

SYCAMORE AVE PW MAINT FACILITY UPGRADE

CITY OF MADISON CONTRACT: #11314

TECHNICAL SPECIFICATIONS

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1	SECTION 00 01 00 – TECHNICAL SECTIONS - TABLE OF CONTENTS
2	
3	DIVISION 1 – GENERAL REQUIREMENTS
4	00 31 46 PERMITS
5	00 43 25 SUBSTITUTION REQUEST FORM (DURING BIDDING)
6	00 43 43 WAGES RATES FORM
7	00 62 7613 SALES TAX FORM
8	01 25 13 PRODUCT SUBSTITUTION PROCEDURES
9	01 26 13 REQUEST FOR INFORMATION (RFI)
10	01 26 46 CONSTRUCTION BULLETIN (CB)
11	01 26 57 CHANGE ORDER REQUEST (COR)
12	01 26 63 CHANGE ORDER (CO)
13	01 29 73 SCHEDULE OF VALUES
14	01 29 76 PROGRESS PAYMENT PROCEDURES
15	01 31 13 PROJECT COORDINATION
16	01 31 19 PROJECT MEETINGS
17	01 31 23 PROJECT MANAGEMENT WEB SITE
18	01 32 16 CONSTRUCTION PROGRESS SCHEDULES
19	01 32 19 SUBMITTALS SCHEDULE
20	01 32 26 CONSTRUCTION PROGRESS REPORTING
21	01 32 33 PHOTOGRAPHIC DOCUMENTATION
22	01 33 23 SUBMITTALS
23	01 45 50 AIR BARRIER SYSTEM
24	01 45 16 FIELD QUALITY CONTROL PROCEDURES
25	01 45 29 TESTING LABORATORY SERVICES
26	01 50 00 TEMPORARY FACILITIES AND CONTROLS
27	01 60 00 PRODUCT REQUIREMENTS
28	01 71 23 FIELD ENGINEERING
29	01 73 29 CUTTING AND PATCHING
30	01 74 13 PROGRESS CLEANING
31	01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
32	01 76 00 PROTECTING INSTALLED CONSTRUCTION
33	01 77 00 CLOSEOUT PROCEDURES
34	01 78 13 COMPLETION AND CORRECTION DATA
35	01 78 23 OPERATION AND MAINTENANCE MANUAL
36	01 78 36 WARRANTIES
37	01 78 39 AS-BUILT DRAWINGS
38	01 78 43 SPARE PARTS AND EXTRA MATERIALS
39	01 79 00 DEMONSTRATION AND TRAINING
40	01 91 00 COMMISSIONING
41	01 95 00 MEASUREMENT AND VERIFICATION
42	
43	DIVISION 2 - SITE CONSTRUCTION
44	02 41 19 SELECTIVE DEMOLITION, ALTERATION, AND PATCHING
45	
46	DIVISION 3 - CONCRETE
47	NOT APPLICABLE
48	
49	DIVISION 4 - MASONRY
50	NOT APPLICABLE
51	
52	DIVISION 5 - METALS
53	NOT APPLICABLE
54	
55	DIVISION 6 - WOOD AND PLASTICS
56	06 01 10 ROUGH CARPENTRY
57	06 01 20 FINISH CARPENTRY
58	06 41 00 ARCHITECTURAL WOODWORK

1	
2	
3	DIVISION 7 - THERMAL AND MOISTURE PROTECTION
4	07 21 00 BUILDING INSULATION
5	07 84 10 THROUGH-PENETRATIONS FIRE STOPPING SYSTEMS
6	07 92 00 JOINT SEALANTS
7	
8	DIVISION 8 - DOORS AND WINDOWS
9	08 11 00 STEEL FRAMES
10	08 21 00 WOOD DOORS
11	08 71 00 DOOR HARDWARE
12	08 81 00 GLAZING
13	
14	DIVISION 9 - FINISHES
15	09 21 16 GYPSUM BOARD ASSEMBLIES
16	09 51 10 ACOUSTICAL CEILING PANELS
17	09 65 00 RESILIENT FLOORING, WALL BASE AND ACCESSORIES
18	09 91 23 INTERIOR PAINTING
19	
20	DIVISION 10 - SPECIALTIES
21	10 22 00 PARTITIONS SYSTEMS
22	10 26 13 CORNER GUARDS
23	
24	DIVISION 11 - EQUIPMENT
25	NOT APPLICABLE
26	
27	DIVISION 12 - FURNISHINGS
28	NOT APPLICABLE
29	
30	DIVISION 13 – SPECIAL CONSTRUCTION
31	NOT APPLICABLE
32	
33	DIVISION 14 – CONVEYING SYSTEMS
34	NOT APPLICABLE
35	
36	DIVISION 21 – FIRE PROTECTION
37	21 00 00 FIRE PROTECTION SYSTEMS
38	
39	DIVISION 22 – PLUMBING
40	22 05 00 PLUMBING GENERAL PROVISIONS
41	22 05 90 TEST, ADJUST AND BALANCING
42	22 06 00 PIPE AND PIPE FITTINGS
43	22 03 10 NATURAL GAS PIPING
44	22 06 30 PIPING SPECIALTIES
45	22 09 10 SUPPORTS AND ANCHORS
46	22 10 00 VALVES
47	22 14 00 PUMPS
48	22 25 00 MECHANICAL INSULATION
49	22 45 10 MECHANICAL EQUIPMENT
50	22 63 00 WATER TREATMENT
51	22 70 00 SOLAR WATER HEATING EQUIPMENT
52	
53	DIVISION 23 – HVAC
54	23 05 00 HVAC GENERAL PROVISIONS
55	23 05 90 TESTING, ADJUSTING AND BALANCING
56	23 06 00 PIPE AND PIPE FITTINGS
57	23 06 30 PIPING SPECIALTIES

1	23 09 10	SUPPORTS AND ANCHORS
2	23 10 00	VALVES
3	23 14 00	PUMPS
4	23 20 00	VIBRATION ISOLATION
5	23 25 00	MECHANICAL INSULATION
6	23 63 00	WATER TREATMENT
7	23 66 00	AIR-COOLED CONDENSING UNITS
8	23 74 00	TERMINAL AIR DISTRIBUTION UNITS
9	23 74 10	TERMINAL HEATING UNITS
10	23 76 20	DIRECT-FIRED MAKEUP AIR HEATING UNITS
11	23 76 30	AIR HANDLING UNITS
12	23 82 00	FANS
13	23 84 00	DUCTWORK
14	23 86 00	DUCTWORK ACCESSORIES
15	23 87 00	AIR OUTLETS AND INLETS
16	23 89 50	VARIABLE FREQUENCY DRIVES
17	23 90 00	CONTROLS AND INSTRUMENTATION
18	23 91 00	DIRECT DIGITAL CONTROL SYSTEMS
19	23 95 00	CONTROL SEQUENCES
20	23 95 10	DDC POINTS LIST
21	23 96 00	STARTING OF MECHANICAL SYSTEMS
22		
23		DIVISION 26 – ELECTRICAL
24	26 05 00	ELECTRICAL GENERAL PROVISIONS
25	26 10 00	ELECTRICAL DEMOLITION AND ALTERNATIONS
26	26 11 00	RACEWAYS AND BOXES
27	26 12 00	LOW VOLTAGE WIRES AND CABLES
28	26 14 00	WIRING DEVICES
29	26 16 20	PANELBOARDS
30	26 18 50	EQUIPMENT CONNECTIONS
31	26 19 00	SUPPORTING DEVICES
32	26 45 00	GROUNDING AND BONDING
33	26 51 00	INTERIOR BUILDING LIGHTING
34	26 51 10	LIGHTING CONTROL SYSTEMS
35		
36		DIVISION 27 – COMMUNICATIONS
37	27 05 00	TELECOMMUNICATIONS RACEWAY SYSTEMS
38	27 10 00	COMMUNICATIONS CABLING & EQUIPMENT
39	27 21 33	WIRELESS ACCESS POINTS
40		
41		DIVISION 28 – ELECTRONIC SAFETY AND SECURITY
42	28 13 00	ACCESS CONTROL SYSTEM (WAP)
43	28 31 00	FIRE ALARM SYSTEMS (KEYSCAN)
44		

**SECTION 00 31 46
PERMITS**

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. REFERENCES 1
7 1.3. GENERAL CONTRACTORS REQUIREMENTS 1
8 PART 2 – PRODUCTS – THIS SECTION NOT USED 1
9 PART 3 – EXECUTION – THIS SECTION NOT USED 1

10
11 **PART 1 – GENERAL**

12
13 **1.1. SUMMARY**

- 14 A. Each project has varying requirements for permits, inspections, and fees based on the scope, size, and location of
15 the project.
16 B. The City of Madison (Owner) is subject to all permits, inspections and associated fees for construction,
17 demolition, utility connection, storm water management, and other similar requirements that may be required
18 to complete the scope of work associated with these contract documents.
19 C. The General Contractor (GC) shall be responsible for obtaining all permits and inspections. All permits must be
20 obtained by the contractor and all City of Madison permit fees will be paid by the City.
21

22 **1.2. REFERENCES**

- 23 A. The following references are not intended to be all inclusive. It shall be the GC’s responsibility to determine all
24 requirements based on the scope of work in the contract documents.
25 B. City of Madison Ordinances: Review all ordinances that may require a permit or fee that may be connected with
26 a required permit. Contact the following City Agencies to determine the exact requirements during bidding
27 1. Building Inspection
28 2. Zoning
29 3. Engineering
30 4. Water Utility
31 5. Traffic Engineering
32 6. Others as may be specified by the contract documents.
33 B. State Statutes
34 C. Other Regulatory Regulations
35 D. Other Agencies or companies that may have related requirements
36 1. Madison Metropolitan Sewerage District
37 2. Local gas and electric utility companies
38 3. Other utility companies
39

40 **1.3. GENERAL CONTRACTORS REQUIREMENTS**

- 41 A. The GC shall be responsible for all of the following:
42 1. Execute application for all required permits as may be required by the scope of work described within the
43 contract documents.
44 2. All permits must be obtained by the contractor and all City of Madison permit fees will be paid by the
45 City. **(INCLUDE LANGUAGE FOR NON CITY OF MADISON PERMITS)**
46 3. Scheduling all required inspections that may be conditions of any required permits.
47 B. The GC shall provide high quality scanned images of all required permits and inspections and upload them to the
48 Contract Documents-Regulatory Documents Library on the Project Management Web Site.
49

50 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

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52 **PART 3 – EXECUTION – THIS SECTION NOT USED**

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56 **END OF SECTION**
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**SECTION 00 43 25
SUBSTITUTION REQUEST FORM (DURING BIDDING)**

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3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 PART 2 – PRODUCTS – THIS SECTION NOT USED 1
8 PART 3 - EXECUTION 1
9 3.1. REQUESTING A SUBSTITUTION DURING BIDDING 1
10 3.2. SUBMISSION REVIEW 2
11 3.3. SUBSTITUTION APPROVAL 2
12 3.4. SUBSTITUTION REQUEST FORM 3
13

14 **PART 1 – GENERAL**

15
16 **1.1. SUMMARY**

- 17 A. The City of Madison uses a specific list of preferred products for various specification items to establish
18 standards of quality, utility, and appearance required.
19 B. The City of Madison will not allow substitutions for specified Products except as follows:
20 1. The Product is no longer produced or the product manufacturer is no longer in business.
21 2. The manufacturer has significantly changed performance data, product dimensions, or other such design
22 criteria for the specified Product(s).
23 3. Products specified by naming one or more Products or manufacturer’s and “or approved equal” or
24 “approved equivalent.”
25 C. The procedures in this specification shall apply to all proposals by Contractors, Suppliers, Vendors, and
26 Manufacturers when the conditions in item 1.1.B. above have been met during the bidding phase.
27

28 **1.2. RELATED SPECIFICATIONS**

- 29 A. 01 25 13 Product Substitution Procedures
30

31 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

32
33 **PART 3 - EXECUTION**

34
35 **3.1. REQUESTING A SUBSTITUTION DURING BIDDING**

- 36 A. In the event that a substitution is requested during the bidding phase the Contractor, Supplier, Vendor, or
37 Manufacturer shall do all of the following:
38 1. Submit a Substitution Request Form for each different product. Use a printed/scanned copy of the form
39 at the end of this specification as a cover sheet.
40 2. Support your request with complete data, drawings, specifications, performance data and samples as
41 appropriate. A complete submission shall include the following:
42 a. Substitution Request Form as a cover sheet
43 b. Comparison of qualities of the proposed substitutions with that specified.
44 c. Changes required in other elements of the Work because of the substitution.
45 d. Effect on the construction schedule.
46 e. Cost data comparing the proposed substitution with the Product specified.
47 f. Any required license fees or royalties.
48 g. Availability of maintenance service and source of replacement materials.
49 3. Submit the Substitution Request Form and all required supporting documentation to the City Project
50 Manager and Project Architect.
51 a. Submissions to be done as complete PDF files for each product, appropriately titled
52 b. Email submissions to the Project Architect and City Project Manager at the email addresses
53 provided on the last page of Section D of the contract documents.
54 i. The subject line shall include the contract number and “Request for Substitution”.
55 Example: Contract 1234 – Request for Substitution
56 4. Submissions must be received by the substitution request deadline specified in Section A of the Contract
57 Documents.
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3.2. SUBMISSION REVIEW

- A. The Project Architect, City Project Manager, members of the design team, and the Owners staff shall review all submissions for substitutions during the bidding phase.

