section.
- 40 H. Water Heater:
- 41 1. Install all water heaters in accordance with details, manufacturer's recommendations, and  
42 applicable Codes.  
43 2. For units located on concrete pads, plumb level and orient to allow access to the controls,  
44 elements and other items requiring service.  
45 3. Connect hot and cold water piping to the unit with line-size, isolation valves and dielectric  
46 unions.  
47 4. Start up the unit and adjust all controls for proper temperature control and maximum  
48 efficiency.  
49 5. Where indicated, install instantaneous electric water heaters in enclosure rated for area  
50 classification.  
51 a. Silicone seal all piping and wiring penetrations.
- 52 I. Reduce Pressure Backflow Preventer: Install on water lines as required by Code.

1 **3.2 FIELD QUALITY CONTROL**

2 A. Test piping and fixtures for leaks per Specification Section 15060.

3 **END OF SECTION**



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**SECTION 15530**  
**STEAM DISTRIBUTION SYSTEM**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6 A. Furnish all labor, materials, tools, equipment, and services for Steam Distribution System, as  
7 indicated, in accordance with provisions of Contract Documents.

8 B. Systems Included:

- 9 1. Steam traps.  
10 2. Pipe and fittings installation and testing.

11 C. Completely coordinate with work of other trades.

12 **1.2 QUALITY ASSURANCE**

13 A. Piping standards: See Section 15060.

14 **1.3 SUBMITTALS**

15 A. Product Data: Traps.

16 B. Contract Closeout Information:

- 17 1. Operating and maintenance data.  
18 2. Test reports.

19 **PART 2 - PRODUCTS**

20 **2.1 ACCEPTABLE MANUFACTURERS**

21 A. Steam traps :

- 22 1. Base:  
23 a. Armstrong International.  
24 2. Optional:  
25 a. Illinois.  
26 b. Spirax Sarco.

27 B. Thermostatic Radiator Valves:

- 28 1. Base:  
29 a. Armstrong International.  
30 2. Optional:  
31 a. Illinois.  
32 b. Spirax Sarco.  
33 c. Hoffman Specialty.

34 C. Other manufacturers desiring approval comply with Section 01640.

35 **2.2 MATERIALS**

36 A. Specialties:

- 37 1. Steam traps - general:  
38 a. Sizes: As indicated, minimum; increase size if required to meet capacity requirements.  
39 b. Provide dirt pocket and wye strainer full size of trap opening.  
40 c. Provide shut-off valve and union on each inlet.  
41 d. Provide check and gate valve in discharge, at each lift leg.  
42 2. Steam traps, low pressure (15 psig and less):

- 1                   3. Equipment traps: Use F & T type rated at 15 psi working pressure. Each trap shall be sized  
 2 using 1/2 psi pressure drop and 2 times scheduled flow rate of equipment. Where two traps  
 3 are shown each trap shall be sized for 100 percent redundancy.  
 4

TRAP SIZE (IN)	CAPACITY (LBS/HR)
3/4	400
1	700
1-1/4	900
1-1/2	1700

- 5  
 6                   4. End of main traps: Use inverted bucket type. Trap sizes shall be as indicated on plans. If  
 7 size is not indicated, the minimum trap size shall be 3/4 IN. The minimum capacities for  
 8 each size of trap shall be as follows (based on 2 psi differential):  
 9

TRAP SIZE (IN)	ORIFICE SIZE (IN)	CAPACITY (LBS/HR)
3/4	3/16	350
3/4	1/4	800
1	3/8	1600
1-1/4	1/2	2600
1-1/2	9/16	4000

- 10  
 11                   5. Bucket traps: Straight through pattern to permit maximum headroom under return piping.  
 12                   a. Provide check valve on required lift legs.  
 13                   b. Basis of Design: Armstrong Series 200 and 800.  
 14                   c. Rated for 250 psig operating pressure.  
 15                   6. Float and thermostatic traps (F & T):  
 16                   a. Basis of Design (15 to 30 psig): Armstrong Series B.  
 17                   b. Basis of Design (Above 30 psig): Armstrong Series A.  
 18                   7. Steam traps on equipment: Provide traps and cooling legs, 18 IN deep minimum:  
 19                   a. Connect trap line to cooling leg 6 IN from bottom.  
 20                   b. Provide cap.  
 21                   c. Install trap above floor (elevate equipment if necessary).  
 22                   d. Where equipment is mounted close to structural floor and it is not possible to elevate  
 23                   equipment, install trap below floor; provide sleeve in floor.  
 24                   8. Strainers: See Section 15100.  
 25                   B. Pipe And Fittings: See Specification Section 15060.

26 **PART 3 - EXECUTION**

27 **3.1 PIPING - GENERAL**

- 28                   A. Install in accordance with Section 15300 and Section 15011.  
 29                   B. Provide drain piping from safety valves and valves that have test levers to floor drain.

30 **3.2 STRAINERS**

- 31                   A. Provide full line size wye strainers ahead of steam traps and where indicated.  
 32                   1. See Piping Specialties: Section 15100.

33 **3.3 TESTING**

- 34                   A. Allow no piping to be insulated, concealed, or furred-in until it has been tested to satisfaction of  
 35                   Engineer.  
 36                   B. Upon completion of a section or of entire piping systems, hydrostatically test to pressure not less  
 37                   than 50 percent in excess of maximum pressure to which pipe will ordinarily be subjected, but in  
 38                   no case less than 150 psi.  
 39                   1. Remove traps during tests and valve off or bypass coils, pumps and equipment, etc.  
 40                   C. Repair leaks and replace defective pipe disclosed by tests and repeat tests until piping is air tight.

1 **3.4 CLEANING**

- 2 A. Cleaning of steam supply piping: Before steam supply system is placed in service either for  
3 temporary or permanent use, clean and flush as follows:
- 4 1. For temporary use where additional piping will be added to system as construction proceeds,  
5 flush piping by "blowing down" with steam.
  - 6 2. At completion of project after piping is complete, flush piping by "blowing down" with steam  
7 until visual inspection indicates system cleaned. During "blow down" period: Waste  
8 condensate to sewer.
  - 9 3. After "blow down" period is complete, thoroughly clean strainers and traps.
- 10 B. Cleaning of condensate return piping: Before steam condensate return system is placed in  
11 service either for temporary or permanent use, clean and flush as follows:
- 12 1. For temporary use where additional piping will be added to system as construction proceeds,  
13 and before strainers, traps, equipment, etc., are installed, flush piping by "blowing down" with  
14 steam.
  - 15 2. At completion of project after piping is complete, and steam supply mains are "Blown Down",  
16 flush steam condensate return piping by "blowing down" with steam until visual inspection  
17 indicates system cleaned.
  - 18 3. Prior to "blowing down" system remove strainers and traps from system and bypass  
19 equipment connected to system.
  - 20 4. During "blow down" period: Waste condensate to sewer or atmosphere outside building.
  - 21 5. After "blow down" period, clean strainers and traps and reinstall in piping system. Reconnect  
22 equipment previously bypassed.

23 **END OF SECTION**

24



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**SECTION 15605**  
**HVAC: EQUIPMENT**

3

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6

A. Section Includes: Heating, ventilating, and cooling equipment.

7

B. Related Specification Sections include but are not necessarily limited to:

8

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

9

2. Division 01 - General Requirements.

10

3. Section 11005 - Equipment: Basic Requirements.

11

4. Section 15890 - HVAC: Ductwork.

12

5. Section 15970 - Instrumentation and Control for HVAC Systems.

13

6. Section 15990 - HVAC Systems: Balancing and Testing.

14

**1.2 QUALITY ASSURANCE**

15

A. Referenced Standards:

16

1. Air Movement and Control Association (AMCA).

17

2. Air Conditioning and Refrigeration Institute (ARI).

18

3. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):

19

a. HVAC Applications Handbook, Chapter entitled "Sound and Vibration Control."

20

b. 20, Methods of Testing for Rating Remote Mechanical-Draft Air-Cooled Refrigerant

21

Condensers.

22

c. 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency

23

by Particle Size.

24

4. Canadian Standards Association (CSA).

25

5. National Electrical Manufacturers Association (NEMA):

26

a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

27

6. National Fire Protection Association (NFPA):

28

a. 70, National Electrical Code (NEC).

29

7. National Roofing Contractors Association (NRCA).

30

8. Underwriters Laboratories, Inc. (UL):

31

a. 507, Standard for Electric Fans.

32

9. Building Code:

33

a. International Code Council (ICC):

34

1) International Building Code and associated standards, 2006 Edition including all

35

amendments, referred to herein as Building Code.

36

B. Miscellaneous:

37

1. Gage thickness specified herein shall be manufacturer's standard gage for steel and Brown and Sharpe gage for non-ferrous metals.

38

2. Corrosion protection of equipment to be as specified herein.

39

40

**1.3 SUBMITTALS**

41

A. Shop Drawings:

42

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

43

2. Fabrication and/or layout Drawings.

44

3. Product technical data including:

45

a. Acknowledgement that products submitted meet requirements of standards referenced.

46

b. Manufacturer's installation instructions.

47

c. Wiring diagrams.

48

d. Control diagrams.

49

e. Manufacturer's catalog cuts and technical data.

50

f. Corrosion-protection information.

51

g. Fan curves.

52

- 1 h. Sound data.
- 2 i. Vibration isolation.
- 3 j. Control description.
- 4 k. Performance data on all equipment.
- 5 4. Certifications:
- 6 a. Provide certification of thickness of corrosion-protection coating.
- 7 B. Operation and Maintenance Manuals:
- 8 1. See Specification Section 01342 for requirements for:
- 9 a. The mechanics and administration of the submittal process.
- 10 b. The content of Operation and Maintenance Manuals.

11 **PART 2 - PRODUCTS**

12 **2.1 ACCEPTABLE MANUFACTURERS**

- 13 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 14 1. Vibration isolation assemblies:
- 15 a. Mason.
- 16 b. Vibration Mounting and Controls Co.
- 17 c. Aero-Marine Engineering, Inc.
- 18 2. Cooling coils - direct expansion:
- 19 a. Carrier.
- 20 b. Daikin.
- 21 c. McQuay.
- 22 3. Heating and cooling coils - water - steam:
- 23 a. Carrier.
- 24 b. Daikin.
- 25 c. McQuay.
- 26 4. Heating coil - electric:
- 27 a. Carrier.
- 28 b. Daikin.
- 29 c. McQuay.
- 30 5. Fan coils:
- 31 a. Carrier.
- 32 b. Daikin.
- 33 c. McQuay.
- 34 6. Unit heater - electric:
- 35 a. Brasch.
- 36 b. Chromalox..
- 37 7. Unit heaters --steam:
- 38 a. Modine Manufacturing Co.
- 39 b. Armstrong-Hunt Inc.
- 40 8. Air-cooled condensing units - split system:
- 41 a. Carrier.
- 42 b. Daikin.
- 43 c. McQuay.
- 44 9. Roof-mounted centrifugal exhaust fans:
- 45 a. Loren Cook.
- 46 b. Greenheck.
- 47 c. PennBarry Ventilator Co., Inc.
- 48 10. Dehumidifiers - packaged desiccant bed:
- 49 a. Dectron.
- 50 b. Desert Air.
- 51 B. Submit request for substitution in accordance with Specification Section 01640.

52 **2.2 GENERAL**

- 53 A. All Manufactured Units:
- 54 1. Comply with Specification Section 11005.
- 55 2. Factory wired and assembled.

- 1 3. Use fasteners made of same material as unit.
- 2 4. Fabricate motor assemblies and unit housings with vibration isolation assemblies:
- 3 a. Type: As per Table 42, Chapter 47, ASHRAE HVAC Applications Handbook.

## 4 2.3 MANUFACTURED UNITS

### 5 A. Equipment Coils:

- 6 1. Cooling coils - direct expansion:
  - 7 a. ARI certified.
  - 8 b. Material:
    - 9 1) Aluminum.
    - 10 2) Copper with aluminum fins for use in administration units only.
  - 11 c. Fin spacing: Minimum 80 fins per foot.
  - 12 d. Minimum standard operating limit: 250 psi.
  - 13 e. Size and capacity as scheduled.
- 14 2. Heating and cooling coils - water - steam:
  - 15 a. ARI certified.
  - 16 b. Material:
    - 17 1) Aluminum.
    - 18 2) Copper with aluminum fins for use in administration units only.
  - 19 c. Fin spacing: Minimum 80 fins per foot.
  - 20 d. Minimum standard operating limit: 200 psi.
  - 21 e. Equip with vent, drain and condensate connections.
  - 22 f. Size and capacity as scheduled on Drawings.
- 23 3. Heating coil - electric:
  - 24 a. ARI certified.
  - 25 b. 80-percent nickel, 20-percent chromium elements.
  - 26 c. Maximum heating density: 35 watts/SQ IN.
  - 27 d. Built-in thermal protection.
  - 28 e. Airflow switch.
  - 29 f. Built-in circuit fusing.
  - 30 g. Control voltage transformer.
  - 31 h. Terminal block.
  - 32 i. Magnetic contactor.
  - 33 j. Fused disconnect switch.
  - 34 k. Step controller as required by instrumentation.
  - 35 l. Single point electrical connection.
  - 36 m. Size and capacity as scheduled on Drawings.

### 37 B. Fan Coils:

- 38 1. ARI certified.
- 39 2. Coils: See paragraph(s) in Article 2.3, Equipment Coils.
- 40 3. Blower:
  - 41 a. Fan wheels: Centrifugal forward-curved, double width.
  - 42 b. Fan housing: Galvanized steel.
  - 43 c. Statically and dynamically balanced.
  - 44 d. Motor:
    - 45 1) See Specification Section 11005.
    - 46 2) Integral overload protection.
- 47 4. Cabinet:
  - 48 a. Material: Galvanized steel, 18 GA minimum.
  - 49 b. Exposed units equipped with hinged access panel, intake and discharge grilles.
  - 50 c. Concealed units equipped with return plenum, filter section and discharge duct collar.
- 51 5. Drain pans:
  - 52 a. Material: Galvanized steel.
  - 53 b. Equip with drain connection.
  - 54 c. Insulated.
- 55 6. Filters: See Specification Section 15890.
- 56 7. Size and capacity as scheduled on Drawings.

### 57 C. Unit Heater - Electric:

- 58 1. UL listed, corrosion-resistant washable.

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2. Material:
    - a. Fan: Non-sparking aluminum.
    - b. Heater case: Stainless steel.
    - c. Heating Monel fintube.
    - d. Junction box: NEMA 4X.
  3. Fan motor:
    - a. See Specification Section 11005.
    - b. Built-in overload protection.
  4. Louvered outlet grille.
  5. Rear grille.
  6. Built-in over temperature protection.
  7. Accessories:
    - a. Mounting bracket: Stainless steel.
- D. Unit Heaters -Steam:
1. Type: Vertical.
  2. Capacity rated in accordance with AMCA standards.
  3. Material:
    - a. Casings: Minimum 20 GA steel.
    - b. Coil: Copper with aluminum fins.
    - c. Fans: Aluminum.
  4. Fan motor:
    - a. See Specification Section 11005.
    - b. Built-in thermal overload protection.
  5. Dynamically balanced fan.
  6. Adjustable air deflector blades.
  7. Steam trap: See hidden Paragraph Steam Trap in Article 2.3.
  8. Accessories:
    - a. Pipe suspension kit.
    - b. 40 to 90 DegF, 5 DegF differential thermostat.
  9. Size and capacity as scheduled on Drawings.
- E. Air-Cooled Condensing Units - Split System:
1. ARI rated.
  2. UL listed.
  3. Materials:
    - a. Casing: Galvanized steel.
    - b. Mounting/lifting rails: Steel.
    - c. Outdoor coil: Seamless aluminum tubing and aluminum fins.
    - d. Fan blades: Aluminum.
  4. Weatherproof casing:
    - a. Hail screen for condenser coil.
    - b. Access panels.
  5. Compressor:
    - a. Hermetically sealed.
    - b. Internal pressure protector.
    - c. Crankcase heater.
    - d. Internal spring mounts.
    - e. Centrifugal oil pump.
    - f. Built-in overload protection.
  6. Condenser fans and motors:
    - a. Vertical discharge.
    - b. Direct drive.
    - c. Statically and dynamically balanced.
    - d. Motor:
      - 1) See Specification Section 11005.
      - 2) Permanently lubricated bearings.
      - 3) Built-in current and thermal overload protection.
  7. Built-in refrigerant filter dryer.
  8. Built-in liquid line and gas line service valves with gage ports.
  9. Outdoor coil:
    - a. Fins mechanically bonded to tubing.
    - b. Lab tested to 2000 psi.



- 1 10. 24 V factory-wired controls to include fusing and control power transformer.
- 2 11. Size and capacity as scheduled on Drawings.
- 3 F. Roof-Mounted Centrifugal Exhaust Fans:
- 4 1. AMCA certified.
- 5 2. Non-overloading horsepower capability.
- 6 3. Materials:
- 7 a. Top cap: Spun aluminum.
- 8 b. Wheel and inlet shroud: Aluminum.
- 9 c. Baffle: Aluminum.
- 10 d. Base: One-piece aluminum.
- 11 e. Drive assembly supports: Steel.
- 12 f. Drive shaft: Solid stainless steel.
- 13 g. Minimum 10 GA motor mounting plate.
- 14 4. Backward inclined blades.
- 15 5. Tapered inlet shroud.
- 16 6. Statically and dynamically balanced wheel.
- 17 7. Bearings:
- 18 a. Cast iron pillow blocks.
- 19 b. Concentric bearing locking collar for drive shafts 1 IN and larger.
- 20 1) SKF "ConCentra."
- 21 2) Dodge "D Lock."
- 22 c. Regreaseable.
- 23 d. 200,000 HR average life.
- 24 e. Five-to-one load capability to actual load ratio.
- 25 8. Weathertight compartment for motor and drives.
- 26 a. Separated from airstream.
- 27 9. Motor:
- 28 a. See Specification Section 11005.
- 29 b. Driver and driven sheaves:
- 30 1) Keyed hub type.
- 31 2) Drive sheaves: Fixed pitch diameter.
- 32 3) Driver:
- 33 a) Shipped with variable pitch diameter sheave.
- 34 b) Fixed pitch diameter size based on approved test and balance reports.
- 35 4) V-belt drives sized for 150 percent motor horsepower.
- 36 10. Automatic drive belt tensioner.
- 37 11. Vibration isolated drive assembly.
- 38 12. Accessories:
- 39 a. Prefabricated insulated aluminum roof curb.
- 40 b. Backdraft damper: See Specification Section 15890.
- 41 c. Bird screen.
- 42 d. Extended grease lines and fittings.
- 43 13. Size and capacity as scheduled on Drawings.
- 44 G. Dehumidifiers – Recycling Type:
- 45 1. Factory assembled recycling refrigerant.
- 46 2. ETL or CSA listed.
- 47 3. Heat generated by the compressor shall be rejected to the leaving air stream.
- 48 4. Blower motor: Service factor 1.5.
- 49 5. Corrosion resistant coating on copper tubing
- 50 6. Cabinet:
- 51 a. 16 gage and 20 gage steel.
- 52 b. Removable panels for service of all internal parts.
- 53 c. Minimum 1/2 IN thick fiberglass insulation.
- 54 1) Reinforced mesh.
- 55 2) Conductivity less than 0.232 BTU/IN.HR.SQ FT at 75 DegF.
- 56 7. Built in filter rack.
- 57 8. Evaporator coil:
- 58 a. 1/2 IN seamless copper tubes.
- 59 b. Aluminum fins, 12 fins per inch.
- 60 9. Condenser coil:
- 61 a. 1/2 IN seamless copper tubes.

- 1                    b. Aluminum fins, 8 fins per inch.
- 2                    c. 16 gage galvanized casing.
- 3                    10. Drain pan.
- 4                    11. Compressor:
  - 5                    a. Hermetic.
  - 6                    b. Three phase
- 7                    12. Microprocessor Control.
- 8                    13. In line solder type liquid line filter drier.
- 9                    14. Built-in control panel:
  - 10                   a. Separate compartment.
  - 11                   b. Factory mounted and wired.
  - 12                   c. Panel to include:
    - 13                   1) Motor starters.
    - 14                   2) Control relays.
    - 15                   3) Overloads.
    - 16                   4) Protective fuses.
    - 17                   5) Factory wired terminal strip.
    - 18                   6) Integral 120 V control transformer.
    - 19                   7) Manual-off-auto switch.
- 20                   15. Size and capacity as scheduled on Drawings.
  
- 21                   H. Finned Tube Radiation - Steam:
  - 22                   1. General:
    - 23                   a. Finned tube radiation of lengths, capacities, styles and accessories as indicated or
    - 24                   specified herein.
  - 25                   2. Cabinets:
    - 26                   a. Minimum 16 GA, cold-rolled steel front.
    - 27                   b. Provide full 18 GA backplate for element support.
    - 28                   c. Brace and reinforce the front a minimum of 4 FT-0 IN OC without visible fasteners.
  - 29                   3. Pedestal type:
    - 30                   a. Where indicated, provide cabinets of minimum 16 GA cold-rolled steel, side panel and
    - 31                   stamped steel discharge grille.
    - 32                   b. Provide with 3/4 IN half coupling and pedestal bracket for mounting.
  - 33                   4. Elements:
    - 34                   a. Steel tube and steel fins with tube mechanically bonded to fin to eliminate noise and
    - 35                   ensure durability/performance at scheduled ratings.
    - 36                   b. Vertically adjustable bearing cradle or rod type hangers to allow for
    - 37                   expansion/contraction.
    - 38                   c. Provide brackets minimum of 3 FT OC.
  - 39                   5. Finish:
    - 40                   a. Flat, black, heat-resisting paint for backplate.
    - 41                   b. Factory-primed finish on covers and accessories.
  - 42                   6. Accessories:
    - 43                   a. Provide the following accessories:
      - 44                   1) End panels, inside/outside corners, enclosure extensions.
      - 45                   2) Access panels.
      - 46                   3) Factory-mounted dampers as indicated.
      - 47                   4) Sill extensions, mullion channels, pilaster covers as indicated.

48                   **PART 3 - EXECUTION**

49                   **3.1 INSTALLATION**

- 50                   A. Install in accordance with Specification Section 11005.
- 51                   B. Install fixed pitched drive sheave after sheave has been sized based on accepted test and
- 52                   balance report.

53                   **3.2 FIELD QUALITY CONTROL**

- 54                   A. Comply with Specification Section 15990.





1 2014/09/08

2 **SECTION 15890**  
3 HVAC: DUCTWORK

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes: HVAC ductwork and accessories.
- 7 B. Related Specification Sections include but are not necessarily limited to:
- 8 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 9 2. Division 01 - General Requirements.
- 10 3. Section 10200 - Louvers and Vents.
- 11 4. Section 11005 - Equipment: Basic Requirements.
- 12 5. Section 15970 - Instrumentation and Control for HVAC Systems.

13 **1.2 QUALITY ASSURANCE**

- 14 A. Referenced Standards:
- 15 1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
- 16 a. 52, Method of Testing Air Conditioning Devices Used in General Ventilation for
- 17 Removing Particulate Matter.
- 18 2. National Fire Protection Association (NFPA).
- 19 3. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
- 20 a. Ducted Electric Heat Guide for Air Handling Systems.
- 21 b. HVAC Duct Construction Standards - Metal and Flexible.
- 22 4. Underwriters Laboratory, Inc. (UL):
- 23 a. 555, Standard for Safety Fire Damper and Ceiling Fire Damper.
- 24 b. 555S, Standard for Safety Leakage Rated Dampers for Use in Smoke Control Systems.
- 25 c. Building Materials Directory.
- 26 5. Building Code:
- 27 a. International Code Council (ICC):
- 28 1) International Building Code and associated standards, 2006 Edition including all
- 29 amendments, referred to herein as Building Code.
- 30 B. Qualifications:
- 31 1. Fabricator: Firms regularly engaged in the manufacture of the specific product, of type, size
- 32 required, whose products have been in use in similar service for not less than three (3)
- 33 years.
- 34 2. Installers: Firm with at least five (5) years installation experience on products similar to that
- 35 required for this Project.

36 **1.3 DEFINITIONS**

- 37 A. Installer or Applicator:
- 38 1. Installer or applicator is the person actually installing or applying the product in the field at the
- 39 Project site.
- 40 2. Installer and applicator are synonymous.

41 **1.4 SUBMITTALS**

- 42 A. Shop Drawings:
- 43 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 44 the submittal process.
- 45 2. See Specification Section 11005.
- 46 3. Efficiency ratings per ASHRAE 52 for factory built and assembled filter units.
- 47 4. Scaled ductwork drawings (1/4 IN equals 1 FT) showing duct and accessory layout and
- 48 support.

- 1 B. Operation and Maintenance Manuals:
- 2 1. See Specification Section 01342 for requirements for:
- 3 a. The mechanics and administration of the submittal process.
- 4 b. The content of Operation and Maintenance Manuals.
- 5 C. Miscellaneous Submittal:
- 6 1. Documentation of qualifications for fabricators and installers.

## 7 PART 2 - PRODUCTS

### 8 2.1 ACCEPTABLE MANUFACTURERS

- 9 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 10 1. Transverse joints (factory fabricated aluminum):
- 11 a. Ductmate Industries, Inc.
- 12 2. Turning vanes:
- 13 a. Ductmate Industries, Inc.
- 14 b. Duro Dyne.
- 15 c. SEMCO Incorporated.
- 16 d. Ward Industries, Inc.
- 17 3. Flexible duct connections:
- 18 a. Vent Fabrics.
- 19 b. Duro Dyne.
- 20 4. Backdraft dampers:
- 21 a. Air Balance.
- 22 b. Ruskin.
- 23 c. American Warming.
- 24 5. Ceiling diffusers:
- 25 a. Anemostat.
- 26 b. Carnes.
- 27 c. Titus.
- 28 6. Grilles and registers:
- 29 a. Anemostat.
- 30 b. Carnes.
- 31 c. Titus.
- 32 7. Manual (volume) dampers:
- 33 a. Air Balance.
- 34 b. Ruskin.
- 35 c. American Warming.
- 36 8. Duct sealers:
- 37 a. Chicago Mastic.
- 38 b. 3M Co.
- 39 c. Permatex.
- 40 d. Benjamin Foster.
- 41 9. Temperature control and automatic dampers:
- 42 a. Air Balance.
- 43 b. Ruskin.
- 44 c. American Warming.
- 45 B. Submit request for substitution in accordance with Specification Section 01640.

### 46 2.2 COMPONENTS

- 47 A. Duct and Fittings (Metallic):
- 48 1. Materials: 3003 H-14 aluminum alloy.
- 49 2. Fabrication:
- 50 a. Minimum sheet material thickness:
- 51 1) Ducts with largest side or diameter to 30 IN: 0.05 IN thick.
- 52 2) Ducts with largest side or diameter greater than 30 IN: 0.08 IN thick.

- 1                   b. Utilize SMACNA HVAC Duct Construction Standards for minimum of 2 IN water gage  
2                   static pressure for the minimum sheet material thickness specified herein.  
3                   1) Heavier gage sheet material may be used with associated reinforcement as an  
4                   alternate to minimum thickness specified.  
5                   2) Lighter gage sheet material with associated reinforcement shall not be used as an  
6                   alternate to minimum thickness specified.
- 7                   c. Longitudinal seams:  
8                   1) 0.050 material:  
9                   a) Pittsburgh seam.  
10                   b) Continuously welded.  
11                   2) 0.080 material: Continuously welded.  
12                   d. Continuously weld seams on factory assembled units.
- 13                   e. Transverse joints (Alternate A):  
14                   1) SMACNA T-22 companion flange.  
15                   2) Gasketed.  
16                   3) Rigidity class:  
17                   a) Ducts with largest side or diameter to 30 IN: SMACNA Class D (1-1/2 x 1-1/2 x  
18                   1/8 IN angles).  
19                   b) Ducts with largest side or diameter greater than 30 to 54 IN: SMACNA Class H  
20                   (2-1/2 x 2-1/2 x 3/16 IN angles).
- 21                   f. Transverse joints (Alternate B):  
22                   1) Materials and fabrication:  
23                   a) Angles: Aluminum.  
24                   (1) Ductmate 35.  
25                   b) Corners: Aluminum.  
26                   (1) Ductmate DC 35.  
27                   c) Snap cleats: Aluminized or stainless steel.  
28                   d) Gaskets: Closed cell neoprene.  
29                   e) Bolts: Stainless steel.  
30                   f) Sheet metal screws: Self-drilling stainless steel with unthreaded section under  
31                   head.
- 32                   2) Fabrication:  
33                   a) Rigidity class: SMACNA Class H.  
34                   b) 3/8 IN DIA x 1 IN bolts.
- 35                   B. Supports and Hangers:  
36                   1. Materials:  
37                   a. Support angles: Aluminum or stainless steel.  
38                   b. Hanger rods: Stainless steel.  
39                   c. Anchors: Stainless steel wedge type.  
40                   2. Fabrication: Trapeze type units.
- 41                   C. Turning Vanes:  
42                   1. Materials: Same as duct.  
43                   2. Fabrication:  
44                   a. Fabricate double vane units.  
45                   b. Pressure drop through elbows: Maximum 20 percent of velocity pressure.
- 46                   D. Flexible Connections:  
47                   1. Materials: Hypalon, double coated closely woven glass fabric.  
48                   2. Fabrication: Withstand 4.5 IN water column, positive and negative pressure.
- 49                   E. Drain Pan:  
50                   1. Materials: Aluminum.  
51                   2. Fabrication: 0.080 IN.
- 52                   F. Diffusers:  
53                   1. Materials:  
54                   a. Body: Extruded aluminum.  
55                   b. Ceiling diffuser gaskets: Sponge rubber.  
56                   2. Fabrication:  
57                   a. Type: Square or rectangular with removable core.

- 1                   b. Key operated opposed blade damper mounted in neck except where indicated on  
2                   Drawings to be omitted.  
3                   1) Dampers to be housed in round to square adapters.  
4                   c. Linear supply diffusers:  
5                   1) Internal pattern control vanes which also function as volume control dampers,  
6                   adjustable through slots.  
7                   2) Mounting: Hanger inside ductwork.  
8                   3) Length: As indicated on Drawings.  
9                   4) Number of slots, size, location, and throw: See Drawings.  
10                  d. Finish:  
11                  1) Circular diffusers: Clear satin anodized.  
12                  2) Interior of perforated supply and return diffusers: Flat black paint.
- 13                  G. Air Grille and Register Assembly:  
14                  1. Materials:  
15                  a. Assembly: Extruded aluminum.  
16                  b. Gaskets: Sponge rubber.  
17                  2. Fabrication:  
18                  a. Supply registers: Two (2) sets individually adjustable louvers.  
19                  b. Exhaust and return registers: 45-degree deflection front blades.  
20                  c. Dampers: Key-operated opposed blade.  
21                  d. Screws, duct collars, and transitions as required.  
22                  e. Finish:  
23                  1) Manufacturer's standard factory applied finish.  
24                  2) Color: White.
- 25                  H. Air Filters:  
26                  1. Materials:  
27                  a. Holding frame: Aluminum.  
28                  2. Fabrication:  
29                  a. Factory built and assembled unit.  
30                  b. Efficiency rating as per ASHRAE 52.  
31                  c. 2 IN thickness minimum.  
32                  d. Efficiency: MERV 8..  
33                  e. Air velocity: 450 FPM maximum.  
34                  f. Clean pressure drop: 0.2 IN WG maximum.  
35                  g. Size, capacity, and type: As indicated on Drawings.
- 36                  I. Temperature Control, Automatic and Manually (Volume) Operated Dampers:  
37                  1. Material:  
38                  a. Body: 6063 T5 aluminum.  
39                  b. Seal blade edge: Extruded vinyl.  
40                  2. Fabrication:  
41                  a. Frame thickness: 0.125 IN minimum.  
42                  b. Provide flanged connections.  
43                  c. Blades:  
44                      1) Two-position damper: Parallel blade.  
45                      2) Mixing and volume damper: Opposed blade.  
46                      3) Airfoil shape.  
47                      4) Maximum 6 IN width.  
48                  d. Linkage: Concealed in frame.  
49                  e. Axles: 1/2 IN plated steel hex.  
50                  f. Bearings: Molded synthetic.  
51                  g. Seals:  
52                      1) Jamb: Flexible compression type.  
53                  h. Control shaft: Removable, 1/2 IN DIA.  
54                  i. Air leakage (4 FT SQ damper) at 4 IN WG pressure: 99 cfm maximum.  
55                  j. Motors for motor operated damper: See Specification Section 15970.  
56                  k. Provide outboard support for operator linkage where damper motor is to be installed  
57                  outside of duct.  
58                  l. Provide stainless steel locking quadrants for manual (volume) dampers.  
59                  m. Provide fold out operator mounting bracket where damper motor is to be installed on  
60                  face of damper or inside duct.



- 1 n. Finish: 215 R1 anodized.
- 2 J. Louvers: See Specification Section 10200.

3 **2.3 MAINTENANCE MATERIALS**

- 4 A. Extra Materials:
  - 5 1. Furnish Owner with the following extra materials:
  - 6 a. Two complete filter media changes for each filter unit.
  - 7 b. Filter media used during construction is in addition to this requirement.

8 **PART 3 - EXECUTION**

9 **3.1 INSTALLATION**

- 10 A. See Specification Section 11005.
- 11 B. Metal Ductwork:
  - 12 1. Install with longitudinal seams sealed for zero leakage.
  - 13 a. For welded seams, submit sample for approval by Engineer.
  - 14 2. Install gaskets at each transverse joint and fasten sections together with bolts.
  - 15 a. Tighten for zero leakage.
  - 16 3. Install supports and hangers with anchors in accordance with SMACNA HVAC Duct
  - 17 Construction Standards.
  - 18 4. Install turning vanes in square elbows:
  - 19 a. Unsupported vane length not to exceed 48 IN.
  - 20 b. Position vanes at proper angle to meet specified pressure drop.
  - 21 5. Install flexible connections at fans:
  - 22 a. Locate as close as possible to fan.
  - 23 b. Allow 1 IN of slack to prevent vibration transmission.
  - 24 c. Install thrust restraints across connectors.
- 25 C. Drain Pans:
  - 26 1. Install at fan coil cooling coils, control valves above finished ceilings and at other sources of
  - 27 moisture.
  - 28 2. Install metal tubing at drain and terminate above floor drain, equipment drain and as shown
  - 29 on Drawings.
- 30 D. Dampers:
  - 31 1. Install where indicated on Drawings of sizes shown.
- 32 E. Diffusers:
  - 33 1. Install where shown on Drawings of size and capacities scheduled on Drawings.
  - 34 2. Install painted lay-in type in lay-in ceilings.
  - 35 3. Install prime painted diffusers in areas where duct work is concealed.
  - 36 4. Install anodized diffusers in exposed duct work.
- 37 F. Air Grille and Register Assemblies:
  - 38 1. Install where shown on Drawings of size and capacities scheduled on Drawings.
  - 39 2. Install prime painted grilles and registers in areas where duct work is concealed.
  - 40 a. Field paint to match adjacent surface finish.
- 41 G. Air Filters:
  - 42 1. Install where shown on Drawings of size and capacity scheduled on Drawings.
  - 43 2. Do not operate equipment during construction without filters.

44 **END OF SECTION**

45



1 2014/09/15

2

## SECTION 15970

3

### INSTRUMENTATION AND CONTROL FOR HVAC SYSTEMS

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

###### A. Section Includes:

7

1. Instrumentation and control for HVAC systems.

8

2. Temperature control.

9

3. Ventilation control.

10

4. Heating control.

11

5. Cooling control.

12

6. Control wiring.

13

7. Panels and accessories.

14

8. Miscellaneous.

15

###### B. Related Specification Sections include but are not necessarily limited to:

16

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

17

2. Division 01 - General Requirements.

18

3. Section 10400 - Identification Devices.

19

4. Section 13440 - Instrumentation for Process Control: Basic Requirements.

20

5. Section 15605 - HVAC: Equipment.

21

6. Section 15890 - HVAC: Ductwork.

22

7. Division 16 - Electrical.

23

##### 1.2 QUALITY ASSURANCE

24

###### A. See Specification Section 11005.

25

###### B. Referenced Standards:

26

1. ASTM International (ASTM):

27

a. D1693, Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.

28

2. Instrumentation, Systems, and Automation Society (ISA):

29

a. S5.1, Instrumentation Symbols and Identification.

30

b. S5.4, Standard Instrument Loop Diagrams.

31

3. National Electrical Manufacturers Association (NEMA):

32

a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

33

4. National Fire Protection Association (NFPA):

34

a. 70, National Electrical Code (NEC).

35

5. Underwriters Laboratories, Inc. (UL).

36

###### C. Miscellaneous:

37

1. Controls to be in compliance with Specification Section 16010 for NEMA and NFPA 70 enclosure class requirements unless noted or specified otherwise.

38

2. Unless specifically noted otherwise, components of systems shall be industrial duty suitable for moist, corrosive environments.

39

40

41

##### 1.3 SYSTEM DESCRIPTION

42

###### A. Work shall be provided as an integrated operating system.

43

###### B. Provide a complete system of automatic temperature control, thermostats, relays, valves, damper operators and other associated controls and appurtenances required to maintain minimum conditions described in detail herein and on Drawings, together with thermometers, gages and other accessory equipment.

44

1. Assemble control system with complete system of wiring and air piping to fulfill requirements of the Contract Documents.

45

46

47

48

49

###### C. Install system using competent mechanics under direct supervision of control manufacturer.

- 1 D. Controls, as set out in "Sequence of Operation," are designed to illustrate operating functions  
2 only.  
3 1. Control sequence shall be considered supplementary to "Sequence of Operation."  
4 2. These minimum specified items, and any additional controls, not indicated but required to  
5 meet performance as outlined in the Contract Documents, shall be furnished and installed at  
6 no additional cost to Owner to make a complete system.
- 7 E. Sequence of Operation - General:  
8 1. Sequence of operation indicated illustrates basic operating functions only.  
9 2. Contractor shall review Drawings and submit complete installation data, including minor  
10 details, to provide proper operation in his proposal.  
11 3. Where an item differs from specifications, control manufacturer shall submit manufacturer's  
12 recommendations subject to Engineer's approval.  
13 4. Filter Plant Level Pipe Gallery:  
14 a. Steam Unit Heaters FP-UH-01 thru FP-UH-07:  
15 1) Steam coil in each is wild.  
16 2) Each unit heater motor is individually circuited from 115 volt electrical panel.  
17 3) Each unit heater motor is controlled by wall mounted thermostat:  
18 a) Room temperature above set point (65 DegF adjustable): Heater motor is  
19 "ON".  
20 b) Room temperature below set point: Heater motor is "OFF".  
21 b. Dehumidifier FP-DH-01 thru FP-DH-04:  
22 1) Each dehumidifier is individually circuited from Switch Board  
23 2) Each dehumidifier is individually controlled by room humidistat:  
24 a) Room humidity above set point: dehumidifier is "ON".  
25 b) Room humidity below set point: dehumidifier is "OFF".  
26 5. Filter Plant Operations Level:  
27 a. Steam radiators FP-FT-01 thru FP-FT-55:  
28 1) Controlled by existing heater controls.  
29 b. Motor operated damper FP-MOD-01:  
30 1) Interlocked with Dehumidifier FP-DH-03:  
31 a) Dehumidifier "ON"; Damper is "OPEN"  
32 b) Dehumidifier "OFF"; Damper is "CLOSED".  
33 c. Motor operated dampers FP-MOD-02 thru FP-MOD-12:  
34 1) Dampers are controlled thru a "HAND-OFF-AUTO" switch  
35 2) Switch in "HAND" mode; Dampers are "OPEN"  
36 3) Switch in "OFF" mode; Dampers are "CLOSED"  
37 4) Switch in "AUTO" mode; Dampers are controlled by room mounted thermostat:  
38 a) Room temperature above set point (80 DegF adjustable); Dampers are  
39 "OPEN".  
40 b) Room temperature below set point; Dampers are "CLOSED".  
41 d. Motor operated dampers FP-MOD-13 thru FP-MOD-25:  
42 1) Dampers are controlled thru a "HAND-OFF-AUTO" switch  
43 2) Switch in "HAND" mode; Dampers are "OPEN"  
44 3) Switch in "OFF" mode; Dampers are "CLOSED"  
45 4) Switch in "AUTO" mode; Dampers are controlled by room mounted thermostat:  
46 a) Room temperature above set point (80 DegF adjustable); Dampers are  
47 "OPEN".  
48 b) Room temperature below set point; Dampers are "CLOSED".  
49 6. Filter Plant Chemical Addition:  
50 a. Steam unit heater FC-UH-01:  
51 1) Coil is wild.  
52 2) Heater motor is controlled by wall mounted thermostat:  
53 a) Room temperature above set point (75 DegF adjustable); Motor is "OFF".  
54 b) Room temperature below set point; Motor is "ON".  
55 b. Exhaust fan FC-EF-01:  
56 1) Fan is circuited from panel board.  
57 2) Fan runs continuous.  
58 c. Exhaust fan FC-EF-02:  
59 1) Fan is circuited from panel board.  
60 2) Fan is controlled thru a "HAND-OFF-AUTO":  
61 3) Switch in "HAND" mode; FAN is "ON"

- 1 4) Switch in "OFF" mode; FAN is "OFF"
- 2 5) Switch in "AUTO" mode; FAN is interlocked with end switch on Motor Operated
- 3 Damper FC-MOD-02.:
- 4 a) Damper "OPEN"; Fan is "ON".
- 5 b) Damper "CLOSED"; Fan is "OFF".
- 6 d. Motor Operated Damper FC-MOD-01:
- 7 1) Circuited from panel board.
- 8 2) Damper is controlled thru a "HAND-OFF" switch:
- 9 3) Switch in "HAND" mode; Damper is "OPEN"
- 10 4) Switch in "OFF" mode; Damper is "CLOSED"
- 11 e. Motor Operated Damper FC-MOD-02:
- 12 1) Circuited from panel board.
- 13 2) Damper is controlled thru a "HAND-OFF-AUTO" switch:
- 14 3) Switch in "HAND" mode; Damper is "OPEN"
- 15 4) Switch in "OFF" mode; Damper is "CLOSED"
- 16 5) Switch is "AUTO" mode; Damper is controlled by wall mounted thermostat:
- 17 a) Room temperature above set point (75 DegF adjustable); Damper is "OPEN".
- 18 b) Room temperature below set point; Damper is "CLOSED".
- 19 f. Unit heater FC-EUH-01 and FC-EUH-02:
- 20 1) Heaters are controlled by wall mounted thermostat:
- 21 a) Room temperature above set point (75 DegF adjustable); Heaters are "OFF".
- 22 b) Room temperature below set point; Heaters are "ON".
- 23 g. Unit heater FC-EUH-03:
- 24 1) Heaters are controlled by unit mounted thermostat:
- 25 a) Room temperature above set point (75 DegF adjustable); Heater is "OFF".
- 26 b) Room temperature below set point; Heater is "ON".
- 27 h. Unit heater FC-EUH-04:
- 28 1) Heaters are controlled by unit mounted thermostat:
- 29 a) Room temperature above set point (75 DegF adjustable); Heater is "OFF".
- 30 b) Room temperature below set point; Heater is "ON".

#### 31 1.4 SUBMITTALS

- 32 A. Shop Drawings:
- 33 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 34 the submittal process.
- 35 2. Wiring diagrams showing point to point termination with auxiliary interlocks for each item in
- 36 each control loop.
- 37 3. Information on equipment proposed for use including corrosion protection.
- 38 4. Instrument loop diagrams and word description of loop function for each individual unit
- 39 controlled including auxiliary interlocks in full compliance with ISA S5.4.
- 40 a. Show components in system and ensure diagrams are in full compliance with ISA S5.1
- 41 (Instrumentation Symbols and Identification) and other related ISA standards.
- 42 B. Quality Control Submittals:
- 43 1. Secure from equipment manufacturers, detailed and complete control and power wiring
- 44 diagrams, word descriptions of controls provided as part of the HVAC equipment or
- 45 equipment interfaced or interlocked thereto, and submit with equipment manufacturer's
- 46 submittals.
- 47 a. Provide the above information to control manufacturer.
- 48 C. Operation and Maintenance Manuals:
- 49 1. See Specification Section 01342 for requirements for:
- 50 a. The mechanics and administration of the submittal process.
- 51 b. The content of Operation and Maintenance Manuals.