3.3. SUBSTITUTION APPROVAL

- A. All requests for substitutions that have been approved shall be published by Addenda to the bid documents.

NOTE SEE NEXT PAGE FOR SAMPLE SUBSTITUTION REQUEST FORM.

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3.4. SUBSTITUTION REQUEST FORM

For Pre-bid Substitution Requests all text boxes on this form are required information for a complete request.

	<h1>Substitution Request</h1>		
Today's Date:	<input type="text"/>		
Project Title:	<input type="text"/>		
Project Number:	<input type="text"/>	Contract Number:	<input type="text"/>
<p><i>By completing and submitting this form for review the General Contractor affirms that all of the following statements are correct:</i></p> <ol style="list-style-type: none"><i>The General Contractor affirms that this request is in compliance with the requirements described in Specification 01 25 13 Product Substitution Procedures.</i><i>The function, appearance, and quality of the proposed substitution are equal or superior to the specified item.</i><i>The proposed substitution does not affect dimensions shown on the drawings.</i><i>The proposed substitution will have no adverse affects on other trades, the construction schedule, or any specified warranty requirements.</i><i>Maintenance and service parts will be locally available for the proposed substitution. (GC shall provide supporting documentation in the attachments section below.)</i><i>The General Contractor shall be responsible for any and all costs associated with this substitution request if approved. This includes but is not to limited to fees for building design, engineering design fees, detailing fees, plan review fees, construction costs, and inspection fees.</i>			
<p style="text-align: center;"><u>GC Substitution Request:</u></p>			
General Title:	<input type="text"/>		
Related Specification:	<input type="text"/>	<input type="text"/>	<input type="text"/>
Reason for Substitution:	<input type="text"/>		
Proposed Substitution: (include Name, Model, etc.)	<input type="text"/>		
Submitted By:	<input type="text"/>	Phone:	<input type="text"/>
Company:	<input type="text"/>	Email:	<input type="text"/>

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**SECTION 00 43 43
WAGE RATES FORM**

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PART 1 – GENERAL 1
1.1. SUMMARY 1
1.2. RELATED SPECIFICATIONS 1
PART 2 – PRODUCTS – NOT USED 1
PART 3 - EXECUTION 1
3.1. GENERAL REQUIREMENTS..... 1
3.2. GENERAL CONTRACTORS RESPONSIBILITIES 1

PART 1 – GENERAL

1.1. SUMMARY

- A. The Reimbursable Hourly Worksheet is a contractor provided document that indicates the basic rate of pay, fringe benefits, and each companies cost of required insurance for all Trades and Classifications that will be performing productive labor during the execution of this contract.
 - 1. Rates shall be similar to recognized rates published by the Bureau of Labor Statistics, Associated General Contractors (AGC), Associated Builders and Contractors (ABC), appropriate union contracts, and other similar organizations or documents.
- B. The Reimbursable Labor Rate Worksheet shall provide the basis for labor rates being used on Change Order Request forms.

1.2. RELATED SPECIFICATIONS

- A. Section 01 26 57 Change Order Request
- B. Section 01 29 76 Progress Payment Procedures
- C. Section 01 31 23 Project Management Web Site (SharePoint)
- D. Section 01 32 19 Submittals Schedule

PART 2 – PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1. GENERAL REQUIREMENTS

- A. Prior to the Pre-Construction Meeting the City Project Manager (CPM) or the City Construction Manager (CCM) shall provide the GC a copy of the *Reimbursable Labor Rate Worksheet.xls*.
 - 1. See the last page of this specification for an example of the worksheet.
- B. The GC shall provide all subcontractors that will be performing productive labor during the execution of this contract with additional copies of the worksheet as needed.
- C. All contractors shall be required to fill out and submit completed worksheets for all Trades and Classifications of labor that will be performing productive labor during the execution of this contract.

3.2. GENERAL CONTRACTORS RESPONSIBILITIES

- A. The GC shall consolidate all Trades and Classifications into one master Excel Workbook of all trades.
- B. The GC shall provide the combined workbook as required by Section 1.6 of Specification 01 32 19 Submittals Schedule for review and approval by the Owners Representatives.
 - 1. Submittal shall be an Exported PDF of the completed Excel Workbook.
 - a. As an Exported PDF the individual worksheets will be bookmarked and the document will be word searchable for easy reference.
- C. The GC shall only use the rates posted in the approved submittal throughout the execution of this contract.

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Reimbursable Hourly Rate Worksheet

(see bottom of page for instructions)

Project Name: _____
 Project Location: _____
 Project Number: _____
 Contractor: _____
 Rates are based on the following documentation: _____

Enter TRADE Here:

Carpenter

<u>Classification:</u>		<u>Foreman</u>	<u>Journeyman</u>	<u>Laborer</u>	<u>Apprt 1</u>	<u>Other</u>	<u>Other</u>	<u>Other</u>
Base Rate (BR)		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Vacation		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Health Insurance		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Pension		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Apprenticeship		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<i>Sub-total</i>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
BR Sub-total		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Work. Comp	% of BR	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Gen Liability	% of BR	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
WI Unemploy	% of BR	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Fed Unemploy	% of BR	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
FICA	% of BR	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<i>Sub-total</i>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
TOTAL COST		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00

Enter YOUR percentage of base rate in the column below.

0	- Work. Comp
0	- Gen Liability
0	- WI Unemploy
0.6	- Fed Unemploy
7.65	- FICA

Form Instructions:

1. Provide a work sheet for ALL Trade Classifications that will be performing on site productive labor during the execution of this project.
2. Responsible contractor to complete only boxes that are shaded, all non-shaded boxes are formula driven.
3. Contractor shall provide the name of the source used for these rates. (union contract, Bureau of Labor and Statistics, AGC, ABC, etc.) and be prepared to provide copies if so requested.

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END OF SECTION

**SECTION 00 62 76.13
SALES TAX FORM**

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4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATION SECTIONS 1
7 1.2. TAX EXEMPT FORM 1
8 PART 2 – PRODUCTS – THIS SECTION NOT USED 1
9 PART 3 – EXECUTION – THIS SECTION NOT USED 1

10
11 **PART 1 – GENERAL**

12
13 **1.1. SUMMARY**

- 14 A. The City of Madison is a qualifying tax exempt entity in the State of Wisconsin.
15 B. The Contractor shall refer to *Section 102.9 – Bidders Understanding of the City of Madison Standard*
16 *Specifications for Public Works Construction* for more information on Tax Exempt Status.
17 C. This project constructs or remodels facilities owned by the City of Madison in Madison, Wisconsin.
18

19 **1.2. RELATED SPECIFICATION SECTIONS**

- 20 A. Parts of this specification will reference articles within “The City of Madison Standard Specifications for Public
21 Works Construction”.
22 1. Use the following link to access the Standard Specifications web page:
23 <http://www.cityofmadison.com/business/pw/specs.cfm>
24 a. Click on the “Part” chapter identified in the specification text. For example if the specification
25 says “Refer to City of Madison Standard Specification 210.2” click the link for Part II, the Part II
26 PDF will open.
27 b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you
28 to the referenced text.
29

30 **1.3. TAX EXEMPT FORM**

- 31 A. The Contractor can access Wisconsin Sales and Use Tax Exemption Certificates (form S-211, Wisconsin
32 Department of Revenue) from the City of Madison Finance website.
33 1. City of Madison tax exempt information and signature by Purchasing Supervisor is already completed.
34 2. Website: <http://www.cityofmadison.com/employeeenet/finance/purchasing>
35 a. Under the title *Purchasing Forms*, scroll down to the form link titled *Sales Tax Exempt Form S-211*.
36

37 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

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39 **PART 3 – EXECUTION – THIS SECTION NOT USED**

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44 **END OF SECTION**
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SECTION 01 25 13
PRODUCT SUBSTITUTION PROCEDURES

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 PART 2 – PRODUCTS..... 1
8 2.1. SUBSTITUTION REQUEST FORM..... 1
9 PART 3 - EXECUTION 1
10 3.1. REQUESTING A SUBSTITUTION DURING BIDDING..... 1
11 3.2. REQUESTING A SUBSTITUTION AFTER AWARD OF CONTRACT 2
12 3.3. UNAUTHORIZED SUBSTITUTIONS..... 2
13

PART 1 – GENERAL

1.1. SUMMARY

- 17 A. The City of Madison uses a specific list of preferred products for various specification items to establish
18 standards of quality, utility, and appearance required.
19 B. The City of Madison will not allow substitutions for specified Products except as follows:
20 1. The Product is no longer produced or the product manufacturer is no longer in business.
21 2. The manufacturer has significantly changed performance data, product dimensions, or other such design
22 criteria for the specified Product(s).
23 3. Products specified by naming one or more Products or manufacturer’s and “or approved equal” or
24 “approved equivalent.”
25 C. The City of Madison will not allow substitutions for specified Products as follows:
26 1. For Products specified by naming only one Product and manufacturer, no substitute product will be
27 considered.
28 2. For Products specified by naming several Products or manufacturers select any one of the products or
29 manufacturers named, which complies with the specifications. No substitute product will be considered.
30 D. Request for substitutions from any party other than the General Contractor (GC) will not be accepted.
31

1.2. RELATED SPECIFICATIONS

- 33 A. Section 01 26 13 Request for Information (RFI)
34 B. Section 01 31 23 Project Management Web Site
35 C. Section 01 33 23 Submittals
36

PART 2 – PRODUCTS

2.1. SUBSTITUTION REQUEST FORM

- 40 A. During bidding all contractors (General and Sub-contractors) and suppliers of materials or products shall provide
41 hard copy of the Substitution Request form and all required attachments directly to the Project Architect.
42 1. Contractors and suppliers shall use the screen shot of the form located at the end of this specification to
43 print a hard copy for all pre-bid substitution requests.
44 B. After bidding only the GC shall submit a request and shall use the form located on the Project Management Web
45 Site.
46

PART 3 - EXECUTION

3.1. REQUESTING A SUBSTITUTION DURING BIDDING

- 50 A. In the event that a substitution is requested during the bidding phase the Contractor or Supplier shall meet the
51 substitution request deadline listed in the bidding documents. No substitution request will be considered during
52 the bidding period after the stated substitution request deadline. In general this procedure shall be as follows:
53 1. Submit a Substitution Request Form for each different product
54 2. Support your request with complete data, drawings, specifications, performance data and samples as
55 appropriate. A complete submission shall include the following:
56 i. Substitution Request Form as a cover sheet
57 ii. Comparison of qualities of the proposed substitutions with that specified.
58 iii. Changes required in other elements of the Work because of the substitution.