#### 52 1.5 PROJECT CONDITIONS

- 53 A. Unless stated otherwise, the environment and air streams will include varying concentrations of
- 54 the following chemical components:
- 55 1. Condensation.

1 **PART 2 - PRODUCTS**

2 **2.1 ACCEPTABLE MANUFACTURERS**

- 3 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:  
4 1. Manufacturer's catalog numbers hereinafter are for reference to type, style, dimension,  
5 related items and to establish a standard of quality.  
6 a. Reference to a manufacturer's number hereinafter does not imply full compliance to  
7 these Specifications.  
8 2. Instrumentation and control systems:  
9 a. Honeywell.  
10 b. Johnson Control Co.  
11 B. Submit request for substitution in accordance with Specification Section 01640.

12 **2.2 EQUIPMENT**

- 13 A. Dampers:  
14 1. Refer to Specification Section 15890.  
15 B. Damper Operators:  
16 1. Provide operators of proper size and number to secure true throttling or two-position action  
17 as required.  
18 2. Furnish damper operators for installation inside ductwork and attached to frame of damper,  
19 or installed outside ductwork and connected to extended shaft as required.  
20 3. Provide operators for outside air, spring-loaded with sufficient power to assure tight closing of  
21 dampers on fan shutdown or in the fail safe position indicated by "Sequence of Controls."  
22 4. Electric operators:  
23 a. Provide operators:  
24 1) Fully immersed in oil gear train.  
25 2) Enclosed in closed cast aluminum housing.  
26 b. As an alternate to 4.a.: Provide operators in NEMA 4X enclosure, Belimo ZS-300.  
27 c. Provide damper operators with integral spring return motor springs to make controls fail  
28 safe in position specified under "Sequence of Controls."  
29 d. Provide end switches permitting simultaneous operation or interlocking with other  
30 equipment.  
31 e. Provide separate electrical circuits for damper operators with no more than four (4)  
32 operators on a circuit.  
33 5. Coordinate with dampers provided:  
34 a. Provide damper operators that are rated for the required torque.  
35 b. If single damper operator can not meet torque requirement, provide sectional dampers  
36 to match operator torque.  
37 6. Ensure coordination to provide for the installation of tight closing dampers low leakage type  
38 (6 cfm per square foot at 4 IN WC pressure across damper) with compatible dampers,  
39 damper operators and related controls.  
40 C. Electric Control Instruments:  
41 1. Provide stainless steel sensing elements type thermostats with liquid filled, compensated  
42 thermal systems so that equally spaced dial graduations are possible over entire range.  
43 a. Make thermal systems field detachable with averaging or plain bulbs as installation  
44 conditions dictate.  
45 b. Provide sensing elements minimum of 60 IN in length and suitable for operation from -30  
46 to 300 DegF.  
47 c. Provide reverse acting on-off type thermostats for controlling ventilating fans.  
48 d. Provide multiple stage thermostats where designated in Paragraph "Sequence of  
49 Operation."  
50 2. Provide transformers for supplying current to control equipment operating at less than 120 V  
51 and where required by manufacturer's automatic control system design capable of supplying  
52 125 percent of energy requirements of equipment connected for not less than 1 HR.  
53 a. Enclose transformers in UL listed cabinets with conduit connections.  
54 b. Provide fused disconnect switches on both primary and secondary sides.  
55 c. Provide in full compliance with Division 16 Specification Sections.

- 1 3. Provide each thermostat with an accurate red-reading thermometer sensing temperature
- 2 outside of enclosure.
- 3 4. Label thermostat with identification tag of HVAC equipment controlled using phenolic
- 4 nameplate in accordance with Specification Section 10400.
- 5 D. Local Temperature Control Panel:
- 6 1. Panel shall be floor or wall-mounted and be sized to accommodate electrical switches,
- 7 protective devices (except electrical switches and devices furnished as an integral part of air
- 8 handling unit).
- 9 2. Manufacture panels in one (1) of the following manners:
- 10 a. NEMA electrical panel boxes with windows.

## 11 2.3 FABRICATION

- 12 A. Corrosion Protection:
- 13 1. Protect metal parts of controls, instrumentation and related items from corrosive atmosphere
- 14 by either protective coatings or select materials.
- 15 a. Aluminum and stainless steel require no further protection.
- 16 2. Provide NEMA 4X fiberglass control enclosures with tempered glass windows and vapor tight
- 17 gaskets, illustrated in Hoffman Bulletin A-50, for protection of controls from corrosive
- 18 environment.
- 19 a. Install control instruments inside enclosure and extend remote stainless steel sensing
- 20 elements through enclosure wall.
- 21 b. Provide vapor tight seals for penetrations of enclosure.
- 22 3. Provide in each enclosure industrial corrosion inhibitors, Hoffman Corrosion Inhibitors, as
- 23 illustrated in Hoffman's technical Bulletin HCl.
- 24 4. Protect metal accessory items such as mounting brackets and fasteners not stainless steel,
- 25 fiberglass or aluminum by epoxy or phenolic coatings.
- 26 5. Protect electric motor operator with corrosion inhibitors inside enclosure.

## 27 PART 3 - EXECUTION

### 28 3.1 INSTALLATION

- 29 A. Comply with requirements of Specification Section 16120 and Specification Section 16130.
- 30 B. Identification: See Specification Section 10400.
- 31 C. Connect control devices to perform functions indicated and perform in required sequence.
- 32 D. Use remote element temperature transmitters for points of temperature transmitters for points of
- 33 temperature measurement occurring in air ducts or shafts, or in mechanical piping system.
- 34 E. Use remote element pressure transmitters of panel-mounted pressure gages.
- 35 F. Where continuous indication of space temperature is on local control panels, install a thermostat
- 36 and a temperature transmitter side by side.
- 37 1. Pipe continuous indication signal to a receiver on panel.
- 38 2. A resistance element or thermocouple signal may be used with continuous indicating meter,
- 39 calibrated in degrees Fahrenheit.
- 40 G. In general, locate thermostats for room control immediately inside door, above light switch, unless
- 41 shown otherwise.
- 42 1. Where light switch is in an entryway to room, locate thermostat on wall within room so it is
- 43 capable of sensing true space conditions.
- 44 2. Prior to installation, coordinate thermostat location with Engineer.
- 45 H. Mount local control panels adjacent to equipment served.
- 46 I. Where a temperature indicating gage is used at the panel, a pressure gage indicating transmitter
- 47 signal is not required.
- 48 J. Locate panels so visual observation and adjustment can be accomplished from floor level.

## 49 END OF SECTION





1 2014/09/08

2

## SECTION 15990

3

### HVAC SYSTEMS: BALANCING AND TESTING

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

###### A. Section Includes:

7

1. Adjusting, balancing, and testing of all heating, ventilating and air conditioning (HVAC) systems, including the following systems:

8

9

###### B. Related Sections include but are not necessarily limited to:

10

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

11

2. Division 01 - General Requirements.

12

3. Section 15605 - HVAC: Equipment.

13

4. Section 15890 - HVAC: Ductwork.

14

5. Section 15970 - Instrumentation and Control for HVAC Systems.

15

##### 1.2 QUALITY ASSURANCE

16

###### A. Referenced Standards:

17

1. Associated Air Balance Council (AABC):

18

- a. National Standards for Total System Balance.

19

2. American Industrial Hygiene Association (AIHA):

20

- a. Z9.5, Laboratory Ventilation.

21

3. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):

22

- a. HVAC Applications Handbook, Chapter entitled "Laboratories."

23

- b. HVAC Systems and Equipment Handbook, Chapter entitled "Testing, Adjusting, and Balancing."

24

4. National Environmental Balancing Bureau (NEBB):

25

- a. Procedural Standards for Testing Adjusting Balancing of Environmental Systems.

26

###### B. Qualifications:

27

1. Work of this Section to be accomplished by an independent testing and balancing firm certified by one (1) of the following:

28

- a. Associated Air Balance Council (AABC).

29

- b. National Environmental Balancing Bureau (NEBB).

30

- c. Other certification entity approved by Engineer.

31

2. The independent firm shall not be the same firm as the firm installing the HVAC equipment, nor under contract to the firm installing the equipment.

32

33

##### 1.3 SUBMITTALS

34

###### A. Shop Drawings:

35

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

36

2. Certifications:

37

- a. Letter stating the name and qualifications of the firm proposed.

38

- b. Evidence that relevant subcontractors have been notified of the requirement to coordinate balance and test elements in the work with the testing and balancing firm.

39

3. Report forms:

40

- a. Procedures and forms to be used in calibrating of test instruments, balancing systems, and recording and reporting test data.

41

42

###### B. Informational Submittals:

43

1. Completed test reports and data forms upon completion of installation, balance and testing of HVAC systems.

44

- a. Insert recorded information on report forms required by specifications and approved for use on project.

45

46

47

- 1           b. Additional written verification and other related information clearly identifying project,  
2           date and specifics of verification.
- 3           c. Utilize report forms similar to those shown in Section V of AABC Standard.
- 4           d. Provide forms typed and signed by the testing and balancing firm.

5   **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)**

6   **PART 3 - EXECUTION**

7   **3.1 PREPARATION**

- 8           A. Secure approved Shop Drawings of all HVAC equipment.
- 9           B. Procedures and Forms:
  - 10           1. Submit procedures and forms to be used in calibration of test instruments, balancing
  - 11           systems, and recording and reporting test data.
  - 12           2. Obtain approval before beginning balancing and testing.
- 13           C. Do not begin balancing and testing until HVAC systems are complete and in full working order.
  - 14           1. Place HVAC systems into full operation and continue their operation during each working day
  - 15           of balancing and testing.
- 16           D. Provide qualified heating and ventilating Engineer(s) to supervise and perform balancing and
- 17           testing.
- 18           E. Review design Drawings, Specifications, approved Shop Drawings and other related items to
- 19           become thoroughly acquainted with the design of HVAC systems.
- 20           F. Check all installed systems against Contract Drawings, Specifications and Shop Drawings to see
- 21           that system is installed as required.
  - 22           1. Report deficiencies to the Engineer.
  - 23           2. Report deficiencies to Contractor for remedial action including providing corrective measures
  - 24           required in the function of any part of system to complete balancing.
- 25           G. Make necessary adjustments as required to balance the systems.

26   **3.2 FIELD QUALITY CONTROL**

- 27           A. Balance and Test Air Systems:
  - 28           1. Adjust equipment RPM to design requirements.
  - 29           2. Report motor full load amperes.
  - 30           3. Obtain design CFM at fans.
    - 31           a. Make pitot tube traverse of main supply and exhaust ducts within 5 percent.
    - 32           4. Test and record system static pressures, suction and discharge.
    - 33           5. Obtain design CFM for recirculated air.
    - 34           6. Obtain design CFM outside air.
    - 35           7. Test and record entering air temperatures, (DB).
    - 36           8. Test and record leaving air temperatures, (DB).
    - 37           9. Test and record leaving air temperatures, (WB).
    - 38           10. Adjust dampers in supply, exhaust and return air ducts to design CFM.
    - 39           11. Test diffusers, grilles, and registers as follows:
      - 40           a. Adjust to comply with design requirements within 10 percent.
      - 41           b. Identify location and area of each.
      - 42           c. Adjust face velocity to establish required CFM.
        - 43           1) Retest after initial adjustments.
      - 44           d. Adjust to minimize drafts and to ensure uniform air distribution in all areas.
    - 45           12. Identify and list size, type and manufacturer of diffusers, grilles, registers, and HVAC
    - 46           equipment.
      - 47           a. Use manufacturer's ratings on equipment to make required calculations.

- 1 13. Adjust and assure that the operation of automatically operated dampers are as specified.
- 2 a. Check and calibrate controls.
- 3 14. Prepare and submit reports.

4  
5

**END OF SECTION**





DIVISION 16  
ELECTRICAL





1 2014/09/05

2

## SECTION 16010

3

### ELECTRICAL: BASIC REQUIREMENTS

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

A. Section Includes: Basic requirements for electrical systems.

7

B. Related Specification Sections include but are not necessarily limited to:

8

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

9

2. Division 01 - General Requirements.

10

3. Section 05505 - Metal Fabrications.

11

4. Section 10400 - Identification Devices.

12

5. Section 11005 - Equipment: Basic Requirements.

13

6. Division 16 - Electrical.

14

7. Section 16120 - Wire and Cable - 600 Volt and Below.

15

8. Section 16130 - Raceways and Boxes.

16

##### 1.2 QUALITY ASSURANCE

17

A. Referenced Standards:

18

1. Aluminum Association (AA).

19

2. American Iron and Steel Institute (AISI).

20

3. ASTM International (ASTM):

21

a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

22

b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

23

4. ETL Testing Laboratories (ETL).

24

5. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

25

a. C2, National Electrical Safety Code (NESC).

26

6. National Electrical Manufacturers Association (NEMA):

27

a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

28

7. National Fire Protection Association (NFPA):

29

a. 70, National Electrical Code (NEC).

30

8. Underwriters Laboratories, Inc. (UL).

31

32

33

B. Where UL test procedures have been established for the product type, use UL or ETL approved electrical equipment and provide with the UL or ETL label.

34

35

##### 1.3 DEFINITIONS

36

A. For the purposes of providing materials and installing electrical work the following definitions shall be used.

37

1. Outdoor area: Exterior locations where the equipment is normally exposed to the weather and including below grade structures, such as vaults, manholes, handholes and in-ground pump stations.

38

2. Architecturally finished interior area: Offices, laboratories, conference rooms, restrooms, corridors and other similar occupied spaces.

39

3. Non-architecturally finished interior area: Pump, chemical, mechanical, electrical rooms and other similar process type rooms.

40

4. Highly corrosive and corrosive area: Areas identified on the Drawings where there is a varying degree of spillage or splashing of corrosive materials such as water, wastewater or chemical solutions; or chronic exposure to corrosive, caustic or acidic agents, chemicals, chemical fumes or chemical mixtures.

41

5. Hazardous areas: Class I, II or III areas as defined in NFPA 70.

42

6. Shop fabricated: Manufactured or assembled equipment for which a UL test procedure has not been established.

43

44

45

46

47

48

49

50

51

1 **1.4 SYSTEM DESCRIPTION**

- 2 A. Execution of this Contract will involve replacement of existing equipment.  
3 1. The Contractor is responsible for coordinating with the Engineer and the Owner which  
4 equipment shall remain in service throughout the duration of the project, which equipment  
5 can be out of service for extended periods, , and which equipment shall have a limited  
6 downtime, and to schedule his work accordingly.  
7 2. Temporary equipment and wiring, installed in accordance with the NFPA70, may be used if  
8 necessary to maintain operation or to limit downtime.  
9 3. Under no circumstances shall equipment be taken out of service without the Owner's  
10 permission.  
11 4. Comply with requirements of Specification Section 01601.

12 **1.5 SUBMITTALS**

- 13 A. Shop Drawings:  
14 1. See Specification Section 01340 for requirements for the mechanics and administration of  
15 submittal process.  
16 2. See Specification Section 11005 and individual specification sections for submittal  
17 requirements for products defined as equipment.  
18 3. General requirements:  
19 a. Provide manufacturer's technical information on products to be used, including product  
20 descriptive bulletin.  
21 b. Include data sheets that include manufacturer's name and product model number.  
22 1) Clearly identify all optional accessories.  
23 c. Acknowledgement that products are UL or ETL listed or are constructed utilizing UL or  
24 ETL recognized components.  
25 d. Manufacturer's delivery, storage, handling and installation instructions.  
26 e. Product installation details.  
27 f. See individual specification sections for any additional requirements.  
28 B. Operation and Maintenance Manuals:  
29 1. See Specification Section 01342 for requirements for:  
30 a. The mechanics and administration of the submittal process.  
31 b. The content process of Operation and Maintenance Manuals.  
32 C. When a Specification Section includes products specified in another Specification Section, each  
33 Specification Section shall have the required Shop Drawing transmittal form per Specification  
34 Section 01340 and all Specification Sections shall be submitted simultaneously.

35 **1.6 DELIVERY, STORAGE, AND HANDLING**

- 36 A. See Specification Section 01600.  
37 B. Protect nameplates on electrical equipment to prevent defacing.

38 **1.7 AREA DESIGNATIONS**

- 39 A. Designation of an area will determine the NEMA rating of the electrical equipment enclosures,  
40 types of conduits and installation methods to be used in that area.  
41 1. Outdoor areas:  
42 a. Wet.  
43 b. Also, corrosive and/or hazardous when specifically designated on the Drawings or in the  
44 Specifications.  
45 2. Indoor areas:  
46 a. Dry.  
47 b. Also, wet, corrosive and/or hazardous when specifically designated on the Drawings or  
48 in the Specifications.



1 **PART 2 - PRODUCTS**

2 **2.1 ACCEPTABLE MANUFACTURERS**

- 3 A. Subject to compliance with the Contract Documents, refer to specific Division 16 Specification  
4 Sections and specific material paragraphs below for acceptable manufacturers.
- 5 B. Submit request for substitution in accordance with Specification Section 01640.
- 6 C. Provide all components of a similar type by one (1) manufacturer.

7 **2.2 MATERIALS**

- 8 A. Electrical Equipment Support Pedestals and/or Racks:
- 9 1. Approved manufacturers:
- 10 a. Modular strut:
- 11 1) Unistrut Building Systems.
- 12 2) Eaton B-Line.
- 13 3) Globe Strut.
- 14 4) Thomas & Betts Superstrut.
- 15 2. Material requirements:
- 16 a. Modular strut:
- 17 1) Aluminum: AA Type 6063-T6.
- 18 2) Fiberglass: Fire-retardant polyester or vinylester resin, ASTM E84, UL 94.
- 19 b. Mounting hardware:
- 20 1) Stainless steel.
- 21 c. Anchorage per Specification Section 05505.

22 **PART 3 - EXECUTION**

23 **3.1 INSTALLATION**

- 24 A. Install and wire all equipment, including prepurchased equipment, and perform all tests necessary  
25 to assure conformance to the Drawings and Specification Sections and ensure that equipment is  
26 ready and safe for energization.
- 27 B. Install equipment in accordance with the requirements of:
- 28 1. NFPA 70.
- 29 2. IEEE C2.
- 30 3. The manufacturer's instructions.
- 31 C. In general, conduit routing is not shown on the Drawings.
- 32 1. The Contractor is responsible for routing all conduits including those shown on one-line and  
33 control block diagrams and home runs shown on floor plans.
- 34 2. Conduit routings and stub-up locations that are shown are approximate; exact routing to be  
35 as required for equipment furnished and field conditions.
- 36 D. When complete branch circuiting is not shown on the Drawings:
- 37 1. A homerun indicating panelboard name and circuit number will be shown and the circuit  
38 number will be shown adjacent to the additional devices (e.g., light fixture and receptacles)  
39 on the same circuit.
- 40 2. The Contractor is to furnish and install all conduit and conductors required for proper  
41 operation of the circuit.
- 42 3. The indicated home run conduit and conductor size shall be used for the entire branch  
43 circuit.
- 44 4. See Specification Section 16120 for combining multiple branch circuits in a common conduit.
- 45 E. Do not use equipment that exceed dimensions or reduce clearances indicated on the Drawings or  
46 as required by the NFPA 70.
- 47 F. Install equipment plumb, square and true with construction features and securely fastened.
- 48 G. Install electrical equipment, including pull and junction boxes, minimum of 6 IN from process, gas,  
49 air and water piping and equipment.

- 1 H. Install equipment so it is readily accessible for operation and maintenance, is not blocked or  
 2 concealed and does not interfere with normal operation and maintenance requirements of other  
 3 equipment.
- 4 I. Device Mounting Schedule:  
 5 1. Unless indicated otherwise on the Drawings, mounting heights are as indicated below:  
 6 a. Light switch (to center): 48 IN.  
 7 b. Receptacle in architecturally finished areas (to center): 18 IN.  
 8 c. Receptacle on exterior wall of building (to center): 18 IN.  
 9 d. Receptacle in non-architecturally finished areas (to center): 48 IN.  
 10 e. Telephone outlet in architecturally finished areas (to center): 18 IN.  
 11 f. Telephone outlet for wall-mounted phone (to center): 54 IN.  
 12 g. Safety switch (to center of operating handle): 54 IN.  
 13 h. Separately mounted motor starter (to center of operating handle): 54 IN.  
 14 i. Pushbutton or selector switch control station (to center): 48 IN.  
 15 j. Panelboard (to top): 72 IN.
- 16 J. Avoid interference of electrical equipment operation and maintenance with structural members,  
 17 building features and equipment of other trades.  
 18 1. When it is necessary to adjust the intended location of electrical equipment, unless  
 19 specifically dimensioned or detailed, the Contractor may make adjustments of up to 6 IN in  
 20 equipment location with the Engineer's approval.  
 21 a. 1 FT at grade, floor and roof level in any direction in the horizontal plane.  
 22 b. 1 FT for equipment other than lighting at ceiling level in any direction in the horizontal  
 23 plane.  
 24 c. 1 FT for lighting fixtures at ceiling level in any direction in the horizontal plane.  
 25 d. 1 FT on walls in a horizontal direction within the vertical plane.  
 26 e. Changes in equipment location exceeding those defined above require the Engineer's  
 27 approval.
- 28 K. Provide electrical equipment support system per the following area designations:  
 29 1. Dry areas:  
 30 a. Aluminum system consisting of aluminum channels and fittings with stainless steel nuts  
 31 and hardware.  
 32 2. Wet areas:  
 33 a. Aluminum system consisting of aluminum channels and fittings with stainless steel nuts  
 34 and hardware.  
 35 3. Corrosive areas:  
 36 a. Aluminum system consisting of aluminum channels and fittings with stainless steel nuts  
 37 and hardware.  
 38 b. Fiberglass system consisting of fiberglass channels and fittings, nuts and hardware.  
 39 4. Highly corrosive areas:  
 40 a. Fiberglass system consisting of fiberglass channels and fittings, nuts and hardware.
- 41 L. Provide all necessary anchoring devices and supports rated for the equipment load based on  
 42 dimensions and weights verified from approved submittals, or as recommended by the  
 43 manufacturer.  
 44 1. See Specification Section 05505.  
 45 2. Do not cut, or weld to, building structural members.  
 46 3. Do not mount safety switches or other equipment to equipment enclosures, unless enclosure  
 47 mounting surface is properly braced to accept mounting of external equipment.
- 48 M. Provide corrosion resistant spacers to maintain 1/4 IN separation between metallic equipment  
 49 and/or metallic equipment supports and mounting surface in wet areas, on below grade walls and  
 50 on walls of liquid containment or processing areas such as Basins, Clarifiers, Digesters,  
 51 Reservoirs, etc.
- 52 N. Do not place equipment fabricated from aluminum in direct contact with earth or concrete.
- 53 O. Screen or seal all openings into equipment mounted outdoors to prevent the entrance of rodents  
 54 and insects.
- 55 P. Do not use materials that may cause the walls or roof of a building to discolor or rust.
- 56 Q. Identify electrical equipment and components in accordance with Specification Section 10400.





1 2016/07/09

2

3

**SECTION 16050**  
**ELECTRICAL SCHEDULES**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6

A. Section Includes: Electrical Schedules.

7

B. Related Sections include but are not necessarily limited to:

8

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

9

2. Division 01 - General Requirements.

10

**1.2 SUBMITTALS**

11

A. Operation and Maintenance Manuals:

12

1. See Specification Section 01342 for requirements for:

13

a. The mechanics and administration of the submittal process.

14

b. The content of Operation and Maintenance Manuals.

15

2. Provide as-built conditions of all the schedules.

16

**PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)**

17

**PART 3 - EXECUTION**

18

**3.1 CABLE TRAY SCHEDULE**

19

A. See Attachment 16050A.

20

**3.2 CABLE SCHEDULES**

21

A. See Attachment 16050B.

22

**END OF SECTION**

23



## Cable Tray Schedule

Drawing Tray Number	Loading Width / Depth (in)	Minimum Cable Loading (lbs/ft)	Section Cable Type	Section Width (in)	Section Weight (lbs/ft)	Qty of Cables per Section	Section Fill (%)	Revision
CT-FP01-C*	36" / 3"	100	Section: 1	P2	18	20.9	29	75%
			Section: 2	C1	6	3.0	25	32%
			Section: 3	C2	3		1	
			Section: 4	C3	3	1.0	23	27%
			Section: 5	P4	6	7.2	2	58%
CT-FP01-N*	36" / 3"	100	Section: 1	P2	18	2.3	7	10%
			Section: 2	C1	12	3.6	25	18%
			Section: 3	C2	3	0.1	2	2%
			Section: 4	C3	3	1.0	24	28%
CT-FP01-S*	36" / 3"	100	Section: 1	P2	18	3.2	7	12%
			Section: 2	C1	12	3.3	24	17%
			Section: 3	C2	3		0	
			Section: 4	C3	3	1.0	24	28%
CT-FP02-C*	36" / 3"	100	Section: 1	P2	18	14.1	18	51%
			Section: 2	C1	12	0.9	9	5%
			Section: 3	C2	3	0.1	5	3%
			Section: 4	C3	3	0.6	14	16%
CT-FP02-N*	36" / 3"	100	Section: 1	P2	18	1.2	4	5%
			Section: 2	C1	12	3.5	26	18%
			Section: 3	C2	3		0	
			Section: 4	C3	3	1.1	25	29%
CT-FP02-S	36" / 3"	100	Section: 1	P2	18	3.9	9	15%
			Section: 2	C1	12	3.4	25	17%
			Section: 3	C2	3		1	
			Section: 4	C3	3	1.0	24	27%
CT-FP03-C*	36" / 3"	100	Section: 1	P2	18	14.6	16	51%
			Section: 2	C1	12	0.5	5	3%
			Section: 3	C2	3	0.1	7	4%
			Section: 4	C3	3	0.5	13	15%
CT-FP03-N*	36" / 3"	100	Section: 1	P2	18	2.8	11	12%
			Section: 2	C1	12	3.5	25	18%
			Section: 3	C2	3		0	
			Section: 4	C3	3	1.0	24	28%

## Cable Tray Schedule

Drawing Tray Number	Loading Width / Depth (in)	Minimum Cable Loading (lbs/ft)	Section Cable Type	Section Width (in)	Section Weight (lbs/ft)	Qty of Cables per Section	Section Fill (%)	Revision
CT-FP03-S*	36" / 3"	100						
			Section: 1	P2	18	2.7	3	9%
			Section: 2	C1	12	4.3	37	23%
			Section: 3	C2	3	0.0	1	1%
			Section: 4	C3	3	1.4	32	39%
CT-FP04-C*	36" / 3"	100						
			Section: 1	P2	18	15.7	20	56%
			Section: 2	C1	12	0.1	1	0%
			Section: 3	C2	3	0.0	2	1%
			Section: 4	C3	3	0.5	13	15%
CT-FP04-N*	36" / 3"	100						
			Section: 1	P2	18	0.8	3	3%
			Section: 2	C1	12	3.4	26	18%
			Section: 3	C2	3	0	0	
			Section: 4	C3	3	1.1	25	29%
CT-FP04-S*	36" / 3"	100						
			Section: 1	P2	18	2.7	8	11%
			Section: 2	C1	12	3.4	25	17%
			Section: 3	C2	3		0	
			Section: 4	C3	3	1.0	24	28%
CT-FP05-C*	36" / 3"	100						
			Section: 1	P2	24	34.4	30	87%
			Section: 2	C1	6		0	
			Section: 3	C2	3	0.6	23	16%
			Section: 4	C3	3	0.0	1	1%
CT-FP06-C*	36" / 3"	100						
			Section: 1	P2	18	6.6	8	23%
			Section: 2	C1	12		0	
			Section: 3	C2	3	0.5	20	14%
			Section: 4	C3	3		0	
CT-FP07-C*	36" / 3"	100						
			Section: 1	P2	18	5.1	10	19%
			Section: 2	C1	12	0.4	5	2%
			Section: 3	C2	3	0.3	11	8%
			Section: 4	C3	3	0.5	12	14%
CT-FP08-C*	36" / 3"	100						
			Section: 1	P2	18	2.3	6	9%
			Section: 2	C1	12	0.1	1	0%
			Section: 3	C2	3	0.3	8	7%
			Section: 4	C3	3	0.5	12	14%



## Cable Tray Schedule

Drawing Tray Number	Loading Width / Depth (in)	Minimum Cable Loading (lbs/ft)	Section Cable Type	Section Width (in)	Section Weight (lbs/ft)	Qty of Cables per Section	Section Fill (%)	Revision
<b>CT-FP09-C*</b>	<b>36" / 3"</b>	<b>100</b>						
			<b>Section: 1</b>	P2	18	5.2	5	18%
			<b>Section: 2</b>	C1	12	0.2	2	1%
			<b>Section: 3</b>	C2	3	0.0	2	1%
			<b>Section: 4</b>	C3	3		0	
<b>CT-FP10-C*</b>	<b>36" / 3"</b>	<b>100</b>						
			<b>Section: 1</b>	P2	18	3.0	5	10%
			<b>Section: 2</b>	C1	12	0.4	4	2%
			<b>Section: 3</b>	C2	3	0.1	2	2%
			<b>Section: 4</b>	C3	3		0	
<b>CT-FP11-C*</b>	<b>36" / 3"</b>	<b>100</b>						
			<b>Section: 1</b>	P2	18	2.7	5	11%
			<b>Section: 2</b>	C1	12	0.1	2	1%
			<b>Section: 3</b>	C2	3		0	
			<b>Section: 4</b>	C3	3	0.0	1	1%
<b>CT-FP12-C*</b>	<b>36" / 3"</b>	<b>100</b>						
			<b>Section: 1</b>	P2	18	2.0	4	8%
			<b>Section: 2</b>	C1	12	0.2	1	1%
			<b>Section: 3</b>	C2	3	0.1	3	2%
			<b>Section: 4</b>	C3	3		0	

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## Cable Tray Schedule

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Drawing Tray Number	Loading Width / Depth (in)	Minimum Cable Loading (lbs/ft)	Section Cable Type	Section Width (in)	Section Weight (lbs/ft)	Qty of Cables per Section	Section Fill (%)	Revision
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**NOTES:**

1. The trays can be subdivided into separate sections with the use of barriers. In the cable schedules the asterisks (\*) is replaced by a number that represents a specific section of the tray that has a barrier.
2. The fill percentage is based on calculations using the cables identified in the Cable Schedules. Additional cables can be installed in the field as long as the NEC requirements for cable tray fill is followed.
3. The listed Cable Types represent the type of cables that can be installed in that section of cable tray.
4. The fill percentage and weights are an estimate, actual installed fill and weight will change base on actual manufacturers data for the cables installed.

**CABLE TYPES:**

- C1 = NEC 725 Class 1, multiconductor power and control cables (e.g. process control, HVAC control).  
= NEC 760 Non-power limited FA cables.
- C2 = NEC 725, Class 2 and 3, multiconductor power and control cables  
(e.g. Low-voltage lighting, security, HVAC control).  
= NEC 760 Power-limited fire alarm cables.  
= NEC 800 Communication cables (e.g. DeviceNet, Foundation Fieldbus, telephone, LAN).
- C3 = Analog instrumentation cables.  
= NEC 770 Fiber optic cables.
- P1 = Bundled single conductor 250 kcmil and larger power cables.
- P2 = Multiconductor 4/0 AWG and smaller power cables.
- P3 = Bundled Single conductor 15kV cables.
- P4 = Multiconductor 4/0 AWG and larger power cables.

## Cable Schedule

Cable Number	Orgin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
00210-P1	SWITCHBOARD FP-SWBD-01 210 VALVE JUNCTION BOX	CT-FP01-C*	1	1 3/C W/G	10	
00EFT-A1	EAST FLUORIDE TANK LEVEL PROBE JBOX RELOCATED TANK MONITORING PANEL	CT-FP01-C*	4	1 TSP	16	
00EFT-A2	EAST FLUORIDE TANK SENSOR JBOX RELOCATED TANK MONITORING PANEL	CT-FP01-C*	4	1 TST	16	
00EFT-A3	EAST FLUORIDE TANK SENSOR JBOX RELOCATED TANK MONITORING PANEL	CT-FP01-C*	4	1 TST	16	
00FOT-C1	FUEL OIL TANK LEVEL PROBE JBOX RELOCATED TANK MONITORING PANEL	CT-FP01-C*	2	1 3/C	12	
00FT-C1	FLUORIDE TANK JBOX RELOCATED TANK MONITORING PANEL	CT-FP01-C*	2	1 3/C	14	
00FT-C2	FLUORIDE TANK JBOX RELOCATED TANK MONITORING PANEL	CT-FP01-C*	2	1 3/C	14	
00SEC-F1	AERATION BUILDING SECURITY RACK IN SERVER ROOM	CT-FP09-C*	3			
		CT-FP01-C*	3			
		CT-FP02-C*	3			
		CT-FP03-C*	3			
		CT-FP04-C*	3			
		CT-FP05-C*	3			
		CT-FP06-C*	3			

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
00SL-P1	SWITCHBOARD FP-SWBD-01 SITE LIGHTING JBOX IN CENTER GALLERY	CT-FP01-C*	1	1 4/C W/G	6	
		CT-FP02-C*	1			
		CT-FP03-C*	1			
		CT-FP04-C*	1			
		CT-FP05-C*	1			
00WFT-A1	WEST FLUORIDE TANK LEVEL PROBE JBOX RELOCATED TANK MONITORING PANEL	CT-FP01-C*	4	1 TSP	16	
00WFT-A2	WEST FLUORIDE TANK SENSOR JBOX RELOCATED TANK MONITORING PANEL	CT-FP01-C*	4	1 TST	16	
00WFT-A3	WEST FLUORIDE TANK SENSOR JBOX RELOCATED TANK MONITORING PANEL	CT-FP01-C*	4	1 TST	16	
AI500-A1	AI-500 CONTROL PANEL CP-0306	CT-FP08-C*	4	1 TSP	16	
		CT-FP07-C*	4			
		CT-FP04-C*	4			
		CT-FP03-C*	4			
		CT-FP02-C*	4			
		CT-FP01-C*	4			
AI501-A1	AI-501 CONTROL PANEL CP-0306	CT-FP08-C*	4	1 TSP	16	
		CT-FP07-C*	4			
		CT-FP04-C*	4			
		CT-FP03-C*	4			
		CT-FP02-C*	4			
		CT-FP01-C*	4			

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty	Description	Size (AWG/kcmil)	Revision
		Tray	Section				
AI506-A1	AI-506 CONTROL PANEL CP-0306	CT-FP08-C*	4	1	TSP	16	
		CT-FP07-C*	4				
		CT-FP04-C*	4				
		CT-FP03-C*	4				
		CT-FP02-C*	4				
		CT-FP01-C*	4				
AI511-A1	AI-511 CONTROL PANEL CP-0306	CT-FP08-C*	4	1	TSP	16	
		CT-FP07-C*	4				
		CT-FP04-C*	4				
		CT-FP03-C*	4				
		CT-FP02-C*	4				
		CT-FP01-C*	4				
AI520-A1	AI-520 CONTROL PANEL CP-0306	CT-FP08-C*	4	1	TSP	16	
		CT-FP07-C*	4				
		CT-FP04-C*	4				
		CT-FP03-C*	4				
		CT-FP02-C*	4				
		CT-FP01-C*	4				
AI521-A1	AI-521 CONTROL PANEL CP-0306	CT-FP08-C*	4	1	TSP	16	
		CT-FP07-C*	4				
		CT-FP04-C*	4				
		CT-FP03-C*	4				
		CT-FP02-C*	4				
		CT-FP01-C*	4				

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
AI522-A1	AI-522 CONTROL PANEL CP-0306	CT-FP08-C*	4	1 TSP	16	
		CT-FP07-C*	4			
		CT-FP04-C*	4			
		CT-FP03-C*	4			
		CT-FP02-C*	4			
		CT-FP01-C*	4			
AI523-A1	AI-523 CONTROL PANEL CP-0306	CT-FP08-C*	4	1 TSP	16	
		CT-FP07-C*	4			
		CT-FP04-C*	4			
		CT-FP03-C*	4			
		CT-FP02-C*	4			
		CT-FP01-C*	4			
AI524-A1	AI-524 CONTROL PANEL CP-0306	CT-FP08-C*	4	1 TSP	16	
		CT-FP07-C*	4			
		CT-FP04-C*	4			
		CT-FP03-C*	4			
		CT-FP02-C*	4			
		CT-FP01-C*	4			
AI525-A1	AI-525 CONTROL PANEL CP-0306	CT-FP08-C*	4	1 TSP	16	
		CT-FP07-C*	4			
		CT-FP04-C*	4			
		CT-FP03-C*	4			
		CT-FP02-C*	4			
		CT-FP01-C*	4			

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
AIT510-A1	AIT-510 CONTROL PANEL CP-0306	CT-FP08-C*	4	1 TSP	16	
		CT-FP07-C*	4			
		CT-FP04-C*	4			
		CT-FP03-C*	4			
		CT-FP02-C*	4			
		CT-FP01-C*	4			
B7-A1	BASIN 7 JUNCTION BOX IN CENTER GALLERY CONTROL PANEL CP-O306	CT-FP05-C*	4	1 TSP	16	
		CT-FP04-C*	4			
		CT-FP03-C*	4			
		CT-FP02-C*	4			
		CT-FP01-C*	4			
B7-P1	PANELBOARD FP-LP-01	CT-FP05-C*	1	1 3/C	12	
	BASIN 7 JUNCTION BOX IN CENTER GALLERY					
B8LIT401-A1	CONTROL PANEL CP-0306 LVL INDICATING TRANSMITTER LIT-401	CT-FP01-C*	4	1 TSP	16	
		CT-FP02-C*	4			
		CT-FP11-C*	4			
		CT-FP02-N*	4			
		CT-FP04-N*	4			
B8LSHH402-C1	CONTROL PANEL CP-0306 NEW JBOX IN NORTH GALLERY	CT-FP01-C*	2	1 2/C	14	
		CT-FP02-C*	2			
		CT-FP11-C*	2			
		CT-FP02-N*	2			
		CT-FP04-N*	2			
B8SLL403-C1	CONTROL PANEL CP-0306 NEW JBOX IN NORTH GALLERY	CT-FP01-C*	2	1 2/C	14	
		CT-FP02-C*	2			
		CT-FP11-C*	2			
		CT-FP02-N*	2			
		CT-FP04-N*	2			

## Cable Schedule

Cable Number	Orgin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/ kcmil)	Revision
		Tray	Section			
B8-P1	PANEL GN BASIN #8 JBOX IN NORTH GALLERY	CT-FP01-C*	1	1 2/C W/G	4	
		CT-FP02-C*	1			
		CT-FP11-C*	1			
		CT-FP02-N*	1			
		CT-FP04-N*	1			
FCFLAIT	FCFLAIT	CT-FP03-S*	4	1 TSP	16	
	QUAD 1 CONTROL PANEL					
FCFLDT01LSH	FCFLDT01LSH	CT-FP03-S*	2	1 2/C	14	
	QUAD 1 CONTROL PANEL					
FCFLDT01WIT	FCFLDT01WIT	CT-FP03-S*	4	1 TSP	16	
	QUAD 1 CONTROL PANEL					
FCFLDT01WSH	FCFLDT01WSH	CT-FP03-C*	2	1 2/C	14	
	QUAD 1 CONTROL PANEL					
FCFLFP01VFD-A1	FCFLFP01VFD	CT-FP03-S*	4	2 TSP	16	
	QUAD 1 CONTROL PANEL					
FCFLFP01VFD-C1	FCFLFP01VFD	CT-FP03-S*	2	1 2/C	14	
	QUAD 1 CONTROL PANEL					
FCFLFP02VFD-A1	FCFLFP02VFD	CT-FP03-S*	2	1 2/C	14	
	QUAD 1 CONTROL PANEL					
FCFLFP02VFD-C1	FCFLFP02VFD	CT-FP03-S*	4	2 TSP	16	
	QUAD 1 CONTROL PANEL					
FCFLFSH	FCFLFSH	CT-FP03-S*	2	1 2/C	14	
	QUAD 1 CONTROL PANEL					



## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FCFLSUMPLSH	FCFLSUMPLSH QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 2/C	14	
FCFLTP01-P1	SWITCHBOARD FP-SWBD-01 FLUORIDE TRANSFER PUMP FC-FLTP-01 MOTOR STARTER	CT-FP01-C*	1	1 4/C	12	
FCFLTP02-P1	SWITCHBOARD FP-SWBD-01 FLUORIDE TRANSFER PUMP FC-FLTP-02 MOTOR STARTER	CT-FP01-C*	1	1 4/C	12	
FCFLTP1	FCFLTP1 FC-FLTP01-MS	CT-FP02-C* CT-FP01-C* CT-FP10-C* CT-FP07-C* CT-FP02-C* CT-FP01-C*	2 2 2 2 2 2	1 4/C	14	
FCFLTP2	FCFLTP2 FC-FLTP02-MS	CT-FP01-C* CT-FP02-C* CT-FP07-C* CT-FP10-C* CT-FP02-S CT-FP03-S*	2 2 2 2 2 2	1 4/C	14	
FCFLTPHT-P1	PANELBOARD FP-LP-04 FLUORIDE TRANSFER PUMP ENCLOSURE HEAT TRACE	CT-FP01-C*	1	1 3/C	10	

## Cable Schedule

Cable Number	Orgin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FCFLTPLSH	FCFLTPLSH QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 2/C	14	
		CT-FP10-C*	2			
		CT-FP07-C*	2			
		CT-FP03-C*	2			
		CT-FP02-C*	2			
		CT-FP01-C*	2			
FCFLTPREC-P1	PANELBOARD FP-LP-04 FLUORIDE TRANSFER PUMP ENCLOSURE RECEPTACLE	CT-FP01-C*	1	1 3/C	12	
FCFLTPTSH	FCFLTPTSH QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 2/C	14	
		CT-FP10-C*	2			
		CT-FP07-C*	2			
		CT-FP03-C*	2			
		CT-FP02-C*	2			
		CT-FP01-C*	2			
FCIH01-P1	MAIN SWITCHBOARD MSB INSTANT WATER HEATER FC-EWH-01	CT-FP01-C*	1	1 3/C W/G	3/0	
		CT-FP02-C*	1			
		CT-FP03-C*	1			
		CT-FP04-C*	1			
		CT-FP07-C*	1			
		CT-FP10-C*	1			
		CT-FP01-S*	1			
		CT-FP03-S*	1			

## Cable Schedule

Cable Number	Orgin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/ kcmil)	Revision
		Tray	Section			
FCLP01-P1	PANEL FP-PLD-01  LIGHTING PANEL FC-LP-01	CT-FP05-C*	1	1 3/C W/G	1/0	
		CT-FP04-C*	1			
		CT-FP03-C*	1			
		CT-FP02-C*	1			
		CT-FP09-C*	1			
		CT-FP02-S	1			
		CT-FP04-S*	1			
FCPFPLSHH	FCPFPLSHH  QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 2/C	14	
FCPODT01WIT	FCPODT01WIT  QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FCPOST01LIT	FCPOST01LIT  QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FCPOST01LSH	FCPOST01LSH  QUAD 1 CONTROL PANEL	CT-FP04-S*	2	1 2/C	14	
FCPOST01LSHH	FCPOST01LSHH  QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 2/C	14	
FCSHFP01	FCSHP01  QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 4/C	14	
FCSHFP02	FCSHP02  QUAD CONTROL PANEL	CT-FP03-S*	2	1 4/C	14	
FCSHST01LIT	FCSHST01LIT  QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	

## Cable Schedule

Cable Number	Orgin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FCSHT02LIT	FCSHT02LIT QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FPAD01-P1	PANELBOARD FP-LP-04 AIR DRYER/TANK RECEPTACLE	CT-FP01-C*	1	1 3/C	12	
FPAIRC01-P1	SWITCHBOARD FP-SWBD-01 AIR COMPRESSOR #1 SAFETY SWITCH	CT-FP01-C*	1	1 3/C W/G	2	
FPAIRC02-P1	SWITCHBOARD FP-SWBD-01 AIR COMPRESSOR #2 SAFETY SWITCH	CT-FP01-C*	1	1 3/C W/G	2	
FPA-P1	PANEL FP-PLD-02 PANEL A	CT-FP05-C* CT-FP07-C* CT-FP08-C*	1 1 1	1 4/C W/G	1	
FPATS01-P1	CIRCUIT BREAKER FP-CB-1 AUTOMATIC TRANSFER SWITCH FP-ATS-1	CT-FP01-C*	5	1 4/C W/G	4/0	
FPATS01-P2	CIRCUIT BREAKER FP-CB-1 AUTOMATIC TRANSFER SWITCH FP-ATS-1	CT-FP01-C*	5	1 4/C W/G	4/0	
FPBUSNET06	NEAR COL. F9 LWR. LEVEL FP-114 NETWORK RACK	CT-FP08-C* CT-FP08-C* CT-FP05-C* CT-FP06-C*	3 3 3 3	2 CAT 6	24	
FPBUSNET-E1	FP-111 WORK STATION FP-114 NETWORK RACK	CT-FP12-C* CT-FP07-C* CT-FP05-C* CT-FP06-C*	3 3 3 3	1 CAT 6	24	

## Cable Schedule

Cable Number	Orgin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty	Description	Size (AWG/kcmil)	Revision
		Tray	Section				
FPBUSNET-E10	FP-106 CENTER CONSOLE FP-114 NETWORK RACK	CT-FP06-C*	3	1	CAT 6	24	
		CT-FP05-C*	3				
		CT-FP03-C*	3				
		CT-FP02-C*	3				
FPBUSNET-E11	FP-106 CENTER CONSOLE FP-114 NETWORK RACK	CT-FP06-C*	3	1	CAT 6	24	
		CT-FP05-C*	3				
		CT-FP03-C*	3				
		CT-FP02-C*	3				
FPBUSNET-E12	FP-106 CENTER CONSOLE FP-114 NETWORK RACK	CT-FP06-C*	3	1	CAT 6	24	
		CT-FP05-C*	3				
		CT-FP03-C*	3				
		CT-FP02-C*	3				
FPBUSNET-E13	QUAD 1 CONTROL PANEL FP-114 NETWORK RACK	CT-FP06-C*	3	1	CAT 6	24	
		CT-FP05-C*	3				
		CT-FP07-C*	3				
		CT-FP10-C*	3				
		CT-FP03-S*	2				
FPBUSNET-E14	QUAD 1 CONTROL PANEL FP-114 NETWORK RACK	CT-FP06-C*	3	1	CAT 6	24	
		CT-FP05-C*	3				
		CT-FP07-C*	3				
		CT-FP10-C*	3				
		CT-FP03-S*	3				
FPBUSNET-E15	QUAD 3 CONTROL PANEL FP-114 NETWORK RACK	CT-FP01-N*	3	1	CAT 6	24	
		CT-FP12-C*	3				
		CT-FP05-C*	3				
		CT-FP06-C*	3				

## Cable Schedule

Cable Number	Orgin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPBUSNET-E16	QUAD 3 CONTROL PANEL FP-114 NETWORK RACK	CT-FP01-N*	3	1 CAT 6	24	
		CT-FP12-C*	3			
		CT-FP05-C*	3			
		CT-FP06-C*	3			
FPBUSNET-E17	COLUMN F8 LOWER LEVEL FP-114 NETWORK RACK	CT-FP05-C*	3	1 CAT 6	24	
		CT-FP06-C*	3			
FPBUSNET-E18	COLUMN F8 LOWER LEVEL FP-114 NETWORK RACK	CT-FP05-C*	3	1 CAT 6	24	
		CT-FP06-C*	3			
FPBUSNET-E19	NEAR COL. F9 LWR. LEVEL FP-114 NETWORK RACK	CT-FP09-C*	3	1 CAT 6	24	
		CT-FP07-C*	3			
		CT-FP05-C*	3			
		CT-FP07-C*	3			
FPBUSNET-E2	FP-111 WORK STATION FP-114 NETWORK RACK	CT-FP06-C*	3	1 CAT 6	24	
		CT-FP05-C*	3			
		CT-FP07-C*	3			
		CT-FP08-C*	3			
FPBUSNET-E20	NEAR COL. F9 LWR. LEVEL FP-114 NETWORK RACK	CT-FP08-C*	3			
		CT-FP07-C*	3			
		CT-FP05-C*	3			
		CT-FP06-C*	3			
FPBUSNET-E3	FP-111 WORK STATION FP-114 NETWORK RACK	CT-FP06-C*	3	1 CAT 6	24	
		CT-FP05-C*	3			
		CT-FP07-C*	3			
		CT-FP08-C*	3			

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty	Description	Size (AWG/kcmil)	Revision
		Tray	Section				
FPBUSNET-E4	FP-111 WORK STATION FP-114 NETWORK RACK	CT-FP06-C*	3	1	CAT 6	24	
		CT-FP05-C*	3				
		CT-FP07-C*	3				
		CT-FP08-C*	3				
FPBUSNET-E5	FP-111 WORK STATION FP-114 NETWORK RACK	CT-FP06-C*	3	1	CAT 6	24	
		CT-FP05-C*	3				
		CT-FP07-C*	3				
		CT-FP08-C*	3				
FPBUSNET-E6	FP-111 WORK STATION FP-114 NETWORK RACK	CT-FP06-C*	3	1	CAT 6	24	
		CT-FP05-C*	3				
		CT-FP07-C*	3				
		CT-FP08-C*	3				
FPBUSNET-E7	FP-106 CENTER CONSOLE FP-114 NETWORK RACK	CT-FP05-C*	3	1	CAT 6	24	
		CT-FP05-C*	3				
		CT-FP03-C*	3				
		CT-FP04-C*	3				
FPBUSNET-E8	FP-106 CENTER CONSOLE FP-114 NETWORK RACK	CT-FP06-C*	3	1	CAT 6	24	
		CT-FP05-C*	3				
		CT-FP03-C*	3				
		CT-FP02-C*	3				
FPBUSNET-E9	FP-106 CENTER CONSOLE FP-114 NETWORK RACK	CT-FP06-C*	3				
		CT-FP05-C*	3				
		CT-FP03-C*	3				
		CT-FP02-S	3				
FPBWP301-C1	BACKWASH PUMP 301 VFD VFVDBWP301	CT-FP01-C*	2	1	3/C	12	
	BACKWASH PUMP BWP301 DISCONNECT MOTOR HEATER POWER						

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPBWP301-C2	BACKWASH PUMP 301 VFD VFVDBWP301	CT-FP01-C*	2	1 2/C	14	
	BACKWASH PUMP BWP301 DISCONNECT					
FPBWP301-P1	BACKWASH PUMP 301 VFD VFVDBWP301	CT-FP01-C*	1	1 3/C W/G	2/0	
	BACKWASH PUMP BWP301 DISCONNECT					
FPBWP302-C1	BACKWASH PUMP 302 VFD VFVDBWP302	CT-FP01-C*	2	1 3/C	12	
	BACKWASH PUMP BWP302 DISCONNECT	CT-FP09-C*	2			
	MOTOR HEATER POWER					
FPBWP302-C2	BACKWASH PUMP 302 VFD VFVDBWP302	CT-FP01-C*	2	1 2/C	14	
	BACKWASH PUMP BWP302 DISCONNECT	CT-FP09-C*	2			
FPBWP302-P1	BACKWASH PUMP 302 VFD VFVDBWP302	CT-FP01-C*	1	1 3/C W/G	2/0	
	BACKWASH PUMP BWP302 DISCONNECT	CT-FP09-C*	1			
FPCLP01-P1	MANUAL TRANSFER SWITCH FP-MTS-01	CT-FP05-C*	1	1 4/C W/G	1/0	
	CRITICAL LOADS PANEL FP-CLP-01	CT-FP06-C*	1			
FPCP0306-P1	CRITICAL LOADS PANEL FP-CLP-01	CT-FP06-C*	1	1 3/C	12	
	CONTROL PANEL CP-0306	CT-FP05-C*	1			
		CT-FP04-C*	1			
		CT-FP03-C*	1			
		CT-FP02-C*	1			
		CT-FP01-C*	1			
FPCV301-A1	CONTROL VALVE CV-301 CP	CT-FP01-C*	4	1 TSP	16	
	CONTROL PANEL CP-0306					
FPCV301-A2	CONTROL PANEL CP-0306	CT-FP01-C*	4	1 TSP	16	
	CONTROL VALVE CV-301 CP					



## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPCV301-C1	CONTROL VALVE CV-301 CP CONTROL PANEL CP-0306	CT-FP01-C*	2	1 7/C	14	
FPCV301-C2	CONTROL VALVE CV-301 CP CONTROL PANEL CP-0306	CT-FP01-C*	2	1 7/C	14	
FPCV301-P1	SWITCHBOARD FP-SWBD-01 CONTROL VALVE CV-301 SAFETY SWITCH	CT-FP01-C*	1	1 4/C	12	
FPCV302-C1	CONTROL VALVE CV-302 CP CONTROL PANEL CP-0306	CT-FP01-C*	2	1 7/C	14	
FPCV302-C2	CONTROL VALVE CV-302 CP CONTROL PANEL CP-0306	CT-FP01-C*	2	1 7/C	14	
FPCV302-P1	SWITCHBOARD FP-SWBD-01 CONTROL VALVE CV-302 SAFETY SWITCH	CT-FP01-C*	1	1 4/C	12	
FDPH01-P1	MAIN SWITCHBOARD MSB DEHUMIDIFIER FP-DH-01	CT-FP01-C* CT-FP02-C* CT-FP03-C* CT-FP12-C* CT-FP01-N* CT-FP03-N*	1 1 1 1 1 1	1 3/C W/G	6	
FDPH02-P1	MAIN SWITCHBOARD MSB DEHUMIDIFIER FP-DH-02	CT-FP01-C* CT-FP02-C* CT-FP11-C* CT-FP02-N*	1 1 1 1	1 3/C W/G	6	

## Cable Schedule

Cable Number	Orgin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/ kcmil)	Revision
		Tray	Section			
FPDH03-P1	MAIN SWITCHBOARD MSB DEHUMIDIFIER FP-DH-03	CT-FP01-C*	1	1 4/C	10	
		CT-FP02-C*	1			
		CT-FP03-C*	1			
		CT-FP04-C*	1			
		CT-FP07-C*	1			
		CT-FP08-C*	1			
FPDH04-P1	MAIN SWITCHBOARD MSB DEHUMIDIFIER FP-DH-04	CT-FP01-C*	1	1 3/C W/G	6	
		CT-FP09-C*	1			
		CT-FP02-S	1			
		CT-FP04-S*	1			
FPEB-C1	BLOWER STARTER FP-RVSS-2 EAST AIR SCOUR BLOWER SURGE PANEL	CT-FP01-C*	2	1 7/C	14	
FPEB-C2	BLOWER STARTER FP-RVSS-2 EAST AIR SCOUR BLOWER SELECTOR SWITCH	CT-FP01-C*	2	1 7/C	14	
FPEB-P1	BLOWER STARTER FP-RVSS-2 EAST AIR SCOUR BLOWER DISCONNECT	CT-FP01-C*	1	1 3/C W/G	1	
FPEF1-P1	PANEL FP-PLD-02 PANELEF-1	CT-FP05-C*	1	1 4/C W/G	1/0	
		CT-FP04-C*	1			
		CT-FP03-C*	1			
		CT-FP11-C*	1			
FPF01AIT-A1	FB1 TURBIDITY TRANSMITTER FP-F01-AIT QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FPF01ALIT-A1	FB1 CELL A LEVEL TRANSMITTER FP-F1A-LIT QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF01BLIT-A1	FB1 CELL B LEVEL TRANSMITTER FP-F1B-LIT QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FPF01CVA-C1	FB1 Influent Valve FPF01CV-A QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 7/C	14	
FPF01CVB-C1	FB1 DRAIN VALVE FPF01CV-B QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 7/C	14	
FPF01CVC-C1	FB1 Wash Water Valve FPF01CV-C QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 7/C	14	
FPF01CVDA-C1	FB1 Wash Water Left Cell VALVE FPF01CV-DA QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 7/C	14	
FPF01CVDB-C1	FB1 Wash Water Right Cell VALVE FPF01CV-DB QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 7/C	14	
FPF01CVE-A1	FB1 EFFLUENT VALVE FPF01CV-E QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FPF01CVE-C1	FB1 EFFLUENT VALVE FPF01CV-E QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 4/C	14	
FPF01CVF-A1	FB1 FILTER TO WASTE VALVE FPF01CV-F QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FPF01CVF-A2	FB1 FILTER TO WASTE VALVE FPF01CV-F QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FPF01CVGA-C1	FB1 LEFT AIR WASH VALVE FPF01CV-GA QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 3/C	14	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF01CVGB-C1	FB1 RIGHT AIR WASH VALVE FPF01CV-GB QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 3/C	14	
FPF01FIT-A1	FB1 FLOW TRANSMITTER FP-F01-FIT QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FPF01PDIT-A1	FB1 DIFF PRESSURETRANSMITTER FP-F01-PDIT QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FPF02AIT-A1	FB2 TURBIDITY TRANSMITTER FP-F02-AIT QUAD 2 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	
FPF02ALIT-A1	FB2 CELL A LEVEL TRANSMITTER FP-F2A-LIT QUAD 2 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	
FPF02BLIT-A1	FB2 CELL B LEVEL TRANSMITTER FP-F2B-LIT QUAD 2 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	
FPF02CVA-C1	FB2 INFLUENT VALVE FPF02CV-A QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 7/C	14	
FPF02CVB-C1	FB2 DRAIN VALVE FPF02CV-B QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 7/C	12	
FPF02CVC-C1	FB2 Wash Water Valve FPF02CV-C QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 7/C	14	
FPF02CVDA-C1	FB2 Wash Water Left Cell VALVE FPF02CV-DA QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 7/C	14	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF02CVDB-C1	FB2 Wash Water Right Cell VALVE FPF02CV-DB QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 7/C	14	
FPF02CVE-A1	FB2 EFFLUENT VALVE FPF02CV-E QUAD 2 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	
FPF02CVE-C1	FB2 EFFLUENT VALVE FPF02CV-E QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 4/C	14	
FPF02CVF-A1	FB2 FILTER TO WASTE VALVE FPF02CV-F QUAD 2 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	
FPF02CVF-A2	FB2 FILTER TO WASTE VALVE FPF02CV-F QUAD 2 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	
FPF02CVGA-C1	FB2 LEFT AIR WASH VALVE FPF02CV-GA QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 3/C	14	
FPF02CVGB-C1	FB2 RIGHT AIR WASH VALVE FPF02CV-GB QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 3/C	14	
FPF02FIT-A1	FB2 FLOW TRANSMITTER FP-F02-FIT QUAD 2 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	
FPF02PDIT-A1	FB2 DIFF PRESSURETRANSMITTER FP-F02-PDIT QUAD 2 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	
FPF03AIT-A1	FB3 TURBIDITY TRANSMITTER FP-F03-AIT QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF03ALIT-A1	FB3 CELL A LEVEL TRANSMITTER FP-F3A-LIT QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FPF03BLIT-A1	FB3 CELL B LEVEL TRANSMITTER FP-F3B-LIT QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FPF03CVA-C1	FB3 Influent Valve FPF03CV-A QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 7/C	14	
FPF03CVB-C1	FB3 DRAIN VALVE FPF03CV-B QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 7/C	14	
FPF03CVC-C1	FB3 Wash Water Valve FPF03CV-C QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 7/C	14	
FPF03CVDA-C1	FB3 Wash Water Left Cell VALVE FPF03CV-DA QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 7/C	14	
FPF03CVDB-C1	FB3 Wash Water Right Cell VALVE FPF03CV-DB QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 7/C	14	
FPF03CVE-A1	FB3 EFFLUENT VALVE FPF03CV-E QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FPF03CVE-C1	FB3 EFFLUENT VALVE FPF03CV-E QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 4/C	14	
FPF03CVF-A1	FB3 FILTER TO WASTE VALVE FPF03CV-F QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FPF03CVF-A2	FB3 FILTER TO WASTE VALVE FPF03CV-F QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/ kcmil)	Revision
		Tray	Section			
FPF03CVGA-C1	FB3 LEFT AIR WASH VALVE FPF03CV-GA QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 3/C	14	
FPF03CVGB-C1	FB3 RIGHT AIR WASH VALVE FPF03CV-GB QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 3/C	14	
FPF03FIT-A1	FB3 FLOW TRANSMITTER FP-F03-FIT QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FPF03PDIT-A1	FB3 DIFF PRESSURE TRANSMITTER FP-F03-PDIT QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FPF04AIT-A1	FB4 TURBIDITY TRANSMITTER FP-F04-AIT QUAD 2 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	
FPF04ALIT-A1	FB4 CELL A LEVEL TRANSMITTER FP-F4A-LIT QUAD 2 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	
FPF04BLIT-A1	FB4 CELL B LEVEL TRANSMITTER FP-F4B-LIT QUAD 2 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	
FPF04CVA-C1	FB4 INFLUENT VALVE FPF04CV-A QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 7/C	14	
FPF04CVB-C1	FB4 DRAIN VALVE FPF04CV-B QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 7/C	14	
FPF04CVC-C1	FB4 Wash Water Valve FPF04CV-C QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 7/C	14	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF04CVDA-C1	FB4 Wash Water Left Cell VALVE FPF04CV-DA QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 7/C	14	
FPF04CVDB-C1	FB4 Wash Water Right Cell VALVE FPF04CV-DB QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 7/C	14	
FPF04CVE-A1	FB4 EFFLUENT VALVE FPF04CV-E QUAD 2 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	
FPF04CVE-C1	FB4 EFFLUENT VALVE FPF04CV-E QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 4/C	14	
FPF04CVF-A1	FB4 FILTER TO WASTE VALVE FPF04CV-F QUAD 2 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	
FPF04CVF-A2	FB4 FILTER TO WASTE VALVE FPF04CV-F QUAD 2 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	
FPF04CVGA-C1	FB4 LEFT AIR WASH VALVE FPF04CV-GA QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 3/C	14	
FPF04CVGB-C1	FB4 RIGHT AIR WASH VALVE FPF04CV-GB QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 3/C	14	
FPF04FIT-A1	FB4 FLOW TRANSMITTER FP-F04-FIT QUAD 2 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	
FPF04PDIT-A1	FB4 DIFF PRESSURE TRANSMITTER FP-F04-PDIT QUAD 2 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	



## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF05AIT-A1	FB5 TURBIDITY TRANSMITTER FP-F05-AIT QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FPF05ALIT-A1	FB5 CELL A LEVEL TRANSMITTER FP-F5A-LIT QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FPF05BLIT-A1	FB5 CELL B LEVEL TRANSMITTER FP-F5B-LIT QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FPF05CVA-C1	FB5 Influent Valve FPF05CV-A QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 7/C	14	
FPF05CVB-C1	FB5 DRAIN VALVE FPF05CV-B QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 7/C	14	
FPF05CVC-C1	FB5 Wash Water Valve FPF05CV-C QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 7/C	14	
FPF05CVDA-C1	FB5 Wash Water Left Cell VALVE FPF05CV-DA QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 7/C	14	
FPF05CVDB-C1	FB5 Wash Water Right Cell VALVE FPF05CV-DB QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 7/C	14	
FPF05CVE-A1	FB5 EFFLUENT VALVE FPF05CV-E QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FPF05CVE-C1	FB5 EFFLUENT VALVE FPF05CV-E QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 4/C	14	
FPF05CVF-A1	FB5 FILTER TO WASTE VALVE FPF05CV-F QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF05CVF-A2	FB5 FILTER TO WASTE VALVE FPF05CV-F QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FPF05CVGA-C1	FB5 LEFT AIR WASH VALVE FPF05CV-GA QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 3/C	14	
FPF05CVGB-C1	FB5 RIGHT AIR WASH VALVE FPF05CV-GB QUAD 1 CONTROL PANEL	CT-FP03-S*	2	1 3/C	14	
FPF05FIT-A1	FB5 FLOW TRANSMITTER FP-F05-FIT QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FPF05PDIT-A1	FB5 DIFF PRESSURE TRANSMITTER FP-F05-PDI QUAD 1 CONTROL PANEL	CT-FP03-S*	4	1 TSP	16	
FPF06AIT-A1	FB6 TURBIDITY TRANSMITTER FP-F06-AIT QUAD 2 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	
FPF06ALIT-A1	FB6 CELL A LEVEL TRANSMITTER FP-F6A-LIT QUAD 2 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	
FPF06BLIT-A1	FB6 CELL B LEVEL TRANSMITTER FP-F6B-LIT QUAD 2 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	
FPF06CVA-C1	FB6 INFLUENT VALVE FPF06CV-A QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 7/C	14	
FPF06CVB-C1	FB6 DRAIN VALVE FPF06CV-B QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 7/C	14	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF06CVC-C1	FB6 Wash Water Valve FPF06CV-C QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 7/C	14	
FPF06CVDA-C1	FB6 Wash Water Left Cell VALVE FPF06CV-DA QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 7/C	14	
FPF06CVDB-C1	FB6 Wash Water Right Cell VALVE FPF06CV-DB QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 7/C	14	
FPF06CVE-A1	FB6 EFFLUENT VALVE FPF06CV-E QUAD 2 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	
FPF06CVE-C1	FB6 EFFLUENT VALVE FPF06CV-E QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 4/C	14	
FPF06CVF-A1	FB6 FILTER TO WASTE VALVE FPF06CV-F QUAD 2 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	
FPF06CVF-A2	FB6 FILTER TO WASTE VALVE FPF06CV-F QUAD 2 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	
FPF06CVGA-C1	FB6 LEFT AIR WASH VALVE FPF06CV-GA QUAD 2 CONTROL PANEL	CT-FP04-S*	2	1 3/C	14	
FPF06CVGB-C1	FB6 RIGHT AIR WASH VALVE FPF06CV-GB QUAD 1 CONTROL PANEL	CT-FP04-S*	2	1 3/C	14	
FPF06FIT-A1	FB6 FLOW TRANSMITTER FP-F06-FIT QUAD 1 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF06PDIT-A1	FB6 DIFF PRESSURE TRANSMITTER FP-F06-PDIT QUAD 1 CONTROL PANEL	CT-FP04-S*	4	1 TSP	16	
FPF07AIT-A1	FB7 TURBIDITY TRANSMITTER FP-F07-AIT QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	
FPF07ALIT-A1	FB7 CELL A LEVEL TRANSMITTER FP-F7A-LIT QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	
FPF07BLIT-A1	FB7 CELL B LEVEL TRANSMITTER FP-F7B-LIT QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	
FPF07CVA-C1	FB7 Influent Valve FPF07CV-A QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 7/C	14	
FPF07CVB-C1	FB7 DRAIN VALVE FPF07CV-B QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 7/C	14	
FPF07CVC-C1	FB7 Wash Water Valve FPF07CV-C QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 7/C	14	
FPF07CVDA-C1	FB7 Wash Water Left Cell VALVE FPF07CV-DA QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 7/C	14	
FPF07CVDB-C1	FB7 Wash Water Right Cell VALVE FPF07CV-DB QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 7/C	14	
FPF07CVE-A1	FB7 EFFLUENT VALVE FPF07CV-E QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF07CVE-C1	FB7 EFFLUENT VALVE FPF07CV-E QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 4/C	14	
FPF07CVF-A1	FB7 FILTER TO WASTE VALVE FPF07CV-F QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	
FPF07CVF-A2	FB7 FILTER TO WASTE VALVE FPF07CV-F QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	
FPF07CVGA-C1	FB7 LEFT AIR WASH VALVE FPF07CV-GA QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 3/C	14	
FPF07CVGB-C1	FB7 RIGHT AIR WASH VALVE FPF07CV-GB QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 3/C	14	
FPF07FIT-A1	FB7 FLOW TRANSMITTER FP-F07-FIT QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	
FPF07PDIT-A1	FB7 DIFF PRESSURE TRANSMITTER FP-F07-PDIT QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	
FPF08AIT-A1	FB8 TURBIDITY TRANSMITTER FP-F08-AIT QUAD 2 CONTROL PANEL	CT-FP02-S	4	1 TSP	16	
FPF08ALIT-A1	FB8 CELL A LEVEL TRANSMITTER FP-F8A-LIT QUAD 2 CONTROL PANEL	CT-FP02-S	4	1 TSP	16	
FPF08BLIT-A1	FB8 CELL B LEVEL TRANSMITTER FP-F8B-LIT QUAD 2 CONTROL PANEL	CT-FP02-S	4	1 TSP	16	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors		Size (AWG/kcmil)	Revision
		Tray	Section	Qty	Description		
FPF08CVA-C1	FB8 INFLUENT VALVE FPF08CV-A QUAD 2 CONTROL PANEL	CT-FP02-S	2	1	7/C	14	
FPF08CVB-C1	FB8 DRAIN VALVE FPF08CV-B QUAD 2 CONTROL PANEL	CT-FP02-S	2	1	7/C	14	
FPF08CVC-C1	FB8 Wash Water Valve FPF08CV-C QUAD 2 CONTROL PANEL	CT-FP02-S	2	1	7/C	14	
FPF08CVDA-C1	FB8 Wash Water Left Cell VALVE FPF08CV-DA QUAD 2 CONTROL PANEL	CT-FP02-S	2	1	7/C	14	
FPF08CVDB-C1	FB8 Wash Water Right Cell VALVE FPF08CV-DB QUAD 2 CONTROL PANEL	CT-FP02-S	2	1	7/C	14	
FPF08CVE-A1	FB8 EFFLUENT VALVE FPF08CV-E QUAD 2 CONTROL PANEL	CT-FP02-S	4	1	TSP	16	
FPF08CVE-C1	FB8 EFFLUENT VALVE FPF08CV-E QUAD 2 CONTROL PANEL	CT-FP02-S	2	1	4/C	14	
FPF08CVF-A1	FB8 FILTER TO WASTE VALVE FPF08CV-F QUAD 2 CONTROL PANEL	CT-FP02-S	4	1	TSP	16	
FPF08CVF-A2	FB8 FILTER TO WASTE VALVE FPF08CV-F QUAD 2 CONTROL PANEL	CT-FP02-S	4	1	TSP	16	
FPF08CVGA-C1	FB8 LEFT AIR WASH VALVE FPF08CV-GA QUAD 2 CONTROL PANEL	CT-FP02-S	2	1	3/C	14	
FPF08CVGB-C1	FB8 RIGHT AIR WASH VALVE FPF08CV-GB QUAD 2 CONTROL PANEL	CT-FP02-S	2	1	3/C	14	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/ kcmil)	Revision
		Tray	Section			
FPF08FIT-A1	FB8 FLOW TRANSMITTER FP-F08-FIT QUAD 2 CONTROL PANEL	CT-FP02-S	4	1 TSP	16	
FPF08PDIT-A1	FB8 DIFF PRESSURE TRANSMITTER FP-F08-PDIT QUAD 2 CONTROL PANEL	CT-FP02-S	4	1 TSP	16	
FPF09AIT-A1	FB9 TURBIDITY TRANSMITTER FP-F09-AIT QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	
FPF09ALIT-A1	FB9 CELL A LEVEL TRANSMITTER FP-F9A-LIT QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	
FPF09BLIT-A1	FB9 CELL B LEVEL TRANSMITTER FP-F9B-LIT QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	
FPF09CVA-C1	FB9 Influent Valve FPF09CV-A QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 7/C	14	
FPF09CVB-C1	FB9 DRAIN VALVE FPF09CV-B QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 7/C	14	
FPF09CVC-C1	FB9 Wash Water Valve FPF09CV-C QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 7/C	14	
FPF09CVDA-C1	FB9 Wash Water Left Cell VALVE FPF09CV-DA QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 7/C	14	
FPF09CVDB-C1	FB9 Wash Water Right Cell VALVE FPF09CV-DB QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 7/C	14	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF09CVE-A1	FB9 EFFLUENT VALVE FPF09CV-E QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	
FPF09CVE-C1	FB9 EFFLUENT VALVE FPF09CV-E QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 4/C	14	
FPF09CVF-A1	FB9 FILTER TO WASTE VALVE FPF09CV-F QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	
FPF09CVF-A2	FB9 FILTER TO WASTE VALVE FPF09CV-F QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	
FPF09CVGA-C1	FB9 LEFT AIR WASH VALVE FPF09CV-GA QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 3/C	14	
FPF09CVGB-C1	FB9 RIGHT AIR WASH VALVE FPF09CV-GB QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 3/C	14	
FPF09FIT-A1	FB9 FLOW TRANSMITTER FP-F09-FIT QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	
FPF09PDIT-A1	FB9 DIFF PRESSURE TRANSMITTER FP-F09-PDIT QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	
FPF10AIT-A1	FB10 TURBIDITY TRANSMITTER FP-F10-AIT QUAD 2 CONTROL PANEL	CT-FP02-S	4	TSP	16	
FPF10ALIT-A1	FB10 CELL A LEVEL TRANSMITTER FP-F10A-LIT QUAD 2 CONTROL PANEL	CT-FP02-S	4	1 TSP	16	



## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF10BLIT-A1	FB10 CELL B LEVEL TRANSMITTER FP-F10B-LIT QUAD 2 CONTROL PANEL	CT-FP02-S	4	1 TSP	16	
FPF10CVA-C1	FB10 INFLUENT VALVE FPF10CV-A QUAD 2 CONTROL PANEL	CT-FP02-S	2	1 7/C	14	
FPF10CVB-C1	FB10 DRAIN VALVE FPF10CV-B QUAD 2 CONTROL PANEL	CT-FP02-S	2	1 7/C	14	
FPF10CVC-C1	FB10 Wash Water Valve FPF10CV-C QUAD 2 CONTROL PANEL	CT-FP02-S	2	1 7/C	14	
FPF10CVDA-C1	FB10 Wash Water Left Cell VALVE FP10CV-DA QUAD 2 CONTROL PANEL	CT-FP02-S	2	1 7/C	14	
FPF10CVDB-C1	FB10 Wash Water Right Cell VALVE FP10CV-DB QUAD 2 CONTROL PANEL	CT-FP02-S	2	1 7/C	14	
FPF10CVE-A1	FB10 EFFLUENT VALVE FPF10CV-E QUAD 2 CONTROL PANEL	CT-FP02-S	4	1 TSP	16	
FPF10CVE-C1	FB10 EFFLUENT VALVE FPF10CV-E QUAD 2 CONTROL PANEL	CT-FP02-S	2	1 4/C	14	
FPF10CVF-A1	FB10 FILTER TO WASTE VALVE FPF10CV-F QUAD 2 CONTROL PANEL	CT-FP02-S	4	1 TSP	16	
FPF10CVF-A2	FB10 FILTER TO WASTE VALVE FPF10CV-F QUAD 2 CONTROL PANEL	CT-FP02-S	4	1 TSP	16	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF10CVGA-C1	FB10 LEFT AIR WASH VALVE FPF10CV-GA QUAD 2 CONTROL PANEL	CT-FP02-S	2	1 3/C	14	
FPF10CVGB-C1	FB10 RIGHT AIR WASH VALVE FPF10CV-GB QUAD 1 CONTROL PANEL	CT-FP02-S	2	1 3/C	14	
FPF10FIT-A1	FB10 FLOW TRANSMITTER FP-F10-FIT QUAD 1 CONTROL PANEL	CT-FP02-S	4	1 TSP	16	
FPF10PDIT-A1	FB10 DIFF PRESSURE TRANSMITTER FP-F10-PDIT QUAD 1 CONTROL PANEL	CT-FP02-S	4	1 TSP	16	
FPF11AIT-A1	FB11 TURBIDITY TRANSMITTER FP-F11-AIT QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	
FPF11ALIT-A1	FB11 CELL A LEVEL TRANSMITTER FP-F11A-LIT QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	
FPF11BLIT-A1	FB11 CELL B LEVEL TRANSMITTER FP-F11B-LIT QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	
FPF11CVA-C1	FB11 Influent Valve FPF11CV-A QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 7/C	14	
FPF11CVB-C1	FB11 DRAIN VALVE FPF11CV-B QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 7/C	14	
FPF11CVC-C1	FB11 Wash Water Valve FPF11CV-C QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 7/C	14	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF11CVDA-C1	FB11 Wash Water Left Cell VALVE FPF11CV-DA QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 7/C	14	
FPF11CVDB-C1	FB11 Wash Water Right Cell VALVE FPF11CV-DB QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 7/C	14	
FPF11CVE-A1	FB11 EFFLUENT VALVE FPF11CV-E QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	
FPF11CVE-C1	FB11 EFFLUENT VALVE FPF11CV-E QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 4/C	14	
FPF11CVF-A1	FB11 FILTER TO WASTE VALVE FPF11CV-F QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	
FPF11CVF-A2	FB11 FILTER TO WASTE VALVE FPF11CV-F QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	
FPF11CVGA-C1	FB11 LEFT AIR WASH VALVE FPF11CV-GA QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 3/C	14	
FPF11CVGB-C1	FB11 RIGHT AIR WASH VALVE FPF11CV-GB QUAD 1 CONTROL PANEL	CT-FP01-S*	2	1 3/C	14	
FPF11FIT-A1	FB11 FLOWTRANSMITTER FP-F11-FIT QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	
FPF11PDIT-A1	FB11 DIFF PRESSURE TRANSMITTER FP-F11-PDIT QUAD 1 CONTROL PANEL	CT-FP01-S*	4	1 TSP	16	

## Cable Schedule

Cable Number	Orgin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF12AIT-A1	FB12 TURBIDITY TRANSMITTER FP-F12-AIT QUAD 2 CONTROL PANEL	CT-FP02-S	4	1 TSP	16	
FPF12ALIT-A1	FB12 CELL A LEVEL TRANSMITTER FP-F12A-LIT QUAD 2 CONTROL PANEL	CT-FP02-S	4	1 TSP	16	
FPF12BLIT-A1	FB12 CELL B LEVEL TRANSMITTER FP-F12B-LIT QUAD 2 CONTROL PANEL	CT-FP02-S	4	1 TSP	16	
FPF12CVA-C1	FB12 INFLUENT VALVE FPF12CV-A QUAD 2 CONTROL PANEL	CT-FP02-S	2	1 7/C	14	
FPF12CVB-C1	FB12 DRAIN VALVE FPF12CV-B QUAD 2 CONTROL PANEL	CT-FP02-S	2	1 7/C	14	
FPF12CVC-C1	FB12 Wash Water Valve FPF12CV-C QUAD 2 CONTROL PANEL	CT-FP02-S	2	1 7/C	14	
FPF12CVDA-C1	FB12 Wash Water Left Cell VALVE FP12CV-DA QUAD 2 CONTROL PANEL	CT-FP02-S	2	1 7/C	14	
FPF12CVDB-C1	FB12 Wash Water Right Cell VALVE FP12CV-DB QUAD 2 CONTROL PANEL	CT-FP02-S	2	1 7/C	14	
FPF12CVE-A1	FB12 EFFLUENT VALVE FPF12CV-E QUAD 2 CONTROL PANEL	CT-FP02-S	4	1 TSP	16	
FPF12CVE-C1	FB12 EFFLUENT VALVE FPF12CV-E QUAD 2 CONTROL PANEL	CT-FP02-S	2	1 4/C	14	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF12CVF-A1	FB12 FILTER TO WASTE VALVE FPF12CV-F QUAD 2 CONTROL PANEL	CT-FP02-S	4	1 TSP	16	
FPF12CVF-A2	FB12 FILTER TO WASTE VALVE FPF12CV-F QUAD 2 CONTROL PANEL	CT-FP02-S	4	1 TSP	16	
FPF12CVGA-C1	FB12 LEFT AIR WASH VALVE FPF12CV-GA QUAD 2 CONTROL PANEL	CT-FP02-S	2	1 3/C	14	
FPF12CVGB-C1	FB12 RIGHT AIR WASH VALVE FPF12CV-GB QUAD 2 CONTROL PANEL	CT-FP02-S	2	1 3/C	14	
FPF12FIT-A1	FB12 FLOW TRANSMITTER FP-F12-FIT QUAD 2 CONTROL PANEL	CT-FP02-S	4	1 TSP	16	
FPF12PDIT-A1	FB12 DIFF PRESSURE TRANSMITTER FP-F12-FDIT QUAD 2 CONTROL PANEL	CT-FP02-S	4	1 TSP	16	
FPF13AIT-A1	FB13 TURBIDIT Transmitter FP-F13-AIT QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	
FPF13ALIT-A1	FB13 CELL A LEVEL TRANSMITTER FP-F13A-LIT QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	
FPF13BLIT-A1	FB13 CELL B LEVEL TRANSMITTER FP-F13B-LIT QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	
FPF13CVA-C1	FB13 INFLUENT VALVE FPF13CV-A QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 7/C	14	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF13CVB-C1	FB13 DRAIN VALVE FPF13CV-B QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 7/C	14	
FPF13CVC-C1	FB13 WASH WATER VALVE FPF13CV-C QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 7/C	14	
FPF13CVDA-C1	FB13 WASH WATER LEFT CELL VALVE FPF13CV-DA QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 7/C	14	
FPF13CVDB-C1	FB13 WASH WATER RIGHT CELL VALVE FPF13CV-DB QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 7/C	14	
FPF13CVE-A1	FB13 EFFLUENT VALVE FPF13CV-E QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	
FPF13CVE-C1	FB13 EFFLUENT VALVE FPF13CV-E QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 4/C	14	
FPF13CVF-A1	FB13 FILTER TO WASTE VALVE FPF13CV-F QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	
FPF13CVF-A2	FB13 FILTER TO WASTE VALVE FPF13CV-F QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	
FPF13CVGA-C1	FB13 LEFT AIRWASH VALVE FPF13CV-GA QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 3/C	14	
FPF13CVGB-C1	FB13 RIGHT AIRWASH VALVE FPF13CV-GB QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 3/C	14	

## Cable Schedule

Cable Number	Orgin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/ kcmil)	Revision
		Tray	Section			
FPF13FIT-A1	FB13 FLOW TRANSMITTER FP-F13-FIT QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	
FPF13PDIT-A1	FB13 DIFF PRESSURE TRANSMITTER FP-F13-PDIT QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	
FPF14AIT-A1	FB14 TURBIDITY TRANSMITTER FP-F14-AIT QUAD 4 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	
FPF14ALIT-A1	FB14 CELL A LEVEL TRANSMITTER FP-F14A-LIT QUAD 3 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	
FPF14BLIT-A1	FB14 CELL B LEVEL TRANSMITTER FP-F14B-LIT QUAD 3 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	
FPF14CVA-C1	FB14 INFLUENT VALVE FPF14CV-A QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 7/C	12	
FPF14CVB-C1	FB14 DRAIN VALVE FPF14CV-B QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 7/C	14	
FPF14CVC-C1	FB14 WASH WATER VALVE FPF14CV-C QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 7/C	14	
FPF14CVDA-C1	FB14 WASH WATER LEFT CELL VALVE FPF14-DA QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 7/C	14	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF14CVDB-C1	FB14 WASH WATER RIGHT CELL VALVE FPF14-DB  QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 7/C	14	
FPF14CVE-A1	FB14 EFFLUENT VALVE FPF14CV-E  QUAD 4 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	
FPF14CVE-C1	FB14 EFFLUENT VALVE FPF14CV-E  QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 4/C	14	
FPF14CVF-A1	FB14 FILTER TO WASTE VALVE FPF14CV-F  QUAD 4 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	
FPF14CVF-A2	FB14 FILTER TO WASTE VALVE FPF14CV-F  QUAD 4 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	
FPF14CVGA-C1	FB14 LEFT AIR WASH VALVE FPF14CV-GA  QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 3/C	14	
FPF14CVGB-C1	FB14 RIGHT AIR WASH VALVE FPF14CV-GB  QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 3/C	14	
FPF14FIT-A1	FB14 FLOW TRANSMITTER FP-F14-FIT  QUAD 4 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	
FPF14PDIT-A1	FB14 DIFF PRESSURE TRANSMITTER FP-F14-PDIT  QUAD 4 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	
FPF15AIT-A1	FB15 TURBIDITY Transmitter FP-F15-AIT  QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	



## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF15ALIT-A1	FB15 CELL A LEVEL TRANSMITTER FP-F15A-LIT QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	
FPF15BLIT-A1	FB15 CELL B LEVEL TRANSMITTER FP-F15B-LIT QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	
FPF15CVA-C1	FB15 INFLUENT VALVE FPF15CV-A QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 7/C	14	
FPF15CVB-C1	FB15 DRAIN VALVE FPF15CV-B QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 7/C	14	
FPF15CVC-C1	FB15 WASH WATER VALVE FPF15CV-C QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 7/C	14	
FPF15CVDA-C1	FB15 WASH WATER LEFT CELL VALVE FPF15CV-DA QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 7/C	14	
FPF15CVDB-C1	FB15 WASH WATER RIGHT CELL VALVE FPF15CV-DB QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 7/C	14	
FPF15CVE-A1	FB15 EFFLUENT VALVE FPF15CV-E QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	
FPF15CVE-C1	FB15 EFFLUENT VALVE FPF15CV-E QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 4/C	14	
FPF15CVF-A1	FB15 FILTER TO WASTE VALVE FPF15CV-F QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	