1

For Pre-bid Substitution Requests all text boxes on this form are required information for a complete request.

		<h1>Substitution Request</h1>	
Today's Date:	<input type="text"/>		
Project Title:	<input type="text"/>		
Project Number:	<input type="text"/>	Contract Number:	<input type="text"/>
<p>By completing and submitting this form for review the General Contractor affirms that all of the following statements are correct:</p> <ol style="list-style-type: none">1 The General Contractor affirms that this request is in compliance with the requirements described in <i>Specification 01 25 13 Product Substitution Procedures</i>.2 The function, appearance, and quality of the proposed substitution are equal or superior to the specified item.3 The proposed substitution does not affect dimensions shown on the drawings.4 The proposed substitution will have no adverse affects on other trades, the construction schedule, or any specified warranty requirements.5 Maintenance and service parts will be locally available for the proposed substitution. (GC shall provide supporting documentation in the attachments section below.)6 The General Contractor shall be responsible for any and all costs associated with this substitution request if approved. This includes but is not to limited to fees for building design, engineering design fees, detailing fees, plan review fees, construction costs, and inspection fees.			
<u>GC Substitution Request:</u>			
General Title:	<input type="text"/>		
Related Specification:	<input type="text"/>	<input type="text"/>	<input type="text"/>
Reason for Substitution:	<input type="text"/>		
Proposed Substitution: (include Name, Model, etc.)	<input type="text"/>		
Submitted By:	<input type="text"/>	Phone:	<input type="text"/>
Company:	<input type="text"/>	Email:	<input type="text"/>

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END OF SECTION

**SECTION 01 26 13
REQUEST FOR INFORMATION (RFI)**

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 1.3. PERFORMANCE REQUIREMENTS..... 1
8 1.4. QUALITY ASSURANCE 1
9 PART 2 – PRODUCTS..... 1
10 2.1. REQUEST FOR INFORMATION FORM 1
11 PART 3 - EXECUTION 1
12 3.1. CONTRACTOR INITIATED RFI 2
13 3.3. RFI RESPONSES 2
14 3.4. COMMENCEMENT OF WORK RELATED TO AN RFI 2
15

PART 1 – GENERAL

1.1. SUMMARY

- 19 A. Contractors shall use the RFI form/process to request additional information or clarification regarding the
20 construction documents.
21 B. All RFI documentation will be processed through the through the Construction Administration-Request for
22 Information Library on the Project Management Web Site (PMWS).
23

1.2. RELATED SPECIFICATIONS

- 24 A. Section 01 26 46 Construction Bulletin (CB)
25 B. Section 01 26 57 Change Order Request (COR)
26 C. Section 01 26 63 Change Order (CO)
27 D. Section 01 31 23 Project Management Web Site (PMWS)
28 E. Section 01 91 00 Commissioning
29
30

1.3. PERFORMANCE REQUIREMENTS

- 31 A. RFI issues initiated by any contractor shall be done through the General Contractor (GC).
32 1. RFIs submitted by any Sub-contractor under the GCs control shall be returned with no response.
33 B. Submit a new RFI for each issue. Only multiple questions that are of a similar nature may be combined into one
34 RFI shall be allowed and responded to.
35
36

1.4. QUALITY ASSURANCE

- 37 A. The GC shall be responsible for all of the following:
38 1. Ensure that any request for additional information is valid and the information being requested is not
39 addressed in the construction documents.
40 2. Ensure that all requests are clearly stated and the RFI form is completely filled out.
41 3. Ensure that all Work associated an RFI response is carried out as intended.
42 B. The PA shall be responsible for the following:
43 1. Ensure that all responses to contractor initiated RFIs are properly responded to in a timely fashion.
44 a. The CPM, Owner, consulting staff, and other City staff shall be responsible for the initial review of
45 the RFI. The PA shall be responsible for codifying all consultant and Owner/City staff comments
46 into a unified RFI response.
47
48

PART 2 – PRODUCTS

2.1. REQUEST FOR INFORMATION FORM

- 49 A. The RFI form is located on the Project Management Web Site. The GC, PA, or CPM as appropriate shall click the
50 link in the left margin of the project web site opening a new form. Project information is pre-loaded, provide
51 additional information as indicated below in the execution to complete the form.
52
53
54
55

PART 3 - EXECUTION

1 **3.1. CONTRACTOR INITIATED RFI**

- 2 A. Immediately on discovery of the need for additional information or interpretation of the Contract Documents
3 any contractor may initiate an RFI for additional information or clarification through the GC.
4 B. The GC shall select the "Submit an RFI" link on the Project Management Web Site and completely fill out the
5 form as follows:
6 1. Contract related information will be automatically populated on the form.
7 2. Thoroughly explain the issue at hand, provide backup information (photographs, sketches, drawings,
8 data, etc) as necessary, and clearly state the question or problem that requires a resolution. Combine
9 like or related issues but do not include multiple issues on one form.
10 a. Example. If a duct interferes with other critical piping and electrical work include all issues into
11 one RFI.
12 b. Example. If you have a question regarding the chiller and another regarding toilet partitions
13 create separate RFIs.
14 3. Check all relevant boxes for trades affected. This will assist the design team in determining who should
15 be reviewing the RFI.
16 C. Upon completing the RFI click the "Submit" button. The PMWS software will automatically route the RFI to the
17 appropriate reviewers.
18

19 **3.3. RFI RESPONSES**

- 20 A. Responses to simple RFI issues shall use the response section of the RFI form and shall be completed within five
21 (5) working days of the RFI form being submitted.
22 B. Responses to more complex issues may require additional time or may require a Construction Bulletin to be
23 published. The initial RFI shall be responded to within five (5) working days stating that the RFI is being
24 reviewed and provide an estimated date for the response.
25 C. The following GC generated RFIs will be returned without action:
26 1. Requests for approval of submittals
27 2. Requests for approval of substitutions
28 3. Requests for approval of Contractor's means and methods.
29 4. Requests for coordination information already indicated in the Contract Documents.
30 5. Requests for adjustments in the Contract Time or the Contract Sum.
31 6. Requests for interpretation of A/E's actions on submittals.
32 7. Incomplete RFI or inaccurately prepared RFI.
33

34 **3.4. COMMENCEMENT OF WORK RELATED TO AN RFI**

- 35 A. The GC shall only proceed with the Work of an RFI when additional information is not required.
36 B. The GC shall not proceed with any Work associated with an RFI while it is under review.
37 C. The GC shall not proceed with any Work associated with an RFI that clearly states a CB will be issued in response
38 to the RFI.
39 D. The GC will be required to immediately remove and replace unauthorized Work and all costs required to
40 conform to the Contract Documents shall be borne by the GC.
41
42
43

44 **END OF SECTION**
45
46

**SECTION 01 26 46
CONSTRUCTION BULLETIN (CB)**

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 1.3. PERFORMANCE REQUIREMENTS..... 1
8 1.4. QUALITY ASSURANCE 2
9 PART 2 – PRODUCTS..... 2
10 2.1. CONSTRUCTION BULLETIN FORM 2
11 PART 3 - EXECUTION 2
12 3.1. WRITING THE CONSTRUCTION BULLETIN 2
13 3.2. EXECUTING THE CONSTRUCTION BULLETIN..... 2
14

PART 1 – GENERAL

1.1. SUMMARY

- 18 A. Construction Bulletins (CB) are formal published construction documents that modify the original contract bid
19 documents after construction has commenced. CBs may be published for many reasons, including but not
20 limited to the following:
21 1. Clarification of existing construction documents including specifications, plans, and details
22 2. Change in product or equipment
23 3. A response to a Request for Information
24 4. Change in scope of the contract as either an add or a deduct of work
25 B. CBs provide a higher degree of detail in response to a Request for Information (RFI) through directives, revised
26 plans/details, and specifications as necessary.
27 C. The CB may change the original contract documents through additions or deletions to the Work.
28 D. Where the directives of a CB are significant enough to warrant a Change Order Request (COR) the GC shall use all
29 information provided in the CB to assemble all required back-up documentation for additions and deletions of
30 materials, labor and other related contract costs for the COR.
31 E. All CB documentation will be processed through the Construction Administration-Construction Bulletin Library
32 on the Project Management Web Site (PMWS).
33

1.2. RELATED SPECIFICATIONS

- 34 A. Section 01 26 13 Request for Information (RFI)
35 B. Section 01 26 57 Change Order Request (COR)
36 C. Section 01 26 63 Change Order (CO)
37 D. Section 01 31 23 Project Management Web Site
38 E. Section 01 91 00 Commissioning
39
40

1.3. PERFORMANCE REQUIREMENTS

- 41 A. Project Architect (PA): The PA shall be the only person authorized to publish a CB as needed for any reason
42 indicated in section 1.1.A above. The PA shall consult as necessary with any of the following while drafting the
43 CB and shall confirm final direction with the CPM prior to issuing a CB:
44 1. City Project manager (CPM)
45 2. Owner
46 3. Members of the consulting staff
47 4. Members of city staff
48 5. The General Contractor
49 6. Sub-contractors
50 7. Commissioning Agent (CxA)
51 B. General Contractor: The GC shall be responsible for the following as needed:
52 1. Executing the directives of the CB when he/she believes that no changes in labor, materials, equipment,
53 or contract duration will be required for additions or deletions.
54 2. Submit a COR when he/she believes that a change in labor, materials, equipment or contract duration
55 will be required for additions or deletions.
56
57

1 **1.4. QUALITY ASSURANCE**

- 2 A. The PA shall be responsible for ensuring the final CB sufficiently provides direction, details, specifications and
3 other information as necessary for the GC to perform the intended Work.
4 B. The PA shall be responsible for ensuring the final CB is published as expeditiously as practical based on the
5 complexity of the CB being written. CBs that may affect the GC critical path shall be given priority.
6

7 **PART 2 – PRODUCTS**

8
9 **2.1. CONSTRUCTION BULLETIN FORM**

- 10 A. The CB form is located on the Project Management Web Site. The PA shall click the link in the left margin of the
11 project web site opening a new form. Project information is pre-loaded, the PA only needs to enter information
12 and make attachments as needed to complete the form.
13

14 **PART 3 - EXECUTION**

15
16 **3.1. WRITING THE CONSTRUCTION BULLETIN**

- 17 A. The PA shall draft a CB as needed using the Construction Bulletin form on the Project Management Web Site.
18 1. The PA and/or consulting staff as necessary shall provide specifications, model numbers and performance
19 data, details and other such information necessary to clearly state the intentions of the CB.
20 2. The consulting staff, CPM, Owner, CxA and other City Staff shall review the draft and recommend
21 changes as needed.
22 3. The PA shall amend the draft as necessary into a final CB for review
23 B. Once the final CB has been approved the PA shall “Submit” the CB through the Project Management Web Site to
24 the GC.
25

26 **3.2. EXECUTING THE CONSTRUCTION BULLETIN**

- 27 A. The GC shall acknowledge receipt of the CB on the Project Management Web Site as instructed in the Tutorial
28 Manual provided to the awarded contractor.
29 B. The GC shall notify all Sub-contractors of the CB and publish the CB to all field sets of drawings and specifications
30 as appropriate.
31 C. The GC shall execute the directives of the CB or submit COR documentation as necessary during the execution
32 and implementation of the CB.
33 1. See Specification 01 26 57 Change Order Request (COR)
34
35
36