## Cable Schedule

Cable Number	Orgin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF15CVF-A2	FB15 FILTER TO WASTE VALVE FPF15CV-F QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	
FPF15CVGA-C1	FB15 LEFT AIRWASH VALVE FPF15CV-GA QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 3/C	14	
FPF15CVGB-C1	FB15 RIGHT AIRWASH VALVE FPF15CV-GB QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 7/C	14	
FPF15FIT-A1	FB15 FLOW TRANSMITTER FP-F15-FIT QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	
FPF15PDIT-A1	FB15 DIFF PRESSURE TRANSMITTER FP-F15-PDIT QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	
FPF16AIT-A1	FB16 TURBIDITY TRANSMITTER FP-F16-AIT QUAD 4 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	
FPF16ALIT-A1	FB16 CELL A LEVEL TRANSMITTER FP-F16A-LIT QUAD 3 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	
FPF16BLIT-A1	FB16 CELL B LEVEL TRANSMITTER FP-F16B-LIT QUAD 3 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	
FPF16CVA-C1	FB16 INFLUENT VALVE FPF16CV-A QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 7/C	14	
FPF16CVB-C1	FB16 DRAIN VALVE FPF16CV-B QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 7/C	14	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF16CVC-C1	FB16 WASH WATER VALVE FPF16CV-C QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 7/C	14	
FPF16CVDA-C1	FB16 WASH WATER LEFT CELL VALVE FPF16-DA QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 7/C	14	
FPF16CVDB-C1	FB16 WASH WATER RIGHT CELL VALVE FPF16-DB QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 7/C	14	
FPF16CVE-A1	FB16 EFFLUENT VALVE FPF16CV-E QUAD 4 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	
FPF16CVE-C1	FB16 EFFLUENT VALVE FPF16CV-E QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 4/C	14	
FPF16CVF-A1	FB16 FILTER TO WASTE VALVE FPF16CV-F QUAD 4 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	
FPF16CVF-A2	FB16 FILTER TO WASTE VALVE FPF16CV-F QUAD 4 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	
FPF16CVGA-C1	FB15 LEFT AIRWASH VALVE FPF15CV-GA QUAD 3 CONTROL PANEL	CT-FP02-N*	2	1 3/C	14	
FPF16CVGB-C1	FB16 RIGHT AIR WASH VALVE FPF16CV-GB QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 3/C	14	
FPF16FIT-A1	FB16 FLOW TRANSMITTER FP-F16-FIT QUAD 4 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF16PDIT-A1	FB16 DIFF PRESSURE TRANSMITTER FP-F16-PDIT QUAD 4 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	
FPF17AIT-A1	FB17 TURBIDITY Transmitter FP-F17-AIT QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	
FPF17ALIT-A1	FB17 CELL A LEVEL TRANSMITTER FP-F17A-LIT QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	
FPF17BLIT-A1	FB17 CELL B LEVEL TRANSMITTER FP-F17B-LIT QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	
FPF17CVA-C1	FB17 INFLUENT VALVE FPF17CV-A QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 7/C	14	
FPF17CVB-C1	FB17 DRAIN VALVE FPF17CV-B QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 7/C	14	
FPF17CVC-C1	FB17 WASH WATER VALVE FPF17CV-C QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 7/C	14	
FPF17CVDA-C1	FB17 WASH WATER LEFT CELL VALVE FPF17CV-DA QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 7/C	14	
FPF17CVDB-C1	FB17 WASH WATER RIGHT CELL VALVE FPF17CV-DB QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 7/C	14	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF17CVE-A1	FB17 EFFLUENT VALVE FPF17CV-E QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	
FPF17CVE-C1	FB17 EFFLUENT VALVE FPF17CV-E QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 4/C	14	
FPF17CVF-A1	FB17 FILTER TO WASTE VALVE FPF17CV-F QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	
FPF17CVF-A2	FB17 FILTER TO WASTE VALVE FPF17CV-F QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	
FPF17CVGA-C1	FB17 LEFT AIRWASH VALVE FPF17CV-GA QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 3/C	14	
FPF17CVGB-C1	FB17 RIGHT AIRWASH VALVE FPF17CV-GB QUAD 3 CONTROL PANEL	CT-FP01-N*	2	1 3/C	14	
FPF17FIT-A1	FB17 FLOW TRANSMITTER FP-F17-FIT QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	
FPF17PDIT-A1	FB17 DIFF PRESSURE TRANSMITTER FP-F17-PDIT QUAD 3 CONTROL PANEL	CT-FP01-N*	4	1 TSP	16	
FPF18AIT-A1	FB18 TURBIDITY TRANSMITTER FP-F18-AIT QUAD 4 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	
FPF18ALIT-A1	FB18 CELL A LEVEL TRANSMITTER FP-F18A-LIT QUAD 3 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	

## Cable Schedule

Cable Number	Orgin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/ kcmil)	Revision
		Tray	Section			
FPF18BLIT-A1	FB18 CELL B LEVEL TRANSMITTER FP-F18B-LIT QUAD 3 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	
FPF18CVA-C1	FB18 INFLUENT VALVE FPF18CV-A QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 7/C	14	
FPF18CVB-C1	FB18 DRAIN VALVE FPF18CV-B QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 7/C	14	
FPF18CVC-C1	FB18 WASH WATER VALVE FPF18CV-C QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 7/C	14	
FPF18CVDA-C1	FB18 WASH WATER LEFT CELL VALVE FPF18-DA QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 7/C	14	
FPF18CVDB-C1	FB18 WASH WATER RIGHT CELL VALVE FPF18-DB QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 7/C	14	
FPF18CVE-A1	FB18 EFFLUENT VALVE FPF18CV-E QUAD 4 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	
FPF18CVE-C1	FB18 EFFLUENT VALVE FPF18CV-E QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 4/C	14	
FPF18CVF-A1	FB18 FILTER TO WASTE VALVE FPF18CV-F QUAD 4 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	
FPF18CVF-A2	FB18 FILTER TO WASTE VALVE FPF18CV-F QUAD 4 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF18CVGA-C1	FB18 LEFT AIR WASH VALVE FPF18CV-GA QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 3/C	14	
FPF18CVGB-C1	FB18 RIGHT AIR WASH VALVE FPF18CV-GB QUAD 4 CONTROL PANEL	CT-FP02-N*	2	1 3/C	14	
FPF18FIT-A1	FB18 FLOW TRANSMITTER FP-F18-FIT QUAD 4 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	
FPF18PDIT-A1	FB18 DIFF PRESSURE TRANSMITTER FP-F18-PDIT QUAD 4 CONTROL PANEL	CT-FP02-N*	4	1 TSP	16	
FPF19AIT-A1	FB19 TURBIDITY Transmitter FP-F19-AIT QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	
FPF19ALIT-A1	FB19 CELL A LEVEL TRANSMITTER FP-F19A-LIT QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	
FPF19BLIT-A1	FB19 CELL B LEVEL TRANSMITTER FP-F19B-LIT QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	
FPF19CVA-C1	FB19 INFLUENT VALVE FPF19CV-A QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 7/C	14	
FPF19CVB-C1	FB19 DRAIN VALVE FPF19CV-B QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 7/C	14	
FPF19CVC-C1	FB19 WASH WATER VALVE FPF19CV-C QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 7/C	14	

## Cable Schedule

Cable Number	Orgin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/ kcmil)	Revision
		Tray	Section			
FPF19CVDA-C1	FB19 WASH WATER LEFT CELL VALVE FPF19CV-DA  QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 7/C	14	
FPF19CVDB-C1	FB19 WASH WATER RIGHT CELL VALVE FPF19CV-DB  QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 7/C	14	
FPF19CVE-A1	FB19 EFFLUENT VALVE FPF19CV-E  QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	
FPF19CVE-C1	FB19 EFFLUENT VALVE FPF19CV-E  QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 4/C	14	
FPF19CVF-A1	FB19 FILTER TO WASTE VALVE FPF19CV-F  QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	
FPF19CVF-A2	FB19 FILTER TO WASTE VALVE FPF19CV-F  QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	
FPF19CVGA-C1	FB19 LEFT AIRWASH VALVE FPF19CV-GA  QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 3/C	14	
FPF19CVGB-C1	FB19 RIGHT AIRWASH VALVE FPF19CV-GB  QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 3/C	14	
FPF19FIT-A1	FB19 FLOWTRANSMITTER FP-F19-FIT  QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	
FPF19PDIT-A1	FB19 DIFF PRESSURE TRANSMITTER FP-F19- PDIT  QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	



## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF20AIT-A1	FB20 TURBIDITY TRANSMITTER FP-F20-AIT QUAD 4 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	
FPF20ALIT-A1	FB20 CELL A LEVEL TRANSMITTER FP-F20A-LIT QUAD 3 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	
FPF20BLIT-A1	FB20 CELL B LEVEL TRANSMITTER FP-F20B-LIT QUAD 3 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	
FPF20CVA-C1	FB20 INFLUENT VALVE FPF20CV-A QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 7/C	14	
FPF20CVB-C1	FB20 DRAIN VALVE FPF20CV-B QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 7/C	14	
FPF20CVC-C1	FB20 WASH WATER VALVE FPF20CV-C QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 7/C	14	
FPF20CVDA-C1	FB20 WASH WATER LEFT CELL VALVE FPF20-DA QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 7/C	14	
FPF20CVDB-C1	FB20 WASH WATER RIGHT CELL VALVE FPF20-DB QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 7/C	14	
FPF20CVE-A1	FB20 EFFLUENT VALVE FPF20CV-E QUAD 4 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	
FPF20CVE-C1	FB20 EFFLUENT VALVE FPF20CV-E QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 4/C	14	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF20CVF-A1	FB20 FILTER TO WASTE VALVE FPF20CV-F QUAD 4 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	
FPF20CVF-A2	FB20 FILTER TO WASTE VALVE FPF20CV-F QUAD 4 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	
FPF20CVGA-C1	FB20 LEFT AIR WASH VALVE FPF20CV-GA QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 3/C	14	
FPF20CVGB-C1	FB20 RIGHT AIR WASH VALVE FPF20CV-GB QUAD 3 CONTROL PANEL	CT-FP04-N*	2	1 3/C	14	
FPF20FIT-A1	FB20 FLOW TRANSMITTER FP-F20-FIT QUAD 3 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	
FPF20PDIT-A1	FB20 DIFF PRESSURE TRANSMITTER FP-F20-PDIT QUAD 3 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	
FPF21AIT-A1	FB21 TURBIDITY Transmitter FP-F21-AIT QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	
FPF21ALIT-A1	FB21 CELL A LEVEL TRANSMITTER FP-F21A-LIT QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	
FPF21BLIT-A1	FB21 CELL B LEVEL TRANSMITTER FP-F21B-LIT QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	
FPF21CVA-C1	FB21 INFLUENT VALVE FPF21CV-A QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 7/C	14	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF21CVB-C1	FB21 DRAIN VALVE FPF21CV-B QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 7/C	14	
FPF21CVC-C1	FB21 WASH WATER VALVE FPF21CV-C QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 7/C	14	
FPF21CVDA-C1	FB21 WASH WATER LEFT CELL VALVE FPF21CV-DA QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 7/C	14	
FPF21CVDB-C1	FB21 WASH WATER RIGHT CELL VALVE FPF21CV-DB QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 7/C	14	
FPF21CVE-A1	FB21 EFFLUENT VALVE FPF21CV-E QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	
FPF21CVE-C1	FB21 EFFLUENT VALVE FPF21CV-E QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 4/C	14	
FPF21CVF-A1	FB21 FILTER TO WASTE VALVE FPF21CV-F QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	
FPF21CVF-A2	FB21 FILTER TO WASTE VALVE FPF21CV-F QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	
FPF21CVGA-C1	FB21 LEFT AIRWASH VALVE FPF21CV-GA QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 3/C	14	
FPF21CVGB-C1	FB21 RIGHT AIRWASH VALVE FPF21CV-GB QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 3/C	14	

## Cable Schedule

Cable Number	Orgin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/ kcmil)	Revision
		Tray	Section			
FPF21FIT-A1	FB21 FLOWTRANSMITTER FP-F21-FIT QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	
FPF21PDIT-A1	FB21 DIFF PRESSURE TRANSMITTER FP-F21-PDIT QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	
FPF22AIT-A1	FB22 TURBIDITY TRANSMITTER FP-F22-AIT QUAD 4 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	
FPF22ALIT-A1	FB22 CELL A LEVEL TRANSMITTER FP-F22A-LIT QUAD 3 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	
FPF22BLIT-A1	FB22 CELL B LEVEL TRANSMITTER FP-F22B-LIT QUAD 3 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	
FPF22CVA-C1	FB22 INFLUENT VALVE FPF22CV-A QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 7/C	14	
FPF22CVB-C1	FB22 DRAIN VALVE FPF22CV-B QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 7/C	14	
FPF22CVC-C1	FB22 WASH WATER VALVE FPF22CV-C QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 7/C	14	
FPF22CVDA-C1	FB22 WASH WATER LEFT CELL VALVE FPF22-DA QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 7/C	14	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF22CVDB-C1	FB22 WASH WATER RIGHT CELL VALVE FPF22-DB  QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 7/C	14	
FPF22CVE-A1	FB22 EFFLUENT VALVE FPF22CV-E  QUAD 4 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	
FPF22CVE-C1	FB22 EFFLUENT VALVE FPF22CV-E  QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 4/C	14	
FPF22CVF-A1	FB22 FILTER TO WASTE VALVE FPF22CV-F  QUAD 4 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	
FPF22CVF-A2	FB22 FILTER TO WASTE VALVE FPF22CV-F  QUAD 4 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	
FPF22CVGA-C1	FB22 LEFT AIR WASH VALVE FP224CV-GA  QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 3/C	14	
FPF22CVGB-C1	FB22 RIGHT AIR WASH VALVE FPF22CV-GB  QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 3/C	14	
FPF22FIT-A1	FB22 FLOW TRANSMITTER FP-F22-FIT  QUAD 4 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	
FPF22PDIT-A1	FB22 DIFF PRESSURE TRANSMITTER FP-F22-PDIT  QUAD 4 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	
FPF23AIT-A1	FB23 TURBIDITY Transmitter FP-F23-AIT  QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	

## Cable Schedule

Cable Number	Orgin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/ kcmil)	Revision
		Tray	Section			
FPF23ALIT-A1	FB23 CELL A LEVEL TRANSMITTER FP-F23A-LIT QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	
FPF23BLIT-A1	FB23 CELL B LEVEL TRANSMITTER FP-F23B-LIT QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	
FPF23CVA-C1	FB23 INFLUENT VALVE FPF23CV-A QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 7/C	14	
FPF23CVB-C1	FB23 DRAIN VALVE PF23CV-B QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 7/C	14	
FPF23CVC-C1	FB23 WASH WATER VALVE FPF23CV-C QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 7/C	14	
FPF23CVDA-C1	FB23 WASH WATER LEFT CELL VALVE FPF23CV-DA QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 7/C	14	
FPF23CVDB-C1	FB23 WASH WATER RIGHT CELL VALVE FPF23CV-DB QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 7/C	14	
FPF23CVE-A1	FB23 EFFLUENT VALVE FPF23CV-E QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	
FPF23CVE-C1	FB23 EFFLUENT VALVE FPF23CV-E QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 4/C	14	
FPF23CVF-A1	FB23 FILTER TO WASTE VALVE FPF23CV-F QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	

## Cable Schedule

Cable Number	Orgin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF23CVF-A2	FB23 FILTER TO WASTE VALVE FPF23CV-F QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	
FPF23CVGA-C1	FB23 LEFT AIRWASH VALVE FPF23CV-GA QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 3/C	14	
FPF23CVGB-C1	FB23 RIGHT AIRWASH VALVE FPF23CV-GB QUAD 3 CONTROL PANEL	CT-FP03-N*	2	1 3/C	14	
FPF23FIT-A1	FB23 FLOW TRANSMITTER FP-F23-FIT QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	
FPF23PDIT-A1	FB23 DIFF PRESSURE TRANSMITTER FP-F23-PDIT QUAD 3 CONTROL PANEL	CT-FP03-N*	4	1 TSP	16	
FPF24AIT-A1	FB24 TURBIDITY TRANSMITTER FP-F24-AIT QUAD 4 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	
FPF24ALIT-A1	FB24 CELL A LEVEL TRANSMITTER FP-F24A-LIT QUAD 3 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	
FPF24BLIT-A1	FB24 CELL B LEVEL TRANSMITTER FP-F24B-LIT QUAD 3 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	
FPF24CVA-C1	FB24 INFLUENT VALVE FPF24CV-A QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 7/C	14	
FPF24CVB-C1	FB24 DRAIN VALVE FPF24CV-B QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 7/C	14	

## Cable Schedule

Cable Number	Orgin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF24CVC-C1	FB24 WASH WATER VALVE FPF24CV-C QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 7/C	14	
FPF24CVDA-C1	FB24 WASH WATER LEFT CELL VALVE FPF24-DA QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 7/C	14	
FPF24CVDB-C1	FB24 WASH WATER RIGHT CELL VALVE FPF24-DB QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 7/C	14	
FPF24CVE-A1	FB24 EFFLUENT VALVE FPF24CV-E QUAD 4 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	
FPF24CVE-C1	FB24 EFFLUENT VALVE FPF24CV-E QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 4/C	14	
FPF24CVF-A1	FB24 FILTER TO WASTE VALVE FPF24CV-F QUAD 4 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	
FPF24CVF-A2	FB24 FILTER TO WASTE VALVE FPF24CV-F QUAD 4 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	
FPF24CVGA-C1	FB24 LEFT AIR WASH VALVE FPF24CV-GA QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 3/C	14	
FPF24CVGB-C1	FB24 RIGHT AIR WASH VALVE FPF24CV-GB QUAD 4 CONTROL PANEL	CT-FP04-N*	2	1 3/C	14	
FPF24FIT-A1	FB24 FLOW TRANSMITTER FP-F24-FIT QUAD 4 CONTROL PANEL	CT-FP04-N*	4	1 TSP	16	



## Cable Schedule

Cable Number	Orgin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPF24PDIT-A1	FB24 DIFF PRESSURE TRANSMITTER FP-F24-PDIT	CT-FP04-N*	4	1 TSP	16	
	QUAD 4 CONTROL PANEL					
FPFMIX3-C1	QUAD 2 CONTROL PANEL	CT-FP04-S*	1	1 7/C	14	
	CHEMICAL INDUCTION MIXER F-MIX3 CONTROL PANEL					
FPFMIX3-P1	SWITCHBOARD FP-SWBD-01 CHEMICAL INDUCTION MIXER F-MIX3 CONTROL PANEL	CT-FP05-C*	1	1 3/C W/G	8	
		CT-FP07-C*	1			
		CT-FP10-C*	1			
		CT-FP01-S*	1			
		CT-FP03-S*	1			
FPGN-P1	PANEL FP-PLD-01 PANEL GN	CT-FP05-C*	1	1 3/C W/G	1	
		CT-FP04-C*	1			
		CT-FP12-C*	1			
		CT-FP01-N*	1			
		CT-FP03-N*	1			
FPGS-P1	PANEL FP-PLD-01 PANEL GS	CT-FP05-C*	1	1 3/C W/G	1	
		CT-FP04-C*	1			
		CT-FP03-C*	1			
		CT-FP02-C*	1			
		CT-FP09-C*	1			
		CT-FP02-S	1			
FPHSTN01-P1	SWITCHBOARD FP-SWBD-01 HOIST CONNECTOR @ COLUMN ROW 4	CT-FP01-C*	1	1 4/C	12	
		CT-FP02-C*	1			
		CT-FP11-C*	1			
		CT-FP02-N*	1			
		CT-FP04-N*	1			

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPHSTN02-P1	HOIST CONNECTOR @ COLUMN ROW 4	CT-FP04-N*	1	1 4/C	12	
	HOIST CONNECTOR @ COLUMN ROW 2					
FPHSTS01-P1	SWITCHBOARD FP-SWBD-01	CT-FP01-C*	1	1 4/C	12	
	HOIST CONNECTOR @ COLUMN ROW 9	CT-FP02-C*	1			
		CT-FP03-C*	1			
		CT-FP04-C*	1			
		CT-FP07-C*	1			
		CT-FP10-C*	1			
FPHSTS02-P1	HOIST CONNECTOR @ COLUMN ROW 9	CT-FP10-C*	1	1 4/C	12	
	HOIST CONNECTOR @ COLUMN ROW 12	CT-FP01-S*	1			
FPHSTS03-P1	HOIST CONNECTOR @ COLUMN ROW 12	CT-FP03-S*	1	1 4/C	12	
	HOIST CONNECTOR @ COLUMN ROW 15					
FPL2-P1	PANEL FP-PLD-02	CT-FP05-C*	1	1 4/C W/G	1	
	PANEL L2	CT-FP06-C*	1			
FPLP01-P1	PANEL FP-PLD-01	CT-FP05-C*	1	1 3/C W/G	1/0	
	PANEL FP-LP-01					
FPLTGGN11-P1	PANELBOARD GN	CT-FP03-N*	1	1 3/C	12	
	LIGHT FIXTURE					
FPLTGGN9-P1	PANELBOARD GN	CT-FP03-N*	1	1 3/C	12	
	LIGHT FIXTURE					
FPLTGGG11-P1	PANELBOARD GS	CT-FP01-S*	1	1 3/C	12	
	LIGHT FIXTURE	CT-FP04-S*	1			

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPLTGG9-P1	PANELBOARD GS	CT-FP01-S*	1	1 3/C	12	
	LIGHT FIXTURE	CT-FP04-S*	1			
FPMTS01-P1	MOBILE GENERATOR TERM. CABINET	CT-FP06-C*	1	1 4/C W/G	3/0	
	MANUAL TRANSFER SWITCH	CT-FP05-C*	1			
FPFIT301-A1	PRESSURE INDICATING TRANSMITTER PIT-301	CT-FP01-C*	4	1 TSP	16	
	CONTROL PANEL CP-0306					
FPPLD01-P1	CIRCUIT BREAKER FP-CB-2	CT-FP05-C*	1	1 4/C W/G	3/0	
	PANELBOARD FP-PLD-1					
FPPLD01-P2	CIRCUIT BREAKER FP-CB-2	CT-FP05-C*	1	1 4/C W/G	3/0	
	PANELBOARD FP-PLD-1					
FPPLD02-P1	CIRCUIT BREAKER FP-CB-3	CT-FP05-C*	1	1 4/C W/G	3/0	
	PANELBOARD FP-PLD-2					
FPPLD02-P2	CIRCUIT BREAKER FP-CB-3	CT-FP05-C*	1	1 4/C W/G	3/0	
	PANELBOARD FP-PLD-2					
FPPS303-C1	PRESSURE SWITCH PS-303	CT-FP01-C*	2	1 5/C	14	
	CONTROL PANEL CP-0306					
FPQUAD1-P1	CRITICAL LOADS PANEL FP-CLP-01 QUAD 1 CONTROL PANEL	CT-FP06-C*	1	1 3/C	12	
		CT-FP05-C*	1			
		CT-FP07-C*	1			
		CT-FP08-C*	1			
		CT-FP10-C*	1			
		CT-FP01-S*	1			

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPQUAD2-P1	CRITICAL LOADS PANEL FP-CLP-01 QUAD 2 CONTROL PANEL	CT-FP05-C*	1	1 3/C	12	
		CT-FP06-C*	1			
		CT-FP04-C*	1			
		CT-FP03-C*	1			
		CT-FP02-C*	1			
		CT-FP09-C*	1			
		CT-FP02-S	1			
FPQUAD3-P1	CRITICAL LOADS PANEL FP-CLP-01 QUAD 3 CONTROL PANEL	CT-FP06-C*	1	1 3/C	12	
		CT-FP05-C*	1			
		CT-FP04-C*	1			
		CT-FP12-C*	1			
		CT-FP01-N*	1			
FPQUAD4-P1	CRITICAL LOADS PANEL FP-CLP-01 QUAD 4 CONTROL PANEL	CT-FP06-C*	1	1 3/C	12	
		CT-FP05-C*	1			
		CT-FP04-C*	1			
		CT-FP03-C*	1			
		CT-FP02-C*	1			
		CT-FP11-C*	1			
		CT-FP02-N*	1			
FPRECGN10-P1	PANELBOARD GN RECEPTACLE	CT-FP03-N*	1	1 3/C	12	
FPRECGN10-P2	PANELBOARD GN RECEPTACLE	CT-FP03-N*	1	1 3/C	12	
		CT-FP01-N*	1			
FPRECGN10-P3	RECEPTACLE RECEPTACLE	CT-FP03-N*	1	1 3/C	12	
FPRECGN8-P1	PANELBOARD GN RECEPTACLE	CT-FP03-N*	1	1 3/C	12	
		CT-FP01-N*	1			

## Cable Schedule

Cable Number	Orgin Description (From)	Cable Routing (From/To)		Conductors Qty Description		Size (AWG/kcmil)	Revision
	Destination Description (To)	Tray	Section				
FPRECGN8-P2	PANELBOARD GN RECEPTACLE	CT-FP03-N*	1	1	3/C	12	
FPRECGN8-P3	RECEPTACLE RECEPTACLE	CT-FP01-N*	1	1	3/C	12	
FPRECGS13-P1	PANELBOARD GS BASIN #1 RECEPTACLE	CT-FP02-S CT-FP04-S*	1 1	1	3/C	12	
FPRECGS6-P1	PANELBOARD GS RECEPTACLE	CT-FP02-S CT-FP04-S*	1 1	1	3/C	12	
FPRECGS6-P2	PANELBOARD GS RECEPTACLE	CT-FP02-S	1	1	3/C	12	
FPRECGS6-P3	RECEPTACLE RECEPTACLE	CT-FP02-S	1	1	3/C	12	
FPRECGS8-P1	PANELBOARD GS RECEPTACLE	CT-FP01-S* CT-FP04-S*	1 1	1	3/C	12	
FPRECGS8-P2	PANELBOARD GS RECEPTACLE	CT-FP02-S	1	1	3/C	12	
FPRECGS8-P3	RECEPTACLE RECEPTACLE	CT-FP05-C*	1	1	3/C	12	
FPRHREC01-P1	PANEL GN EXTERIOR JBOX ON NORTH SIDE OF FP	CT-FP03-N*	1	1	3/C	12	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPRHV01-C1	CONTROL PANEL CP-0306 RODNEY HUNT VALVE	CT-FP01-C*	2	1 9/C	14	
		CT-FP02-C*	2			
		CT-FP03-C*	2			
		CT-FP12-C*	2			
		CT-FP01-N*	2			
		CT-FP03-N*	2			
FPRHV01-P1	SWITCHBOARD FP-SWBD-01 EXTERIOR JBOX ON NORTH SIDE OF FP	CT-FP01-C*	1	1 4/C	10	
		CT-FP02-C*	1			
		CT-FP03-C*	1			
		CT-FP12-C*	1			
		CT-FP01-N*	1			
		CT-FP03-N*	1			
FPSMPP01-P1	PANELBOARD FP-CLP-01 BASIN 7 SAMPLE PMP FP-SMPP-01	CT-FP05-C*	1	1 3/C	12	
		CT-FP04-C*	1			
		CT-FP07-C*	1			
		CT-FP08-C*	1			
FPSMPP02-P1	PANELBOARD FP-CLP-01 EFFLUENT SAMPLE PMP FP-SMPP-02	CT-FP05-C*	1	1 3/C	12	
		CT-FP04-C*	1			
		CT-FP07-C*	1			
		CT-FP08-C*	1			
FPSMPP03-P1	PANELBOARD FP-CLP-01 BASIN 1 SAMPLE PMP FP-SMPP-03	CT-FP05-C*	1	1 3/C	12	
		CT-FP04-C*	1			
		CT-FP07-C*	1			
		CT-FP08-C*	1			
FPSMPP04-P1	PANELBOARD FP-CLP-01 INFLUENT1 SAMPLE PMP FP-SMPP-03	CT-FP05-C*	1	1 3/C	12	
		CT-FP04-C*	1			
		CT-FP07-C*	1			

## Cable Schedule

Cable Number	Orgin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
FPTLD01-P1	SWITCHBOARD FP-SWBD-1 TRANSFORMER LV DIST FP-TLD-1	CT-FP01-C*	1	1 3/C W/G	1/0	
		CT-FP02-C*	1			
		CT-FP03-C*	1			
		CT-FP04-C*	1			
		CT-FP05-C*	1			
FPTLD01-P2	SWITCHBOARD FP-SWBD-1 TRANSFORMER LV DIST FP-TLD-1	CT-FP01-C*	1	1 3/C W/G	1/0	
		CT-FP02-C*	1			
		CT-FP03-C*	1			
		CT-FP04-C*	1			
		CT-FP05-C*	1			
FPTLD02-P1	SWITCHBOARD FP-SWBD-01 TRANSFORMER LV DIST FP-TLD-2	CT-FP01-C*	1	1 3/C W/G	1/0	
		CT-FP02-C*	1			
		CT-FP03-C*	1			
		CT-FP04-C*	1			
		CT-FP05-C*	1			
FPTLD02-P2	SWITCHBOARD FP-SWBD-01 TRANSFORMER LV DIST FP-TLD-2	CT-FP01-C*	1	1 3/C W/G	1/0	
		CT-FP02-C*	1			
		CT-FP03-C*	1			
		CT-FP04-C*	1			
		CT-FP05-C*	1			
FPWB-C1	BLOWER STARTER FP-RVSS-1 WEST AIR SCOUR BLOWER SURGE PANEL	CT-FP01-C*	2	1 7/C	14	
FPWB-C2	BLOWER STARTER FP-RVSS-1 WEST AIR SCOUR BLOWER SELECTOR SWITCH	CT-FP01-C*	2	1 7/C	14	
FPWB-P1	BLOWER STARTER FP-RVSS-1 WEST AIR SCOUR BLOWER DISCONNECT	CT-FP01-C*	1	1 3/C W/G	1	

## Cable Schedule

Cable Number	Origin Description (From) Destination Description (To)	Cable Routing (From/To)		Conductors Qty Description	Size (AWG/kcmil)	Revision
		Tray	Section			
LSL512-C1	LEVEL SWITCH LSL-512	CT-FP08-C*	2	1 2/C	14	
		CT-FP07-C*	2			
	CONTROL PANEL CP-0306	CT-FP04-C*	2			
		CT-FP03-C*	2			
		CT-FP02-C*	2			
		CT-FP01-C*	2			
TI507-A1	TI-507	CT-FP08-C*	4	1 TSP	16	
		CT-FP07-C*	4			
	CONTROL PANEL CP-0306	CT-FP04-C*	4			
		CT-FP03-C*	4			
		CT-FP02-C*	4			
		CT-FP01-C*	4			



1 2014/09/15

2 **SECTION 16060**  
3 **GROUNDING**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes: Material and installation requirements for grounding system(s).
- 7 B. Related Specification Sections include but are not necessarily limited to:
- 8 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 9 2. Division 01 - General Requirements.
- 10 3. Section 10400 - Identification Devices.
- 11 4. Section 13101 - Lightning Protection System.
- 12 5. Section 16010 - Electrical: Basic Requirements.
- 13 6. Section 16080 - Acceptance Testing.
- 14 7. Section 16120 - Wire and Cable - 600 Volt and Below.
- 15 8. Section 16130 - Raceways and Boxes.

16 **1.2 QUALITY ASSURANCE**

- 17 A. Referenced Standards:
- 18 1. ASTM International (ASTM):
- 19 a. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard,
- 20 Medium-Hard, or Soft.
- 21 2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
- 22 a. 837, Standard for Qualifying Permanent Connections Used in Substation Grounding.
- 23 3. National Fire Protection Association (NFPA):
- 24 a. 70, National Electrical Code (NEC).
- 25 1) Article 250, Grounding and Bonding.
- 26 2) Article 610, Cranes and Hoists.
- 27 3) Article 620, Elevators, Dumbwaiters, Escalators, Moving Walks, Platform Lifts, and
- 28 Stairway Chairlifts.
- 29 4. Underwriters Laboratories, Inc. (UL):
- 30 a. 467, Grounding and Bonding Equipment.
- 31 B. Assure ground continuity is continuous throughout the entire Project.

32 **1.3 SUBMITTALS**

- 33 A. Shop Drawings:
- 34 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 35 the submittal process.
- 36 2. Product technical data.
- 37 a. Provide submittal data for all products specified in PART 2 of this Specification Section
- 38 except:
- 39 1) Grounding clamps, terminals and connectors.
- 40 2) Exothermic welding system.
- 41 b. See Specification Section 16010 for additional requirements.

42 **PART 2 - PRODUCTS**

43 **2.1 ACCEPTABLE MANUFACTURERS**

- 44 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 45 1. Ground rods and bars and grounding clamps, connectors and terminals:
- 46 a. Burndy.
- 47 b. Harger Lightning Protection.
- 48 c. Heary Brothers.

- 1 d. Joslyn.
- 2 e. Robbins Lightning Protection.
- 3 f. Thomas & Betts Blackburn.
- 4 g. Thompson.
- 5 2. Exothermic weld connections:
- 6 a. Erico Products Inc., Cadweld.
- 7 b. Harger Lightning Protection.
- 8 c. Thermoweld.
- 9 d. Thomas & Betts Furseweld.
- 10 B. Submit request for substitution in accordance with Specification Section 01640.

11 **2.2 COMPONENTS**

- 12 A. Wire and Cable:
- 13 1. Bare conductors: Soft drawn stranded copper meeting ASTM B8.
- 14 2. Insulated conductors: Color coded green, per Specification Section 16120.
- 15 B. Conduit: As specified in Specification Section 16130.
- 16 C. Ground Bars:
- 17 1. Solid copper:
- 18 a. 1/4 IN thick.
- 19 b. 2 or 4 IN wide.
- 20 c. 24 IN long minimum in main service entrance electrical rooms, 12 IN long elsewhere.
- 21 2. Predrilled grounding lug mounting holes.
- 22 3. Stainless steel or galvanized steel mounting brackets.
- 23 4. Insulated standoffs.
- 24 D. Ground Rods:
- 25 1. 3/4 IN x 10 FT.
- 26 2. Copper clad:
- 27 a. Heavy uniform coating of electrolytic copper molecularly bonded to a rigid steel core.
- 28 b. Corrosion resistant bond between the copper and steel.
- 29 c. Hard drawn for a scar-resistant surface.
- 30 E. Grounding Clamps, Connectors and Terminals:
- 31 1. Mechanical type:
- 32 a. Standards: UL 467.
- 33 b. High copper alloy content.
- 34 2. Compression type for interior locations:
- 35 a. Standards: UL 467.
- 36 b. High copper alloy content.
- 37 c. Non-reversible.
- 38 d. Terminals for connection to bus bars shall have two bolt holes.
- 39 3. Compression type suitable for direct burial in earth or concrete:
- 40 a. Standards: UL 467, IEEE 837.
- 41 b. High copper alloy content.
- 42 c. Non-reversible.
- 43 F. Exothermic Weld Connections:
- 44 1. Copper oxide reduction by aluminum process.
- 45 2. Molds properly sized for each application.

46 **PART 3 - EXECUTION**

47 **3.1 INSTALLATION**

- 48 A. General:
- 49 1. Install products in accordance with manufacturer's instructions.
- 50 2. Size grounding conductors and bonding jumpers in accordance with NFPA 70, Article 250,
- 51 except where larger sizes are indicated on the Drawings.
- 52 3. Remove paint, rust, or other non-conducting material from contact surfaces before making
- 53 ground connections.

- 1 4. Where ground conductors pass through floor slabs or building walls provide nonmetallic
- 2 sleeves and install per Specification Section 01800.
- 3 5. Do not splice grounding conductors except at ground rods.
- 4 6. Install ground rods and grounding conductors in undisturbed, firm soil.
- 5 a. Provide excavation required for installation of ground rods and ground conductors.
- 6 b. Use driving studs or other suitable means to prevent damage to threaded ends of
- 7 sectional rods.
- 8 c. Unless otherwise specified, connect conductors to ground rods with compressor type
- 9 connectors or exothermic weld.
- 10 d. Provide sufficient slack in grounding conductor to prevent conductor breakage during
- 11 backfill or due to ground movement.
- 12 e. Backfill excavation completely, thoroughly tamping to provide good contact between
- 13 backfill materials and ground rods and conductors.
- 14 7. Do not use exothermic welding if it will damage the structure the grounding conductor is
- 15 being welded to.
- 16 B. Grounding Electrode System:
- 17 a. Extend existing grounding electrode system to new equipment as indicated on the
- 18 Drawings.
- 19 C. Low Voltage Transformer Separately Derived Grounding System:
- 20 1. Ground separately mounted step-down transformers XO terminal to one of the following:
- 21 a. Closest building steel using mechanical type terminal bolted to the steel, compression
- 22 type connection or exothermic weld.
- 23 b. Closest water pipe using a mechanical type connection.
- 24 D. Raceway Bonding/Grounding:
- 25 1. All metallic conduit shall be installed so that it is electrically continuous.
- 26 2. All conduits to contain a grounding conductor with insulation identical to the phase
- 27 conductors, unless otherwise indicated on the Drawings.
- 28 3. NFPA 70 required grounding bushings shall be of the insulating type.
- 29 4. Provide double locknuts at all panels.
- 30 5. Bond all conduit, at entrance and exit of equipment, to the equipment ground bus or lug.
- 31 6. Provide bonding jumpers if conduits are installed in concentric knockouts.
- 32 7. Make all metallic raceway fittings and grounding clamps tight to ensure equipment grounding
- 33 system will operate continuously at ground potential to provide low impedance current path
- 34 for proper operation of overcurrent devices during possible ground fault conditions.
- 35 E. Equipment Grounding:
- 36 1. All utilization equipment shall be grounded with an equipment ground conductor.
- 37 F. Handhole Grounding:
- 38 1. Provide a ground rod and ground bar, when indicated or as needed, in each manhole and
- 39 handhole with exposed metal parts.
- 40 a. Expose a minimum of 4 IN of the rod above the floor for field connections to the rod.
- 41 2. Connect all exposed metal parts (e.g., conduits and cable racks) to the ground rod and to the
- 42 largest equipment grounding conductor passing through the handhole.

43 **3.2 FIELD QUALITY CONTROL**

- 44 A. Leave grounding system uncovered until observed by Owner.
- 45 B. Acceptance testing: See Specification Section 16080.

46 **END OF SECTION**

47



1 2014/08/19

2

3

**SECTION 16080**  
**ACCEPTANCE TESTING**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes: Basic requirements for acceptance testing.
- 7 B. Related Specification Sections include but are not necessarily limited to:
- 8 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 9 2. Division 01 - General Requirements.
- 10 3. Section 11005 - Equipment: Basic Requirements.
- 11 4. Division 16 - Electrical.

12 **1.2 QUALITY ASSURANCE**

- 13 A. Referenced Standards:
- 14 1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
- 15 a. 400, Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable
- 16 Systems.
- 17 b. 400.3, Guide for Partial Discharge Testing of Power Cable Systems in a Field
- 18 Environment.
- 19 2. InterNational Electrical Testing Association (NETA):
- 20 a. ATS, Standard for Acceptance Testing Specifications for Electric Power Equipment and
- 21 Systems.
- 22 3. Nationally Recognized Testing Laboratory (NRTL).
- 23 4. Telecommunications Industry Association/Electronic Industries Alliance/American National
- 24 Standards Institute (TIA/EIA/ANSI):
- 25 a. 455-78-B, Optical Fibres - PART 1-40: Measurement Methods and Test Procedures -
- 26 Attenuation.
- 27 B. Qualifications:
- 28 1. Testing firm qualifications: See Specification Section 11005.
- 29 2. Field personnel:
- 30 a. See Specification Section 11005.
- 31 b. As an alternative, supervising technician may be certified by the equipment
- 32 manufacturer.
- 33 3. Analysis personnel:
- 34 a. See Specification Section 11005.
- 35 b. As an alternative, supervising technician may be certified by the equipment
- 36 manufacturer.

37 **1.3 SUBMITTALS**

- 38 A. Shop Drawings:
- 39 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 40 the submittal process.
- 41 2. See Specification Section 11005 for electrical equipment and connection testing plan
- 42 submittal requirements.
- 43 B. Informational Submittals:
- 44 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 45 the submittal process.
- 46 2. Prior to energizing equipment:
- 47 a. Photocopies of continuity tests.
- 48 3. Within two (2) weeks after successful completion of Demonstration Period (Commissioning
- 49 Period):
- 50 a. Single report containing information including:
- 51 1) Summary of Project.

- 1                                   2) Information from pre-energization testing.
- 2                                   3) See testing and monitoring reporting requirements in Specification Section 11005.

3       **PART 2 - PRODUCTS**

4       **2.1 FACTORY QUALITY CONTROL**

- 5           A. Provide Division 16 equipment with all routing factory tests required by the applicable industry
- 6           standards or NRTL.
- 7           B. Factory testing will not be accepted in lieu of field acceptance testing requirements specified in
- 8           this Specification Section and Specification Section 11005.

9       **PART 3 - EXECUTION**

10       **3.1 FIELD QUALITY CONTROL**

- 11           A. General:
  - 12           1. See Specification Section 11005.
  - 13           2. Complete electrical testing in three (3) phases:
    - 14           a. Pre-energization testing phase.
    - 15           b. Equipment energized with no load.
    - 16           c. Equipment energized under load.
  - 17           3. Perform testing in accordance with this Specification Section and NETA ATS.
  - 18           4. Provide field setting and programming of all adjustable protective devices and meters to
  - 19           settings provided by the Engineer.
- 20           B. Equipment Monitoring and Testing Plan: See Specification Section 11005.
- 21           C. Instruments Used in Equipment and Connections Quality Control Testing: See Specification
- 22           Section 11005.
- 23           D. Testing and Monitoring Program Documentation: See Specification Section 11005.
- 24           E. Electrical Equipment and Connections Testing Program:
  - 25           1. See Specification Section 11005.
  - 26           2. See individual Division 16 Specification Sections for equipment specific testing requirements.
  - 27           3. Test all electrical equipment.
    - 28           a. Perform all required NETA testing.
    - 29           b. Perform all required NETA testing plus the optional testing identified with each specific
    - 30           type of equipment in Article 3.2 of this Specification Section.

31       **3.2 SPECIFIC EQUIPMENT TESTING REQUIREMENTS**

- 32           A. Switchboards:
  - 33           1. Perform inspections and tests per NETA ATS 7.1.
  - 34           2. Components: Test all components per applicable paragraphs of this Specification Section
  - 35           and NETA ATS.
- 36           B. Transformers - Small Dry Type:
  - 37           1. Perform inspections and tests per NETA ATS 7.2.1.1.
  - 38           2. Perform the following additional tests:
    - 39           a. Record phase-to-phase, phase-to-neutral, and neutral-to-ground voltages at no load
    - 40           after energizing, and at operating load after startup.
  - 41           3. Adjust tap connections as required to provide secondary voltage within 2-1/2 percent of
  - 42           nominal under normal load after approval of Engineer.
  - 43           4. Record as-left tap connections.
- 44           C. Transformers - Large Dry Type:
  - 45           1. Perform inspections and tests per NETA ATS 7.2.1.2.
  - 46           2. Components: Test all components per applicable paragraphs of this Specification Section
  - 47           and NETA ATS.







1 2014/09/05

2

## SECTION 16120

3

### WIRE AND CABLE: 600 VOLT AND BELOW

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

###### A. Section Includes:

7

###### 1. Material and installation requirements for:

8

a. Building wire.

9

b. Power cable.

10

c. Control cable.

11

d. Instrumentation cable.

12

e. Wire connectors.

13

f. Insulating tape.

14

g. Pulling lubricant.

15

###### B. Related Specification Sections include but are not necessarily limited to:

16

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

17

2. Division 01 - General Requirements.

18

3. Section 16010 - Electrical: Basic Requirements.

19

4. Section 16080 - Acceptance Testing.

20

##### 1.2 QUALITY ASSURANCE

21

###### A. Referenced Standards:

22

###### 1. Insulated Cable Engineers Association (ICEA):

23

a. S-58-679, Standard for Control Cable Conductor Identification.

24

###### 2. National Electrical Manufacturers Association (NEMA):

25

a. ICS 4, Industrial Control and Systems: Terminal Blocks.

26

###### 3. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA):

27

a. WC 57/S-73-532, Standard for Control Cables.

28

b. WC 70/S-95-658, Non-Shielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.

29

###### 4. National Fire Protection Association (NFPA):

30

a. 70, National Electrical Code (NEC).

31

b. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

32

###### 5. Telecommunications Industry Association/Electronic Industries Alliance/American National Standards Institute (TIA/EIA/ANSI):

33

a. 568, Commercial Building Telecommunications Cabling Standard.

34

###### 6. Underwriters Laboratories, Inc. (UL):

35

a. 44, Standard for Safety Thermoset-Insulated Wires and Cables.

36

b. 83, Standard for Safety Thermoplastic-Insulated Wires and Cables.

37

c. 467, Standard for Safety Grounding and Bonding Equipment.

38

d. 486A, Standard for Safety Wire Connectors and Soldering Lugs for use with Copper Conductors.

39

e. 486C, Standard for Safety Splicing Wire Connections.

40

f. 510, Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.

41

g. 1277, Standard for Safety Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

42

h. 1581, Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords.

43

i. 2250, Standard for Safety Instrumentation Tray Cable.