37 **END OF SECTION**
38

**SECTION 01 26 57
CHANGE ORDER REQUESTS (COR)**

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATION SECTIONS 2
7 1.3. DEFINITIONS AND STANDARDS 2
8 1.4. CONTRACT EXTENSION 3
9 1.5. OVERHEAD AND PROFIT MARKUP 3
10 1.6. PERFORMANCE REQUIREMENTS 3
11 1.7. QUALITY ASSURANCE 4
12 PART 2 – PRODUCTS 4
13 2.1. CHANGE ORDER REQUEST FORM 4
14 PART 3 - EXECUTION 4
15 3.1. ESTABLISHING A CHANGE ORDER REQUEST 4
16 3.2. SUBMIT A CHANGE ORDER REQUEST FORM 4
17 3.3. CHANGE ORDER REQUEST REVIEW, APPROVAL, AND PROCESSING 5
18 3.4. EMERGENCY CHANGE ORDER REQUEST 5

PART 1 – GENERAL

1.1. SUMMARY

- 23 A. Except in cases of emergency, no changes in the Work required by the Contract Documents may be made
24 by the General Contractor (GC) without having prior approval of the City Engineer or his representative.
25 B. The City may at any time, without invalidating the Contract and without Notice to Sureties, order changes in
26 the Work by written Change Order (CO). Such changes may include additions and/or deletions.
27 C. Where the City desires to make changes in the Work through use of written Change Order Request (COR), the
28 following procedures apply:
29 1. If requested by the City, the GC shall prepare and submit a detailed proposal, including all cost and time
30 adjustments to which the GC believes it will be entitled if the change proposed is incorporated into the
31 Contract. The City shall be under no legal obligation to issue a Change Order for such proposal.
32 2. The parties shall attempt in good faith to reach agreement on the adjustments needed to the Contract to
33 properly incorporate the proposed change(s) into the Work. In the event that the parties agree on such
34 adjustments, the City may issue a Change Order and incorporate such changes and agreed to
35 adjustments, if any.
36 3. In some instances, it may be necessary for the City to authorize Work or direct changes in Work for which
37 no final and binding agreement has been reached and for which unit prices are not applicable. In such
38 cases the following shall apply.
39 a. Upon written request by the City, the GC shall perform proposed Work
40 b. The cost of such change may be determined in accordance with this specification.
41 c. In the event agreement cannot be accomplished as contemplated herein, the City may authorize
42 the Work to be performed by City forces or to hire others to complete the Work. Such action on
43 the part of the City shall not be the basis of a claim by the GC for failure to allow it to perform the
44 changed Work.
45 D. Where changes in the Work are made by the City through use of a force account basis, the GC shall as soon as
46 practicable, and in no case later than ten (10) working days from the receipt of such order, unless another time
47 period has been agreed to by both parties, give the City written Notice, stating:
48 1. The date, circumstances and source of the extra work; and,
49 2. The cost of performing extra work described by such Order, if any; and,
50 3. Effect of the order on the required completion date of the Project, if any.
51 E. The giving of each Notice by the GC as prescribed by this specification, shall be a requirement to liability of the
52 City for payment of any additional costs incurred by the GC in implementing changes in the Work. Under this
53 specification, no order or statement of the City shall be treated as a Change Order, or shall entitle the GC to an
54 equitable adjustment of the terms of this Contract or damages for costs incurred by the GC on any activity for
55 which the Notice was not given.
56 F. In the event Work is required due to an emergency as described in this specification the GC must request an
57 equitable adjustment as soon as practicable, and in no case later than ten (10) working days of the
58 commencement of such emergency.

- 1 G. All GC requests for equitable adjustment shall be submitted to the CPM per the specifications below. Such
2 requests shall set forth with specificity the amount of and reason(s) for the proposed adjustment and shall be
3 accompanied by supporting information and documents.
4 H. No adjustment of any kind shall be made to this Contract, if asserted by the GC for the first time, after the date
5 of final payment.
6 I. This specification shall be used by the GC when preparing documentation for any COR to ensure each has been
7 properly and completely filled out as required by the City of Madison.
8 J. All COR documentation will be processed through the Construction Administration-Change Order Request
9 Library on the Project Management Web Site (PMWS).

10
11 **1.2. RELATED SPECIFICATION SECTIONS**

- 12 A. Section 01 26 13 Request for Information (RFI)
13 B. Section 01 26 46 Construction Bulletins (CB)
14 C. Section 01 26 63 Change Order (CO)
15 D. Section 01 31 23 Project Management Web Site
16 E. Section 01 91 00 Commissioning
17 F. Parts of this specification will reference articles within "The City of Madison Standard Specifications for Public
18 Works Construction".
19 1. Use the following link to access the Standard Specifications web page:
20 <http://www.cityofmadison.com/business/pw/specs.cfm>
21 a. Click on the "Part" chapter identified in the specification text. For example if the specification
22 says "Refer to City of Madison Standard Specification 210.2" click the link for Part II, the Part II
23 PDF will open.
24 b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you
25 to the referenced text.
26

27 **1.3. DEFINITIONS AND STANDARDS**

- 28 A. LABOR: The amount of time and cost associated with the performance of human effort for a defined scope of
29 Work. Labor is further defined as follows:
30 1. Labor rate is the total hourly rate which includes the basic rate of pay, fringe benefits plus each
31 company's cost of required insurance, also referred to as a reimbursable labor rate.
32 2. Unit labor is the labor hours anticipated to install the corresponding unit of material.
33 3. Labor cost is the labor hours multiplied by the hourly labor rates.
34 B. MATERIAL: Actual material cost is the amount paid, or to be paid, by the GC for materials, supplies and
35 equipment entering permanently into the Work, including cost of transportation and applicable taxes. The cost
36 shall not exceed the usual and customary cost for such items available in the geographical area of the project
37 C. LARGE TOOLS AND MAJOR EQUIPMENT: Large tools and major equipment are those with an initial cost greater
38 than \$1,500, whether from the GC or other sources.
39 1. Tool and equipment use and time allowed is only for extra work associated with change orders.
40 a. Rental Rate is the machine cost associated with operating a piece of equipment for a defined
41 length of time (hour, day, week, or month) and shall not exceed the usual and customary amount
42 for such items available in the geographical area of the project.
43 b. Rental cost is the rental rate multiplied by the anticipated duration the equipment shall be
44 required.
45 2. The GC shall provide a breakdown of all rental rates to indicate what items and costs are associated with
46 the rate. Examples of items to include in the breakdown would be fuel consumption, lubrication,
47 maintenance and other similar expenses but not including profit and overhead.
48 3. When large tools and equipment needed for Change Order work are not already at the job site, the
49 actual cost to get the item there is also reimbursable.
50 D. BOND COST: The cost shall be calculated at 1% of the total proposed change order.
51 E. SUB-CONTRACTOR COSTS: Sub-contractor costs are for those labor, material, and equipment costs required by
52 subcontracted specialties to complete the Change Order work.
53 F. OVERHEAD AND PROFIT Markup: The allowable markup percentage to a COR by the GC and Sub-contractors for
54 overhead and profit. All of the following are expenses associated with overhead and profit and shall not be
55 reimbursable as individual items on any COR:
56 1. CHANGE ORDER PREPARATION: All costs associated with the preparing and processing of the change
57 order.

- 1 2. DESIGN, ESTIMATING, AND SUPERVISION: All such efforts, unless specifically requested by Owner as
- 2 additional Work to be documented as a COR or portion thereof.
- 3 3. INSTALLATION LAYOUT: The layout required for the installation of material and equipment, and the
- 4 installation design, is the responsibility of the GC.
- 5 4. SMALL TOOLS AND SUPPLIES: The cost of small hand tools with an initial cost of \$1,500 or less, along
- 6 with consumable supplies and expendable items such as drill bits, saw blades, gasoline, lubricating or
- 7 cutting oil, and similar items.
- 8 5. GENERAL EXPENSE: The general expense, which is those items that are a specific job cost not associated
- 9 with direct labor and material such as job trailers, foreman truck, and similar items.
- 10 6. RECORD DRAWINGS: The preparation of record or as-built drawings.
- 11 7. OTHER COSTS: Any miscellaneous cost not directly assessable to the execution of the Change Order
- 12 including but not limited to the following:
- 13 a. All association dues, assessments, and similar items.
- 14 b. All education, training, and similar items.
- 15 c. All drafting and/or engineering, unless specifically requested by Owner as additional Work to be
- 16 documented as a Change Order proposal or portion thereof.
- 17 d. All other items including but not limited to review, coordination, estimating and expediting, field
- 18 and office supervision, administrative work, etc.
- 19 G. Contract Extension: The necessary amount of time to be added to the contract deadlines for the completion of a
- 20 change order.
- 21

22 **1.4. CONTRACT EXTENSION**

- 23 A. The GC shall not assume that every COR will require a Contract Extension. If the GC feels a contract extension is
- 24 warranted he/she shall provide sufficient scheduling information that shows how the COR being requested
- 25 impacts the critical path of the project.
- 26 B. The City of Madison strongly encourages the GC to explore alternative methods and practices prior to submitting
- 27 a COR with a request for contract extension.
- 28

29 **1.5. OVERHEAD AND PROFIT MARKUP**

- 30 A. Pursuant to the City of Madison Standard Specifications for Public Works Construction, Section 104.7, Extra
- 31 Work, the following maximum allowable markups shall be strictly enforced on all change orders associated with
- 32 the execution of this contract.
- 33 1. The total maximum overhead and profit shall not exceed fifteen percent (15%) of the total costs.
- 34 2. The total maximum overhead and profit shall be distributed as follows:
- 35 a. For work performed and materials provided solely by the General Contractor, fifteen percent
- 36 (15%) of the total costs.
- 37 b. For work performed and materials provided solely by Sub-contractors and supervised by the
- 38 General Contractor:
- 39 i. Supervision of the GC, five percent (5%) of the total Sub-contractor cost.
- 40 ii. Sub-contractors work and materials ten percent (10%) of the total Sub-contractor cost.
- 41

42 **1.6. PERFORMANCE REQUIREMENTS**

- 43 A. The GC shall become thoroughly familiar with this specification as it will identify procedures and expenses that
- 44 are or are not allowed under the Change Order and Change Order Request process.
- 45 B. The GC shall be responsible for all of the following:
- 46 1. Carefully reviewing the CB that is associated with the COR.
- 47 2. Collecting required supporting documentation from all contractors that quantify the need for a COR.
- 48 a. Labor hours and wage rates
- 49 b. Material costs
- 50 c. Equipment costs
- 51 C. The following shall apply to establishing prices for labor, materials, and equipment costs:
- 52 1. Where Work to be completed has previously been established by individual bid items in the contract bid
- 53 proposal the GC shall use the unit bid prices previously established.
- 54 2. Where Work to be completed was bid as a Lump Sum without individual bid items the GC shall provide a
- 55 breakdown of all labor, materials, equipment including unit rates and quantities required.
- 56 D. The completion date is determined by Owner. The schedule, however, is the responsibility of the GC. Time
- 57 extensions for extra Work will be considered when a schedule analysis of the critical path shows that the Change
- 58 Order Request places the Work beyond the completion date stated in the Contract.