44

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1 **1.3 DEFINITIONS**

- 2 A. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or  
3 instrumentation wire.
- 4 B. Instrumentation Cable:  
5 1. Multiple conductor, insulated, twisted or untwisted, with outer sheath.  
6 2. The following are specific types of instrumentation cables:  
7 a. Analog signal cable:  
8 1) Used for the transmission of low current (e.g., 4-20mA DC) or low voltage (e.g., 0-  
9 10 Vdc) signals, using No. 16 AWG and smaller conductors.  
10 2) Commonly used types are defined in the following:  
11 a) TSP: Twisted shielded pair.  
12 b) TST: Twisted shielded triad.  
13 b. Digital signal cable: Used for the transmission of digital signals between computers,  
14 PLC's, RTU's, etc.
- 15 C. Power Cable: Multi-conductor, insulated, with outer sheath containing building wire, No. 8 AWG  
16 and larger.
- 17 D. Control Cable: Multi-conductor, insulated, with outer sheath containing building wires, No. 14,  
18 No. 12 or No. 10 AWG.
- 19 E. Building Wire: Single conductor, insulated, with or without outer jacket depending upon type.

20 **1.4 SUBMITTALS**

- 21 A. Shop Drawings:  
22 1. See Specification Section 01340 for requirements for the mechanics and administration of  
23 the submittal process.  
24 2. Product technical data:  
25 a. Provide submittal data for all products specified in PART 2 of this Specification Section  
26 except:  
27 1) Wire connectors.  
28 2) Insulating tape.  
29 3) Cable lubricant.  
30 b. See Specification Section 16010 for additional requirements.

31 **1.5 DELIVERY, STORAGE, AND HANDLING**

- 32 A. See Specification Section 16010.

33 **PART 2 - PRODUCTS**

34 **2.1 ACCEPTABLE MANUFACTURERS**

- 35 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:  
36 1. Building wire, power and control cable:  
37 a. Aetna Insulated Wire.  
38 b. Alphawire.  
39 c. Cerrowire.  
40 d. Encore Wire Corporation.  
41 e. General Cable.  
42 f. Okonite Company.  
43 g. Southwire Company.  
44 2. Instrumentation cable:  
45 a. Analog cable:  
46 1) Alphawire.  
47 2) Belden Inc.  
48 3) General Cable.  
49 3. Wire connectors:  
50 a. Burndy Corporation.  
51 b. Buchanan.  
52 c. Ideal.

- 1 d. IlSCO.
- 2 e. 3M Co.
- 3 f. Teledyne Penn Union.
- 4 g. Thomas and Betts.
- 5 h. Phoenix Contact.
- 6 4. Insulating and color coding tape:
- 7 a. 3M Co.
- 8 b. Plymouth Bishop Tapes.
- 9 c. Red Seal Electric Co.
- 10 B. Submit request for substitution in accordance with Specification Section 01640.

11 **2.2 MANUFACTURED UNITS**

- 12 A. Building Wire:
  - 13 1. Conductor shall be copper with 600 V rated insulation.
  - 14 2. Conductors shall be stranded, except for conductors used in lighting and receptacle circuits
  - 15 which may be stranded or solid.
  - 16 3. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL
  - 17 label.
  - 18 4. Conform to NEMA/ICEA WC 70/S-95-658 and UL 83 for type THHN/THWN and
  - 19 THHN/THWN-2 insulation.
  - 20 5. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 for type XHHW-2 insulation.
  - 21 6. Conductors No. 1/0 and larger used in a cable tray shall have a UL CT rating and conform to
  - 22 IEEE 1202 or CSA FT-4.
- 23 B. Power Cable:
  - 24 1. Conductor shall be copper with 600 V rated insulation.
  - 25 2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL
  - 26 label.
  - 27 3. Conform to NEMA/ICEA WC 70/S-95-658 and UL 83 and UL 1277 for type THHN/THWN
  - 28 insulation with an overall PVC jacket.
  - 29 4. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 and UL 1277 for type XHHW-2
  - 30 insulation with an overall PVC jacket.
  - 31 5. Number of conductors as required, including a bare ground conductor.
  - 32 6. Individual conductor color coding:
    - 33 a. ICEA S-58-679, Method 4.
    - 34 b. See PART 3 of this Specification Section for additional requirements.
  - 35 7. Conform to NFPA 70 Type TC.
- 36 C. Control Cable:
  - 37 1. Conductor shall be copper with 600 V rated insulation.
  - 38 2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL
  - 39 label.
  - 40 3. Conform to NEMA/ICEA WC 57/S-73-532 and UL 83 and UL 1277 for type THHN/THWN
  - 41 insulation with an overall PVC jacket.
  - 42 4. Number of conductors as required, provided with or without bare ground conductor of the
  - 43 same AWG size.
    - 44 a. When a bare ground conductor is not provided, an additional insulated conductor shall
    - 45 be provided and used as the ground conductor (e.g., 6/c No. 14 w/g and 7/c No. 14 are
    - 46 equal).
  - 47 5. Individual conductor color coding:
    - 48 a. ICEA S-58-679, Method 1, Table E-2.
    - 49 b. See PART 3 of this Specification Section for additional requirements.
  - 50 6. Conform to NFPA 70 Type TC.
- 51 D. Electrical Equipment Control Wire:
  - 52 1. Conductor shall be copper with 600 V rated insulation.
  - 53 2. Conductors shall be stranded.
  - 54 3. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL
  - 55 label.
  - 56 4. Conform to UL 44 for Type SIS insulation.
  - 57 5. Conform to UL 83 for Type MTW insulation.

- 1 E. Instrumentation Cable:
- 2 1. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL
- 3 label.
- 4 2. Analog cable:
- 5 a. Tinned copper conductors.
- 6 b. 300 V or 600 V PVC insulation with PVC jacket.
- 7 c. Twisted with 100 percent foil shield coverage with drain wire.
- 8 d. Six (6) twists per foot minimum.
- 9 e. Individual conductor color coding: ICEA S-58-679, Method 1, Table E-2.
- 10 f. Conform to UL 2250, UL 1581 and NFPA 70 Type ITC.
- 11 3. Digital cable:
- 12 a. As recommended by equipment (e.g., PLC, RTU) manufacturer.
- 13 b. Horizontal voice and data cable:
- 14 1) Category 6 per TIA/EIA/ANSI 568.
- 15 2) Cable shall be label-verified.
- 16 3) Cable jacket shall be factory marked at regular intervals indicating verifying
- 17 organization and performance level.
- 18 4) Provide different color cable for each of the following cable types:
- 19 a) Security - green.
- 20 b) Voice/Data - blue.
- 21 c) Process Data - white.
- 22 5) Conductors: No. 24 AWG solid untinned copper.
- 23 6) Rated CMP per NFPA 70.
- 24 c. Conform to NFPA 262 and NFPA 70 Type ITC.
- 25 F. Fiber Optic Cable:
- 26 1. Type:
- 27 a. OM3.
- 28 b. Rated for indoor, outdoor or riser use.
- 29 c. Tight buffered.
- 30 d. Listed Rating: OFNR and FT-4.
- 31 2. Number of fibers: As indicated on the Drawings.
- 32 3. Fiber size: Unless otherwise specified, cable shall be 50/125 micrometer (core
- 33 diameter/cladding diameter).
- 34 a. There are a few instances where cables are identified on drawings to be 62.5/125
- 35 micrometer (core diameter/cladding diameter) for compatibility with existing fiber.
- 36 4. Glass fiber core.
- 37 5. Step index.
- 38 6. Maximum attenuation:
- 39 a. At 850 nm: 3.75 dB/km.
- 40 b. At 1300 nm: 1.5dB/km.
- 41 7. Minimum bandwidth:
- 42 a. At 850 nm: 160 MHz/km.
- 43 b. At 1300 nm: 500 MHz/km.
- 44 8. Maximum tensile load:
- 45 a. Installation: 225 LBS.
- 46 b. Long term: 67 LBS.
- 47 9. Cable jacket material:
- 48 a. In rigid aluminum conduit: PVC, or polyethylene.
- 49 b. In plenum or riser: Flame retardant material; PVC not allowed.
- 50 1) Plenum applications: Cable materials shall pass NFPA 262 requirements.
- 51 2) Riser applications: Cable materials shall pass UL 1666 requirements.
- 52 c. In cable tray: Polyethylene or equivalent; PVC not allowed.
- 53 1) Meet vertical flame tray test requirements of NFPA 262.
- 54 10. Cables shall be listed and marked in accordance with the requirements of NFPA 70.
- 55 11. Optical fiber cable type utilized shall be in accordance with NFPA 70.
- 56 12. Utilize LC type connectors:
- 57 a. Tip material: Ceramic or ceramic/glass composite.
- 58 b. Utilize connectors which do not require adhesive, epoxy, or polish.
- 59 G. Wire Connectors:
- 60 1. Twist/screw on type:
- 61 a. Insulated pressure or spring type solderless connector.

- 1 b. 600 V rated.
- 2 c. Ground conductors: Conform to UL 486C and/or UL 467 when required by local codes.
- 3 d. Phase and neutral conductors: Conform to UL 486C.
- 4 2. Compression and mechanical screw type:
  - 5 a. 600 V rated.
  - 6 b. Ground conductors: Conform to UL 467.
  - 7 c. Phase and neutral conductors: Conform to UL 486A.
- 8 3. Terminal block type:
  - 9 a. High density, screw-post barrier-type with white center marker strip.
  - 10 b. 600 V and ampere rating as required, for power circuits.
  - 11 c. 600 V, 20 ampere rated for control circuits.
  - 12 d. 300 V, 15 ampere rated for instrumentation circuits.
  - 13 e. Conform to NEMA ICS 4 and UL 486A.
- 14 H. Insulating and Color Coding Tape:
  - 15 1. Pressure sensitive vinyl.
  - 16 2. Premium grade.
  - 17 3. Heat, cold, moisture, and sunlight resistant.
  - 18 4. Thickness, depending on use conditions: 7, 8.5, or 10 mil.
  - 19 5. For cold weather or outdoor location, tape must also be all-weather.
  - 20 6. Color:
    - 21 a. Insulating tape: Black.
    - 22 b. Color coding tape: Fade-resistant color as specified herein.
  - 23 7. Comply with UL 510.
- 24 I. Cold Shrink Insulation:
  - 25 1. Factory expanded sleeve with removable core.
  - 26 2. With core removed, the insulation will shrink over splice connector providing a water-resistant
  - 27 seal.
  - 28 3. Material: EPDM Rubber.
  - 29 4. Voltage: 1000 V.
  - 30 5. Fungus resistant per ASTM G21.
- 31 J. Electrical Equipment Enclosure and Cable Sealing Bushing:
  - 32 1. Galvanized malleable or ductile iron.
  - 33 2. Zinc electroplated locknut.
  - 34 3. Neoprene sealing ring.
- 35 K. Pulling Lubricant: Cable manufacturer's standard containing no petroleum or other products
- 36 which will deteriorate insulation.

## 37 **PART 3 - EXECUTION**

### 38 **3.1 INSTALLATION**

- 39 A. Permitted Usage of Insulation Types:
  - 40 1. Type XHHW-2:
    - 41 a. Building wire and power and control cable in architectural and non-architectural finished
    - 42 areas.
    - 43 b. Building wire and power and control cable in conduit below grade.
  - 44 2. Type THHN/THWN and THHN/THWN-2:
    - 45 a. Building wire and power and control cable No. 8 AWG and smaller in architectural and
    - 46 non-architectural finished areas.
  - 47 3. Type SIS and MTW:
    - 48 a. For the wiring of control equipment within control panels and field wiring of control
    - 49 equipment within switchgear, switchboards, motor control centers.
- 50 B. Conductor Size Limitations:
  - 51 1. Feeder and branch power conductors shall not be smaller than No. 12 AWG unless
  - 52 otherwise indicated on the Drawings.
  - 53 2. Control conductors shall not be smaller than No. 14 AWG unless otherwise indicated on the
  - 54 Drawings.

1 3. Instrumentation conductors shall not be smaller than No. 18 AWG unless otherwise indicated  
2 on the Drawings.

3 C. Color Code All Wiring as Follows:

4 1. Building wire:

5

	240 V, 208 V, 240/120 V, 208/120 V	480 V, 480/277 V
Phase 1	Black	Brown
Phase 2	Red *	Orange
Phase 3	Blue	Yellow
Neutral	White	White or Gray
Ground	Green	Green

6

\* Orange when it is a high leg of a 120/240 V Delta system.

7

8 a. Conductors No. 6 AWG and smaller: Insulated phase, neutral and ground conductors  
9 shall be identified by a continuous colored outer finish along its entire length.

10 b. Conductors larger than No. 6 AWG:

11 1) Insulated phase and neutral conductors shall be identified by one (1) of the  
12 following methods:

13 a) Continuous colored outer finish along its entire length.

14 b) 3 IN of colored tape applied at the termination.

15 2) Insulated grounding conductor shall be identified by one (1) of the following  
16 methods:

17 a) Continuous green outer finish along its entire length.

18 b) Stripping the insulation from the entire exposed length.

19 c) Using green tape to cover the entire exposed length.

20 3) The color coding shall be applied at all accessible locations, including but not limited  
21 to: Junction and pull boxes, wireways, manholes and handholes.

22 2. Power cables ICEA S-58-679, Method 4 with:

23 a. Phase and neutral conductors identified with 3 IN of colored tape, per the Table herein,  
24 applied at the terminations.

25 b. Ground conductor: Bare.

26 3. Control cables ICEA S-58-679, Method 1, Table E-2:

27 a. When a bare ground is not provided, one (1) of the colored insulated conductors shall be  
28 re-identified by stripping the insulation from the entire exposed length or using green  
29 tape to cover the entire exposed length.

30 b. When used in power applications the colored insulated conductors used as phase and  
31 neutral conductors may have to be re-identified with 3 IN of colored tape, per the Table  
32 herein, applied at the terminations.

33 D. Install all wiring in raceway unless otherwise indicated on the Drawings.

34 E. Feeder, branch, control and instrumentation circuits shall not be combined in a raceway, cable  
35 tray, junction or pull box, except as permitted in the following:

36 1. Where specifically indicated on the Drawings.

37 2. Where field conditions dictate and written permission is obtained from the Engineer.

38 3. Control circuits shall be isolated from feeder and branch power and instrumentation circuits  
39 but combining of control circuits is permitted.

40 a. The combinations shall comply with the following:

41 1) 12 Vdc, 24 Vdc and 48 Vdc may be combined.

42 2) 125 Vdc shall be isolated from all other AC and DC circuits.

43 3) AC control circuits shall be isolated from all DC circuits.

44 4. Instrumentation circuits shall be isolated from feeder and branch power and control circuits  
45 but combining of instrumentation circuits is permitted.

46 a. The combinations shall comply with the following:

47 1) Analog signal circuits may be combined.

48 2) Digital signal circuits may be combined but isolated from analog signal circuits.

- 1 5. Multiple branch circuits for lighting, receptacle and other 120 Vac circuits are allowed to be  
2 combined into a common raceway.  
3 a. Contractor is responsible for making the required adjustments in conductor and raceway  
4 size, in accordance with all requirements of the NFPA 70, including but not limited to:  
5 1) Up sizing conductor size for required ampacity de-ratings for the number of current  
6 carrying conductors in the raceway.  
7 2) The neutral conductors may not be shared.  
8 3) Up sizing raceway size for the size and quantity of conductors.
- 9 F. Ground the drain wire of shielded instrumentation cables at one (1) end only.  
10 1. The preferred grounding location is at the load (e.g., control panel), not at the source (e.g.,  
11 field mounted instrument).
- 12 G. Splices and terminations for the following circuit types shall be made in the indicated enclosure  
13 type using the indicated method.  
14 1. Feeder and branch power circuits:  
15 a. Device outlet boxes:  
16 1) Twist/screw on type connectors.  
17 b. Junction and pull boxes and wireways:  
18 1) Twist/screw on type connectors for use on No. 8 and smaller wire.  
19 2) Compression, mechanical screw or terminal block or terminal strip type connectors  
20 for use on No. 6 AWG and larger wire.  
21 c. Motor terminal boxes:  
22 1) Twist/screw on type connectors for use on No. 10 AWG and smaller wire.  
23 2) Insulated mechanical screw type connectors for use on No. 8 AWG and larger wire.  
24 d. Handholes:  
25 1) Twist/screw on type connectors pre-filled with epoxy for use on No. 8 AWG and  
26 smaller wire.  
27 2) Watertight compression or mechanical screw type connectors for use on No. 6  
28 AWG and larger wire.  
29 2. Control circuits:  
30 a. Junction and pull boxes: Terminal block type connector.  
31 b. Manholes or handholes: Twist/screw on type connectors pre-filled with epoxy.  
32 c. Control panels and motor control centers: Terminal block or strips provided within the  
33 equipment or field installed within the equipment by the Contractor.  
34 3. Instrumentation circuits can be spliced where field conditions dictate and written permission  
35 is obtained from the Engineer.  
36 a. Maintain electrical continuity of the shield when splicing twisted shielded conductors.  
37 b. Junction and pull boxes: Terminal block type connector.  
38 c. Control panels and motor control centers: Terminal block or strip provided within the  
39 equipment or field installed within the equipment by the Contractor.  
40 4. Non-insulated compression and mechanical screw type connectors shall be insulated with  
41 tape or hot or cold shrink type insulation to the insulation level of the conductors.
- 42 H. Insulating Tape Usage:  
43 1. For insulating connections of No. 8 AWG wire and smaller: 7 mil vinyl tape.  
44 2. For insulating splices and taps of No. 6 AWG wire or larger: 10 mil vinyl tape.  
45 3. For insulating connections made in cold weather or in outdoor locations: 8.5 mil, all weather  
46 vinyl tape.
- 47 I. Color Coding Tape Usage: For color coding of conductors.
- 48 J. Fiber Optic Cable:  
49 1. Unless indicated otherwise, install all fiber optic cable in conduit.  
50 a. In cable trays, the cable(s) shall be installed in an interdict that is placed in the tray for  
51 protection of the cable.  
52 2. Splicing:  
53 a. Optical fibers shall not be spliced.  
54 3. Utilize dust tight wall-mounted interconnect center to provide the following:  
55 a. Interconnect fiber optic cable to jumper cable assemblies for connection to the opto-  
56 electronic interface.  
57 4. Where exposed to contact with electric light or power conductors, the noncurrent carrying  
58 metallic members (if applicable) of optical fiber cables entering buildings shall be grounded  
59 as close to the point of entrance as practicable in accordance with NFPA 70.





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**SECTION 16125**  
**HEAT TRACING CABLE**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6 A. Section Includes:

7 1. Heat tracing cable as required for heat tracing of pipes as indicated on the Drawings.

8 B. Related Sections include but are not necessarily limited to:

9 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

10 2. Division 01 - General Requirements.

11 3. Division 15 - Mechanical.

12 4. Section 16010 - Electrical: Basic Requirements.

13 **1.2 QUALITY ASSURANCE**

14 A. Referenced Standards:

15 1. National Electrical Manufacturers Association (NEMA):

16 a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

17 **1.3 SUBMITTALS**

18 A. Shop Drawings:

19 1. See Specification Section 01340 for requirements for the mechanics and administration of  
20 the submittal process.

21 2. Product technical data:

22 a. Power requirements for each circuit based upon actual length of heat trace and  
23 maintained temperature.

24 b. Circuit breaker rating based upon inrush current at minimum expected start-up  
25 temperature.

26 c. Length of heat tape for each pipe size and run.

27 d. Coordinate and verify length and Watts/FT of heat tape required based upon pipe size  
28 and insulation thickness.

29 1) Include the calculations to support the heat tape output.

30 e. See Section 16010 for additional requirements.

31 3. Fabrication and/or layout drawings:

32 a. Wiring diagrams showing physical locations of thermostats and heat trace power supply.

33 B. Operation and Maintenance Manuals:

34 1. See Specification Section 01342 for requirements for:

35 a. The mechanics and administration of the submittal process.

36 b. The content of Operation and Maintenance Manuals.

37 C. Informational Submittals:

38 1. See Specification Section 01340 for requirements for the mechanics and administration of  
39 the submittal process.

40 2. Test reports: Megger test results.

41 **1.4 DELIVERY, STORAGE, AND HANDLING**

42 A. Shall be stored such that they are not exposed to sunlight or other UV rays.

1 **PART 2 - PRODUCTS**

2 **2.1 ACCEPTABLE MANUFACTURERS**

- 3 A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:  
4 1. Thermon.  
5 2. Chemelex Division; Raychem Corp.  
6 3. Chromalox.  
7 B. Submit request for substitution in accordance with Specification Section 01640.

8 **2.2 HEAT TRACING**

- 9 A. Design Parameters:  
10 1. Pipe diameter, length and material: See Drawings and Division 15 Specifications.  
11 2. Flange, valve, pipe support size: See Drawings and Division 15 Specifications.  
12 3. Pipe insulation type and thickness: See Drawings and Division 15 Specifications.  
13 4. Temperatures requirements:  
14 a. Low ambient temperature for the specific location: -25 DegF.  
15 b. Start-up temperature (alarm thermostat set point):  
16 1) Water/wastewater lines: 40 DegF.  
17 c. Maintain temperature (power thermostat set point):  
18 1) Water/wastewater lines: 40 DegF.  
19 d. High temperature exposure with power off: 185 DegF.  
20 5. Wind factor for the specific location: 10 MPH.  
21 6. Electrical requirements:  
22 a. Voltage: 120 V.  
23 b. Circuit breaker: Field coordinate if other than 20A GFEPFI type.  
24 7. Safety factor: 10 percent.  
25 B. Self-regulating or power-limiting parallel circuit construction consisting of an inner core of  
26 conductive material between parallel copper bus wires, with inverse temperature - conductivity  
27 characteristics with metal overbraid.  
28 C. Thermostats adjustable between 35 and 200 DegF minimum with maximum differential range of 9  
29 DegF, furnished complete with NEMA 4 enclosures in all areas, stainless steel temperature bulb  
30 and capillary.  
31 D. All necessary or required components and accessories, such as power connection boxes, end  
32 seals, straps, tape and fitting brackets.  
33 E. In noncorrosive and nonhazardous locations, insulation shall be Polyolefin.  
34 F. In corrosive, hazardous and hydrocarbon locations insulation shall be Fluoropolymer (Teflon).

35 **PART 3 - EXECUTION**

36 **3.1 PREPARATION**

- 37 A. Install materials after piping has been tested and approved.

38 **3.2 INSTALLATION**

- 39 A. Insulate and heat trace wet pipe systems as indicated on Drawings.  
40 B. Install materials in accordance with manufacturer's instructions.  
41 1. Each circuit shall not exceed the manufacturer's recommended maximum length.  
42 C. For Metallic Piping:  
43 1. Heat tracing shall be installed completely wired.  
44 2. Cut heat trace to lengths as required and secure to pipe with glass or polyester fiber tape.  
45 D. For Nonmetallic Piping:  
46 1. Allow for extra heat trace output because nonmetallic pipe has a lower heat transfer.  
47 a. Heat tracing shall be installed completely wired.





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## SECTION 16130 RACEWAYS AND BOXES

### 4 PART 1 - GENERAL

#### 5 1.1 SUMMARY

6 A. Section Includes:

- 7 1. Material and installation requirements for:
- 8 a. Conduits.
  - 9 b. Conduit fittings.
  - 10 c. Conduit supports.
  - 11 d. Wireways.
  - 12 e. Outlet boxes.
  - 13 f. Pull and junction boxes.

14 B. Related Specification Sections include but are not necessarily limited to:

- 15 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 16 2. Division 01 - General Requirements.
- 17 3. Section 16010 - Electrical: Basic Requirements.
- 18 4. Section 16135 - Electrical: Exterior Underground.
- 19 5. Section 16140 - Wiring Devices.

#### 20 1.2 QUALITY ASSURANCE

21 A. Referenced Standards:

- 22 1. Aluminum Association (AA).
- 23 2. ASTM International (ASTM):
  - 24 a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and
  - 25 Steel Products.
  - 26 b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel
  - 27 Hardware.
  - 28 c. D2564, Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC)
  - 29 Plastic Piping Systems.
- 30 3. National Electrical Manufacturers Association (NEMA):
  - 31 a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 32 b. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and
  - 33 Intermediate Metal Conduit (IMC).
  - 34 c. TC 2, Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
  - 35 d. TC 3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
- 36 4. National Electrical Manufacturers Association/American National Standards Institute
- 37 (NEMA/ANSI):
  - 38 a. C80.5, Electrical Aluminum Rigid Conduit.
  - 39 b. OS 1, Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- 40 5. National Fire Protection Association (NFPA):
  - 41 a. 70, National Electrical Code (NEC).
- 42 6. Underwriters Laboratories, Inc. (UL):
  - 43 a. 1, Standard for Flexible Metal Conduit.
  - 44 b. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
  - 45 c. 360, Standard for Liquid-Tight Flexible Steel Conduit.
  - 46 d. 467, Grounding and Bonding Equipment.
  - 47 e. 514A, Metallic Outlet Boxes.
  - 48 f. 514B, Conduit, Tubing, and Cable Fittings.
  - 49 g. 651, Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings.
  - 50 h. 870, Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
  - 51 i. 886, Standard for Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.

1 **1.3 SUBMITTALS**

- 2 A. Shop Drawings:
- 3 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 4 the submittal process.
- 5 2. Product technical data:
- 6 a. Provide submittal data for all products specified in PART 2 of this Specification Section
- 7 except:
- 8 1) Conduit fittings.
- 9 2) Support systems.
- 10 b. See Specification Section 16010 for additional requirements.
- 11 3. Fabrication and/or layout Drawings:
- 12 a. Identify dimensional size of pull and junction boxes to be used.

13 **1.4 DELIVERY, STORAGE, AND HANDLING**

- 14 A. See Specification Section 16010.

15 **PART 2 - PRODUCTS**

16 **2.1 ACCEPTABLE MANUFACTURERS**

- 17 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 18 1. Rigid metallic conduits:
- 19 a. EASCO Aluminum.
- 20 b. Indalex.
- 21 c. VAW of American, Inc.
- 22 2. Rigid nonmetallic conduit:
- 23 a. Carlon.
- 24 b. Cantex.
- 25 c. Osburn Associates.
- 26 d. Champion Fiberglass.
- 27 e. United Fiberglass of America, Inc.
- 28 3. Flexible conduit:
- 29 a. AFC Cable Systems.
- 30 b. Anamet, Inc.
- 31 c. Electri-Flex.
- 32 d. Flexible Metal Hose Company.
- 33 e. International Metal Hose Company.
- 34 f. Triangle PWC Inc.
- 35 g. LTV Steel Company.
- 36 4. Wireway:
- 37 a. Hoffman Engineering Company.
- 38 b. Wiegmann.
- 39 c. Square D.
- 40 5. Conduit fittings and accessories:
- 41 a. Appleton Electric Co.
- 42 b. Carlon.
- 43 c. Cantex.
- 44 d. Crouse-Hinds.
- 45 e. Killark.
- 46 f. Osburn Associates.
- 47 g. OZ Gedney Company.
- 48 h. RACO.
- 49 i. Steel City.
- 50 j. Thomas & Betts.
- 51 6. Support systems:
- 52 a. Unistrut Building Systems.
- 53 b. Eaton B-Line.
- 54 c. Kindorf.
- 55 d. Minerallac Fastening Systems.

- 1 e. Caddy.
- 2 f. Thomas & Betts Superstrut.
- 3 7. Outlet, pull and junction boxes:
- 4 a. Appleton Electric Co.
- 5 b. Eaton Crouse-Hinds.
- 6 c. Killark.
- 7 d. O-Z/Gedney.
- 8 e. Thomas & Betts Steel City.
- 9 f. Raco.
- 10 g. Bell.
- 11 h. Hoffman Engineering Co.
- 12 i. Wiegmann.
- 13 j. Eaton B-Line.
- 14 k. Adalet.
- 15 l. Rittal.
- 16 m. Stahlin.
- 17 B. Submit request for substitution in accordance with Specification Section 01640.

18 **2.2 RIGID METALLIC CONDUITS**

- 19 A. Rigid Aluminum Conduit (RAC):
- 20 1. AA Type 6063 aluminum alloy, T-1 temper.
- 21 2. Maximum copper content of 0.10 percent.
- 22 3. Extruded, seamless.
- 23 4. Standards: NEMA/ANSI C80.5, UL 6.

24 **2.3 RIGID NON-METALLIC CONDUIT**

- 25 A. Schedules 40 (PVC-40) and 80 (PVC-80):
- 26 1. Polyvinyl-chloride (PVC) plastic compound which includes inert modifiers to improve
- 27 weatherability and heat distribution.
- 28 2. Rated for direct sunlight exposure.
- 29 3. Fire retardant and low smoke emission.
- 30 4. Shall be suitable for use with 90 DegC wire and shall be marked "maximum 90 DegC".
- 31 5. Standards: NEMA TC 2, UL 651.
- 32 B. Fiberglass:
- 33 1. Epoxy based resin system using an anhydride curing agent.
- 34 2. Continuous E-glass roving.
- 35 3. Winding angle approximately 54.75 degrees.
- 36 4. Halogen free additive for flame spread and smoke control.
- 37 5. Ultraviolet inhibitor: Carbon black.
- 38 6. Two (2) step curing process.
- 39 7. Tensile strength: 9000 psi per ASTM D2105.
- 40 8. Integral bell and spigot.
- 41 9. Conduits and fittings to be joined with an epoxy adhesive creating a water tight connection.
- 42 10. Standard: UL 1684.

43 **2.4 FLEXIBLE CONDUIT**

- 44 A. PVC-Coated Flexible Galvanized Steel (liquid-tight) Conduit (FLEX-LT):
- 45 1. Core formed of continuous, spiral wound, hot-dip galvanized steel strip with successive
- 46 convolutions securely interlocked.
- 47 2. Extruded PVC outer jacket positively locked to the steel core.
- 48 3. Liquid and vaportight.
- 49 4. Standard: UL 360.

50 **2.5 WIREWAY**

- 51 A. General:
- 52 1. Suitable for lay-in conductors.
- 53 2. Designed for continuous grounding.
- 54 3. Covers:
- 55 a. Hinged or removable in accessible areas.

- 1                    b. Non-removable when passing through partitions.
- 2                    4. Finish: Rust inhibiting primer and manufacturers standard paint inside and out except for
- 3                    stainless steel type.
- 4                    5. Standards: UL 870, NEMA 250.
- 5                    B. Watertight (NEMA 4X rated) Wireway:
- 6                    1. 14 GA Type 304 or 316 stainless steel bodies and covers without knockouts and 10 GA
- 7                    stainless steel flanges.
- 8                    2. Cover: Fully gasketed and held in place with captive clamp type latches.
- 9                    3. Flanges: Fully gasketed and bolted.

10                    **2.6 CONDUIT FITTINGS AND ACCESSORIES**

- 11                    A. Fittings for Use with RAC:
- 12                    1. Locknuts:
- 13                    a. Threaded steel or malleable iron.
- 14                    b. Gasketed or non-gasketed.
- 15                    c. Grounding or non-grounding type.
- 16                    2. Bushings:
- 17                    a. Threaded, insulated metallic.
- 18                    b. Grounding or non-grounding type.
- 19                    3. Hubs: Threaded, insulated and gasketed metallic for raintight connection.
- 20                    4. Couplings:
- 21                    a. Threaded straight type: Same material and finish as the conduit with which they are
- 22                    used on.
- 23                    b. Threadless type: Gland compression or self-threading type, concrete tight.
- 24                    5. Unions: Threaded galvanized steel or zinc plated malleable iron.
- 25                    6. Conduit bodies (ells and tees):
- 26                    a. Body: Cast copper free aluminum with threaded hubs.
- 27                    b. Standard and mogul size.
- 28                    c. Cover:
- 29                    1) Clip-on type with stainless steel screws.
- 30                    2) Gasketed or non-gasketed cast copper free aluminum.
- 31                    7. Expansion couplings:
- 32                    a. 2 IN nominal straight-line conduit movement in either direction.
- 33                    b. Galvanized steel with insulated bushing.
- 34                    c. Gasketed for wet locations.
- 35                    d. Internally or externally grounded.
- 36                    8. Expansion/deflection couplings:
- 37                    a. 3/4 IN nominal straight-line conduit movement in either direction.
- 38                    b. 30-degree nominal deflection from the normal in all directions.
- 39                    c. Metallic hubs, neoprene outer jacket and stainless steel jacket clamps.
- 40                    d. Internally or externally grounded.
- 41                    e. Watertight, raintight and concrete tight.
- 42                    9. Standards: UL 467, UL 514B.
- 43                    B. Fittings for Use with FLEX-LT:
- 44                    1. Connector:
- 45                    a. Straight or angle type.
- 46                    b. Metal construction, insulated and gasketed.
- 47                    c. Composed of locknut, grounding ferrule and gland compression nut.
- 48                    d. Liquid tight.
- 49                    2. Standards: UL 467, UL 514B.
- 50                    C. Fittings for Use with Rigid Nonmetallic PVC Conduit:
- 51                    1. Coupling, adapters and conduit bodies:
- 52                    a. Same material, thickness, and construction as the conduits with which they are used.
- 53                    b. Homogeneous plastic free from visible cracks, holes or foreign inclusions.
- 54                    c. Bore smooth and free of blisters, nicks or other imperfections which could damage the
- 55                    conductor.
- 56                    2. Solvent cement for welding fittings shall be supplied by the same manufacturer as the
- 57                    conduit and fittings.
- 58                    3. Standards: ASTM D2564, NEMA TC 3, UL 651, UL 514B.



- 1 D. Weather and Corrosion Protection Tape:
- 2 1. PVC based tape, 10 mils thick.
- 3 2. Protection against moisture, acids, alkalis, salts and sewage and suitable for direct bury.
- 4 3. Used with appropriate pipe primer.

5 **2.7 ALL RACEWAY AND FITTINGS**

- 6 A. Mark Products:
- 7 1. Identify the nominal trade size on the product.
- 8 2. Stamp with the name or trademark of the manufacturer.

9 **2.8 OUTLET BOXES**

- 10 A. Cast Outlet Boxes:
- 11 1. Die-cast copper free aluminum with manufacturers standard finish.
- 12 2. Threaded hubs and grounding screw.
- 13 3. Styles:
- 14 a. "FS" or "FD".
- 15 b. "Bell".
- 16 c. Single or multiple gang and tandem.
- 17 4. Accessories: 40 mil PVC exterior coating and 2 mil urethane interior coating.
- 18 5. Standards: UL 514A.

- 19 B. Nonmetallic Outlet Boxes:
- 20 1. Polyvinyl-chloride (PVC) plastic compound.
- 21 2. Rated for direct sunlight exposure.
- 22 3. Fire retardant and low smoke emission.
- 23 4. Suitable for use with 90 DegC wire.
- 24 5. Styles:
- 25 a. "FS" or "FD".
- 26 b. Single or multiple gang.
- 27 6. Standards: UL 514A, NEMA TC 3.

- 28 C. See Specification Section 16140 for wiring devices, wallplates and coverplates.

29 **2.9 PULL AND JUNCTION BOXES**

- 30 A. NEMA 4X Rated (metallic):
- 31 1. Body and cover: 14 GA Type 304 or 316 stainless steel.
- 32 2. Seams continuously welded and ground smooth.
- 33 3. No knockouts.
- 34 4. External mounting flanges.
- 35 5. Hinged door and stainless steel screws and clamps.
- 36 6. Door with oil-resistant gasket.

- 37 B. NEMA 4X Rated (Nonmetallic):
- 38 1. Body and cover: Ultraviolet light protected fiberglass-reinforced polyester boxes.
- 39 2. No knockouts.
- 40 3. External mounting flanges.
- 41 4. Hinged door with quick release latches and padlocking hasp.
- 42 5. Door with oil resistant gasket.

- 43 C. NEMA 12 Rated:
- 44 1. Body and cover:
- 45 a. Type 5052 H-32 aluminum, unpainted.
- 46 2. Seams continuously welded and ground smooth.
- 47 3. No knockouts.
- 48 4. External mounting flanges.
- 49 5. Non-hinged cover held closed with captivated cover screws threaded into sealed wells or
- 50 hinged cover held closed with stainless steel screws and clamps.
- 51 6. Flat door with oil resistant gasket.

- 52 D. Miscellaneous Accessories:
- 53 1. Rigid handles for covers larger than 9 SF or heavier than 25 LBS.
- 54 2. Split covers when heavier than 25 LBS.

- 1           3. Weldnuts for mounting optional panels and terminal kits.
- 2           4. Terminal blocks: Screw-post barrier-type, rated 600 volt and 20 ampere minimum.
- 3       E. Standards: NEMA 250, UL 50.

4       **2.10 SUPPORT SYSTEMS**

- 5       A. Multi-conduit Surface or Trapeze Type Support and Pull or Junction Box Supports:
  - 6           1. Material requirements:
    - 7               a. Aluminum: AA Type 6063-T6.
    - 8               b. Fiberglass: Fire-retardent polyester or vinylester resin, ASTM E84, UL 94.
- 9       B. Single Conduit and Outlet Box Support Fasteners:
  - 10           1. Material requirements:
    - 11               a. Stainless steel.
    - 12               b. Aluminum.

13       **2.11 OPENINGS AND PENETRATIONS IN WALLS AND FLOORS**

- 14       A. Sleeves, smoke and fire stop fitting through walls and floors:
  - 15           1. See Specification Section 01800.

16       **PART 3 - EXECUTION**

17       **3.1 RACEWAY INSTALLATION - GENERAL**

- 18       A. Shall be in accordance with the requirements of:
  - 19           1. NFPA 70.
  - 20           2. Manufacturer instructions.
- 21       B. Size of Raceways:
  - 22           1. Raceway sizes are shown on the Drawings, if not shown on the Drawings, then size in accordance with NFPA 70.
  - 23           2. Unless specifically indicated otherwise, the minimum raceway size shall be:
    - 24               a. Conduit: 3/4 IN.
    - 25               b. Wireway: 2-1/2 IN x 2-1/2 IN.
- 26       C. Field Bending and Cutting of Conduits:
  - 27           1. Utilize tools and equipment recommended by the manufacturer of the conduit, designed for the purpose and the conduit material to make all field bends and cuts.
  - 28           2. Do not reduce the internal diameter of the conduit when making conduit bends.
  - 29           3. Prepare tools and equipment to prevent damage to the PVC coating.
  - 30           4. Degrease threads after threading and apply a zinc rich paint.
  - 31           5. Debur interior and exterior after cutting.
- 32       D. Male threads of conduit systems shall be coated with an electrically conductive anti-seize compound.
- 33       E. The protective coating integrity of conduits, fittings, outlet, pull and junction boxes and accessories shall be maintained.
  - 34           1. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.
  - 35           2. Repair PVC coated components utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the conduit; or a self-adhesive, highly conformable, cross-linked silicone composition strip, followed by a protective coating of vinyl tape.
    - 36               a. Total nominal thickness: 40 mil.
  - 37           3. Repair surfaces which will be inaccessible after installation prior to installation.
- 38       F. Remove moisture and debris from conduit before wire is pulled into place.
  - 39           1. Pull mandrel with diameter nominally 1/4 IN smaller than the interior of the conduit, to remove obstructions.
  - 40           2. Swab conduit by pulling a clean, tight-fitting rag through the conduit.
  - 41           3. Tightly plug ends of conduit with tapered wood plugs or plastic inserts until wire is pulled.
- 42       G. Only nylon or polyethylene rope shall be used to pull wire and cable in conduit systems.

- 1 H. Where portions of a raceway are subject to different temperatures and where condensation is  
2 known to be a problem, as in cold storage areas of buildings or where passing from the interior to  
3 the exterior of a building, the raceway shall be sealed to prevent circulation of warm air to colder  
4 section of the raceway.
- 5 I. Fill openings in walls, floors, and ceilings and finish flush with surface.  
6 1. See Specification Section 01800.

### 7 3.2 RACEWAY ROUTING

- 8 A. Raceways shall be routed in the field unless otherwise indicated.  
9 1. Conduit and fittings shall be installed, as required, for a complete system that has a neat  
10 appearance and is in compliance with all applicable codes.  
11 2. Run in straight lines parallel to or at right angles to building lines.  
12 3. Do not route conduits:  
13 a. Through areas of high ambient temperature or radiant heat.  
14 b. In suspended concrete slabs.  
15 4. Conduit shall not interfere with, or prevent access to, piping, valves, ductwork, or other  
16 equipment for operation, maintenance and repair.  
17 5. Provide pull boxes or conduit bodies as needed so that there is a maximum of 360 degrees  
18 of bends in the conduit run or in long straight runs to limit pulling tensions.
- 19 B. All rigid conduits within a structure shall be installed exposed except as follows:  
20 1. As indicated on the Drawings.
- 21 C. Maintain minimum spacing between parallel conduit and piping runs in accordance with the  
22 following when the runs are greater than 30 FT:  
23 1. Between instrumentation and telecommunication: 1 IN.  
24 2. Between instrumentation and 125 V, 48 V and 24 Vdc: 2 IN.  
25 3. Between instrumentation and 600 V and less AC power or control: 6 IN.  
26 4. Between instrumentation and greater than 600 Vac power: 12 IN.  
27 5. Between telecommunication and 125 V, 48 V and 24 Vdc: 2 IN.  
28 6. Between telecommunication and 600 V and less AC power or control: 6 IN.  
29 7. Between telecommunication and greater than 600 Vac power: 12 IN.  
30 8. Between 125 V, 48 V and 24 Vdc and 600 V and less AC power or control: 2 IN.  
31 9. Between 125 V, 48 V and 24 Vdc and greater than 600 Vac power: 2 IN.  
32 10. Between 600 V and less AC and greater than 600 Vac: 2 IN.  
33 11. Between process, gas, air and water pipes: 6 IN.
- 34 D. Conduits shall be installed to eliminate moisture pockets.  
35 1. Where water cannot drain to openings, provide drain fittings in the low spots of the conduit  
36 run.
- 37 E. Conduit shall not be routed on the exterior of structures except as specifically indicated on the  
38 Drawings.
- 39 F. Where sufficient room exists within the housing of roof-mounted equipment, the conduit shall be  
40 stubbed up inside the housing.
- 41 G. Provide all required openings in walls, floors, and ceilings for conduit penetration.  
42 1. See Specification Section 01800.

### 43 3.3 RACEWAY APPLICATIONS

- 44 A. Permitted Raceway Types Per Wire or Cable Types:  
45 1. Power wire or cables: All raceway types.  
46 2. Control wire or cables: All raceway types.  
47 3. Instrumentation cables: Metallic raceway except nonmetallic may be used underground.  
48 4. Motor leads from a VFD: RAC or shielded VFD cables in all other raceways.  
49 5. Telecommunication cables: All raceway types.
- 50 B. Permitted Raceway Types Per Area Designations:  
51 1. Dry areas:  
52 a. RAC.  
53 2. Wet areas:  
54 a. RAC.