1
2 **1.7. QUALITY ASSURANCE**

- 3 A. The GC shall be responsible for ensuring that all COR supporting documentation meets the following
4 requirements prior to completing the COR form on the Project Management Web Site:
5 1. Sufficiently indicates labor, material, and other expenses related to completing the intent of the CB.
6 2. No costs exceed the usual and customary amount for such items available in the geographical area of the
7 project, and no costs exceed those established under the contract.
8 B. The Project Architect (PA), Commissioning Agent (CxA), City Project Manager (CPM), other members of the
9 consulting staff, and city staff shall review all COR requests to ensure that the intent of the CB will be met under
10 the proposal of the COR or request additional information as necessary.
11

12 **PART 2 – PRODUCTS**

13
14 **2.1. CHANGE ORDER REQUEST FORM**

- 15 A. The COR form is located on the Project Management Web Site. The GC shall click the link in the left margin of
16 the project web site opening a new form. Follow additional instructions below in the execution section for filling
17 out the form.
18

19 **PART 3 - EXECUTION**

20
21 **3.1. ESTABLISHING A CHANGE ORDER REQUEST**

- 22 A. Upon receipt of a Construction Bulletin (CB) where the GC believes a significant change in contract scope
23 warrants the submittal of a COR the GC shall do all of the following within ten (10) working days after receipt of
24 the CB:
25 1. Review the CB with all necessary trades and sub-contractors required by the change in scope.
26 a. Additions or deletions to the contract scope shall be as directed within the CB.
27 b. Additions or deletions of labor and materials shall be determined by the GC based on the
28 directives of the CB.
29 2. Assemble all required back-up documentation for additions and deletions of materials, labor and other
30 related contract costs as previously outlined in this specification.
31 3. Submit a COR request form on the Project Management Web Site.
32 B. Submitting a COR does not obligate the GC to complete the work associated with the COR nor does it obligate
33 the Owner to approve the COR as a change to the contract.
34

35 **3.2. SUBMIT A CHANGE ORDER REQUEST FORM**

- 36 A. This specification shall provide a subject overview only. In depth instructions shall be provided to the awarded
37 Contractor in a PDF Instructional Manual.
38 B. The GC shall select the "Submit a COR" link on the Project Management Web Site.
39 C. The software will open a new COR form and the GC shall provide all of the following information:
40 1. DO NOT perform any calculations on this worksheet, only provide the raw data as requested below. All
41 calculations, totals, and markups shall be computed as described within this specification.
42 2. Provide a summary description of the COR request, and justification for any requested time extension to
43 the contract, indicate the number of calendar days being requested for the extension and add any
44 attachments to the form as needed.
45 3. Provide all GC self performance data including all of the following:
46 a. Materials description, quantities, and unit costs.
47 b. Labor hours and rates for all Foremen, Journeymen, and Apprentices by trade.
48 c. Equipment descriptions, quantities, unit costs and rates.
49 4. Provide all Sub-contractor data including all of the following:
50 a. Materials description, quantities, and unit costs.
51 b. Labor hours and rates for all Foremen, Journeymen, and Apprentices by trade.
52 c. Equipment descriptions, quantities, unit costs and rates.
53 5. Ensure all calculations performed by the form have been completed correctly. Contact the CPM directly
54 if you suspect an error before hitting the save button.
55 C. At any time after creating a COR you must at a minimum click "Save as Draft" to save your work.
56 D. When all data has been entered and verified click on the "Submit COR" button. This will kick off the COR Review
57 and Approval process.
58

1 **3.3. CHANGE ORDER REQUEST REVIEW, APPROVAL, AND PROCESSING**

- 2 A. The PA and CPM shall review all CORs submitted by the GC.
3 1. Additional consulting staff and city staff having knowledge of the components of the COR shall review
4 and advise the PA and CPM as to the accuracy of the items, quantities, and associated costs of the COR as
5 directed by the CB.
6 2. The CPM shall review the COR with the Owner.
7 B. If required the PA and CPM, shall in good faith, further negotiate the COR with the GC as necessary. All
8 amendments to any COR shall be documented within the Project Management Web Site software.
9 C. After final review of the COR the CPM and Owner may accept the COR.
10 D. The CPM shall prepare the COR in the form of an official Board of Public Works Change Order for final review and
11 approval as outlined in Section 01 26 63 Change Order (CO).
12 E. The GC shall not act upon any accepted COR until it has received final approval through the Public Works process
13 as an official CO to the Work unless instructed to do so by the CPM. Proceeding without the final approval of a
14 fully authorized Change Order is at the GC's own risk.
15

16 **3.4. EMERGENCY CHANGE ORDER REQUEST**

- 17 A. In the event Work is required due to an emergency as described in the Contract Documents, the GC must
18 request an equitable adjustment as soon as practicable, and in no case later than ten (10) working days of the
19 commencement of such emergency.
20 B. The GC shall provide full documentation of all labor, materials and equipment used during the period of
21 emergency as part of the COR submittal.
22
23
24

25 **END OF SECTION**
26

**SECTION 01 26 63
CHANGE ORDER (CO)**

1
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3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATION SECTIONS 1
7 1.3. BOARD OF PUBLIC WORKS PROCEDURE 1
8 PART 2 – PRODUCTS..... 2
9 2.1. CHANGE ORDER FORM..... 2
10 PART 3 - EXECUTION 2
11 3.1. PREPARATION OF THE CHANGE ORDER 2
12 3.2. EXECUTION OF THE CHANGE ORDER 2
13

PART 1 – GENERAL

1.1. SUMMARY

- 17 A. Except in cases of emergency, no changes in the Work required by the Contract Documents may be made
18 by the General Contractor (GC) without having prior approval of the City Project Manager (CPM).
19 B. The City may at any time, without invalidating the Contract and without Notice to Sureties, order changes in
20 the Work by written Change Order. Such changes may include additions and/or deletions.
21 C. The Change Order (CO) is a Board of Public Works (BPW) form that is reviewed and approved by a specific
22 process.
23 D. The CO form is typically made up of multiple Change Order Requests (CORs) and/or Bid Items as appropriate
24 depending on the type of project and how the contract was bid.
25 E. All CO documentation shall be processed through the Construction Administration-Change Order Library and
26 digital workflow on the Project Management Web Site (PMWS).
27

1.2. RELATED SPECIFICATION SECTIONS

- 28
29 A. Section 01 26 13 Request for Information (RFI)
30 B. Section 01 26 46 Construction Bulletin (CB)
31 C. Section 01 26 63 Change Order Request (COR)
32 D. Section 01 31 23 Project Management Web Site
33 E. Section 01 91 00 Commissioning
34

1.3. BOARD OF PUBLIC WORKS PROCEDURE

- 35
36 A. The Board of Public Works has a very explicit procedure for the review and approval of all change orders
37 associated with any Public Works Contract as follows:
38 1. The Supervisory Chain of the CPM shall review and approve any CO under \$10,000 provided it does not
39 include either of the following:
40 a. The CO does not request a time extension to the contract.
41 b. The CO does not cause the contract contingency sum to be exceeded.
42 2. The Board of Public Works shall review and approve any CO that requires any of the following:
43 a. Any CO over \$10,000.
44 b. Any CO requesting a time extension to the contract regardless of the monetary value of the CO.
45 c. Any CO that that causes the contract contingency sum to be exceeded.
46 B. The Board of Public Works generally meets every other week and only once in August and December. The GC is
47 cautioned that, under normal scheduling, a CO requiring a BPW review will take a minimum of two (2) weeks to
48 achieve final approval.
49 1. The City shall not be responsible for additional delays to the Work caused by the scheduling constraints
50 of the Board of Public Works.
51 C. **SPECIAL NOTE:** The GC is cautioned to never proceed unless told to do so by the CPM. Only in rare instances
52 may the CPM give a written notice to proceed on a COR without an approved CO. Proceeding without the
53 written notice of the CPM or an approved CO is at the GC's own risk.
54

1 **PART 2 – PRODUCTS**

2
3 **2.1. CHANGE ORDER FORM**

- 4 A. The CO form is located on the Project Management Web Site. The CPM shall click the link in the left margin of
5 the project web site opening a new form. Project information is pre-loaded, the CPM only needs to enter
6 information and make attachments as needed to complete the form.
7

8 **PART 3 - EXECUTION**

9
10 **3.1. PREPARATION OF THE CHANGE ORDER**

- 11 A. The CPM shall prepare the required CO forms in the Construction Administration-Change Order Library on the
12 Project Management Web Site as follows:
13 1. Provide information for all contract information.
14 2. Provide a general description of the items described within the change order.
15 3. Provide detailed information for each Item on the CO form. At the option of the CPM he/she may include
16 multiple Change Order Requests each as their own item.
17 4. Provide required pricing and accounting information as needed for the item.
18 5. Insert attachments of contractor/architect provided information that clarifies and quantifies the CO.
19 Attachments may include but not be limited to material lists, estimated labor, revised details or
20 specifications, and other documents that may be related to the requested change.
21 6. Save the final version of the completed CO.
22

23 **3.2. EXECUTION OF THE CHANGE ORDER**

- 24 A. Upon saving the CO as described in section 3.1 above the software associated with the Project Management
25 Web Site shall notify the GC that the CO has been drafted and is ready for review. The GC shall do the following:
26 1. Open the appropriate CO form in the Construction Administration-Change Order Library and review all
27 items on the form.
28 2. The GC shall notify the CPM immediately of any errors or discrepancies on the form and shall not sign or
29 save it.
30 a. The CPM shall make any corrections as needed, re-save the form, and notify the GC.
31 3. If/when the GC concurs with the CO form as drafted the GC shall digitally sign the form and click SAVE.
32 B. After the GC digitally signs/saves the CO it shall be routed through the Project Management Web Site for
33 additional review and/or approvals. The CPM shall do the following:
34 1. Monitor the review process to ensure the software is working properly at each review step.
35 2. Ensure that proper BPW procedures are executed as needed by the CO approval process.
36 a. Schedule the CO on the next available BPW agenda if required.
37 i. Attend the BPW meeting to speak on the CO to board members and answer questions.
38 ii. The GC and/or PA may be required to attend the BPW meeting to address specific
39 information as it relates to the Work and/or materials associated with the CO.
40 3. Monitor final approval and distribution of the CO.
41 4. Notify the GC that the CO has been completed.
42 5. Ensure that the CO is posted to the next Public Works payment schedule.
43 6. Verify that the GC's next Progress Payment-Schedule of Values show the CO as part of the contract sum.
44 C. Upon final approval of the CO the GC may proceed with executing the Work associated with the CO.
45
46
47
48
49

END OF SECTION

SECTION 01 29 73
SCHEDULE OF VALUES

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 1.3. RELATED DOCUMENTS 1
8 1.4. BASIS OF VALUES 2
9 PART 2 – PRODUCTS – THIS SECTION NOT USED 2
10 PART 3 - EXECUTION 2
11 3.1. AIA DOCUMENT G702 – APPLICATION AND CERTIFICATE FOR PAYMENT 2
12 3.2. AIA DOCUMENT G703 – CONTINUATION SHEET 2
13 3.3. INITIAL SCHEDULE OF VALUES SUBMITTAL 3
14 3.4. SOV FOR PROGRESS PAYMENT REQUESTS 3
15

PART 1 – GENERAL

1.1. SUMMARY

- 19 A. The Schedule of Values (SOV) is a Contractor provided statement that allocates portions of the total contract
20 sum to various portions of the contracted work and shall be the basis for reviewing the Contractors Progress
21 Payment Requests.
22 B. AIA Document G702 – Application and Certificate for Payment and AIA Document G703 Continuation Sheet shall
23 be filled out in sufficient detail to be used as a guideline in determining work completed and materials stored on
24 site when verifying Progress Payment Requests.
25 C. The General Contractor shall be responsible for filling out, updating, and providing these work sheets with each
26 Progress Payment Request.
27

1.2. RELATED SPECIFICATIONS

- 29 A. Section 01 26 63 Change Order (CO)
30 B. Section 01 29 76 Progress Payment Procedures
31 C. Section 01 31 23 Project Management Web Site
32 D. Section 01 32 26 Construction Progress Reporting
33 E. Section 01 33 23 Submittals
34 F. Parts of this specification will reference articles within “The City of Madison Standard Specifications for Public
35 Works Construction”.
36 1. Use the following link to access the Standard Specifications web page:
37 <http://www.cityofmadison.com/business/pw/specs.cfm>
38 a. Click on the “Part” chapter identified in the specification text. For example if the specification
39 says “Refer to City of Madison Standard Specification 210.2” click the link for Part II, the Part II
40 PDF will open.
41 b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you
42 to the referenced text.
43