- 1 3. Corrosive areas:
- 2 a. RAC.
- 3 b. Fiberglass.
- 4 4. Highly corrosive areas:
- 5 a. Fiberglass.
- 6 C. Permitted Raceway Types Per Routing Locations:
- 7 1. Embedded in poured concrete walls and floors:
- 8 a. PVC-40.
- 9 b. PVC-80.
- 10 c. Fiberglass.
- 11 d. Fiberglass when emerging from concrete into areas designated as wet, corrosive or
- 12 highly corrosive.
- 13 2. Beneath floor slab-on-grade:
- 14 a. PVC-40.
- 15 b. Fiberglass.
- 16 3. Through floor penetrations, see Specification Section 01800:
- 17 a. Fiberglass in areas designated as wet, corrosive or highly corrosive.
- 18 4. Direct buried conduits and ductbanks:
- 19 a. PVC-80.
- 20 b. Fiberglass.
- 21 c. 90 degree elbows for transitions to above grade:
- 22 1) Fiberglass.
- 23 d. Long sweeping bends greater than 15 degrees:
- 24 1) Fiberglass.
- 25 5. Concrete encased ductbanks:
- 26 a. PVC-40.
- 27 b. Fiberglass.
- 28 c. 90 degree elbows for transitions to above grade:
- 29 1) Fiberglass.
- 30 d. Long sweeping bends greater than 15 degrees:
- 31 1) Fiberglass.
- 32 D. FLEX conduits shall be installed for connections to light fixtures, HVAC equipment and other
- 33 similar devices above the ceilings.
- 34 1. The maximum length shall not exceed:
- 35 a. 6 FT to light fixtures.
- 36 b. 3 FT to all other equipment.
- 37 E. FLEX-LT conduits shall be install as the final conduit connection to light fixtures, dry type
- 38 transformers, motors, electrically operated valves, instrumentation primary elements, and other
- 39 electrical equipment that is liable to vibrate.
- 40 1. The maximum length shall not exceed:
- 41 a. 6 FT to light fixtures.
- 42 b. 3 FT to motors.
- 43 c. 2 FT to all other equipment.
- 44 F. NEMA 4X Rated Wireway:
- 45 1. Surface mounted in areas designated as wet and or corrosive.
- 46 G. NEMA 12 Rated Wireway:
- 47 1. Surface mounted in areas designated as dry in architecturally and non-architecturally
- 48 finished areas.
- 49 H. Underground Conduit: See Specification Section 16135.

### 50 3.4 CONDUIT FITTINGS AND ACCESSORIES

- 51 A. Rigid nonmetallic conduit and fittings shall be joined utilizing solvent cement.
- 52 1. Immediately after installation of conduit and fitting, the fitting or conduit shall be rotated 1/4
- 53 turn to provide uniform contact.
- 54 B. Install Expansion Fittings:
- 55 1. Where conduits are exposed to the sun and conduit run is greater than 200 FT.
- 56 2. Elsewhere as identified on the Drawings.

- 1 C. Install Expansion/Deflection Fittings:  
 2 1. Where conduits enter a structure.  
 3 a. Except electrical manholes and handholes.  
 4 b. Except where the ductbank is tied to the structure with rebar.  
 5 2. Where conduits span structural expansions joints.  
 6 3. Elsewhere as identified on the Drawings.
- 7 D. Threaded connections shall be made wrench-tight.
- 8 E. Conduit joints shall be watertight:  
 9 1. Where subjected to possible submersion.  
 10 2. In areas classified as wet.  
 11 3. Underground.
- 12 F. Terminate Conduits:  
 13 1. In metallic outlet boxes:  
 14 a. RAC:  
 15 1) Conduit hub and locknut.  
 16 2) Insulated bushing and two (2) locknuts.  
 17 3) Use grounding type locknut or bushing when required by NFPA 70.  
 18 2. In NEMA 1 rated enclosures:  
 19 a. RAC:  
 20 1) Conduit hub and locknut.  
 21 2) Insulated bushing and two (2) locknuts.  
 22 3) Use grounding type locknut or bushing when required by NFPA 70.  
 23 3. In NEMA 12 rated enclosures:  
 24 a. Watertight, insulated and gasketed hub and locknut.  
 25 b. Use grounding type locknut or bushing when required by NFPA 70.  
 26 4. In NEMA 4 and NEMA 4X rated enclosures:  
 27 a. Watertight, insulated and gasketed hub and locknut.  
 28 5. When stubbed up through the floor into floor mount equipment:  
 29 a. With an insulated grounding bushing on metallic conduits.  
 30 b. With end bells on nonmetallic conduits.
- 31 G. Threadless couplings shall only be used to join new conduit to existing conduit when the existing  
 32 conduit end is not threaded and it is not practical or possible to cut threads on the existing conduit  
 33 with a pipe threader.

34 **3.5 CONDUIT SUPPORT**

- 35 A. Permitted multi-conduit surface or trapeze type support system per area designations and conduit  
 36 types:  
 37 1. Dry or wet and/or hazardous areas:  
 38 a. Aluminum system consisting of: Aluminum channels, fittings and conduit clamps with  
 39 stainless steel nuts and hardware.  
 40 2. Corrosive areas:  
 41 a. Aluminum system consisting of: Aluminum channels, fittings and conduit clamps with  
 42 stainless steel nuts and hardware.  
 43 b. Fiberglass system consisting of: Fiberglass channels and fittings, nuts and hardware  
 44 and conduit clamps.  
 45 3. Highly corrosive areas:  
 46 a. Fiberglass system consisting of: Fiberglass channels and fittings, nuts and hardware  
 47 and conduit clamps.  
 48 4. Conduit type shall be compatible with the support system material.  
 49 a. Aluminum system may be used with RAC.  
 50 b. Fiberglass system may be used with Fiberglass.
- 51 B. Permitted single conduit support fasteners per area designations and conduit types:  
 52 1. Dry or wet and/or hazardous areas:  
 53 a. Material: Stainless steel and aluminum.  
 54 b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam  
 55 clamps.  
 56 2. Corrosive areas:  
 57 a. Material: Stainless steel and aluminum.

- 1                   b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam
- 2                   clamps.
- 3                   3. Highly corrosive areas:
- 4                   a. Material: Non-metallic.
- 5                   b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam
- 6                   clamps.
- 7                   4. Conduit type shall be compatible with the support fastener material.
- 8                   a. Stainless steel and aluminum system may be used with RAC.
- 9                   b. Nonmetallic fasteners may be used with PVC-40, PVC-80 and fiberglass.
- 10                  C. Conduit Support General Requirements:
- 11                  1. Maximum spacing between conduit supports per NFPA 70.
- 12                  2. Support conduit from the building structure.
- 13                  3. Do not support conduit from process, gas, air or water piping; or from other conduits.
- 14                  4. Provide hangers and brackets to limit the maximum uniform load on a single support to
- 15                  25 LBS or to the maximum uniform load recommended by the manufacturer if the support is
- 16                  rated less than 25 LBS.
- 17                  a. Do not exceed maximum concentrated load recommended by the manufacturer on any
- 18                  support.
- 19                  b. Conduit hangers:
- 20                    1) Continuous threaded rods combined with struts or conduit clamps: Do not use
- 21                    perforated strap hangers and iron bailing wire.
- 22                  c. Do not use suspended ceiling support systems to support raceways.
- 23                  d. Hangers in metal roof decks:
- 24                    1) Utilize fender washers.
- 25                    2) Not extend above top of ribs.
- 26                    3) Not interfere with vapor barrier, insulation, or roofing.
- 27                  5. Conduit support system fasteners:
- 28                  a. Use sleeve-type expansion anchors as fasteners in masonry wall construction.
- 29                  b. Do not use concrete nails and powder-driven fasteners.

### 30   **3.6 OUTLET, PULL AND JUNCTION BOX INSTALLATION**

- 31                  A. General:
- 32                    1. Install products in accordance with manufacturer's instructions.
- 33                    2. See Specification Section 16010 and the Drawings for area classifications.
- 34                    3. Fill unused punched-out, tapped, or threaded hub openings with insert plugs.
- 35                    4. Size boxes to accommodate quantity of conductors enclosed and quantity of conduits
- 36                    connected to the box.
- 37                  B. Outlet Boxes:
- 38                    1. Permitted uses of cast outlet boxes:
- 39                      a. Housing of wiring devices surface mounted in non-architecturally finished dry, wet,
- 40                      corrosive, highly corrosive and hazardous areas.
- 41                      b. Pull and junction box surface mounted in non-architecturally finished dry, wet, corrosive
- 42                      and highly corrosive areas.
- 43                    2. Permitted uses of non-metallic outlet boxes:
- 44                      a. Housing of wiring devices surface mounted in non-architecturally finished highly
- 45                      corrosive areas.
- 46                      b. Pull and junction box surface mounted in non-architecturally finished highly corrosive
- 47                      areas.
- 48                    3. Mount device outlet boxes where indicated on the Drawings and at heights as scheduled in
- 49                      Specification Section 16010.
- 50                    4. Set device outlet boxes plumb and vertical to the floor.
- 51                    5. Place barriers between switches in boxes with 277 V switches on opposite phases.
- 52                    6. Back-to-back are not permitted.
- 53                  C. Pull and Junction Boxes:
- 54                    1. Install pull or junction boxes in conduit runs where indicated or required to facilitate pulling of
- 55                      wires or making connections.
- 56                      a. Make covers of boxes accessible.
- 57                    2. Permitted uses of NEMA 4X metallic enclosure:
- 58                      a. Pull or junction box surface mounted in areas designated as wet and/or corrosive.

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- 3. Permitted uses of NEMA 4X non-metallic enclosure:
  - a. Pull or junction box surfaced mounted in areas designated as highly corrosive.
- 4. Permitted uses of NEMA 12 enclosure:
  - a. Pull or junction box surface mounted in areas designated as dry.

**END OF SECTION**





1 2014/09/10

2 **SECTION 16132**  
3 **CABLE TRAY**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes: Cable tray and associated fittings and supports.
- 7 B. Related Specification Sections include but are not necessarily limited to:
- 8 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 9 2. Division 01 - General Requirements.
- 10 3. Section 10400 - Identification Devices.
- 11 4. Section 16010 - Electrical: Basic Requirements.
- 12 5. Section 16060 - Grounding.
- 13 6. Section 16130 - Raceways and Boxes.

14 **1.2 QUALITY ASSURANCE**

- 15 A. Referenced Standards:
- 16 1. ASTM International (ASTM):
- 17 a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and
- 18 Steel Products.
- 19 b. A510, Standard Specification for General Requirements for Wire Rods and Coarse
- 20 Round Wire, Carbon Steel.
- 21 c. A1011, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural,
- 22 High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and
- 23 Ultra-High Strength.
- 24 d. B633, Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
- 25 2. National Electrical Manufacturers Association (NEMA):
- 26 a. VE-1, Metal Cable Tray Systems.
- 27 b. VE-2, Metal Cable Tray Installation Guidelines.
- 28 3. Underwriters Laboratories, Inc. (UL).
- 29 4. National Fire Protection Association (NFPA):
- 30 a. 70, National Electrical Code (NEC).
- 31 5. Building Code:
- 32 a. International Code Council (ICC):
- 33 1) International Building Code and associated standards, 2012 Edition including all
- 34 amendments, referred to herein as Building Code.

35 **1.3 DEFINITIONS**

- 36 A. Types of Cable Tray:
- 37 1. Ladder: A prefabricated metal structure consisting of two (2) longitudinal side rails
- 38 connected by individual transverse members of rungs.

39 **1.4 SYSTEM DESCRIPTION**

- 40 A. The following is a brief description of the types of the trays to be used.
- 41 1. Filter Plant Building: Aluminum, ladder type.
- 42 B. Miscellaneous:
- 43 1. Cable tray systems are sized on the Drawings.
- 44 2. When cable tray system size is not shown on the Drawings or scheduled, the cable tray shall
- 45 be sized in accordance with the NFPA 70 and the requirements of this Specification Section.
- 46 3. Cable tray runs, where shown, are diagrammatic and intended to be used as a guide, unless
- 47 otherwise indicated on the Drawings.
- 48 a. Site conditions may affect actual routing.
- 49 b. Contractor shall coordinate routing and measurement with other trades and with
- 50 equipment suppliers to avoid interference with equipment, piping, ductwork, etc.

1 **1.5 SUBMITTALS**

- 2 A. Shop Drawings:
- 3 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 4 the submittal process.
- 5 2. Product technical data.
- 6 a. Provide submittal data for all products specified in PART 2 of this Specification Section.
- 7 b. See Specification Section 16010 for additional requirements.
- 8 3. Fabrication and/or layout Drawings:
- 9 a. Routing, size and fittings.
- 10 B. Informational Submittals:
- 11 1. Cable tray fill calculations.
- 12 2. Cable schedule of cables in cable trays.

13 **1.6 DELIVERY, STORAGE, AND HANDLING**

- 14 A. See Specification Section 16010.

15 **PART 2 - PRODUCTS**

16 **2.1 ACCEPTABLE MANUFACTURERS**

- 17 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 18 1. Metallic cable tray systems:
- 19 a. Eaton B-Line.
- 20 b. T.J. Cope.
- 21 c. Husky/Burndy.
- 22 d. Thomas & Betts.
- 23 e. P-W Ind.
- 24 2. Cable tray conduit and ground clamps and brackets:
- 25 a. Eaton B-Line.
- 26 b. P-W Ind.
- 27 c. O.Z. Gedney.
- 28 d. Thomas & Betts.
- 29 B. Submit request for substitution in accordance with Specification Section 01640.

30 **2.2 COMPONENTS**

- 31 A. Ladder Tray:
- 32 1. Materials:
- 33 a. Aluminum:
- 34 1) Side channels: Heat treatable alloy Type 6063-T6.
- 35 2) Transverse elements: Heat-treated alloy Type 6063-T6 (solid channel) or Type
- 36 6063-NHT (tubular).
- 37 3) Hardware: Stainless steel.
- 38 2. Fabrication:
- 39 a. Standard:
- 40 1) Metallic: NEMA VE-1.
- 41 b. The working (allowable) load capacity: As indicated in the Cable Tray Schedule with a
- 42 maximum support span of 12 feet.
- 43 c. Side rails:
- 44 1) I-beam or channel.
- 45 2) Flange in or out (full width top opening).
- 46 3) Useable clear nominal loading depth: As indicated in the Cable Tray Schedule.
- 47 d. Transverse elements: Solid bar, tube, or channel with stiffened flanges.
- 48 e. Useable clear nominal loading width: As indicated in the Cable Tray Schedule.
- 49 f. Maximum centerline rung spacing on straight sections: 9 IN.
- 50 g. Maximum straight section length: 12 feet.
- 51 h. Metallic trays shall be UL classified per NFPA 70 as an equipment grounding conductor.

- 1 B. Fittings:
- 2 1. Radius of bends: 24 inch minimum, as required for cable layout in tray.
- 3 2. Degrees of arc for elbows: As required for cable tray layout.

#### 4 **2.3 ACCESSORIES**

- 5 A. Accessories including but not limited to, splice plates, barrier strips, drop outs, box connector, end
- 6 plate and conduit clamps to be the same material as the tray or other compatible material.
- 7 B. Cable Tray Ground Clamps:
- 8 1. Malleable iron or tin-plated extruded aluminum with stainless steel screws.
- 9 2. Serrated edges to bite into and bond to the cable tray system.
- 10 C. Support system:
- 11 1. Material: See Specification Section 16010 for material specifications.
- 12 2. See PART 3 of this Specification Section for material type.

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

#### 14 **3.1 INSTALLATION**

- 15 A. Install products in accordance with NEMA VE-2 and as recommended by the manufacturer's
- 16 instructions unless otherwise indicated on the Drawings.
- 17 B. Install cable tray, fittings and accessories, as required, for a complete system that has a neat
- 18 appearance and is in compliance with all applicable codes.
- 19 C. Install cable tray systems as close as practical to the locations and elevations shown on the
- 20 Drawings.
- 21 1. Minor changes (12 IN or less) in location or elevation may be made to avoid interference with
- 22 piping, ductwork and equipment.
- 23 2. Obtain Engineer's approval prior to making major changes (greater than 12 IN) in location or
- 24 elevation.
- 25 3. When cable tray is located adjacent to, beneath or near large piping or major equipment, or
- 26 terminates at equipment; do not install cable tray until the installation of such piping and
- 27 equipment is complete.
- 28 4. Insure openings are provided in walls that cable tray will penetrate.
- 29 D. Cable Tray Supports:
- 30 1. North and South Galleries:
- 31 a. Trapexe support trays below main air scour piping supports. See Structural Drawings
- 32 for support locations.
- 33 b. Provide minimal additional supports as required.
- 34 2. Center Gallery:
- 35 a. Provide supports at required locations (12 foot maximum) to provide the loading capacity
- 36 as indicated in the Cable Tray Schedule.
- 37 b. Cantilever bracket type when cable tray is installed adjacent to a wall.
- 38 c. Trapeze type hangers for all other applications.
- 39 E. Permitted prefabricated bracket or trapeze type support system per area designations and tray
- 40 material:
- 41 1. Dry or wet areas:
- 42 a. Aluminum system consisting of: Aluminum channels and fittings with stainless steel nuts
- 43 and hardware and conduit clamps.
- 44 2. Tray material shall be compatible with the support system material.
- 45 a. Aluminum system may be used with aluminum trays.
- 46 F. Whenever cable tray system spans a structural expansion joint provide one (1) of the following:
- 47 1. Expansion connector allowing a minimum of 1 IN straight-line movement of sections.
- 48 2. A 2 IN discontinuity (gap) in the cable tray to allow horizontal and vertical movement.
- 49 G. Maintain electrical continuity of the cable tray system.
- 50 1. Bolt connectors to each section or fitting.
- 51 2. Span expansion connectors by a bonding jumper.



1 2014/09/05

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## SECTION 16135

3

### ELECTRICAL: EXTERIOR UNDERGROUND

#### 4 PART 1 - GENERAL

##### 5 1.1 SUMMARY

6 A. Section Includes:

- 7 1. Material and installation requirements for:  
8 a. Underground conduits and ductbanks.

9 B. Related Specification Sections include but are not necessarily limited to:

- 10 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.  
11 2. Division 01 - General Requirements.  
12 3. Section 02221 - Trenching, Backfilling and Compacting for Utilities.  
13 4. Division 03 - Concrete.  
14 5. Section 10400 - Identification Devices.  
15 6. Section 16060 - Grounding.  
16 7. Section 16130 - Raceways and Boxes.

##### 17 1.2 QUALITY ASSURANCE

18 A. Referenced Standards:

- 19 1. American Association of State Highway and Transportation Officials (AASHTO):  
20 a. HB, Standard Specifications for Highway Bridges.  
21 2. ASTM International (ASTM):  
22 a. A536, Standard Specification for Ductile Iron Castings.  
23 3. National Fire Protection Association (NFPA):  
24 a. 70, National Electrical Code (NEC).  
25 4. Society of Cable Telecommunications Engineers (SCTE):  
26 a. 77, Specification for Underground Enclosure Integrity.

##### 27 1.3 DEFINITIONS

28 A. Direct-Buried Conduit(s):

- 29 1. Individual (single) underground conduit.  
30 2. Multiple underground conduits, arranged in one or more planes, in a common trench.

31 B. Concrete encased ductbank: An individual (single) or multiple conduit(s), arranged in one or  
32 more planes, encased in a common concrete envelope.

##### 33 1.4 SUBMITTALS

34 A. Shop Drawings:

- 35 1. See Specification Section 01340 for requirements for the mechanics and administration of  
36 the submittal process.  
37 2. Product technical data:  
38 a. Provide submittal data for all products specified in PART 2 of this Specification Section.

#### 39 PART 2 - PRODUCTS

##### 40 2.1 ACCEPTABLE MANUFACTURERS

41 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

42 B. Submit request for substitution in accordance with Specification Section 01640.

##### 43 2.2 UNDERGROUND CONDUIT AND ACCESSORIES

44 A. Concrete: Comply with Division 03 Specifications.

- 1 B. Conduit: See Specification Section 16130.
- 2 C. Duct Spacers/Supports:
- 3 1. High density polyethylene or high impact polystyrene.
- 4 2. Interlocking.
- 5 3. Provide 2 IN minimum spacing between conduits.
- 6 4. Accessories, as required:
- 7 a. Hold down bars.
- 8 b. Ductbank strapping.

## 9 PART 3 - EXECUTION

### 10 3.1 GENERAL

- 11 A. Drawings indicate the intended location and routing of ductbanks and direct buried conduit.
- 12 1. Field conditions may affect actual routing.
- 13 B. Install products in accordance with manufacturer's instructions.
- 14 C. Comply with Specification Section 02221 for trenching, backfilling and compacting.

### 15 3.2 UNDERGROUND CONDUITS

- 16 A. General Installation Requirements:
- 17 1. Ductbank types per location:
- 18 a. Concrete encased ductbank:
- 19 1) Under roads.
- 20 2) Pad mounted transformer secondaries.
- 21 3) Generator feeders.
- 22 4) Plant process equipment feeders and controls.
- 23 5) Fiber optic communications.
- 24 b. Direct-buried conduit(s):
- 25 1) As indicated in the Ductbank Schedule.
- 26 2. Do not place concrete or soil until conduits have been observed by the Engineer.
- 27 3. Ductbanks shall be sloped a minimum of 4 IN per 100 FT or as detailed on the Drawings.
- 28 a. Low points shall be at existing handholes.
- 29 4. During construction and after conduit installation is complete, plug the ends of all conduits.
- 30 5. Provide conduit supports and spacers.
- 31 a. Place supports and spacers for rigid nonmetallic conduit on maximum centers as
- 32 indicated for the following trade sizes:
- 33 1) 1 IN and less: 3 FT.
- 34 2) 1-1/4 to 3 IN: 5 FT.
- 35 3) 3-1/2 to 6 IN: 7 FT.
- 36 b. Place supports and spacers for rigid steel conduit on maximum centers as indicated for
- 37 the following trade sizes:
- 38 1) 1 IN and less: 10 FT.
- 39 2) 1-1/4 to 2-1/2 IN: 14 FT.
- 40 3) 3 IN and larger: 20 FT.
- 41 c. Securely anchor conduits to supports and spacers to prevent movement during
- 42 placement of concrete or soil.
- 43 6. Stagger conduit joints at intervals of 6 IN vertically.
- 44 7. Make conduit joints watertight and in accordance with manufacturer's recommendations.
- 45 8. Accomplish changes in direction of runs exceeding a total of 15 degrees by long sweep
- 46 bends having a minimum radius of 25 FT.
- 47 a. Sweep bends may be made up of one or more curved or straight sections or
- 48 combinations thereof.
- 49 9. Furnish manufactured bends at end of runs.
- 50 a. Minimum radius of 18 IN for conduits less than 3 IN trade size and 36 IN for conduits 3
- 51 IN trade size and larger.
- 52 10. Field cuts requiring tapers shall be made with the proper tools and shall match factory tapers.

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11. After the conduit run has been completed:
    - a. Prove joint integrity and test for out-of-round duct by pulling a test mandrel through each conduit.
      - 1) Test mandrel:
        - a) Length: Not less than 12 IN.
        - b) Diameter: Approximately 1/4 IN less than the inside diameter of the conduit.
      - b. Clean the conduit by pulling a heavy duty wire brush mandrel followed by a rubber duct swab through each conduit.
    12. Pneumatic rodding may be used to draw in lead wire.
      - a. Install a heavy nylon cord free of kinks and splices in all unused new ducts.
      - b. Extend cord 3 FT beyond ends of conduit.
    13. Transition from rigid nonmetallic conduit to conduit fiberglass conduit, per Specification Section 16130, prior to entering a structure or going above ground.
      - a. Except rigid nonmetallic conduit may be extended directly to pad mounted transformer boxes and other exterior pad mounted electrical equipment where the conduit is concealed within the enclosure.
      - b. Terminate rigid PVC conduits with end bells.
    14. Place warning tape in trench directly over ductbanks, direct-buried conduit, and direct-buried wire and cable in accordance with Specification Section 10400.
    15. Placement of conduits stubbing into existing handholes shall be located to allow for proper bending radiuses of the cables.

B. Concrete Encased Ductbank:

    1. Ductbank system consists of conduits completely encased in minimum 2 IN of concrete and with separations between different cabling types as required in Specification Section 16130 or as detailed on the Drawings.
    2. Install so that top of concrete encased duct, at any point:
      - a. Is not less than 36 IN below grade.
      - b. Is below pavement sub-grading.
    3. Where identified and for a distance 10 FT either side of the area, the concrete shall be reinforced.
      - a. The reinforcement shall consist of #4 bars and #4 ties placed 12 IN on center, in accordance with Division 03 Specification Sections or as detailed on the Drawings.
    4. Conduit supports shall provide a uniform minimum clearance of 2 IN between the bottom of the trench and the bottom row of conduit.
    5. Conduit separators shall provide a uniform minimum clearance of 2 IN between conduits or as required in Specification Section 16130 for different cabling types.

C. Direct-Buried Conduit(s):

    1. Install so that the top of the uppermost conduit, at any point:
      - a. Is not less than 30 IN below grade.
      - b. Is below pavement sub-grading.
    2. Provide a uniform minimum clearance of 2 IN between conduits or as required in Specification Section 16130 for different cabling types.
      - a. Maintain the separation of multiple planes of conduits by one of the following methods:
        - 1) Install multilevel conduits with the use of conduit supports and separators to maintain the required separations, and backfill with flowable fill (100 PSI) or concrete per Specification Section 02221.
        - 2) Install the multilevel conduits one level at a time.
          - a) Each level is backfilled with the appropriate amount of soil and compaction, per Specification Section 02221, to maintain the required separations.

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**END OF SECTION**





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2 **SECTION 16140**  
3 **WIRING DEVICES**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6 A. Section Includes:

- 7 1. Material and installation requirements for:  
8 a. Light switches.  
9 b. Receptacles.  
10 c. Device wallplates and coverplates.

11 B. Related Specification Sections include but are not necessarily limited to:

- 12 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.  
13 2. Division 01 - General Requirements.  
14 3. Section 16010 - Electrical: Basic Requirements.  
15 4. Section 16130 - Raceways and Boxes.  
16 5. Section 16442 - Motor Control Equipment.

17 **1.2 QUALITY ASSURANCE**

18 A. Referenced Standards:

- 19 1. National Electrical Manufacturers Association (NEMA):  
20 a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).  
21 b. WD 1, General Color Requirements for Wiring Devices.  
22 c. WD 6, Wiring Devices - Dimensional Requirements.  
23 2. Underwriters Laboratories, Inc. (UL):  
24 a. 20, General-Use Snap Switches.  
25 b. 498, Standard for Attachment Plugs and Receptacles.  
26 c. 514A, Metallic Outlet Boxes.  
27 d. 894, Standard for Switches for Use in Hazardous (Classified) Locations.  
28 e. 943, Ground-Fault Circuit-Interrupters.  
29 f. 1010, Standard for Receptacle-Plug Combinations for Use in Hazardous (Classified)  
30 Locations.

31 **1.3 SUBMITTALS**

32 A. Shop Drawings:

- 33 1. See Specification Section 01340 for requirements for the mechanics and administration of  
34 the submittal process.  
35 2. Product technical data:  
36 a. Provide submittal data for all products specified in PART 2 of this Specification Section.  
37 b. See Specification Section 16010 for additional requirements.

38 **PART 2 - PRODUCTS**

39 **2.1 ACCEPTABLE MANUFACTURERS**

40 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

- 41 1. Light switches and receptacles:  
42 a. Bryant.  
43 b. Eaton Cooper Wiring Devices.  
44 c. Hubbell.  
45 d. Leviton.  
46 e. Pass & Seymour.  
47 f. Eaton Crouse-Hinds.  
48 g. Appleton Electric Co.

- 1 h. Killark.  
2 B. Submit request for substitution in accordance with Specification Section 01640.

3 **2.2 LIGHT SWITCHES**

- 4 A. General requirements unless modified in specific requirements paragraph of switches per  
5 designated areas or types:  
6 1. Toggle type, quiet action, Industrial Specification Grade.  
7 2. Self grounding with grounding terminal.  
8 3. Back and side wired.  
9 4. Solid silver cadmium oxide contacts.  
10 5. Rugged urea housing and one-piece switch arm.  
11 6. Rated 20 A, 120/277 Vac.  
12 7. Switch handle color: Ivory.  
13 8. Types as indicated on the Drawings:  
14 a. Single-pole.  
15 b. Double-pole.  
16 c. 3-way.  
17 d. 4-way.  
18 9. Standards: UL 20, UL 514A, NEMA WD 6.
- 19 B. Architecturally Finished Areas:  
20 1. Wallplate:  
21 a. Type 302 stainless steel.  
22 b. Single or multiple gang as required.
- 23 C. Dry Non-architecturally Finished Areas:  
24 1. Coverplate:  
25 a. Gasketed aluminum with stainless steel screws utilizing rocker, front mounted toggle  
26 type switch.  
27 b. Single or multiple gang as required.
- 28 D. Wet Non-architecturally Finished Areas:  
29 1. Coverplate:  
30 a. Gasketed aluminum with stainless steel screws utilizing rocker, front mounted toggle or  
31 pull type switch.  
32 b. Single or multiple gang as required.
- 33 E. Corrosive Areas:  
34 1. Corrosion resistant nickel plated metal parts.  
35 2. Coverplate:  
36 a. Gasketed copper free aluminum with stainless steel screws utilizing rocker, front  
37 mounted toggle or pull type switch.  
38 b. Single or multiple gang as required.
- 39 F. Highly Corrosive Areas:  
40 1. Corrosion resistant nickel plated metal parts.  
41 2. Coverplate:  
42 a. Gray colored high impact thermoplastic.  
43 b. Single or multiple gang as required.

44 **2.3 RECEPTACLES**

- 45 A. General requirements unless modified in specific requirements paragraph of receptacles per  
46 designated areas:  
47 1. Straight blade, Industrial Specification Grade.  
48 2. Brass triple wipe line contacts.  
49 3. One-piece grounding system with double wipe brass grounding contacts and self grounding  
50 strap.  
51 4. Back and side wired.  
52 5. Rated 20 A, 125 Vac.  
53 6. High impact nylon body.  
54 7. Receptacle body color:  
55 a. Normal power: Ivory.





1 2014/07/08

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**SECTION 16239**  
**GENERATOR CONNECTION CABINET**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes: Generator Connection Cabinet.
- 7 B. Related Sections include but are not necessarily limited to:
- 8 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 9 2. Division 01 - General Requirements.
- 10 3. Section 16010 - Electrical: Basic Requirements.

11 **1.2 QUALITY ASSURANCE**

- 12 A. Referenced Standards:
- 13 1. National Electrical Manufacturers Association (NEMA):
- 14 a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- 15 2. Underwriters Laboratories, Inc. (UL):
- 16 a. 1773, Standard for Termination Boxes.

17 **1.3 SUBMITTALS**

- 18 A. Shop Drawings:
- 19 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 20 the submittal process.
- 21 2. Product technical data:
- 22 a. Provide submittal data for all products specified in PART 2 of this Specification Section.
- 23 b. See Specification Section 16010 for additional requirements.

24 **1.4 DELIVERY, STORAGE, AND HANDLING**

- 25 A. See Specification Section 16010.

26 **PART 2 - PRODUCTS**

27 **2.1 ACCEPTABLE MANUFACTURERS**

- 28 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 29 1. Generator Connection Cabinet:
- 30 a. Berthold Electric.
- 31 b. Eaton.
- 32 B. Submit request for substitution in accordance with Specification Section 01640.

33 **2.2 GENERATOR CONNECTION CABINET**

- 34 A. Ratings:
- 35 1. Voltage and amperage: As indicated on the Drawings.
- 36 2. Short circuit withstand: Equal to or greater than the upstream equipment.
- 37 B. Construction:
- 38 1. Bus material: Silver plated copper.
- 39 2. Bus supported with UL Recognized Component insulators.
- 40 3. Permanent bus connection:
- 41 a. Mechanical set screw lugs.
- 42 b. Quantity: As required for the number of conductors indicated on the Drawings.
- 43 4. Field wiring connection:
- 44 a. Mechanical set screw lugs.



1 2014/07/08

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## SECTION 16267

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### REDUCED VOLTAGE SOLID STATE STARTERS - LOW VOLTAGE

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#### PART 1 - GENERAL

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##### 1.1 SUMMARY

6

A. Section Includes: Reduced voltage solid state (RVSS) starters.

7

B. Related Specification Sections include but are not necessarily limited to:

8

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

9

2. Division 01 - General Requirements.

10

3. Section 10400 - Identification Devices.

11

4. Division 13 - Special Construction.

12

##### 1.2 QUALITY ASSURANCE

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A. Referenced Standards:

14

1. American National Standards Institute (ANSI).

15

2. ETL Testing Laboratories (ETL).

16

3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

17

a. C62.41.1, Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits

18

4. National Electrical Manufacturer's Association (NEMA):

19

a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

20

5. National Fire Protection Association (NFPA):

21

a. 70, National Electrical Code (NEC).

22

6. Nationally Recognized Testing Laboratory (NRTL).

23

7. Occupational Safety and Health Administration (OSHA).

24

8. Underwriter's Laboratory, Inc. (UL):

25

a. 508, Standard for Safety Industrial Control Equipment.

26

B. Qualifications:

27

1. Provide drives that are listed and labeled by UL, ETL, or other NRTL as defined by OSHA regulations, or that have been inspected and subsequent field-labeled by such NRTL.

28

a. Where listed drives and other components are installed in a common enclosure, the assembly shall be listed and labeled per UL 508 or equivalent NRTL standard.

29

2. RVSS Supplier shall maintain an authorized service organization within 300 miles of the project site.

30

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33

C. Coordination:

34

1. RVSS manufacturer shall verify with the RVSS is compatible with the driven equipment motor over its required operating range and will do so without exceeding the motor or RVSS safety factors.

35

2. RVSS shall be supplied complete with all required control components.

36

a. Provide control as indicated on the electrical Drawings, specified in this Section and specified in the control system loop descriptions.

37

b. RVSS manufacturer shall review the application and provide, at no additional cost to the Buyer, the hardware and software necessary to allow the RVSS to control the driven equipment motor over its required operating range.

38

1) These may include, but are not limited to, analog and digital interface modules, communication interface modules, switches, lights and other devices.

39

c. Coordinate control devices with devices furnished with driven equipment such as vibration switches, thermal sensors, leak detectors, etc.

40

3. Verify plan dimensions with equipment space requirements as indicated on the Drawings.

41

a. Equipment which exceeds the allotted maximum dimensions may not be acceptable.

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b. Equipment which reduces clear work space below the minimums established by the NEC will not be acceptable.

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##### 1.3 SUBMITTALS

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- 1 A. Shop Drawings:
- 2 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 3 the submittal process.
- 4 2. Schedule of RVSS's for the project listing for each RVSS:
- 5 a. Equipment Tag Number.
- 6 b. RVSS Complete Catalog Number.
- 7 c. RVSS Frame Size.
- 8 d. Rated Input Current.
- 9 e. Rated Continuous Output Current.
- 10 f. Rated Short Circuit Current.
- 11 g. Motor Manufacturer.
- 12 h. Motor Frame Size.
- 13 i. Motor Full Load Amps.
- 14 j. Motor Service Factor.
- 15 3. Product technical data:
- 16 a. Complete electrical ratings and performance specifications confirming compliance with
- 17 specified ratings and performance.
- 18 b. Manufacturer's installation instructions.
- 19 c. Manufacturer's programming and operating instructions.
- 20 4. Fabrication and/or layout Drawings:
- 21 a. Top, front and side exterior views, with details showing maximum overall dimensions of
- 22 enclosure, mounting provisions and conduit/cable entry provisions.
- 23 b. Identify minimum clearances from other RVSS's or electrical equipment required for
- 24 proper cooling at top, bottom, sides and back of enclosure.
- 25 c. Three (3) line diagrams showing AC schematic of RVSS, input, output and bypass
- 26 devices including device ratings.
- 27 d. Interior layout drawings showing location of all components within enclosure, field wiring
- 28 terminal boards, and power and grounding connections.
- 29 e. Field wiring diagrams showing locations and sizes of all electrical connections, ground
- 30 terminations, and requirements for shielded wire usage or any other special installation
- 31 considerations.
- 32 5. Certifications:
- 33 a. Submit with Shop Drawings:
- 34 1) Letter from the RVSS manufacturer stating that the specific application has been
- 35 reviewed and that the RVSS will satisfy the drive duties required with the actual
- 36 motor furnished.
- 37 2) Identification and location of closest authorized service organization.
- 38 b. Submit prior to shipment:
- 39 1) Certified factory test reports confirming compliance with specified requirements.
- 40 c. Submit after installation:
- 41 1) Certified field service reports showing:
- 42 a) Each RVSS is operational.
- 43 b) Each RVSS and its driven equipment motor is compatible.
- 44 c) Each RVSS responds correctly to the input control signals.
- 45 B. Operation and Maintenance Manuals:
- 46 1. See Specification Section 01342 for requirements for:
- 47 a. The mechanics and administration of the submittal process.
- 48 b. The content of Operation and Maintenance Manuals.
- 49 2. Approved copy of RVSS schedule per Submittals Article.
- 50 3. Manufacturers instruction manuals.
- 51 4. Troubleshooting procedures with a cross-reference between symptoms and corrective
- 52 recommendations.
- 53 5. Connection data to permit removal and installation of recommended smallest field-
- 54 replaceable parts.
- 55 6. Recommended spare parts list.
- 56 7. Commissioning sheets showing "as-left" values of all user-programmable or adjustable drive
- 57 parameters.



1 **PART 2 - PRODUCTS**

2 **2.1 ACCEPTABLE MANUFACTURERS**

- 3 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:  
4 1. Reduced voltage solid state starters:  
5 a. Allen Bradley.  
6 b. ASEA-Brown Bovari (ABB).  
7 c. Eaton.  
8 d. Danfoss.  
9 e. General Electric Company.  
10 f. Halmar Robicon Group.  
11 g. Motortronics.  
12 h. Square D Company.
- 13 B. Submit request for substitution in accordance with Specification Section 01640.

14 **2.2 GENERAL**

- 15 A. The RVSS shall consist of a six (6) SCR power section with two (2) SCRs per phase connected  
16 inverse parallel for variable AC output voltage with minimal motor and starter heating.
- 17 B. The RVSS power section shall be capable of providing maximum torque per amp throughout the  
18 motor's speed-torque curve.
- 19 C. The logic control shall consist of a power section for gating the drive SCRs and a control section  
20 for performing all the necessary starter functions.
- 21 D. A snubber circuit shall be used to prevent false firing of SCRs due to dV/dt effects.
- 22 E. The RVSS shall be provided with a by-pass contactor that will effectively "short" the SCR power  
23 section to the incoming line to the motor load without the SCR voltage drop.  
24 1. The contractor shall be a thermal rated contact to bypass the soft starter.  
25 2. A horsepower rated across-the-line starter use to start the motor on a failure of the soft  
26 starter is not required.
- 27 F. RVSS's, whether installed in motor control center (MCC) construction or separately-mounted,  
28 shall constitute complete combination motor controllers per NEC Article 430 and shall provide the  
29 following per the requirements of that article without the addition of any external components or  
30 devices.  
31 1. Motor control.  
32 2. Motor overload protection.  
33 3. Motor and motor branch circuit short circuit and ground fault protection.  
34 4. Motor and controller disconnecting means.
- 35 G. RVSS's shall be "engineered" or "configured" drive packages in which the RVSS chassis, all  
36 input, output and bypass power devices, RVSS accessories, ancillary switches, contactors,  
37 relays, and related control devices are selected, furnished, factory assembled and tested by the  
38 RVSS manufacturer in a single enclosure requiring only connection of the power supply circuit,  
39 motor branch circuit, and external control wiring in the field.

40 **2.3 PERFORMANCE AND DESIGN REQUIREMENTS**

- 41 A. Application:  
42 1. RVSS's shall be designed to operate successfully under the following site conditions:  
43 a. Ambient:  
44 1) Temperature: 0-40 DegC.  
45 2) 95 percent non-condensing relative humidity.  
46 b. Elevation: 3300 FT above MSL.  
47 c. Power supply characteristics:  
48 1) 480V, 3 PH, 3-wire, (+/- 10 percent).  
49 2) Effectively grounded.  
50 d. Available short circuit current:  
51 1) 65,000 A RMS SYM.

- 1 B. Ratings and Performance Specifications:
- 2 1. Voltage rating:
- 3 a. Nominal: 460 or 480 Vac, 3 PH, 60 Hz.
- 4 b. Range for continuous full load operation: 432-528 Vac.
- 5 c. Voltage imbalance tolerance for full load operation: 3 percent minimum.
- 6 2. Current ratings:
- 7 a. Continuous: Equal to or greater than the motor nameplate full load current multiplied by
- 8 the motor service factor.
- 9 b. Short-term overload: 500 percent for 30 seconds.
- 10 c. Short circuit:
- 11 1) 65,000 A RMS SYM, minimum.
- 12 3. Efficiency: 98 percent, minimum, at full speed and full load.
- 13 C. Operational Features:
- 14 1. Pump control functions.
- 15 2. Insensitive to input phase sequence.
- 16 3. Continued operation with momentary voltage dips of 25 percent of rated voltage, or single
- 17 phase condition: 3 sec, minimum.
- 18 4. Controls power loss ride-through: 500 msec, minimum.
- 19 5. Anti-windmilling; ability to safely start into turning motor, forward or reverse.
- 20 D. The RVSS shall be provided with the following minimum user-programmable parameters:
- 21 1. Selectable torque ramp start or current limit start.
- 22 2. Starts per hour.
- 23 3. Time between starts.
- 24 4. Initial current, maximum current and ramp time.
- 25 5. Kick current and time.
- 26 6. Torque ramp.
- 27 7. Motor deceleration time.
- 28 8. Relay outputs.
- 29 E. The RVSS shall be designed such that the power circuit components are fully protected from line
- 30 side disturbances and load side faults:
- 31 1. General:
- 32 a. Shutdown conditions associated with supply circuit conditions which can be corrected
- 33 external to the RVSS motor system shall be provided with automatic reset, with
- 34 shutdown cause logged in memory:
- 35 1) Input under/over voltage.
- 36 2) Input under/over frequency.
- 37 3) Input phase loss.
- 38 b. Shutdown conditions which indicate overload or fault within the RVSS, the output circuit,
- 39 or the motor shall require local manual reset at the RVSS, requiring operator
- 40 intervention.
- 41 1) Shorted SCR.
- 42 2) Component failure.
- 43 3) Under/over current.
- 44 a) Coordinate under current set points with Division 13 or the Engineer.
- 45 4) Overload.
- 46 5) Short circuit
- 47 6) Ground fault.
- 48 7) Logic fault.
- 49 c. When automatic shutdown occurs, RVSS shall restart immediately upon reset, whether
- 50 the drive is in automatic or manual mode.
- 51 d. RVSS shall hold cause of trip data for a minimum of four shutdowns in memory.
- 52 1) Data to be accessible through the keypad, local communication link and remotely.
- 53 e. Common alarm contact.
- 54 2. Input protection:
- 55 a. Input circuit breaker or current-limiting fuses with externally operable disconnect:
- 56 1) Fault current interrupting rating equal to or greater than the specified withstand
- 57 rating of the RVSS.
- 58 2) Handle padlockable in the OFF position.
- 59 b. Incoming line transient suppression:
- 60 1) 6000 V peak per IEEE C62.41.1.

- 1                   2) Phase-to-phase and phase-to-ground protection.
- 2           3. Internal protection:
- 3           a. Surge suppression and power device snubbers.
- 4           b. SCR peak inverse voltage (PIV): 2.5 times line voltage.
- 5           c. Instantaneous overcurrent trip.
- 6           d. Power device over-temperature trip.
- 7           e. Control logic circuit malfunction trip.
- 8           4. Output protection:
- 9           a. Inverse-time overload trip:
- 10            1) UL Class 10 characteristic.
- 11           b. Overvoltage trip.
- 12           c. Over-frequency trip.
- 13           d. Short circuit trip:
- 14            1) Line to line and line to ground.
- 15           e. Ground fault trip.

16   **2.4 OPERATOR AND REMOTE CONTROL INTERFACE**

- 17   A. Drive controls shall be microprocessor-based with on-board human machine interface and both
- 18    local and remote digital communications capability.
- 19    1. All monitoring and control functions, other than those shutdowns specified to be manual reset
- 20    only, shall be available both locally and remotely.
- 21   B. Control circuits shall be 115 Vac or 24 Vdc:
- 22    1. 115 Vac supplied by CPT in the RVSS.
- 23    a. CPT shall have minimum additional capacity of 60 VA greater than that required by
- 24    control devices.
- 25    b. CPT shall have two (2) fuses on the primary side and one fuse on the secondary side.
- 26    c. CPT shall have surge protection on the primary side independent of any other surge
- 27    protection in the VFD.
- 28    2. 24 Vdc supplied by Class 2 power supply in the RVSS.
- 29    a. Power supply shall have minimum additional capacity of 33 percent greater than that
- 30    required by control devices.
- 31    b. Provide two (2) current-limiting fuses on the AC supply to the power supply.
- 32    c. Power supply shall have surge protection on the primary side independent of any other
- 33    surge protection in the RVSS.
- 34   C. Operator Interface:
- 35    1. Door mounted sealed keypad, membrane type with LED or LCD display.
- 36    a. Messages shall be in English and engineering units.
- 37    b. Drive operating parameters shall be programmable.
- 38    c. Menu driven.
- 39    d. Password security.
- 40    e. Display fault and diagnostic data.
- 41    f. Operating parameters, fault and diagnostic data maintained in non-volatile memory with
- 42    historic log of fault and diagnostic data.
- 43     1) Fault descriptions shall be in plain text.
- 44     2) Fault codes are not acceptable.
- 45    g. Gold plated plug-in contacts.
- 46    2. HAND-OFF-REMOTE selector switch.
- 47    3. Status indication:
- 48    a. POWER ON.
- 49    b. RUN STATUS.
- 50    c. RVSS FAULT.
- 51    4. Metering indications (minimum):
- 52    a. Amperes.
- 53    b. Voltage.
- 54    c. Frequency.
- 55    5. Diagnostic indicators located externally on the face of the drive shall show the type of fault
- 56    responsible for drive warning, shutdown or failure.
- 57    a. On occurrence of more than one condition each shall be recorded or indicated by the
- 58    diagnostics.

- 1 D. Remote Control Interface:
- 2 1. Contacts:
- 3 a. Contacts shall be rated 2 A inductive at 120 Vac.
- 4 b. All contacts shall be wired to field wiring terminal boards.

5 **2.5 EQUIPMENT CONSTRUCTION**

- 6 A. Fabrication and Assembly:
- 7 1. Each RVSS system shall be factory-assembled in an enclosure for remote mounting, and
- 8 shall utilize interchangeable plug-in printed circuit boards and power conversion components
- 9 wherever possible.
- 10 a. Factory assembly shall be performed by the RVSS manufacturer or authorized agent.
- 11 b. Systems fabricated or assembled in whole or in part by parties other than the RVSS
- 12 manufacturer or authorized agent will not be acceptable.
- 13 2. Cooling fans shall be provided, as required, to run when drive is running.
- 14 3. Enclosures for separately mounted RVSS's:
- 15 a. NEMA Type 1 for installation in Electrical Rooms.
- 16 b. NEMA Type 12 for installation in other unclassified areas.

- 17 B. Wiring:
- 18 1. The wiring in the RVSS shall be neatly installed in wire ways or with wire ties where wire
- 19 ways are not practical.
- 20 a. Where wire ties are used, the wire bundles are to be held at the back panel with a
- 21 screw-mounted wire tie mounting base.
- 22 b. Bases with a self-sticking back will not be allowed.
- 23 2. All plug-in contacts shall be gold-plated.
- 24 3. Provide terminal boards for all field wiring and inter-unit connections.
- 25 4. Terminal blocks shall be complete with marking strip, covers and pressure connectors.
- 26 a. They shall be non-brittle, interlocking, track-mounted type.
- 27 b. Screw terminals will not be allowed.
- 28 c. A terminal shall be provided for each conductor of external circuits plus one ground for
- 29 each shielded cable.
- 30 d. For free-standing panels, 8 IN of clearance shall be provided between terminals and the
- 31 panel base for conduit and wiring space.
- 32 e. Not less than 25 percent spare terminals shall be provided.
- 33 f. Terminals shall be labeled to agree with identification indicated on the supplier's
- 34 Submittal Drawings.
- 35 g. Each control loop or system shall be individually fused, and all fuses or circuit breakers
- 36 shall be clearly labeled and located for easy maintenance.
- 37 5. All grounding wires shall be attached to the enclosure sheet metal with a ring tongue
- 38 terminal.
- 39 a. The surface of the sheet metal shall be prepared to assure good conductivity and
- 40 corrosion protection.
- 41 6. Wiring shall not be kinked or spliced and shall have markings on both ends or be color
- 42 coded.
- 43 a. Markings or color code shall match the manufacturer's Drawings.
- 44 7. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for
- 45 external connection shall be stranded copper, type MTW or SIS, insulated for not less than
- 46 600 V, with a moisture-resistant and flame-retardant covering rated for not less than 90
- 47 DegC.

- 48 C. Nameplates:
- 49 1. RVSS enclosure shall be provided with a suitable nameplate as specified in Specification
- 50 Section 10400.
- 51 2. Push buttons, selector switches, and pilot lights shall have the device manufacturer's
- 52 standard legend plate.
- 53 3. Relays, terminals and special devices inside the control enclosure shall have permanent
- 54 markings to match identification used on manufacturer's wiring diagrams.
- 55 4. Use stainless steel screws to attach nameplates.

- 56 D. Factory Painting: Enclosure, after being phosphate washed, shall be thoroughly cleaned and
- 57 given at least one coat of rust-inhibiting primer on all inner surfaces prior to fabrication.

1 **2.6 SOURCE QUALITY CONTROL**

2 A. Factory Tests:

- 3 1. Conduct all standard tests in accordance with NEMA and ANSI standards to ensure  
4 conformance to Specification requirements.
- 5 2. Prior to final assembly:
- 6 a. Inspect incoming components.
- 7 b. Test and inspect power devices.
- 8 c. Circuit cards:
- 9 1) Component and functional tests:
- 10 2) Burn-in chamber or temperature cycling test.
- 11 3) System test after burn-in, or temperature cycling.
- 12 3. After final assembly:
- 13 a. Continuity and insulation test of 480 Vac circuits.
- 14 1) Test voltage shall be 2500 Vdc.
- 15 b. Continuity and insulation test of 120 Vac circuits.
- 16 1) Test voltage shall be 500 Vdc.
- 17 c. Drive tests:
- 18 1) Burn-in complete drive at full load for 24 HRS.
- 19 2) Verify all auxiliary circuits operation.
- 20 3) Monitor output variables.
- 21 d. Systems test:
- 22 1) Provide inputs to field connections and simulate on-site operation.
- 23 2) Test all auxiliary equipment.

24 **2.7 MAINTENANCE MATERIALS**

- 25 A. Provide manufacturer's recommended renewable spare parts (e.g., power and control fuses).
- 26 B. Spare parts utilized during pre-start-up or start-up and demonstration testing shall be immediately  
27 restocked, at no cost to the Owner.

28 **PART 3 - EXECUTION**

29 **3.1 INSTALLATION**

- 30 A. Install products in accordance with manufacturer's instructions and as indicated on the Drawings.
- 31 B. Verify the installed motor nameplate electrical requirements do not exceed the RVSS capacity.

32 **3.2 START-UP**

33 A. Pre-Start-up Services:

- 34 1. Shall be completed a minimum of 30 days prior to the start-up and demonstration period.
- 35 a. Shall consist of physical and electrical installation check.
- 36 2. Final adjustments and calibration of drive parameters.
- 37 3. Shall be complete when RVSS's are fully operational.

38 B. Start-up and Demonstration Services:

- 39 1. Provide services of manufacturer's representative to perform start-up services.
- 40 2. Supervise start-up of all units including recheck of settings made during the pre-start-up  
41 tests.
- 42 a. Perform all work in the presence of the Owner's designated representatives.
- 43 3. Simulate operation of the RVSS and its associated control and instrumentation system in  
44 both the manual and automatic modes.
- 45 a. Ensure compatibility of RVSS with associated control and instrumentation signals.
- 46 4. Simulate RVSS failures and demonstrate troubleshooting aids.

47 C. Instruct Owner's Designated Personnel:

- 48 1. Minimum of 4 HRS at the jobsite.
- 49 2. Include both field and classroom instruction.

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3. Instructions shall include proper operation and maintenance procedures including, but not limited to:
    - a. Lubrication.
    - b. Troubleshooting.
    - c. Repair and replacement.
    - d. Parts inventory.
    - e. Maintenance records.

8

**END OF SECTION**

1 2014/08/19

2 **SECTION 16410**  
3 **SAFETY SWITCHES**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes: Safety switches.
- 7 B. Related Specification Sections include but are not necessarily limited to:
- 8 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 9 2. Division 01 - General Requirements.
- 10 3. Section 16010 - Electrical: Basic Requirements.
- 11 4. Section 16490 - Overcurrent and Short Circuit Protective Devices.

12 **1.2 QUALITY ASSURANCE**

- 13 A. Referenced Standards:
- 14 1. National Electrical Manufacturers Association (NEMA):
- 15 a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- 16 b. KS 1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts
- 17 Maximum).
- 18 2. Underwriters Laboratories, Inc. (UL):
- 19 a. 98, Enclosed and Dead-Front Switches.

20 **1.3 SUBMITTALS**

- 21 A. Shop Drawings:
- 22 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 23 the submittal process.
- 24 2. Product technical data:
- 25 a. Provide submittal data for all products specified in PART 2 of this Specification Section.
- 26 b. Provide a table that associates safety switch model number with connected equipment
- 27 tag number.
- 28 c. See Specification Section 16010 for additional requirements.
- 29 B. Operation and Maintenance Manuals:
- 30 1. See Specification Section 01342 for requirements for:
- 31 a. The mechanics and administration of the submittal process.
- 32 b. The content of Operation and Maintenance Manuals.

33 **PART 2 - PRODUCTS**

34 **2.1 ACCEPTABLE MANUFACTURERS**

- 35 A. Subject to compliance with the Contract Documents, the following safety switch manufacturers
- 36 are acceptable:
- 37 1. Eaton.
- 38 2. General Electric Company.
- 39 3. Square D Company.
- 40 4. Siemens.
- 41 B. Submit request for substitution in accordance with Specification Section 01640.

42 **2.2 SAFETY SWITCHES**

- 43 A. General:
- 44 1. Non-fusible or fusible as indicated on the Drawings.
- 45 2. Suitable for service entrance when required.

- 1 3. NEMA Type HD heavy-duty construction.
- 2 4. Switch blades will be fully visible in the OFF position with the enclosure door open.
- 3 5. Quick-make/quick-break operating mechanism.
- 4 6. Deionizing arc chutes.
- 5 7. Manufacture double-break rotary action shaft and switchblade as one (1) common
- 6 component.
- 7 8. Clear line shields to prevent accidental contact with line terminals.
- 8 9. Operating handle (except NEMA 7 and NEMA 9 rated enclosures):
- 9 a. Red and easily recognizable.
- 10 b. Padlockable in the OFF position.
- 11 c. Interlocked to prevent door from opening when the switch is in the ON position with a
- 12 defeater mechanism.
- 13 B. Ratings:
- 14 1. Horsepower rated of connected motor.
- 15 2. Voltage and amperage: As indicated on the Drawings.
- 16 3. Short circuit withstand:
- 17 a. Non-fused: 10,000A.
- 18 b. Fused: 200,000A.
- 19 C. Accessories, when indicated in PART 3 of this Specification Section or on the Drawings:
- 20 1. Neutral kits.
- 21 2. Ground lug kits.
- 22 3. Auxiliary contact kits with 1 N.O. and 1 N.C. contact.
- 23 D. Enclosures:
- 24 1. NEMA 1 rated:
- 25 a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturers
- 26 standard paint inside and out.
- 27 b. With or without knockouts, hinged and lockable door.
- 28 2. NEMA 4X rated (metallic):
- 29 a. Body and cover: Type 304 or 316 stainless steel.
- 30 b. No knockouts, external mounting flanges, hinged and gasketed door.
- 31 3. NEMA 4X rated (nonmetallic):
- 32 a. Body and cover: Ultraviolet light protected fiberglass-reinforced polyester boxes.
- 33 b. No knockouts, external mounting flanges, hinged, gasketed and lockable door.
- 34 4. NEMA 12 rated:
- 35 a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturers
- 36 standard paint inside and out.
- 37 b. No knockouts, external mounting flanges, hinged and gasketed door.
- 38 E. Overcurrent and short circuit protective devices:
- 39 1. Fuses.
- 40 2. See Specification Section 16490 for overcurrent and short circuit protective device
- 41 requirements.
- 42 F. Standards: NEMA KS 1, UL 98.

## 43 PART 3 - EXECUTION

### 44 3.1 INSTALLATION

- 45 A. Install as indicated and in accordance with manufacturer's instructions and recommendations.
- 46 B. Install switches adjacent to the equipment they are intended to serve unless otherwise indicated
- 47 on the Drawings.
- 48 C. Provide auxiliary contact kit on local safety switches for motors being controlled by a variable
- 49 frequency drive.
- 50 1. The VFD is to be disabled with the switch is in the open position.
- 51 D. Permitted uses of NEMA 1 enclosure:
- 52 1. Surface or flush mounted in areas designated dry in architecturally finished areas.



- 1 E. Permitted uses of NEMA 4X metallic enclosure:
- 2 1. Surface mounted in areas designated as wet and/or corrosive.
- 3 F. Permitted uses of NEMA 4X nonmetallic enclosure:
- 4 1. Surface mounted in areas designated as highly corrosive.
- 5 G. Permitted uses of NEMA 12 enclosure:
- 6 1. Surface mounted in areas designated as dry in non-architecturally finished areas.

7 **END OF SECTION**

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1 2014/09/08

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**SECTION 16411**  
**TRANSFER SWITCHES**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
- 7 1. Manual transfer switches.
- 8 2. Automatic transfer switches.
- 9 B. Related Sections include but are not necessarily limited to:
- 10 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 11 2. Division 01 - General Requirements.
- 12 3. Section 16010 - Electrical: Basic Requirements.

13 **1.2 QUALITY ASSURANCE**

- 14 A. Referenced Standards:
- 15 1. National Electrical Manufacturers Association (NEMA):
- 16 a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- 17 b. KS 1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts
- 18 Maximum).
- 19 2. Underwriters Laboratories, Inc. (UL):
- 20 a. 98, Standard for Safety Enclosed and Dead-Front Switches.
- 21 b. 1008, Standard for Safety Switch Equipment.

22 **1.3 SUBMITTALS**

- 23 A. Shop Drawings:
- 24 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 25 the submittal process.
- 26 2. Product technical data:
- 27 a. Provide submittal data for all products specified in PART 2 of this Specification:
- 28 b. See Section 16010 for additional requirements.
- 29 B. Operation and Maintenance Manuals:
- 30 1. See Specification Section 01342 for requirements for:
- 31 a. The mechanics and administration of the submittal process.
- 32 b. The content of Operation and Maintenance Manuals.

33 **1.4 DELIVERY, STORAGE, AND HANDLING**

- 34 A. See Section 16010.

35 **PART 2 - PRODUCTS**

36 **2.1 ACCEPTABLE MANUFACTURERS**

- 37 A. Subject to compliance with the Contract Documents, the listed manufacturers are acceptable:
- 38 1. Automatic transfer switches:
- 39 a. Automatic Switch Company.
- 40 b. Kohler.
- 41 c. Onan.
- 42 d. Russelectric.
- 43 e. Zenith Products.
- 44 2. Manual transfer switches:
- 45 a. Eaton.
- 46 b. Russelectric.

- 1 c. Square D Company.
- 2 B. Submit request for substitution in accordance with Specification Section 01640.

3 **2.2 MANUAL TRANSFER SWITCH**

- 4 A. Double throw load break rated with:
  - 5 1. Quick-make/quick-break operating mechanism.
  - 6 2. Deionizing arc chutes.
  - 7 3. Double-break rotary action shaft and switchblade shall be manufactured as one (1) common
  - 8 component.
  - 9 4. Clear line shields to prevent accidental contact with line terminals.
- 10 B. Operating handle: Easily recognizable and padlockable in both positions.
- 11 C. Wiring configuration to allow single load to be supplied by a normal or alternate source.
- 12 D. Ratings:
  - 13 1. Voltage and amperage: As indicated on Drawings.
  - 14 2. Short circuit withstand: Equal to or greater than the upstream equipment.
- 15 E. Enclosure:
  - 16 1. NEMA 1 rated:
    - 17 a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturers
    - 18 standard paint inside and out.
    - 19 b. With or without knockouts, hinged and lockable door.
- 20 F. Standards: NEMA KS 1, UL 98.

21 **2.3 AUTOMATIC TRANSFER SWITCH**

- 22 A. Construction:
  - 23 1. Electrically operated mechanically held, double throw, air-break type.
  - 24 2. Silver-surface main contacts and protect by arcing contacts.
  - 25 3. Switch shall have provisions for visual inspection of switch blades and contacts.
  - 26 4. Mechanical design will positively open all ungrounded conductors from normal source before
  - 27 connection is made to alternate source and will positively open alternate source before
  - 28 connection is made to normal source.
  - 29 5. Mechanical interlock to ensure the switch cannot be readily disabled, disconnected,
  - 30 improperly adjusted, removed or otherwise made inoperative.
  - 31 6. Make all contacts and coils readily accessible for replacement from front of panel without
  - 32 major disassembly.
  - 33 7. Ratings:
    - 34 a. Continuous duty in both normal and emergency.
    - 35 b. Three-phase, three-pole or 4-pole as indicated on the Drawings, four-wire.
    - 36 c. Voltage and current ratings as indicated on the Drawings.
    - 37 d. Short circuit withstand rating equal to or greater than the normal source electrical gear.
  - 38 8. Standards: UL 1008.
- 39 B. Provide bypass isolation for all transfer switches rated greater than 200A.
  - 40 1. The ATS shall be provided with a bypass isolation switch to permit isolation of the ATS from
  - 41 source and load conductors. The bypass isolation transfer switch assembly shall be
  - 42 configured of two automatic contactor switching devices factory interconnected with silver
  - 43 plated copper bus. The bypass contactor switch shall be constructed to carry full load with
  - 44 the same withstand and close-on ratings as the ATS.
  - 45 2. The primary contactor switching device shall be draw-out configuration and the bypass
  - 46 contactor switching device shall be fixed mounted. The bypass isolation transfer switch shall
  - 47 be front accessible. Cable connections shall be bottom entry.
- 48 C. Operation:
  - 49 1. Microprocessor based control module.
  - 50 2. Open transition.
  - 51 3. Red and green indicating lights with fuses, identification nameplates, and test switch on front
  - 52 to simulate normal power failure at switch.
  - 53 4. Engine starting contacts and all other auxiliary contacts and accessory devices for functions
  - 54 to be performed.

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  - 36
5. Supervisory voltage relays on each phase of normal source and single phase supervisory voltage and frequency relay for emergency source.
    - a. Normal source voltage sensing.
      - 1) Adjustable pickup from 85-100 percent of rated voltage, factory set 90 percent.
      - 2) Adjustable dropout from 75-98 percent of pickup setting, factory set 85 percent.
    - b. Emergency source voltage and frequency sensing:
      - 1) Adjustable pickup from 85-100 percent of rated voltage, factory set 90 percent.
      - 2) Fixed voltage dropout at 85 percent of pickup setting.
      - 3) Adjustable pickup from 90-100 percent of rated frequency, factory set 95 percent.
      - 4) Fixed frequency dropout at 88 percent of pickup setting.
  6. Time delays:
    - a. Engine start, adjustable from 0 to 10 seconds, factory set at 4 seconds, to avoid unnecessary starting caused by short time outages.
    - b. Transfer to generator, adjustable from 0 to 120 seconds, factory set at 10 seconds.
    - c. Retransfer to normal, adjustable from 2 to 30 minutes, factory set at 15 minutes to avoid erratic operation caused by short time reestablishment of normal source.
      - 1) Automatically bypassed when emergency source fails and normal source is available.
    - d. Generator cool down, adjustable from 0 to 60 minutes, factory set at 10 minutes.
  7. Exerciser timer:
    - a. Enable and disable function.
    - b. Selectable to exercise with or without transferring load.
    - c. Adjustable exercise duration from 1 minute to 24 HRS, factory set at 15 minutes.
    - d. Adjustable day of the week exercise setting, factory set for Monday.
  8. In-phase monitor:
    - a. Compare the phase relationship and frequency difference between the normal and emergency sources and permit transfer the first time the sources are within 15 electrical degrees and only if transfer can be accomplished within 60 electrical degrees as determined by monitoring the frequency differences.
    - b. Inphase transfer accomplished if both sources are within 2 Hz of rated frequency and 70 percent or more of rated voltage.
- D. Enclosure:
1. NEMA 1 rated.
  2. Body and cover: Sheet steel finished with a rust inhibiting primer and manufacturers standard paint inside and out.
  3. No knockouts, hinged and lockable door.

## 37 PART 3 - EXECUTION

### 38 3.1 INSTALLATION

- 39 A. Install as indicated and in accordance with manufacturer's recommendations and instructions.
- 40 B. Connect as indicated in one-line diagram.
- 41 C. Mounting of manual transfer switches: Wall-mounted.
- 42 D. Mounting of automatic transfer switches:
  - 43 1. Wall-mounted or floor mounted on 4 IN high concrete pad.
- 44 E. Manual Transfer Switch Enclosure:
  - 45 1. Permitted uses of NEMA 1 rated enclosure:
    - 46 a. Surface mounted in areas designated as dry.

### 47 3.2 SEQUENCE OF OPERATION

- 48 A. Upon loss of power, the ATS shall transfer to the generator feed from the Engine Building.
- 49 B. If utility power is available at the Engine Building, the Filter Plant Building will operate on utility power from the Engine Building.
- 50

1 C. If utility power is not available at the Engine Building, the Engine Building generator ATS starts  
2 the generator and provides generator power to the Filter Plant Building after the ATS has  
3 transferred to generator power.

4 **3.3 FIELD QUALITY CONTROL**

- 5 A. Automatic Transfer Switch Testing:
- 6 1. Simulate power outage by opening normal source overcurrent device.
    - 7 a. Verify engine generator starts and switch transfers in the specified time.
  - 8 2. Close normal source overcurrent device to simulate the return of normal power.
    - 9 a. Verify the switch retransfers and engine generator shuts down in the specified time.
  - 10 3. Perform a manual transfer and retransfer.
  - 11 4. Verify the indicator lights function properly.

12

**END OF SECTION**

1 2014/08/19

2

## SECTION 16412

3

### SEPARATELY MOUNTED CIRCUIT BREAKERS

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

A. Section Includes: Separately mounted circuit breakers.

7

B. Related Sections include but are not necessarily limited to:

8

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

9

2. Division 01 - General Requirements.

10

3. Section 16010 - Electrical: Basic Requirements.

11

4. Section 16490 - Overcurrent and Short Circuit Protective Devices.

12

##### 1.2 QUALITY ASSURANCE

13

A. Referenced Standards:

14

1. National Electrical Manufacturers Association (NEMA):

15

a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

16

2. Underwriters Laboratories, Inc. (UL):

17

a. 489, Standard for Safety Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures.

18

b. 877, Standard for Safety Circuit Breakers and Circuit Breaker Enclosures for Use in Hazardous (Classified) Locations.

19

20

21

##### 1.3 SUBMITTALS

22

A. Shop Drawings:

23

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

24

2. Product technical data:

25

a. Provide submittal data for all products specified in PART 2 of this Specification Section.

26

b. Provide a table that associates equipment model number with equipment tag number.

27

c. See Specification Section 16010 for additional requirements.

28

29

B. Operation and Maintenance Manuals:

30

1. See Specification Section 01342 for requirements for:

31

a. The mechanics and administration of the submittal process.

32

b. The content of Operation and Maintenance Manuals.

32

33

#### PART 2 - PRODUCTS

34

##### 2.1 ACCEPTABLE MANUFACTURERS

35

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

36

1. Eaton.

37

2. General Electric Company.

38

3. Square D Company.

39

4. Siemens.

40

B. Submit request for substitution in accordance with Specification Section 01640.

41

##### 2.2 COMPONENTS

42

A. NEMA 1 rated:

43

1. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturers standard paint inside and out.

44

2. With or without knockouts, hinged or unhinged cover.

45





1 2014/08/19

2

**SECTION 16440**  
**SWITCHBOARDS**

3

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6

A. Section Includes: Low voltage switchboards.

7

B. Related Specification Sections include but are not necessarily limited to:

8

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

9

2. Division 01 - General Requirements.

10

3. Section 16010 - Electrical: Basic Requirements.

11

4. Section 16490 - Overcurrent and Short Circuit Protective Devices.

12

5. Section 16492 - Electrical Metering Devices.

13

**1.2 QUALITY ASSURANCE**

14

A. Referenced Standards:

15

1. National Electrical Manufacturers Association (NEMA):

16

a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

17

b. PB 2, Deadfront Distribution Switchboards.

18

2. Underwriters Laboratories, Inc. (UL):

19

a. 891, Standard for Safety Dead-Front Switchboards.

20

B. Verify the space required for the switchboard is equal to or less than the space allocated.

21

**1.3 SUBMITTALS**

22

A. Shop Drawings:

23

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

24

2. Product technical data.

25

a. Provide submittal data for all products specified in PART 2 of this Specification Section.

26

3. See Specification Section 16010 for additional requirements.

27

4. Fabrication and/or layout Drawings:

28

a. Switchboard layout with alphanumeric designation, protective devices size and type, as indicated in the one-line diagram or switchboard schedule.

29

b. Front elevation and plan Drawing of the assembly.

30

c. Three-line or single line and schematic diagrams.

31

d. Conduit space locations within the assembly.

32

33

B. Operation and Maintenance Manuals:

34

1. See Specification Section 01342 for requirements for:

35

a. The mechanics and administration of the submittal process.

36

b. The content of Operation and Maintenance Manuals.

37

2. Fabrication and/or layout drawings updated with as-build conditions

38

C. Informational Submittals:

39

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

40

2. Ground fault protection system test report signed by the projects supervising electrical foreman.

41

42

43

1 **PART 2 - PRODUCTS**

2 **2.1 ACCEPTABLE MANUFACTURERS**

- 3 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:  
4 1. Eaton.  
5 2. General Electric Company.  
6 3. Square D Company.  
7 4. Siemens.
- 8 B. Submit request for substitution in accordance with Specification Section 01640.

9 **2.2 SWITCHBOARDS**

- 10 A. Ratings:  
11 1. Voltage, number of phases, number of wires, and main bus current rating as indicated on the  
12 Drawings.  
13 2. Assembly short circuit current and interrupting device rating as indicated on the Drawings.  
14 3. Service Entrance Equipment rated when indicated on the Drawings.
- 15 B. Construction:  
16 1. Standards: NEMA PB 2, UL 891.  
17 2. Completely enclosed, dead-front, self-supporting metal structure.  
18 3. Vertical panel sections bolted together.  
19 4. Frames bolted together to support and house bus, cables and other equipment.  
20 5. Frames and insulating blocks to support and brace main buses for short circuit stresses up to  
21 ratings indicated on the Drawings.  
22 6. All sections rear aligned.  
23 7. Devices front removable and load connections front accessible for mounting switchboard  
24 against a wall.  
25 8. NEMA 1 rated enclosure.  
26 9. Interior and exterior steel surfaces cleaned and painted with rust inhibiting primer and  
27 manufacturers standard paint.
- 28 C. Buses:  
29 1. Material: Tin-plated aluminum or silver-plated copper.  
30 2. Main horizontal bus:  
31 a. Fully rated and continuous over length of switchboard with all three (3) phases arranged  
32 in the same vertical plane.  
33 b. Sufficient size to limit temperature rise to 65 DegC over average air temperature outside  
34 the enclosure of 40 DegC.  
35 3. Neutral bus: Fully rated and continuous over length of switchboard.  
36 4. Ground bus: 1/4 x 2 IN copper, continuous over length of switchboard and solidly grounded  
37 to each vertical section structure.  
38 5. Bus joints connected using through bolts and conical spring-type washers for maximum  
39 conductivity.
- 40 D. Overcurrent and Short Circuit Protective Devices:  
41 1. Feeder overcurrent protective devices:  
42 a. Group mounted molded case circuit breaker.  
43 2. See Specification Section 16490 for overcurrent and short circuit protective device  
44 requirements.  
45 3. Factory installed.  
46 4. Means to padlock all feeder devices in the open position.
- 47 E. Metering:  
48 1. Power monitor:  
49 a. Through cabinet mounting.  
50 b. See Specification Section 16492 for meter requirements.

1 **PART 3 - EXECUTION**

2 **3.1 INSTALLATION**

3 A. Install switchboards in accordance with manufacturer's instructions.

4 B. Arrange switchboard as shown on the Drawings.

5 C. Indoor Locations:

6 1. NEMA 1 enclosure.

7 2. Install on concrete housekeeping pad, align front of switchboard with top edge of pad  
8 chamfer and securely fasten to pad.

9 D. Miscellaneous:

10 1. Provide circuit protective devices and other associated equipment as indicated on the  
11 Drawings.

12 2. All control wiring shall be neatly laced and have flexibility at hinge locations.

13 **END OF SECTION**

14



1 2014/08/18

2

## SECTION 16441

3

### PANELBOARDS

#### 4 PART 1 - GENERAL

##### 5 1.1 SUMMARY

###### 6 A. Section Includes:

- 7 1. Lighting and appliance panelboards.
- 8 2. Power distribution panelboards.

###### 9 B. Related Specification Sections include but are not necessarily limited to:

- 10 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 11 2. Division 01 - General Requirements.
- 12 3. Section 16010 - Electrical: Basic Requirements.
- 13 4. Section 16490 - Overcurrent and Short Circuit Protective Devices.

##### 14 1.2 QUALITY ASSURANCE

###### 15 A. Referenced Standards:

- 16 1. National Electrical Manufacturers Association (NEMA):
  - 17 a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 18 b. PB 1, Panelboards.
- 19 2. National Fire Protection Association (NFPA):
  - 20 a. 70, National Electrical Code (NEC).
- 21 3. Underwriters Laboratories, Inc. (UL):
  - 22 a. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
  - 23 b. 67, Standard for Panelboards.

##### 24 1.3 SUBMITTALS

###### 25 A. Shop Drawings:

- 26 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 27 the submittal process.
- 28 2. Product technical data.
  - 29 a. Provide submittal data for all products specified in PART 2 of this Specification Section.
  - 30 b. See Specification Section 16010 for additional requirements.
- 31 3. Fabrication and/or layout Drawings:
  - 32 a. Panelboard layout with alphanumeric designation, branch circuit breakers size and type,
  - 33 as indicated in the panelboard schedules.

###### 34 B. Operation and Maintenance Manuals:

- 35 1. See Specification Section 01342 for requirements for:
  - 36 a. The mechanics and administration of the submittal process.
  - 37 b. The content of Operation and Maintenance Manuals.
- 38 2. Panelboard schedules with as-built conditions.

#### 39 PART 2 - PRODUCTS

##### 40 2.1 ACCEPTABLE MANUFACTURERS

###### 41 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

- 42 1. Eaton.
- 43 2. General Electric Company.
- 44 3. Square D Company.
- 45 4. Siemens.

###### 46 B. Submit request for substitution in accordance with Specification Section 01640.

1 **2.2 MANUFACTURED UNITS**

- 2 A. Standards: NEMA PB 1, NFPA 70, UL 50, UL 67.
- 3 B. Ratings:
- 4 1. Current, voltage, number of phases, number of wires as indicated on the Drawings.
- 5 2. Panelboards rated 240 Vac or less: 10,000 amp minimum short circuit rating or as indicated
- 6 in the schedule.
- 7 3. Panelboards rated 480 Vac: 14,000 amp minimum short circuit rating or as indicated in the
- 8 schedule.
- 9 4. Service Entrance Equipment rated when indicated on the Drawings.
- 10 C. Construction:
- 11 1. Interiors factory assembled and designed such that switching and protective devices can be
- 12 replaced without disturbing adjacent units and without removing the main bus connectors.
- 13 2. Multi-section panelboards: Feed-through or sub-feed lugs.
- 14 3. Main lugs: Solderless type approved for copper and aluminum wire.
- 15 D. Bus Bars:
- 16 1. Main bus bars:
- 17 a. Plated aluminum or copper sized to limit temperature rise to a maximum of 65 DegC
- 18 above an ambient of 40 DegC.
- 19 b. Drilled and tapped and arranged for sequence phasing of the branch circuit devices.
- 20 2. Ground bus and isolated ground bus, when indicated on the Drawings: Solderless
- 21 mechanical type connectors.
- 22 3. Neutral bus bars: Insulated 100 percent rated or 200 percent rated, when indicated on the
- 23 Drawings and with solderless mechanical type connectors.
- 24 E. Enclosure:
- 25 1. Boxes: Code gage galvanized steel, furnish without knockouts.
- 26 2. Trim assembly: Code gage steel finished with rust inhibited primer and manufacturers
- 27 standard paint inside and out.
- 28 3. Lighting and appliance panelboard:
- 29 a. Trims supplied with hinged door over all circuit breaker handles.
- 30 b. Trims for surface mounted panelboards, same size as box.
- 31 c. Trims for flush mounted panelboards, overlap the box by 3/4 IN on all sides.
- 32 d. Doors lockable with corrosion resistant chrome-plated combination lock and catch, all
- 33 locks keyed alike.
- 34 e. Nominal 20 IN wide and 5-3/4 IN deep with gutter space in accordance with NFPA 70.
- 35 f. Clear plastic cover for directory card mounted on the inside of each door.
- 36 g. NEMA 3R or NEMA 12 rated: Door gasketed.
- 37 4. Power distribution panelboard:
- 38 a. Trims cover all live parts with switching device handles accessible.
- 39 b. Less than or equal to 12 IN deep with gutter space in accordance with NFPA 70.
- 40 c. Clear plastic cover for directory card mounted front of enclosure.
- 41 d. NEMA 3R or NEMA 12 rated: Doors gasketed and lockable with corrosion resistant
- 42 chrome-plated combination lock and catch, all locks keyed alike.
- 43 F. Overcurrent and Short Circuit Protective Devices:
- 44 1. Main overcurrent protective device:
- 45 a. Molded case circuit breaker.
- 46 2. Branch overcurrent protective devices:
- 47 a. Mounted molded case circuit breaker.
- 48 3. See Section 16490 for overcurrent and short circuit protective device requirements.
- 49 4. Factory installed.

50 **PART 3 - EXECUTION**

51 **3.1 INSTALLATION**

- 52 A. Install as indicated on the Drawings, in accordance with the NFPA 70, and in accordance with
- 53 manufacturer's instructions.

- 1 B. Support panelboard enclosures from wall studs or modular channels support structure, per  
2 Specification Section 16010.
- 3 C. Provide NEMA 1, NEMA 3R, NEMA 12, or NEMA 4X rated enclosure as indicated on the  
4 Drawings.
- 5 D. Provide Each Panelboard With a Typed Directory:  
6 1. Identify all circuit locations in each panelboard with the load type and location served.  
7 2. Mechanical equipment shall be identified by Owner-furnished designation if different than  
8 designation indicated on the Drawings.  
9 3. Room names and numbers shall be final building room names and numbers as identified by  
10 the Owner if different than designation indicated on the Drawings.

11 **END OF SECTION**  
12





1 2014/09/05

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**SECTION 16442**  
**MOTOR CONTROL EQUIPMENT**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6

A. Section Includes:

7

1. Motor control centers.

8

2. Separately mounted motor starters (including those supplied with equipment).

9

3. Manual motor starters.

10

B. Related Specification Sections include but are not necessarily limited to:

11

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

12

2. Division 01 - General Requirements.

13

3. Section 16010 - Electrical: Basic Requirements.

14

4. Section 16080 - Acceptance Testing.

15

5. Section 16267 - Reduced Voltage Solid State Starters - Low Voltage.

16

6. Section 16490 - Overcurrent and Short Circuit Protective Devices.

17

7. Section 16493 - Control Equipment Accessories.

18

**1.2 QUALITY ASSURANCE**

19

A. Referenced Standards:

20

1. International Electrotechnical Commission (IEC).

21

2. National Electrical Manufacturers Association (NEMA):

22

a. 250, Enclosures for Electrical Equipment (1000 Volt Maximum).

23

b. ICS 2, Controllers, Contactors and Overload Relays Rated 600 V.

24

c. ICS 3, Medium-Voltage Controllers Rated 2001 to 7200 V AC.

25

3. Underwriters Laboratories, Inc. (UL):

26

a. 508, Standard for Industrial Control Equipment.

27

b. 845, Motor Control Centers.

28

B. Miscellaneous:

29

1. Verify motor horsepower loads, other equipment loads, and controls from approved Shop Drawings and notify Engineer of any discrepancies.

30

2. Verify the required instrumentation and control wiring for a complete system and notify Engineer of any discrepancies.

31

32

33

**1.3 SUBMITTALS**

34

A. Shop Drawings:

35

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

36

2. Product technical data:

37

a. Provide submittal data for all products specified in PART 2 of this Specification Section.

38

b. See Specification Section 16010 for additional requirements.

39

3. Fabrication and/or layout Drawings:

40

a. Separately mounted combination starters:

41

1) Unit ladder logic wiring for each unit depicting electrical wiring and identification of terminals where field devices or remote control signals are to be terminated as indicated on the Drawings and/or loop descriptions.

42

43

44

45

B. Operation and Maintenance Manuals:

46

1. See Specification Section 01342 for requirements for:

47

a. The mechanics and administration of the submittal process.

48

b. The content of Operation and Maintenance Manuals.

49

c. Fabrication and/or layout drawings updated with as-built conditions.

1 **PART 2 - PRODUCTS**

2 **2.1 ACCEPTABLE MANUFACTURERS**

3 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

- 4 1. Allen-Bradley.
- 5 2. Eaton.
- 6 3. General Electric Company.
- 7 4. Square D Company.
- 8 5. Siemens.

9 B. Submit request for substitution in accordance with Specification Section 01640.

10 **2.2 SEPARATELY MOUNTED COMBINATION STARTERS**

11 A. Standards:

- 12 1. NEMA 250, NEMA ICS 2.
- 13 2. UL 508.

14 B. Enclosure:

- 15 1. NEMA 4X rated:
  - 16 a. Body and cover: Type 304 or 316 stainless steel.
  - 17 b. No knockouts, external mounting flanges, hinged and gasketed door.

18 C. Operating Handle:

- 19 1. With the door closed the handle mechanism allows complete ON/OFF control of the unit
- 20 disconnect and clear indication of the disconnect status.
- 21 2. Circuit breaker and MCP operators includes a separate TRIPPED position.
- 22 3. Mechanical interlock to prevent to prevent the opening of the door when the disconnect is in
- 23 the ON position with a defeater mechanism for use by authorized personnel.
- 24 4. Mechanical interlock to prevent the placement of the disconnect in the ON position with the
- 25 door open with a defeater mechanism for use by authorized personnel.
- 26 5. Padlockable in the OFF position.
- 27 6. Exceptions: NEMA 7 and NEMA 9 enclosures.

28 D. External mounted overload relay pushbutton.

29 E. Control Devices:

- 30 1. Provide control devices as indicated on the Drawings per Specification Section 16493.
- 31 2. Devices will be accessible with the door closed.

32 F. Control Power Transformer:

- 33 1. 120V secondary.
- 34 2. Fused on primary and secondary side.
- 35 3. Sized for 140 percent of required load.

36 G. Fault Current Withstand Rating: Equal to the rating of the electrical gear from which it is fed.

37 H. Motor Starters: See requirements within this Specification Section.

38 I. Disconnect Switch, Overcurrent and Short Circuit Protective Devices:

- 39 1. Motor circuit protector.
- 40 2. See Specification Section 16490 for overcurrent and short circuit protective device
- 41 requirements.
- 42 3. Factory installed.

43 **2.3 MOTOR STARTERS**

44 A. Standards:

- 45 1. NEMA ICS 2.
- 46 2. UL 508.

47 B. Full Voltage Non-Reversing (FVNR) Magnetic Starters:

- 48 1. NEMA full size rated contactor.
  - 49 a. NEMA half sizes and IEC contactors are not permitted.
- 50 2. Double-break silver alloy contacts.

- 1 3. Overload relays:
- 2 a. Ambient compensated, bimetallic type with interchangeable heaters, 24 percent
- 3 adjustability, single phase sensitivity, an isolated arm contact and manual reset.
- 4 4. Interlock and auxiliary contacts, wired to terminal blocks:
- 5 a. Holding circuit contact, normally open.
- 6 b. Overload alarm contact, normally open.
- 7 c. Normally open auxiliary contact, for remote run status.
- 8 d. Additional field replaceable auxiliary contacts as required per the Sequence of
- 9 Operation.
- 10 e. Two (2 additional normally open spare field replaceable auxiliary contacts.

11 **2.4 MANUAL MOTOR STARTERS**

- 12 A. Standards:
- 13 1. NEMA 250, NEMA ICS 2.
- 14 2. UL 508.
- 15 B. Quick-make, quick-break toggle mechanism that is lockable in the OFF position.
- 16 C. Types:
- 17 1. Horsepower rated, for ON/OFF control.
- 18 2. Horsepower rated, for ON/OFF control and thermal overload protection.
- 19 a. Switch to clearly indicate ON, OFF, and TRIPPED position.
- 20 D. Voltage and current ratings and number of poles as required for the connected motor.
- 21 E. Enclosures:
- 22 1. NEMA 4X rated:
- 23 a. Type 304 or 316 stainless steel.
- 24 b. No knockouts, external mounting flanges.

25 **PART 3 - EXECUTION**

26 **3.1 INSTALLATION**

- 27 A. Install as indicated on the Drawings and in accordance with manufacturer's recommendations
- 28 and instructions.
- 29 B. Mounting height for surface mounted equipment: See Specification Section 16010.
- 30 C. Overload Heaters:
- 31 1. Size for actual motor full load current of the connected motor.
- 32 D. Combination and Manual Starter Enclosures:
- 33 1. Permitted uses of NEMA 4X enclosure:
- 34 a. Surface mounted in all locations.

35 **3.2 FIELD QUALITY CONTROL**

- 36 A. Acceptance Testing: See Specification Section 16080.

37 **END OF SECTION**

38



1 2014/08/19

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3

**SECTION 16460**  
**DRY-TYPE TRANSFORMERS**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes: Dry-type transformers, 1000 kVA and less.
- 7 B. Related Sections include but are not necessarily limited to:
- 8 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 9 2. Division 01 - General Requirements.
- 10 3. Section 16010 - Electrical: Basic Requirements.
- 11 4. Section 16060 - Grounding.

12 **1.2 QUALITY ASSURANCE**

- 13 A. Referenced Standards:
- 14 1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
- 15 a. C57.96, Guide for Loading Dry-Type Distribution and Power Transformers.
- 16 2. National Electrical Manufacturers Association (NEMA):
- 17 a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- 18 b. ST 20, Dry-Type Transformers for General Applications.
- 19 c. TP 1, Guide for Determining Energy Efficiency for Distribution Transformers.
- 20 3. Underwriters Laboratories, Inc. (UL):
- 21 a. 506, Standard for Safety Specialty Transformers.
- 22 b. 1561, Standard for Safety Dry-Type General Purpose and Power Transformers.

23 **1.3 SUBMITTALS**

- 24 A. Shop Drawings:
- 25 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 26 the submittal process.
- 27 2. Product technical data:
- 28 a. Provide submittal data for all products specified in PART 2 of this Specification Section.
- 29 b. See Specification Section 16010 for additional requirements.
- 30 3. Fabrication and/or layout drawings.
- 31 a. Nameplate Drawing.
- 32 4. Certifications:
- 33 a. Sound level certifications.
- 34 B. Operation and Maintenance Manuals:
- 35 1. See Specification Section 01342 for requirements for:
- 36 a. The mechanics and administration of the submittal process.
- 37 b. The content of Operation and Maintenance Manuals.

38 **PART 2 - PRODUCTS**

39 **2.1 ACCEPTABLE MANUFACTURERS**

- 40 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 41 1. Eaton.
- 42 2. General Electric Company.
- 43 3. Square D Company.
- 44 4. Siemens.
- 45 5. Sola/Hevi-Duty.
- 46 B. Submit request for substitution in accordance with Specification Section 01640.