1.3. RELATED DOCUMENTS

- 45 A. The following documents shall be used as the basis for initiating and maintaining the SOV worksheets throughout
46 the execution of this contract.
47 1. Drawing documents and specifications (including general provisions) as provided with the bid set
48 documents and any published addendums.
49 2. Documents associated with revisions or clarifications to number 1 above after awarding of the contract,
50 including but not limited to:
51 a. Construction Bulletins
52 b. Request for Information
53 c. Approved Change Orders
54 3. The latest daily/weekly Construction Progress Report
55 4. Other specifications as identified in Section 1.2 above

1
2 **1.4. BASIS OF VALUES**

- 3 A. The Contractor shall provide a breakdown of the Contract Sum in sufficient detail to assist the Architect and City
4 Project Manager in evaluating Progress Payment Requests. The breakdown detail may require a labor and
5 material breakdown for each division of work or trade or as directed by the CPM.
6 B. The total sum of all items shall equal the Contract Sum.
7

8 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

9
10 **PART 3 - EXECUTION**

11
12 **3.1. AIA DOCUMENT G702 – APPLICATION AND CERTIFICATE FOR PAYMENT**

- 13 A. The Contractor shall use AIA Document G-702 Application and Certificate for Payment with each Progress
14 Payment Request.
15 B. Completely fill out the Project Information section as follows:
16 1. TO OWNER; provide all owner related information as provided in the contract documents.
17 2. PROJECT; provide all contract information including contract number, title and address.
18 3. FROM CONTRACTOR; provide all contractor related information.
19 4. VIA ARCHITECT; provide all the architect's related information including the architect's project reference
20 number if different from the owners.
21 5. Indicate the current APPLICATION NO., PERIOD TO date, and CONTRACT DATE.
22 C. Completely fill out the Contractors Application for Payment section.
23 1. Fill out lines 1 through 9 to reflect the current status of the contract through the payment date being
24 requested.
25 2. The City of Madison calculates retainage on Public Works Contracts as follows:
26 a. In general, across the duration of the contract, 2.5% of the total contract sum, including change
27 orders, is withheld for retainage as referenced from the City of Madison Standard Specification
28 110.2:
29 i. Beginning with Progress Payment 1, 5% retainage will be withheld until such time that 50%
30 of the total contract sum has been paid out.
31 ii. No additional retainage will be withheld after 50% of the total contract sum has been paid,
32 unless additional change orders have been approved after the 50% milestone has been
33 reached. Per City of Madison Standard Specification 110.2, additional retainage up to 10%,
34 may be held in the event there are holds placed by Affirmative Action or liquidated
35 damages by BPW.
36 iii. Retainage for additional change orders after the 50% milestone will be withheld at the rate
37 of 2.5% of the total cost of the change order.
38 iv. Retainage is based on the change orders posted to the City's contract worksheet at the
39 time the progress payment is processed.
40 D. Completely fill out the Change Order Summary section. Only change orders that have been finalized and posted
41 to the City of Madison's Application for Partial Payment worksheet may be itemized into the SOV documents.
42 E. The Contractor shall sign and date the application and it shall be properly notarized.
43 F. The Contractor shall not fill in any information in the Architects Certificate for Payment section.
44

45 **3.2. AIA DOCUMENT G703 – CONTINUATION SHEET**

- 46 A. The Contractor shall use AIA Document G-703 Continuation Sheet to itemize his/her SOV for this contract.
47 Provide additional sheets as necessary.
48 B. Provide information in Column A (Item No.), Column B (Description of Work), and Column C (Scheduled Value) by
49 any method that allocates portions of the total contract sum to various portions of the contracted work.
50 Possible methods include combinations of the following:
51 1. By division of work
52 2. By contractor, sub-contractor, sub sub-contractor
53 3. By specialty item or group
54 4. Other methods of breakdown as may be requested by the City Project Manager or City Construction
55 Manager at the pre-construction meeting.
56 C. Provide total cost of the item/description of work including proportionate shares of profit and overhead related
57 to the item.
58

1 **3.3. INITIAL SCHEDULE OF VALUES SUBMITTAL**

- 2 A. The Contractor shall upload his/her initial SOV to the Project Management Web Site, Submittals Library, no later
3 than five (5) working days after the Pre-construction Meeting.
4 1. The initial SOV shall provide information in Column A (Item No.), Column B (Description of Work), and
5 Column C (Scheduled Value) only.
6 2. The level of detail shall be as described in section 3.2 above.
7 B. The Project Architect (PA) and the City Project Manager (CPM) shall review the SOV as any other submittal and
8 may require modifications to reflect additional detail as necessary.
9 C. The Contractor shall resubmit the SOV as necessary until such time as the PPA and CPM have sufficient detail for
10 assessing and approving future Progress Payment Applications.
11 D. Progress Payment Application 1 will not be processed until such time as the Contractor has met this requirement
12 regardless of the amount of work completed per the application.
13

14 **3.4. SOV FOR PROGRESS PAYMENT REQUESTS**

- 15 A. The Contractor shall update the initial SOV with each Progress Payment Application as follows:
16 1. Initial items and values as part of Section 3.3 above will not be adjusted once the original Schedule of
17 Values submittal has been approved.
18 2. Change orders shall be added as additional items and values at the bottom of the SOV as they become
19 approved and posted to the City's contract worksheet. The value for each change order shall be the
20 value indicated on the SOV and shall stand alone. Values shall not be split out or combined with other
21 existing items with similar work descriptions on the original SOV.
22 3. Fill out Columns D, E, F and G to properly reflect the work completed and materials received since the last
23 Progress Payment Application.
24 4. Only materials delivered and stored on the project site may be reflected on SOV progress updates.
25 B. Provide updated G702 and G703 sheets with each Progress Payment application.
26 C. See Specification 01 29 76 Progress Payment Procedures for additional information on submitting Progress
27 Payment Applications.
28
29
30

31 **END OF SECTION**
32

SECTION 01 29 76
PROGRESS PAYMENT PROCEDURES

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 1.3. RELATED DOCUMENTS 1
8 1.4. PROGRESS PAYMENT MILESTONES 1
9 1.5. PROGRESS PAYMENT SUBMITTAL 4
10 PART 2 - PRODUCTS - THIS SECTION NOT USED 4
11 PART 3 - EXECUTION 4
12 3.1. GENERAL CONTRACTOR PROCEDURE 4
13 3.2. PROJECT ARCHITECT PROCEDURE 5
14 3.3. CITY PROJECT MANAGER PROCEDURE 5
15

PART 1 – GENERAL

1.1. SUMMARY

- 19 A. The General Contractor (GC) shall review this and all related specifications prior to submitting progress payment
20 requests.
21 B. Progress payment requests (Partial Payment-PP) for this contract shall be uploaded digitally by the GC to the
22 Project Management Web Site
23 C. The Project Architect (PA) and City Project Manager (CPM) shall review and amend or approve the PP on the
24 Project Management Web Site.
25 D. After approval of the PP by the CPM, he/she shall forward the PP to the appropriate agencies for BPW
26 contractual review and payment processing.
27

1.2. RELATED SPECIFICATIONS

- 29 A. Section 01 26 63 Change Order (CO)
30 B. Section 01 29 73 Schedule of Values
31 C. Section 01 31 19 Progress Meetings
32 D. Section 01 31 23 Project Management Web Site
33 E. Section 01 32 16 Construction Progress Schedules
34 F. Section 01 32 26 Construction Progress Reporting
35 G. Section 01 33 23 Submittals
36 H. Section 01 45 16 Field Quality Control Procedures
37 I. Section 01 77 00 Closeout Procedures
38 J. Section 01 78 13 Completion and Correction List
39 K. Section 01 78 23 Operation and Maintenance Data
40 L. Section 01 78 36 Warranties
41 M. Section 01 78 39 As-Built Drawings
42 N. Section 01 78 43 Spare Parts and Extra Materials
43 O. Section 01 79 00 Demonstration and Training
44

1.3. RELATED DOCUMENTS

- 46 A. The following documents shall be used when evaluating PP requests.
47 1. Daily and weekly construction progress reports filed since the last payment request.
48 2. Contractors Schedule of Values as updated from the last payment request. See Specification 01 29 73.
49 3. Any document that may be required to be submitted for review and approval, as noted by the
50 specifications listed in Section 1.2 above, or the Progress Payment Milestone Schedule in Section 1.4
51 below, to achieve a required bench mark of contract progression or contract requirement.
52

1.4. PROGRESS PAYMENT MILESTONES

- 54 A. City Engineering-Facility Management has developed the Project Payment Milestone Schedule (Section 1.4
55 below) to assist the GC in providing required construction specific documentation and general contractual
56 documentation in a timely manner.
57 B. The Progress Payment Milestone Schedule is not an all inclusive list. Multiple agencies review progress payment
58 requests and contract closeout requests. Missing, incomplete, or incorrect documentation for any agency may

- 1 be a cause for not processing progress payments. It shall be the sole responsibility of the Contractor for
2 providing documentation as required or requested to the appropriate agencies.
3 C. The milestone schedule is based on the contract total sum and shall be valid for most contracts. Milestone
4 submittals will be required with whatever progress payment hits the percentage of contract total indicated in
5 the schedule.
6 D. The CPM shall review the milestone schedule with each progress payment request and at his/her option may
7 elect to hold processing the progress payment until such time as the contractor has met the requirements for
8 providing construction specific documentation.
9 E. It shall be the General Contractors responsibility to comply with all BPW Contract Administration requirements
10 and related deadlines as outlined in the Award Letter, Award Checklist, and Start Work Letter.
11

Progress Payment (PP) Milestone Schedule		
Milestone Description	Due Before	Remarks
BPW Contract Administration Documentation <ul style="list-style-type: none"> • Workforce profiles • Best Value Contracting Documentation • Sub-contractors prequalification approval & Affirmative Action plans • Other as may be required 	PP-1, or start work as applicable	<ul style="list-style-type: none"> • For GC and Sub-contractors before PP-1 regardless of scheduling • Sub-contractors (if applicable), due 10 days before they may start work • Sub-contractors (if applicable), due 10 days before they may start work
Required Construction Submittals/Administrative Documents <ul style="list-style-type: none"> • Contractors Project Directory • Schedule of Values • Submittals Schedule • Waste Management Plan • Closeout Requirement Checklist • Warranty Checklist 	PP-1	References <ul style="list-style-type: none"> • Specification 01 31 23 • Specification 01 29 73 • Specification 01 32 19 • Specification 01 74 19 • Specification 01 77 00 • Specification 01 78 36 • Various specifications.
Construction Progress Milestones <ul style="list-style-type: none"> • Early submittals, per submittal schedule • Detailed Contract Schedules 	PP-1	See specifications for specific requirements <ul style="list-style-type: none"> • Specification 01 32 19, Examples: concrete mix, structural steel, products with long lead times • See Specification 01 32 16
General Construction Progress Requirements are all up to date <ul style="list-style-type: none"> • Progress Schedules • Submittals/Re-submittals (ongoing) • Schedule of Values • Progress Reporting • LEED Documentation • Waste Management documentation • QMOs are being addressed and closed • Progress Cleaning • As-Built Drawings 	Each future PP	Verified with each Progress Payment Request <ul style="list-style-type: none"> • Specification 01 32 16 • Specification 01 33 23 • Specification 01 29 73 • Specification 01 32 26 • All specifications with LEED documentation requirements • Specification 01 74 19 • Specification 01 45 16 • Specification 01 74 13 • Specification 01 78 39
* All of the above are being updated on the Project Management Web Site as required		
BPW Contract Administration Documentation <ul style="list-style-type: none"> • Weekly payroll reports • Best Value Contracting Reports 	25% CT or PP 2	See 1.4.E above. <i>This progress payment will be withheld by BPW for any missing contractual documentation.</i>

Progress Payment (PP) Milestone Schedule		
Milestone Description	Due Before	Remarks
<ul style="list-style-type: none"> SBE Reports 		
Construction Progress Milestones <ul style="list-style-type: none"> Construction/Contract Closeout Meeting #1 Submittals/Re-submittals complete 	50% CT	<ul style="list-style-type: none"> Specification 01 31 19 Specification 01 33 23
Operation and Maintenance (O & M) drafts	60% CT	<ul style="list-style-type: none"> Specification 01 78 23
Construction/Contract Closeout Meeting #2 <ul style="list-style-type: none"> Construction closeout checklist 	70% CT	<ul style="list-style-type: none"> Specification 01 31 19 Specification 01 77 00
BPW Contract Administration Documentation <ul style="list-style-type: none"> Request Finalization Review from BPW 	80% CT	This is a recommendation to the GC and is not a requirement of this PP. <ul style="list-style-type: none"> Specification 01 77 00
Construction Progress Milestones <ul style="list-style-type: none"> Operation and Maintenance (O & M) finals, accepted All major QMO issues resolved As-Built Drawings, Division Trades ready for GC review 	80% CT	<ul style="list-style-type: none"> Specification 01 78 23 Specification 01 45 16; Items that could prevent occupancy Specification 01 78 39
All of the following shall be completed for this PP: <ul style="list-style-type: none"> Regulatory Inspections completed All QMO reports closed Demonstration and Training completed Attic Stock completed Final Cleaning 	90% CT	Contractor to determine the proper order of completion: <ul style="list-style-type: none"> Governing ordinances and statutes Specification 01 45 16 Specification 01 79 00 Specification 01 78 43 Specification 01 74 13
Construction Closeout Procedures: <ul style="list-style-type: none"> Letter of Substantial Compliance sent to BI and DHS as needed Certificate of Occupancy issued As-Built Drawings, finals, accepted City Letter of Substantial Completion Warranty letters dated and issued 	100% CT	<ul style="list-style-type: none"> Specification 01 77 00 Generated/Signed by the Architect Building Inspection Specification 01 78 39 Signed by the City Engineer Specification 01 78 36
* Completion of this begins the one year warranty.		
BPW Contract Administration Documentation Contract Closeout Procedures <ul style="list-style-type: none"> Construction Closeout has been completed Contractor requests final payment of retainage upon receiving City Letter of Substantial Completion All BPW contractual requirements are verified 	Final	<ul style="list-style-type: none"> Specification 01 77 00 Contractor must provide any missing BPW Contractual Documentation
* Completion of this closes the contract but not the warranty period/bond.		

Progress Payment (PP) Milestone Schedule		
Milestone Description	Due Before	Remarks
NOTE: CT = Contract Total less held retainage		

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1.5. PROGRESS PAYMENT SUBMITTAL

- A. Each progress payment submittal shall be:
 - 1. Digital in PDF format
 - 2. PDF shall be in color
 - 3. Uploaded to the appropriate Project Management library and properly named per the tutorial instructions provided to the awarded contractor.
- B. Submit all required construction progress documentation to the appropriate Project Management Web Site library.
- C. In general the following shall apply to all PP requests:
 - 1. Materials or products:
 - a. On order, being shipped, etc. may not be invoiced.
 - b. Received and stored on the project site may be invoiced.
 - c. Being manufactured off site at any location may not be invoiced (example: cabinetry, ductwork, etc.)
 - d. Completed products stored off site locally waiting for delivery to the project site may be invoiced with prior approval by the CPM. All of the following conditions must be met to be allowed:
 - i. Items must be visually inspected by CPM to verify product is complete.
 - ii. Item must be stored inside a compatible structure and the structure and contents must be insured.
 - iii. Contractor is responsible for condition until installation is completed.
 - 2. All labor and equipment, including rental time for the current progress period may be invoiced.
 - 3. Only completed installations may be invoiced to 100% based on the Schedule of Values.
- D. DO NOT submit BPW Contract Administration Documentation for review with Progress Payment Requests, submit them directly to the correct agency and in the correct format as instructed from information in your BPW Contract Award Packet instructions.

PART 2 - PRODUCTS - THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. GENERAL CONTRACTOR PROCEDURE

- A. The GC shall provide an updated version of his/her schedule of values (AIA documents G702 & G 703) with each PP request.
 - 1. The AIA - Application and Certificate for Payment (G702) shall be properly filled out and prepared for the Architects review. See specification 01 29 73, Schedule of Values for more information.
 - 2. The AIA - Continuation sheets (G703) shall be properly filled out and indicate the dollar value of the completed work to date for each item on the form. See specification 01 29 73, Schedule of Values for more information.
 - a. The GC shall subtotal the work completed to date for all of the original Schedule of Value items.
 - b. Divide the sub total of work completed by the Original Contract Total to obtain a percentage complete of the original Lump Sum Bid. This percentage may be taken out to five (5) decimal places (round fifth place up or down as needed).
 - i. Example: \$5,192.55 of completed work divided by \$10,000 original Contract Total = 0.519255, round this to 0.51926
 - c. Write the percentage in Column 10 on the City Tabular Sheet for the original lump sum bid item in RED ink.
 - 3. Ensure that any newly posted change orders from the City of Madison provided tabulation sheet have been entered on the G703 continuation sheets. Repeat steps a thru c above for each change order on the schedule of values and the City Tabular Sheet.
- B. The GC shall fill out the City of Madison Application and Certificate of Payment cover sheet as follows:
 - 1. The GC shall not change any pre-printed information and shall not write in the box that indicates previous progress payments.
 - 2. The GC shall sign and date the form where indicated.
 - 3. The GC shall provide the dates from and to for the PP being requested.

**SECTION 01 31 13
PROJECT COORDINATION**

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 1.3. GENERAL REQUIREMENTS..... 1
8 1.4. GENERAL CONTRACTOR PERFORMANCE REQUIREMENTS 2
9 1.5. SUB-CONTRACTOR PERFORMANCE REQUIREMENTS..... 2
10 PART 2 – PRODUCTS – THIS SECTION NOT USED 3
11 PART 3 – EXECUTION – THIS SECTION NOT USED 3
12

PART 1 – GENERAL

1.1. SUMMARY

- 16 A. Project Coordination covers many areas within the execution of the Contract Documents and the requirements
17 of proper coordination are the applicable to all contractors executing the Work of this contract.
18 B. This specification provides general information regarding project coordination for the General Contractor and all
19 Sub-contractors. All contractors shall be familiar with project coordination requirements and responsibilities
20 that may be defined in other specification within these Contract Documents.
21 C. The General Contractor shall at all times be responsible for the project, project site, and execution of the
22 Contract Documents.
23

1.2. RELATED SPECIFICATIONS

- 24 A. Section 01 29 76 Progress Payment Procedures
25 B. Section 01 31 19 Progress Meetings
26 C. Section 01 31 23 Project Management Web Site
27 D. Section 01 32 16 Construction Progress Schedules
28 E. Section 01 32 19 Submittals Schedule
29 F. Section 01 33 23 Submittals
30 G. Section 01 43 39 Mockups
31 H. Section 01 45 16 Field Quality Control Procedures
32 I. Section 01 60 00 Product Requirements
33 J. Section 01 77 00 Closeout Procedures, including all specifications referenced therein
34 K. Section 01 91 00 Commissioning
35
36

1.3. GENERAL REQUIREMENTS

- 37 A. The following general requirements shall applicable to all contractors:
38 1. Cooperate with the Owner, all authorized Owner Representatives, Project Architect and all consultants of
39 the Owner.
40 2. Materials, products, and equipment shall be new, as specified and to industry standards except where
41 otherwise noted.
42 3. Labor and workmanship shall be of a high quality and to industry standards.
43 B. Existing conditions:
44 1. Verify all existing conditions noted in the contract documents with actual filed locations. Verify
45 dimensions, sizes and locations, of structural, equipment, mechanical and utility components.
46 2. Report any inconsistencies, errors, omissions, or code violations in writing to the General Contractor (GC)
47 immediately.
48 3. Annotate any inconsistencies, errors, omissions on the GC As-Built record drawings immediately for
49 future reference.
50 C. Contract Documents:
51 1. The Contract Documents are intended to include everything necessary to perform the work. Every item
52 required may not be specifically mentioned, shown, or detailed.
53 a. Except where specifically stated all systems and equipment shall be complete, installed, and fully
54 operable.
55 b. If a conflict exists within the contract documents the contractor shall furnish the item, system, or
56 workmanship of the highest quality, largest, largest quantity, or most closely fits the intent of the
57 contract documents.
58

- 1 c. Manufacturers recommended installation details shall be verified and used prior to installation of
- 2 products and equipment so as to not void warranties.
- 3 D. Errors and Omissions
- 4 1. No Contractor shall take any advantage of any apparent error or omission in the construction documents.
- 5 2. The City of Madison shall be permitted to make such corrections and interpretations as may be deemed
- 6 necessary for the fulfillment of the intent of the construction documents.
- 7 E. Owners Representatives
- 8 1. All contractors shall be familiar with various Owner Representatives having Quality Management
- 9 responsibilities for the duration of this project including but not limited to the following:
- 10 a. Project Architect, responsible for all decisions affecting the code compliance and design intent of
- 11 the construction documents.
- 12 b. Consulting Architects and Engineers, responsible for providing consulting services to the Project
- 13 Architect, Owner, and City Project Manager, also responsible for Quality Management of the
- 14 construction documents.
- 15 c. Owner, the designated representative of the City Agency that will occupy the project upon
- 16 completion.
- 17 d. City Project Manager, responsible for all day to day decisions regarding the execution and
- 18 performance of this Public Works Contract.
- 19 e. Consulting City Staff, responsible for providing consulting services to the Project Architect, Owner,
- 20 and City Project Manager, also responsible for Quality Management of the construction
- 21 documents.
- 22 f. Commissioning Agent (CxA), responsible for ensuring that the project is meeting the Owner's
- 23 Project Requirements and related quality assurance procedures.
- 24 2. Owner Representatives shall be attending progress meetings, pre-installation meetings, performing or
- 25 being present for final testing and acceptance and quality management reporting during the execution of
- 26 the contract documents as outlined in other specifications.
- 27

28 **1.4. GENERAL CONTRACTOR PERFORMANCE REQUIREMENTS**

- 29 A. Assume the responsibility for all Work specified in the Contract Documents except where specifically identified
- 30 to be performed by the Owner or other contractor separately hired by the Owner.
- 31 1. Coordinate all work by Owner, equipment provided Owner, or contractor hired by the Owner into the
- 32 project schedule.
- 33 B. Provide all construction management responsibilities as specified in other Division 1 specifications including but
- 34 not limited to:
- 35 1. Scheduling of work
- 36 2. Coordination of work between other Trades and Sub-contractors
- 37 3. Construction administration and management
- 38 4. Site layout, cleanliness, and protection of completed work/stored materials
- 39 5. Waste Management
- 40 6. Quality Assurance and Quality Control
- 41 C. Use Diggers Hotline and private utility locating companies to accurately locate all public and private utilities on
- 42 the property as needed. The GC is responsible for any repair or replacement to any public or private utility
- 43 damaged during the execution of the Work
- 44 D. Report any inconsistencies, errors, omissions, or code violations in writing to the Project Architect immediately.
- 45 Failure to report inconsistencies prior to beginning work shall indicate that the GC accepted all existing
- 46 conditions.
- 47 E. The GC shall be responsible for assigning work and related responsibilities where the Contract Documents may
- 48 not clearly state who is responsible for providing the work, material, or product.
- 49 F. Provide construction management oversight of all items described in Section 1.5 below.
- 50 G. Coordinate and assist CxA as outlined within 01 91 00 and as directed by Owner.
- 51

52 **1.5. SUB-CONTRACTOR PERFORMANCE REQUIREMENTS**

- 53 A. Be familiar with all of the contract documents as they pertain to your Work, adjacent work and the overall
- 54 progress of the project.
- 55 1. All Sub-contractors shall be familiar with all Division 1 specifications as they may apply to progress,
- 56 progress payments, quality control construction management, and closeout of the contract.
- 57 B. Coordinate your Work with all adjacent work and existing conditions.