1 **2.2 GENERAL PURPOSE DRY-TYPE TRANSFORMERS**

- 2 A. Ventilated or non-ventilated, air cooled, two (2) winding type.
- 3 B. Cores:
- 4 1. High grade, non-aging silicon steel with high magnetic permeability, and low hysteresis and
- 5 eddy current losses.
- 6 2. Magnetic flux densities are to be kept well below the saturation point.
- 7 C. Coils: Continuous wound with electrical grade aluminum.
- 8 D. Ventilated Units:
- 9 1. Core and coils assembly impregnated with non-hygroscopic, thermosetting varnish and
- 10 cured to reduce hot spots and seal out moisture and completely isolated from the enclosure
- 11 by means of vibration dampening pads.
- 12 2. Dripproof, NEMA 1, steel enclosure finished with a weather-resistant enamel and ventilation
- 13 openings protected from falling dirt.
- 14 E. Furnish Taps for Transformers as follows:
- 15 1. 1 PH, 2 kVA and below: None.
- 16 2. 1 PH, 3 to 25 kVA: Two (2) 5 percent FCBN.
- 17 3. 1 PH, 25 kVA and above: Two (2) 2.5 percent FCAN and four (4) 2.5 percent FCBN.
- 18 4. 3 PH, 3 to 15 kVA: Two (2) 5 percent FCBN.
- 19 5. 3 PH, 15 kVA and above: Two (2) 2.5 percent FCAN and four (4) 2.5 percent FCBN.
- 20 F. Sound Levels:
- 21 1. Manufacturer shall guarantee not to exceed the following:
- 22 a. Up to 9 kVA: 40 dB.
- 23 b. 10 to 50 kVA: 45 dB.
- 24 c. 51 to 150 kVA: 50 dB.
- 25 d. 151 to 300 kVA: 55 dB.
- 26 G. Efficiency:
- 27 1. Ventilated, 15 kVA and larger: Energy efficient meeting NEMA TP 1 requirements.
- 28 H. Insulating Material (600 V and below):
- 29 1. 3 to 15 kVA units: 185 DegC insulation system with a 115 DegC rise.
- 30 2. 15 kVA and above units: 220 DegC insulation system with a 150 DegC rise.
- 31 I. Ratings: 60 Hz, voltage, KVA and phase, as indicated on the Drawings.
- 32 J. Finish: Rust inhibited primer and manufacturers standard paint inside and out.
- 33 K. Standards: IEEE C57.96, NEMA ST 20, NEMA TP 1, UL 506, UL 1561.

34 **PART 3 - EXECUTION**

35 **3.1 INSTALLATION**

- 36 A. Install products in accordance with manufacturer's instructions.
- 37 B. Indoor Locations:
- 38 1. Provide ventilated type for 15 kVA units and above.
- 39 2. Provide non-ventilated type for 9 kVA units and below and were indicated on the Drawings.
- 40 3. Mount 9 kVA units and below on wall.
- 41 4. Mount 15 kVA units and above on chamfered 4 IN high concrete housekeeping pad or from
- 42 wall and/or ceiling, at 7 FT above finished floor, using equipment support brackets per
- 43 Section 16010.
- 44 5. Provide rubber vibrations isolation pads.
- 45 C. Enclosures: Painted steel in all areas except stainless steel in highly corrosive areas.
- 46 D. Ground in accordance with Section 16060.

47 **END OF SECTION**

1 2014/08/18

2

## SECTION 16490

3

### OVERCURRENT AND SHORT CIRCUIT PROTECTIVE DEVICES

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

A. Section Includes: Low voltage circuit breakers.

7

B. Related Specification Sections include but are not necessarily limited to:

8

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

9

2. Division 01 - General Requirements.

10

3. Section 16010 - Electrical: Basic Requirements.

11

4. Section 16080 - Acceptance Testing.

12

##### 1.2 QUALITY ASSURANCE

13

A. Referenced Standards:

14

1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

15

a. C37.13, Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures.

16

b. C37.16, Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors -

17

Preferred Ratings, Related Requirements, and Application Recommendations.

18

c. C37.17, Trip Devices for AC and General Purpose DC Low Voltage Power Circuit

19

Breakers.

20

2. National Electrical Manufacturers Association (NEMA):

21

a. AB 1, Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker

22

Enclosures. (Equivalent to UL 489)

23

3. National Fire Protection Association (NFPA):

24

a. 70, National Electrical Code (NEC).

25

4. Underwriters Laboratories, Inc. (UL):

26

a. 489, Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches, and

27

Circuit-Breaker Enclosures.

28

b. 943, Standard for Safety for Ground-Fault Circuit-Interrupters.

29

c. 1066, Standard for Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures.

30

##### 1.3 SUBMITTALS

31

A. Shop Drawings:

32

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

33

2. Product technical data including:

34

a. Provide submittal data for all products specified in PART 2 of this Specification Section.

35

b. See Specification Section 16010 for additional requirements.

36

37

B. Operation and Maintenance Manuals:

38

1. See Specification Section 01342 for requirements for:

39

a. The mechanics and administration of the submittal process.

40

b. The content of Operation and Maintenance Manuals.

41

C. Informational Submittals:

42

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

43

2. Reports:

44

a. As-left condition of all circuit breakers that have adjustable settings.

45

1 **PART 2 - PRODUCTS**

2 **2.1 ACCEPTABLE MANUFACTURERS**

3 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

- 4 1. Circuit breakers:  
5 a. Eaton.  
6 b. General Electric Company.  
7 c. Square D Company.  
8 d. Siemens.

9 B. Submit request for substitution in accordance with Specification Section 01640.

10 **2.2 CIRCUIT BREAKERS**

11 A. Molded Case Type:

- 12 1. General:  
13 a. Standards: NEMA AB 1, UL 489.  
14 b. Unit construction.  
15 c. Over-center, toggle handle operated.  
16 d. Quick-make, quick-break, independent of toggle handle operation.  
17 e. Manual and automatic operation.  
18 f. All poles open and close simultaneously.  
19 g. Three (3) position handle: On, off and tripped.  
20 h. Molded-in ON and OFF markings on breaker cover.  
21 i. One-, two- or three-pole as indicated on the Drawings.  
22 j. Current and interrupting ratings as indicated on the Drawings.  
23 k. Bolt on type.  
24 2. Thermal magnetic type:  
25 a. Inverse time overload and instantaneous short circuit protection by means of a thermal  
26 magnetic element.  
27 b. Frame size 150 amp and below:  
28 1) Non-interchangeable, non-adjustable thermal magnetic trip units.  
29 c. Frame sizes 225 to 400 amp (trip settings 400 A and less):  
30 1) Interchangeable and adjustable instantaneous thermal magnetic trip units.  
31 d. Ground Fault Circuit Interrupter (GFCI) Listed:  
32 1) Standard: UL 943.  
33 2) One- or two-pole as indicated on the Drawings.  
34 3) Class A ground fault circuit.  
35 4) Trip on 5 mA ground fault (4-6 mA range).  
36 3. Solid state trip type:  
37 a. Inverse time overload, instantaneous short circuit and ground fault protection by means  
38 of a solid state trip element, associated current monitors and flux shunt trip mechanism.  
39 b. Frame size 400 amp to 1200 amp (trip settings between 400 and 1200A):  
40 1) Standard rating.  
41 2) Interchangeable current sensor or rating plug.  
42 3) Adjustable long time pick-up setting.  
43 a) Adjustable from 50 to 100 percent of the current sensor or rating plug.  
44 4) Adjustable short time pick-up setting.  
45 5) Adjustable instantaneous pick-up.  
46 6) Fixed ground fault pick-up, when indicated on the Drawings.  
47 4. Motor circuit protector:  
48 a. Adjustable instantaneous short circuit protection by means of a magnetic or solid state  
49 trip element.  
50 b. Sized for the connected motor.

51 **PART 3 - EXECUTION**

52 **3.1 INSTALLATION**

53 A. Current and interrupting ratings as indicated on the Drawings.



- 1 B. Series rated systems not acceptable.
- 2 C. Devices shall be ambient temperature compensated.
- 3 D. Circuit Breakers:
- 4 1. Molded case circuit breakers shall incorporate the following, unless indicated otherwise on
- 5 the Drawings:
- 6 a. Frame sizes 400 amp and less with trip settings 400A and less shall be thermal
- 7 magnetic type.
- 8 b. Frame sizes larger than 400A shall be solid state trip type.
- 9 c. Motor circuit protectors sized for the connected motor.

10 **3.2 FIELD QUALITY CONTROL**

- 11 A. Adjustable Circuit Breakers:
- 12 1. Set all circuit breaker adjustable taps as defined on the Drawings, except adjust motor circuit
- 13 protectors per the motor nameplate and NFPA 70 requirements.
- 14 B. Testing:
- 15 1. Acceptance testing: See Specification Section 16080.

16 **END OF SECTION**

17



1 2014/09/05

2

## SECTION 16492

3

### ELECTRICAL METERING DEVICES

#### 4 PART 1 - GENERAL

##### 5 1.1 SUMMARY

6 A. Section Includes:

- 7 1. Digital metering equipment.
- 8 2. Analog metering equipment.

9 B. Related Sections include but are not necessarily limited to:

- 10 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 11 2. Division 01 - General Requirements.
- 12 3. Section 16010 - Electrical: Basic Requirements.
- 13 4. Section 16080 - Acceptance Testing.

##### 14 1.2 QUALITY ASSURANCE

15 A. Referenced Standards:

- 16 1. National Electrical Manufacturers Association (NEMA):
  - 17 a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- 18 2. National Electrical Manufacturers Association/American National Standards Institute  
(NEMA/ANSI):
  - 19 a. C12.20, For Electricity Meter - 0.2 and 0.5 Accuracy Classes.
- 20 3. National Fire Protection Association (NFPA):
  - 21 a. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use  
22 in Air-Handling Spaces.
- 23 4. Underwriters Laboratories, Inc. (UL):
  - 24 a. 508, Standard for Safety Industrial Control Equipment.

##### 26 1.3 SUBMITTALS

27 A. Shop Drawings:

- 28 1. See Specification Section 01340 for requirements for the mechanics and administration of  
29 the submittal process.
- 30 2. Product technical data including:
  - 31 a. Provide submittal data for all products specified in PART 2 of this Specification:
  - 32 b. See Section 16010 for additional requirements.

33 B. Operation and Maintenance Manuals:

- 34 1. See Specification Section 01342 for requirements for:
  - 35 a. The mechanics and administration of the submittal process.
  - 36 b. The content of Operation and Maintenance Manuals.

#### 37 PART 2 - PRODUCTS

##### 38 2.1 ACCEPTABLE MANUFACTURERS

39 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

- 40 1. Eaton.
- 41 2. Electro Industries.
- 42 3. General Electric Company.
- 43 4. Power Measurement.
- 44 5. Square D Company.
- 45 6. Siemens.

46 B. Submit request for substitution in accordance with Specification Section 01640.

1 **2.2 DIGITAL METERING DEVICES**

2 A. General:

- 3 1. Direct reading metered or calculated values.
- 4 2. Microprocessor based.
- 5 3. Integral LED or LCD display.
- 6 4. Current and potential transformers as required.
- 7 5. Integral fusing.
- 8 6. Operating temperature: 0 DegF to 150 DegF.
- 9 7. Standards:
  - 10 a. NEMA/ANSI C12.20.
  - 11 b. UL 508.

12 B. Type 'C' High Range Meter:

- 13 1. Display the following minimum electrical parameters (accuracy):
  - 14 a. RMS current per phase (+0.2 percent full scale).
  - 15 b. RMS voltage line-to-line and line-to-neutral (+0.2 percent full scale).
  - 16 c. Real power (W): 3 PH total (+0.4 percent full scale).
  - 17 d. Apparent power (VA): 3 PH total (+0.4 percent full scale).
  - 18 e. Reactive power (VAR): 3 PH total (+0.4 percent full scale).
  - 19 f. Power factor (+1.0 percent).
  - 20 g. Frequency (+0.04 percent).
  - 21 h. Percent current individual harmonic and total harmonic distortion (50th).
  - 22 i. Percent voltage individual harmonic and total harmonic distortion (50th).
  - 23 j. Watt-hours (0.5 percent).
  - 24 k. VAR-hours (1.0 percent).
  - 25 l. VA-hours (0.5 percent).
  - 26 m. Ampere demand (+0.2 percent full scale).
  - 27 n. Watt demand (+0.4 percent full scale).
  - 28 o. VAR demand (+0.4 percent full scale).
  - 29 p. VA demand (+0.4 percent full scale).
  - 30 q. Phaser diagram.
- 31 2. NEMA/ANSI C12.20, Class 0.2 revenue accuracy.
- 32 3. Supply voltage: 120 Vac.

33 **PART 3 - EXECUTION**

34 **3.1 INSTALLATION**

- 35 A. Install as indicated and in accordance with manufacturer's recommendations and instructions.
  - 36 1. Provide all equipment as necessary to provide a complete and functioning system.
  - 37 2. Coordinate with the Owner on final computer screen layouts, trending requirements and
  - 38 printouts.
- 39 B. Meter Types:
  - 40 1. Type C meters: Connected to 480V main breakers, unless otherwise indicated on the
  - 41 Drawings

42 **3.2 FIELD QUALITY CONTROL**

- 43 A. Acceptance Testing: See Section 16080.

44 **3.3 TRAINING**

- 45 A. A qualified factory-trained manufacturer's representative shall provide the Owner with 2 HRS of
- 46 on-site training in the operation and maintenance of the metering system and its components.

47 **END OF SECTION**

1 2014/08/19

2

## SECTION 16493

3

### CONTROL EQUIPMENT ACCESSORIES

4

#### PART 1 - GENERAL

5

##### 1.1 SUMMARY

6

###### A. Section Includes:

7

1. Operator control devices (selector switches, pushbuttons, indicator lights, etc.).

8

2. Control devices (timers, relays, contactors, etc.).

9

3. Control panels and operator stations.

10

###### B. Related Sections include but are not necessarily limited to:

11

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

12

2. Division 01 - General Requirements.

13

3. Section 16010 - Electrical: Basic Requirements.

14

##### 1.2 QUALITY ASSURANCE

15

###### A. Referenced Standards:

16

1. National Electrical Manufacturers Association (NEMA):

17

a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

18

b. ICS 2, Industrial Control and System Controllers, Contactors and Overload Relays  
Rated 600 Volts.

19

2. Underwriters Laboratories, Inc. (UL):

20

a. 508, Standard for Safety Industrial Control Equipment.

21

b. 508A, Standard for Safety Industrial Control Panels.

22

###### B. Miscellaneous:

23

1. Supplier of Industrial Control Panels shall build control panel under the provisions of  
UL 508A.

24

a. Entire assembly shall be affixed with a UL 508A label "Listed Enclosed Industrial Control  
Panel" prior to shipment to the jobsite.

25

26

27

28

##### 1.3 SUBMITTALS

29

###### A. Shop Drawings:

30

1. See Specification Section 01340 for requirements for the mechanics and administration of

31

the submittal process.

32

2. Product technical data:

33

a. Provide submittal data for all products specified in PART 2 of this Specification:

34

b. Control panel bill of material.

35

c. See Section 16010 for additional requirements.

36

3. Fabrication and/or layout Drawings.

37

a. Control panel interior and exterior layout.

38

b. Control panel wiring diagrams.

39

###### B. Operation and Maintenance Manuals:

40

1. See Specification Section 01342 for requirements for:

41

a. The mechanics and administration of submittal process.

42

b. The content of Operation and Maintenance Manuals.

43

#### PART 2 - PRODUCTS

44

##### 2.1 ACCEPTABLE MANUFACTURERS

45

###### A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

46

1. Pilot devices and relays:

47

a. Idec.

- 1 b. Potter & Brumsfield.
- 2 c. Time Mark.
- 3 d. ATC Diversified Electronics.
- 4 2. Contactors:
- 5 a. Automatic Switch Company (ASCO).
- 6 b. Eaton.
- 7 c. General Electric Company.
- 8 d. Square D Company.
- 9 e. Siemens.
- 10 f. Allen Bradley.
- 11 3. Photocells and time clocks:
- 12 a. Grasslin.
- 13 b. Tork.
- 14 c. Intermatic.
- 15 d. Paragon.
- 16 4. Alarm devices:
- 17 a. Edwards Signaling.
- 18 b. Federal Signal Corp.
- 19 5. Terminal blocks:
- 20 a. Phoenix Contact.
- 21 b. Allen-Bradley.
- 22 6. Enclosures:
- 23 a. Hoffman Engineering Co.
- 24 b. Wiegmann.
- 25 c. Eaton B-Line.
- 26 d. Adalet.
- 27 e. Stahlin.
- 28 B. Submit request for substitution in accordance with Specification Section 01640.

## 29 **2.2 PILOT DEVICES**

- 30 A. General Requirements:
- 31 1. Standards: NEMA ICS 2, UL 508.
- 32 2. Heavy-duty NEMA 4/13 watertight/oiltight.
- 33 3. Heavy-duty NEMA 4/4X corrosion resistant.
- 34 4. Heavy-duty factory sealed, explosion-proof and dust ignition-proof (Class I and II).
- 35 5. Mounting hole: 30.5 mm.
- 36 6. Contact blocks: 10 amp, NEMA A600 rated, number as required to fulfill functions shown or
- 37 specified.
- 38 7. Legend plate marked as indicated on Drawings or specified.
- 39 B. Selector Switches:
- 40 1. Two, three- or four-position rotary switch as required to fulfill functions shown or specified.
- 41 2. Maintained contact type.
- 42 3. Knob or lever type operators.
- 43 C. Pushbuttons:
- 44 1. Non-illuminated type:
- 45 a. Protective boot.
- 46 b. Momentary contact.
- 47 c. Standard flush and mushroom operators.
- 48 d. Red colored buttons for START or ON and green for STOP or OFF.
- 49 e. Emergency stop pushbuttons: Mushroom head operator and maintained contact.
- 50 2. Illuminating type:
- 51 a. Protective boot.
- 52 b. Momentary contact.
- 53 c. Standard flush operator.
- 54 d. Serves as both pushbutton control and indicating light.
- 55 e. Red colored lenses for START or ON and green color for STOP or OFF.
- 56 f. Resistor-type full voltage light unit with lens and panel gasket.
- 57 D. Indicating Lights:
- 58 1. Allowing replacement of bulb without removal from control panel.

- 1           2. Lamp: LED, 120 V or 24 V as required.
- 2           3. Full voltage type.
- 3           4. Push-to-test indicating lights.
- 4           5. Glass lens.
- 5           6. Color code lights as follows:
- 6           a. Green: OFF or stopped; valve open.
- 7           b. Amber: Standby; auto mode; ready.
- 8           c. Red: ON or running; valve closed.

9   **2.3 RELAYS**

- 10          A. General Requirements:
- 11           1. Standards: NEMA ICS 2, UL 508.
- 12          B. Control Relays:
- 13           1. General purpose (ice cube) type:
- 14           a. Plug-in housing.
- 15           b. Clear polycarbonate dust cover with clip fastener.
- 16           c. Coil voltage: 120 Vac or as required.
- 17           d. Contacts:
- 18           1) 10 amp continuous.
- 19           2) Silver cadmium oxide.
- 20           3) Minimum of 3 SPDT contacts.
- 21           e. Sockets: DIN rail mounted.
- 22           f. Internal neon or LED indicator is lit when coil is energized.
- 23           g. Manual operator switch.
- 24           2. Industrial type:
- 25           a. Coil voltage: 120 Vac or as required.
- 26           b. Contacts:
- 27           1) 10 amp, NEMA A600 rated.
- 28           2) Double break, silver alloy.
- 29           3) Convertible from normally open to normally closed or vice versa, without removing
- 30           any wiring.
- 31           4) Expandable from 2 poles to 12 poles.
- 32           c. Provide contacts for all required control plus two spares.
- 33          C. Time Delay Relays:
- 34           1. General purpose type:
- 35           a. Timing modes: On and Off delay, interval, one shot and repeat cycle.
- 36           b. Plug-in housing.
- 37           c. Polycarbonate dust cover with clip fastener.
- 38           d. Coil voltage: 120 Vac or as required.
- 39           e. Contacts:
- 40           1) 10 amp continuous.
- 41           2) Silver cadmium oxide.
- 42           3) Two normally open and two normally closed DPDT contacts.
- 43           f. Sockets: DIN rail mounted.
- 44           g. External timing adjustment knob.
- 45           h. Timing ranges: 0.05 seconds to 16.65 HRS.
- 46           i. Repeat accuracy: +1 percent.
- 47           2. Solid State industrial type:
- 48           a. Timing modes: On and Off delay and repeat cycle.
- 49           b. Industrial housing.
- 50           c. Coil voltage: 120 Vac or as required.
- 51           d. Contacts:
- 52           1) 5 amp, NEMA B150 rated.
- 53           2) Silver alloy.
- 54           3) Convertible On Delay and Off Delay contacts.
- 55           4) One normally open and one normally closed timed contacts.
- 56           5) One normally open and one normally closed instantaneous contacts.
- 57           e. Furnish with "on" and "timing out" indicators.
- 58           f. External timing adjustment knob.
- 59           g. Timing ranges: 0.05 seconds to 10 HRS.

- 1 h. Repeat accuracy: +1 percent.
- 2 3. Mechanical industrial type:
- 3 a. Timing modes: On and Off delay.
- 4 b. Coil voltage: 120 Vac or as required.
- 5 c. Contacts:
- 6 1) 10 amp, NEMA A600 rated.
- 7 2) Double break, silver alloy.
- 8 3) Convertible On Delay and Off Delay contacts.
- 9 4) Convertible normally open and normally closed timed contacts.
- 10 5) Convertible normally open instantaneous contacts.
- 11 d. External timing adjustment knob.
- 12 e. Timing ranges: 0.2 - 60 sec or 5 - 180 sec.
- 13 f. Repeat accuracy: Greater than +10 percent.

14 **2.4 CONTACTORS**

- 15 A. General Requirements:
- 16 1. Standards: NEMA ICS 2, UL 508.
- 17 B. Lighting and Remote Control Switches:
- 18 1. Electrically operated, electrically held.
- 19 2. Coil voltage: 120 Vac or as required.
- 20 3. Contacts: Totally enclosed, double-break silver-cadmium-oxide.
- 21 4. Rated for ballasted lighting, tungsten and general use loads.
- 22 5. Number of poles, continuous ampere rating and voltage, as indicated on Drawings or as
- 23 specified.
- 24 6. Auxiliary control relays, as indicated on Drawings or as specified.
- 25 7. Auxiliary contacts, as indicated on Drawings or as specified.
- 26 C. Definite Purpose:
- 27 1. Coil voltage: 120 Vac or as required.
- 28 2. Contacts: Totally enclosed, double-break silver-cadmium-oxide.
- 29 3. Resistive load and horsepower rated.
- 30 4. Number of poles, continuous ampere rating and voltage, as indicated on Drawings or as
- 31 specified.
- 32 5. Auxiliary contacts, as indicated on Drawings or as specified.

33 **2.5 PHOTOCELLS AND TIME CLOCKS**

- 34 A. Photocells:
- 35 1. Weatherproof enclosure.
- 36 2. Adjustable turn-on range, initially set at 1.0 footcandles.
- 37 a. Turn-off level approximately three times turn-on.
- 38 3. Provide time delay device to eliminate nuisance switching.
- 39 4. Voltage, amperage and/or wattage ratings as required for the application.

40 **2.6 MISCELLANEOUS DEVICES**

- 41 A. Control Power Transformer:
- 42 1. Primary voltage: 480 V.
- 43 2. Secondary voltage: 120 V.
- 44 3. Sized for 125 percent of required load.
- 45 4. Fused on primary and secondary.
- 46 5. Standard: NEMA ST 1.

47 **2.7 TERMINATION EQUIPMENT**

- 48 A. General Requirements:
- 49 1. Modular type with screw compression clamp.
- 50 2. Screws: Stainless steel.
- 51 3. Current bar: Nickel-plated copper alloy.
- 52 4. Thermoplastic insulation rated for -40 to +90 DegC.
- 53 5. Wire insertion area: Funnel-shaped to guide all conductor strands into terminal.
- 54 6. End sections and end stops at each end of terminal strip.
- 55 7. Machine-printed terminal markers on both sides of block.



- 1           8. Spacing: 6 mm.
- 2           9. Wire size: 22-12 AWG.
- 3           10. Rated voltage: 600 V.
- 4           11. DIN rail mounting.
- 5           B. Standard-type block:
- 6           1. Rated current: 30 A.
- 7           2. Color: Gray body.
- 8           C. Bladed-type disconnect block:
- 9           1. Terminal block with knife blade disconnect which connects or isolated the two sides of the
- 10           block.
- 11           2. Rated current: 10 A.
- 12           3. Color:
- 13           a. Panel control voltage leaves enclosure - normal: Gray body, orange switch.
- 14           b. Foreign voltage entering enclosure: Orange body, orange switch.
- 15           D. Grounded-type block:
- 16           1. Electrically grounded to mounting rail.
- 17           2. Terminal ground wires and analog cable shields.
- 18           3. Color: Green and yellow body.
- 19           E. Fuse Holders:
- 20           1. Blocks can be ganged for multi-pole operation.
- 21           2. Spacing: 9.1 mm.
- 22           3. Wire size: 30-12 AWG.
- 23           4. Rated voltage: 300 V.
- 24           5. Rated current: 12 A.
- 25           6. Fuse size: 1/4 x 1-1/4.
- 26           7. Blown fuse indication.
- 27           8. DIN rail mounting.

## 28   **2.8 ENCLOSURES**

- 29           A. Control Panels:
- 30           1. NEMA 4X rated:
- 31           a. Body and cover: 14 GA Type 304 or 316 stainless steel.
- 32           b. Seams continuously welded and ground smooth.
- 33           c. No knockouts.
- 34           d. External mounting flanges.
- 35           e. Hinged door and stainless steel screws and clamps.
- 36           f. Door with oil-resistant gasket.
- 37           2. NEMA 12 enclosure:
- 38           a. Body and cover: 14 GA steel finished with rust inhibiting primer and manufacturers
- 39           standard paint inside and out.
- 40           b. No knockouts.
- 41           c. External mounting flanges.
- 42           d. Non-hinged stainless steel cover held closed with captivated cover screws threaded into
- 43           sealed wells or hinged cover held closed with stainless steel screws and clamps.
- 44           e. Flat door with oil resistant gasket.
- 45           3. Control panel miscellaneous accessories:
- 46           a. Back plane mounting panels: Steel with white enamel finish or Type 304 stainless steel.
- 47           b. Interiors shall be white or light gray in color.
- 48           c. Wire management duct:
- 49           1) Bodies: PVC with side holes.
- 50           2) Cover: PVC snap-on.
- 51           3) Size as required.
- 52           d. Rigid handles for covers larger than 9 SF or heavier than 25 LBS.
- 53           e. Split covers when heavier than 25 LBS.
- 54           f. Floor stand kits made of same material as the enclosure.
- 55           g. Weldnuts for mounting optional panels and terminal kits.
- 56           h. Ground bonding jumper from door, across hinge, to enclosure body.
- 57           4. Standards: NEMA 250, UL 508.

- 1 B. Operator Control Stations:
- 2 1. NEMA 4/13 rated:
- 3 a. Die cast aluminum body with manufacturers standard finish.
- 4 b. Gasketed die cast aluminum cover with manufacturers standard finish.
- 5 c. Number of device mounting holes as required.
- 6 2. NEMA 4X rated:
- 7 a. Type 304 or 316 stainless steel body.
- 8 b. Gasketed Type 304 or 316 stainless steel cover.
- 9 c. Number of device mounting holes as required.

10 **2.9 MAINTENANCE MATERIALS**

- 11 A. Provide 100 percent replacement lamps for indicating lights.
- 12 B. Provide 10 percent replacement caps for indicating lights.

13 **PART 3 - EXECUTION**

14 **3.1 INSTALLATION**

- 15 A. Install as indicated and in accordance with manufacturer's recommendations and instructions.
- 16 B. Control Panels:
- 17 1. Size as required to mount the equipment.
- 18 2. Permitted uses of NEMA 4X enclosure:
- 19 a. Surface mounted in areas designated as wet and/or corrosive or highly corrosive.
- 20 3. Permitted uses of NEMA 12 enclosure:
- 21 a. Surface mounted in areas designated as dry and/or dusty architecturally or non-
- 22 architecturally finished areas.
- 23 C. Operator Control Stations:
- 24 1. Permitted uses of NEMA 4/13 enclosure:
- 25 a. Surface mounted in areas designated as dry and/or dusty architecturally or non-
- 26 architecturally finished areas and wet.
- 27 2. Permitted uses of NEMA 4X enclosure:
- 28 a. Surface mounted in areas designated as wet and/or corrosive or highly corrosive.

29 **3.2 FIELD QUALITY CONTROL**

- 30 A. See Section 16010.

31 **END OF SECTION**

1 2014/09/05

2

3

**SECTION 16500**  
**INTERIOR AND EXTERIOR LIGHTING**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6

A. Section Includes:

7

1. Material and installation requirements for:

8

a. Interior building lighting fixtures.

9

b. Exterior building and site lighting fixtures.

10

c. Lamps.

11

d. Ballasts.

12

e. Light poles.

13

f. Lighting control.

14

B. Related Specification Sections include but are not necessarily limited to:

15

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

16

2. Division 01 - General Requirements.

17

3. Division 03 - Concrete.

18

4. Section 16010 - Electrical: Basic Requirements.

19

5. Section 16120 - Wire and Cable - 600 Volt and Below.

20

6. Section 16493 - Control Equipment Accessories.

21

**1.2 QUALITY ASSURANCE**

22

A. Referenced Standards:

23

1. American National Standards Institute (ANSI).

24

2. Certified Ballast Manufacturers (CBM).

25

3. Federal Communications Commission (FCC):

26

a. Code of Federal Regulations (CFR), 47 CFR 18, Industrial, Scientific and Medical Equipment.

27

4. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

28

a. C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

29

5. National Electrical Manufacturers Association (NEMA):

30

a. 250, Enclosures for Electrical Equipment (1000Volts Maximum).

31

b. LE 4, Recessed Luminaires, Ceiling Compatibility.

32

6. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):

33

a. C82.1, Lamp Ballasts - Line Frequency Fluorescent Lamp Ballast.

34

b. C82.4, Ballasts for High-Intensity Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type).

35

c. C82.11, High-Frequency Fluorescent Lamp Ballasts - Supplements.

36

7. National Fire Protection Association (NFPA):

37

a. 70, National Electrical Code (NEC).

38

b. 101, Life Safety Code.

39

8. Underwriters Laboratories, Inc. (UL):

40

a. 248-4, Low-Voltage Fuses - Part 4: Class CC Fuses.

41

b. 924, Standard for Emergency Lighting and Power Equipment.

42

c. 935, Standard for Fluorescent-Lamp Ballasts.

43

d. 1029, Standard for High-Intensity-Discharge Lamp Ballasts.

44

e. 1598, Luminaires.

45

f. 8750, Light Emitting Diode (LED) Equipment for Use in Lighting Products

46

9. United States Department of Energy (USDOE):

47

a. EPCAct, the National Energy Policy Act.

48

1 **1.3 SUBMITTALS**

- 2 A. Shop Drawings:
- 3 1. See Specification Section 01340 for requirements for the mechanics and administration of
- 4 the submittal process.
- 5 2. Product technical data:
- 6 a. Provide submittal data for all products specified in PART 2 of this Specification Section.
- 7 b. Identify fixtures by Fixture Schedule number.
- 8 c. Fixture data sheet including:
- 9 1) Photometric performance data including candlepower distribution and coefficient of
- 10 utilization (CU) table.
- 11 2) Fixture effective projected areas for pole mounted fixtures.
- 12 d. Pole data shall include:
- 13 1) Pole wind loading.
- 14 2) Anchor bolt template.
- 15 e. See Specification Section 16010 for additional requirements.

16 **PART 2 - PRODUCTS**

17 **2.1 ACCEPTABLE MANUFACTURERS**

- 18 A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 19 1. Lighting fixtures: See Fixture Schedule.
- 20 2. Lamps:
- 21 a. Osram/Sylvania.
- 22 b. General Electric.
- 23 c. Philips.
- 24 d. Venture.
- 25 3. Ballasts: Fixture manufacturer's standard.
- 26 B. Submit request for substitution in accordance with Specification Section 01640.

27 **2.2 GENERAL REQUIREMENTS**

- 28 A. All lighting fixtures and electrical components:
- 29 1. UL labeled.
- 30 2. Fixtures complete with lamps and ballasts.
- 31 B. Provide all recessed fixtures with gaskets of rubber, fiberglass, or equivalent material to prevent
- 32 light leaks around flush trim.
- 33 1. Provide recessed fixtures with trim gaskets cemented in proper position.
- 34 C. Provide standard plaster frame for all recessed lighting fixtures installed in plaster walls or
- 35 ceilings.
- 36 1. Design, finish and fabricate material to preclude possibility of rust stain in plaster.
- 37 D. No live parts normally exposed to contact.
- 38 E. When intended for use in wet areas: Mark fixtures "Suitable for wet locations."
- 39 F. When intended for use in damp areas: Mark fixtures "Suitable for damp locations" or "Suitable for
- 40 wet locations."

41 **2.3 LIGHT FIXTURES**

- 42 A. LED Fixtures:
- 43 1. LEDs, drivers, and optics shall be manufacturer's standard for the type fixture indicated in
- 44 the Fixture Schedule.
- 45 B. Fluorescent:
- 46 1. UL 1598.
- 47 2. NEMA LE 4 for recessed locations.
- 48 3. Lenses: As indicated in Fixture Schedule, with the following minimums:

- 1 4. Finish:
- 2 a. Manufacturer's standard polyester, acrylic enamel or epoxy powder coating applied after
- 3 fabrication.
- 4 b. Manufacturer's standard color or special color specified in Fixture Schedule.
- 5 5. Prewired and provided with lamps that are properly mated to the ballast operating
- 6 characteristics.
- 7 C. High Intensity Discharge:
- 8 1. UL 1598.
- 9 2. Finish:
- 10 a. Manufacturer's standard polyester, acrylic enamel or epoxy powder coating applied after
- 11 fabrication.
- 12 b. Manufacturer's standard color or special color specified in Fixture Schedule.
- 13 3. Prewired and provided with lamps that are properly mated to the ballast operating
- 14 characteristics.
- 15 4. Provided with safety chain.
- 16 D. LED:
- 17 1. UL 8750, UL 1598.
- 18 2. As indicated in the fixture schedule.
- 19 E. Exit Signs and Emergency Lighting Units: UL 924, NFPA 101.

## 20 2.4 LAMPS

- 21 A. Fluorescent:
- 22 1. T8 (265 mA) instant or rapid-start medium bipin lamps.
- 23 a. Correlated color temperature of 3500 degrees Kelvin.
- 24 b. Minimum color rendering index (CRI) of 70.
- 25 c. Minimum initial lumen ratings for each lamp type shall be:
- 26 1) 2800 lumens for 48 IN, 32 watt F32T8 lamp.
- 27 B. High Intensity Discharge (HID) Lamps:
- 28 1. Metal halide lamps:
- 29 a. Metal halide lamps shall be pulse-start type.
- 30 1) If used in an open luminaire, the lamp shall be rated for use in an open fixture and
- 31 incorporate a protective arc tube shroud design.
- 32 b. Clear lamps:
- 33 1) Correlated color temperature of 4000 degrees Kelvin.
- 34 2) Minimum color rendering index (CRI) of 65.
- 35 c. Minimum initial lumen ratings for metal halide lamps with a medium base in a vertical
- 36 position shall be:
- 37 1) 3200 lumens for 50 watt, ED-17 (ANSI M110) clear lamp.
- 38 2) 5600 lumens for 70 watt, ED-17 (ANSI M98) clear lamp.
- 39 3) 8500 lumens for 100 watt, ED-17 (ANSI M90) clear lamp.
- 40 4) 14250 lumens for 150 watt, ED-17 (ANSI M102) clear lamp.
- 41 5) 17500 lumens for 175 watt, ED-17 (ANSI M137) clear lamp.
- 42 d. Minimum initial lumen ratings for metal halide lamps with a mogul base in a vertical
- 43 position shall be:
- 44 1) 14250 lumens for 150 watt, ED-28 (ANSI M102) clear lamp.
- 45 2) 17500 lumens for 175 watt, ED-28 (ANSI M137) clear lamp.
- 46 3) 20000 lumens for 200 watt, ED-28 (ANSI M136) clear lamp.
- 47 4) 25000 lumens for 250 watt, ED-28 (ANSI M138) clear lamp.
- 48 5) 32300 lumens for 320 watt, ED-28 or ED-37 (ANSI M132) clear lamp.
- 49 6) 36000 lumens for 350 watt, ED-28 or ED-37 (ANSI M131) clear lamp.
- 50 7) 42000 lumens for 400 watt, ED-28 or ED-37 (ANSI M135) clear lamp.
- 51 8) 47500 lumens for 450 watt, ED-37 (ANSI M144) clear lamp.
- 52 2. Uncoated (clear) unless identified as coated in the fixture schedule.
- 53 3. The specified fixture in the fixture schedule shall dictate the required lamp operating position
- 54 and base type.
- 55 4. Provide lamps that have the correct bulb shape for the fixture specified.

1 **2.5 BALLASTS**

- 2 A. Fluorescent High Frequency Electronic Ballasts:
- 3 1. UL 935.
- 4 2. "High Frequency" electronic operating lamps at a frequency of 20 KHz or higher without
- 5 visible flicker.
- 6 3. Power factor: Greater than 90 percent.
- 7 4. Input current total harmonic distortion (THD) of less than 20 percent.
- 8 5. Lamp current crest factor: Less than 1.7, in accordance with lamp manufacturer's
- 9 recommendations and NEMA/ANSI C82.11.
- 10 6. Instant start with lamps wired in parallel.
- 11 7. Support a sustained short to ground or open circuit of any output leads without damage to
- 12 the ballast.
- 13 8. Ballast Factor: Greater than 0.85 per NEMA/ANSI C82.11.
- 14 9. Audible noise rating: Class A or better.
- 15 10. Operation in ambient temperatures up to 40 DegC (105 DegF) without damage.
- 16 11. Light output to remain constant for a line voltage fluctuation of +5 percent.
- 17 12. Meet the requirements of the FCC 47 CFR 18, for non-consumer equipment for EMI and RFI.
- 18 13. Meet NEMA/ANSI C82.11 standards regarding harmonic distortion.
- 19 14. Meet IEEE C62.41 Cat. A for transient protection.
- 20 15. Comply with all applicable state and federal efficiency standards.
- 21 16. UL listed, Class P.
- 22 17. Contain no Polychlorinated Biphenyls (PCB's).
- 23 B. High Intensity Discharge Ballasts:
- 24 1. NEMA/ANSI C82.4, UL 1029.
- 25 2. Metal halide:
- 26 a. Input voltage variation: +10 percent.
- 27 b. Maximum lamp regulation spread: 20 percent.
- 28 c. Minimum power factor: 90 percent.
- 29 d. Starting current: Not greater than operating current.
- 30 e. Maximum input voltage dip: 40 percent.
- 31 f. Crest factor: 1.5 to 1.8.
- 32 g. Types:
- 33 1) Lead-type regulators: Constant wattage autotransformer (CWA) and pulse start.
- 34 2) Lag-type regulators: Magnetic regulator and pulse start.
- 35 h. Contain no Polychlorinated Biphenyls (PCB's).
- 36 3. Ballasts for exterior use:
- 37 a. Starting temperature: -20 DegF.

38 **2.6 MAINTENANCE MATERIALS**

- 39 A. Furnish a minimum of 2 or 10 percent of total of each type and wattage of lamps, whichever is
- 40 greater.
- 41 B. Furnish a minimum of 10 percent of total of each type and amperage of fuses for fixtures
- 42 indicated to be fused.
- 43 C. Spare parts are to be stored in a box clearly labeled as to its contents.

44 **PART 3 - EXECUTION**

45 **3.1 INSTALLATION**

- 46 A. Coordinate fixture types with ceiling construction.
- 47 1. Provide mounting hardware for the ceiling system in which the fixture is to be installed.
- 48 B. Fasten lighting fixtures supported by suspended ceiling systems to ceiling framing system with
- 49 hold down clips.
- 50 C. Provide mounting brackets and/or structural mounting support for wall-mounted fixtures.
- 51 1. Do not support fixture from conduit system.
- 52 2. When fixtures are supported from outlet boxes, install per NFPA 70.

- 1 3. Supports for fixtures mounted on exterior walls shall not be attached to exterior face of the
- 2 wall.
- 3 D. Provide pendant LED, and/or HID fixtures with swivel hangers which will allow fixture to swing in
- 4 any direction but will not permit stem to rotate.
- 5 1. Provide hangers with enclosure rating (NEMA 1, 4, or 7) equal to enclosure requirements of
- 6 area in which they are installed.
- 7 2. Swivel hangers for fixtures in mechanical equipment areas: Shock absorbing type.
- 8 3. Secure HID fixtures with safety chain.
- 9 E. Pendant mounted, open, industrial fluorescent fixtures:
- 10 1. Not in continuous rows, shall be supported by conduit or by approved chains:
- 11 a. Hardwired to ceiling mounted junction box.
- 12 2. In continuous rows, shall be rigidly supported with conduit and fasten fixtures to each other
- 13 or mount on continuous metal channel per Specification Section 16010.
- 14 a. Hardwired to ceiling mounted junction box.
- 15 b. Provide reflector alignment clips.
- 16 F. Locate fixtures in accordance with reflected ceiling plans.
- 17 G. Locate in exact center of tile when indicated.
- 18 1. Relocate misplaced fixtures and replace damaged ceiling materials.
- 19 H. Mount lighting fixtures at heights indicated in Specification Section 16010 or per fixture schedule
- 20 or as indicted on the Drawings.
- 21 I. Install exterior fixtures so that water can not enter or accumulate in the wiring compartment.
- 22 J. Where indicated provide two-level control of three (3) and/or four (4) lamp fluorescent fixtures.
- 23 1. Provide two (2) ballasts per fixture and control inside lamp(s) in each fixture by one (1) switch
- 24 or set of switches and the outside two (2) lamps by a second switch or group of switches.
- 25 K. Ground fixtures and ballasts.

### 26 3.2 LIGHTING CONTROL

- 27 A. See Specification Section 16493 for lighting control equipment.
- 28 B. Exterior fixtures not controlled by individual photocells:
- 29 1. Major equipment:
- 30 a. Lighting control panel, LCP101.
- 31 b. Electrically held lighting contactor.
- 32 1) Mounted in control panel.
- 33 2) Quantity of contactors and number of poles as required.
- 34 3) Auxiliary contact.
- 35 c. Photocell mounted on roof.
- 36 d. Three-position (HOA) switch panel mounted.
- 37 e. Red panel mounted indicator light.
- 38 2. Sequence of operation:
- 39 a. When the HOA switch is in the HAND position
- 40 1) Contactor is energized and the exterior lights are ON.
- 41 2) Contactor auxiliary contact is energized and the indicator light is ON.
- 42 b. When the HOA switch is in the OFF position:
- 43 1) Contactor is de-energized and the exterior lights are OFF.
- 44 2) Contactor auxiliary contact is de-energized and the indicator light is OFF.
- 45 c. When the HOA switch is in the AUTO position:
- 46 1) Contactor is energized and de-energized according to the light level as seen by the
- 47 photocell.
- 48 2) Contactor auxiliary contact is energized and de-energized according to the light
- 49 level as seen by the photocell.

### 50 3.3 ADJUST AND CLEAN

- 51 A. See Specification Section 01710.
- 52 B. Replace all inoperable lamps with new lamps prior to final acceptance.

- 1 C. Replace all inoperable LED fixtures with new fixtures prior to final acceptance.
- 2 D. Aim all emergency lighting units, so that, the path of egress is illuminated.

3

**END OF SECTION**



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This media should not be considered a certified**

**I, Charles A. Haas, am the Coordinating Professional on  
the Florence Water Treatment Plant Phase II Filter Plant  
Improvements Project.**