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1. Perform your work in proper sequence according to the GC's project schedule and in relation to the work of other trades.
 2. Notify other sub-contractors and trades whose work may be connected to, combined with, or influenced by your work and allow them reasonable time and access to complete their work.
 3. Join your work to the work of others in accordance with the intent of the Contract Documents.
 4. Order materials and schedule deliveries to facilitate the general progress of the Work.
- C. Cooperate with all other trades to facilitate the general progress of the work. This shall include providing every reasonable opportunity for the installation of work by others and the storage of their materials and equipment.
1. In no case shall any contractor exclude from the premises or work any Sub-contractor or their employees.
 2. In no case shall any contractor interfere with the execution or installation of Work by any other Sub-contractor or their employees.
- D. Arrange your work, equipment, and materials and dispose of your construction waste so as to not interfere with the work or storage of materials of others.
- E. Coordinate all work as indicated during pre-installation meetings with Owner Representatives, the GC and other trades. Any work improperly coordinated shall be relocated as designated by the Owner Representative at no additional cost to the City.
- F. Coordinate and assist CxA as outlined within 01 91 00 and as directed by Owner.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 – EXECUTION – THIS SECTION NOT USED

END OF SECTION

**SECTION 01 31 19
PROJECT MEETINGS**

1
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3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 1.3. PROJECT MEETING TYPES 1
8 1.4. GENERAL REQUIREMENTS 1
9 PART 2 – PRODUCTS – NOT USED IN THIS SECTION 1
10 PART 3 - EXECUTION 1
11 3.1. PRECONSTRUCTION MEETING 1
12 3.2. PROJECT MANAGEMENT WEB SITE – TUTORIAL MEETING 2
13 3.3. CONSTRUCTION PROGRESS MEETINGS 2
14 3.4. PRE-INSTALLATION MEETINGS 3
15 3.6 PRE-CONTRACT CLOSEOUT MEETINGS 3
16 3.7 OTHER SPECIAL MEETINGS 3
17

PART 1 – GENERAL

1.1. SUMMARY

- 21 A. The purpose of this specification is to identify various project related meetings and the responsible parties for
22 scheduling, agendas, minutes, and required attendance.
23 B. This specification is not intended to be inclusive of all meeting types or a complete list of required meetings.
24 C. This specification is not intended to cover planning and execution meetings between the General Contractor
25 (GC) and his/her sub-contractors.

1.2. RELATED SPECIFICATIONS

- 27
28 A. 01 31 23 Project Management Web Site
29 B. 01 32 16 Construction Progress Schedules
30 C. 01 43 39 Mockups
31 D. 01 91 00 Commissioning
32

1.3. PROJECT MEETING TYPES

- 33 A. The following project meeting types may be used but not limited to the following
34 1. Preconstruction Meeting
35 2. Project Management Web Site – Tutorial Meeting
36 3. Construction Progress Meetings
37 4. Pre-installation Meetings (including mock-up review meetings)
38 5. Weekly Trade Meetings
39 6. Special Meetings
40 7. Commissioning Meetings
41
42

1.4. GENERAL REQUIREMENTS

- 43 A. Representatives of Contractors, Subcontractors, and suppliers attending meetings shall be qualified and
44 authorized to act on behalf of the entity each represents.
45
46

PART 2 – PRODUCTS – NOT USED IN THIS SECTION

PART 3 - EXECUTION

3.1. PRECONSTRUCTION MEETING

- 50
51 A. After execution of the Contract the City Project Manager (CPM) shall schedule and conduct the Preconstruction
52 Meeting at the Owner’s facilities. The CPM shall coordinate the meeting agenda with the Project Architect and
53 the GC Project Manager.
54 B. The CPM shall be responsible for the final agenda.
55 C. The CPM and Project Architect shall take notes on the meeting and post completed meeting minutes.
56 D. Attendance shall be required by all of the following:
57 1. Owner Representative(s)
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2. Architect and applicable sub consultant(s)
 3. General Contractor and applicable subcontractors and suppliers
 4. City Quality Management Staff
 5. Commissioning Agent
 6. Others, as may be invited for particular agenda items.
- E. Topics of the Preconstruction Meeting shall include but not be limited to the following:
1. Staff and contractor introductions
 2. Completion Date
 3. BPW Administrative requirements and due outs
 - a. Small Business Enterprise (SBE) (if applicable)
 - b. Certified payroll forms
 - c. Workforce profiles
 - d. Best Value Contracting (BVC)
 4. General Facility Management Division 1 Specifications, including:
 - a. Section 01 29 76 Progress Payment Procedures
 - b. Section 01 31 23 Project Management Web Site (overview)
 - c. Section 01 45 16 Field Quality Control Procedures
 - d. Section 01 77 00 Closeout Procedures
 - e. Section 01 91 00 Commissioning
 5. Project Meeting scheduling
 - a. Section 01 31 19 Project Meetings
 6. Construction Schedule
 7. Commissioning Process

3.2. PROJECT MANAGEMENT WEB SITE – TUTORIAL MEETING

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- A. The CPM shall schedule and conduct a tutorial presentation of the PMWS prior to the beginning of construction.
 - B. The CPM shall be responsible for the final agenda, there will be no minutes.
 - C. The required attendance list in 3.1.D. above shall apply except for City Staff in items 1 and 4 who are already familiar with the PMWS system.
 - D. It is recommended that all contractors bring their lap top, tablet or other internet capable device with them including a fully charged battery and internet connection devices as necessary.

3.3. CONSTRUCTION PROGRESS MEETINGS

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- A. In general all of the following shall apply:
 1. Representatives of Contractors, Subcontractors, and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.
 2. The attendance shall be from the required attendance list in 3.1.D. above.
 - B. The General Contractor Project Manager (GCPM) shall:
 1. Schedule and conduct all construction progress meetings biweekly or more frequently as required.
 2. Prepare agenda for meetings including, but not limited to the following:
 - a. Safety
 - b. Current Schedule, including review of the critical path and 6-week look ahead schedule
 - c. Status of project related documentation (Submittals, RFIs, CBs, etc.)
 - d. Quality Observation Log and status of correction of deficient items
 - e. Project questions and issues from meeting attendees
 - f. BPW Administration Check
 - g. Other as needed
 - h. Status of CORs and COs to be reviewed outside the standard progress meeting time.
 3. Make physical arrangements for meetings.
 4. GCPM to post meeting agendas to the appropriate libraries on the Project Management Web Site (PMWS) no less than two (2) working days prior to the scheduled meeting. Notify all required attendees, applicable parties to the contract, and others affected of the posted meeting agenda.
 5. Preside at meetings.
 6. Route a meeting attendance roster for attendees to sign-in on.
 7. GCPM to record the minutes of the meeting; include significant proceedings and decisions. Post meeting minutes to the PMWS no more than two (2) working days after the completed meeting. Meeting minutes shall include a scanned copy of the attendance sign-in sheet. Notify all required meeting attendees, applicable parties to the contract, and others affected by decisions made at the meetings.

**SECTION 01 31 23
 PROJECT MANAGEMENT WEB SITE**

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PART 1 – GENERAL 1
 1.1. GENERAL DESCRIPTION 1
 1.2. SHAREPOINT PROCEDURE OVERVIEW 1
 1.3. RELATED SPECIFICATIONS 2
 PART 2 - PRODUCTS 2
 2.1. SHAREPOINT SYSTEM RELATED PRODUCTS 2
 PART 3 - EXECUTION 2
 3.1. POST BID-OPENING 2
 3.2. POST PRE-CONSTRUCTION MEETING 3

PART 1 – GENERAL

1.1. GENERAL DESCRIPTION

- A. The City of Madison (CoM) has established a web based Project Management Tool (PMT) using a Microsoft product called SharePoint (SP).
- B. The software is used throughout the design, construction and warranty process of major remodels and new construction projects executed as a City of Madison, Board of Public Works project.
- C. Initially deployed in mid-2013, the PMT software has been successfully deployed on several projects, and we continue to modify/update/enhance the PMT on a regular basis.

1.2. SHAREPOINT PROCEDURE OVERVIEW

- A. The CoM PMT is a system of consolidated Document & Form Libraries and Data Lists that assist in performing day to day functions of design/construction management while reducing the use of surface mail, email and email attachments.
 - 1. Document libraries store a wide variety of documents in many different formats including but not limited to Word, Excel, PDF, photographs (all popular formats), etc.
 - 2. Data Lists contain consolidated data information that can be generated and stored for further use. Punch Lists and Warranty issues will be examples of Data Lists.
 - 3. Form Libraries are primarily used when a specific work flow process is needed. The form acts as the cover letter. An example of this would be the Submittal Review Process.
 - 4. Libraries are controlled by Permission Groups and Permission Levels.
- B. The following libraries and sub-libraries on the PMWS are provided for specific workflows and contract documentation. Related specification numbers are in "()" if applicable.

Contract Documents	Construction Administration	Construction Progress	LEED Documentation	Quality Control	Construction Closeout
<i>GC Partial Pay Apps (01 29 76)</i>	<i>Change Order Requests (COR Form) (01 26 57)</i>	<i>Schedules (01 32 16)</i>	<i>LEED Documents</i>	<i>Regulatory Inspections</i>	<i>Misc Closeout Documents</i>
<i>Construction Documents</i>	<i>Change Orders (CO Form) (01 26 63)</i>	<i>Progress Meetings (01 31 19)</i>	<i>Waste Management (01 74 19)</i>	<i>Commissioning Checklists</i>	<i>O & M Manuals (01 78 23)</i>
<i>Regulatory Documents</i>	<i>Construction Bulletins (CB Form) (01 26 46)</i>	<i>Daily Journal (DJ Form) (01 32 26)</i>		<i>System Performance Tests</i>	<i>Product Warranties /Guarantees (01 78 36)</i>
<i>Testing Contract</i>	<i>Request for Information (RFI Form) (01 26 13)</i>			<i>Quality Management Observation (QMO Form) (01 45 16)</i>	<i>As-Builts (01 78 39)</i>
	<i>Submittals (SUB Form) (01 33 23)</i>			<i>Safety and Incident Reports</i>	<i>Attic Stock (01 78 23)</i>
	<i>Substitution Request (SR Form) (01 25 13)</i>			<i>Material Testing & Field Reports</i>	<i>Demonstration and Training (01 79 00)</i>

Contract Documents	Construction Administration	Construction Progress	LEED Documentation	Quality Control	Construction Closeout
					Warranty Issues (WI Form) (01 78 23)

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- C. A tutorial document on the web based PMT will be provided to the General Contractor (GC) who is awarded the contract. Additional training will be provided as needed for the GC and Sub-Contractors (SC) by the CoM.
- D. The PMT has predefined work flows that channel automated alerts as documents are uploaded, reviewed, and completed. These workflows are designed for inbound information from the contractor as well as outbound information from the Architectural/Engineer consultant and the Owner.
- E. The GC will be required to receive email notifications, access the internet to review related documentation and be able to upload/download documentation to the various project libraries.
- F. The SC's will be required (at a minimum) to receive email notifications and access the internet to review related documentation. Prior to setting up the final PMT the GC and CPM shall meet to review all SP workflows, the GC will determine to what level over the minimum requirements the SC's will be involved.

1.3. RELATED SPECIFICATIONS

- A. The following specification sections are directly related to the CoM PMT system.
 - 1. 01 25 13 Product Substitution Procedures
 - 2. 01 26 13 Request for Information (RFI)
 - 3. 01 26 46 Construction Bulletins (CB)
 - 4. 01 26 57 Change Order Request (COR)
 - 5. 01 26 63 Change Order (CO)
 - 6. 01 29 76 Progress Payment Procedures
 - 7. 01 31 19 Project Meetings
 - 8. 01 32 16 Construction Progress Schedules
 - 9. 01 32 26 Construction Progress Reporting
 - 10. 01 32 33 Photographic Documentation
 - 11. 01 33 23 Submittals
 - 12. 01 45 16 Field Quality Control Procedures (Owner)

PART 2 - PRODUCTS

2.1. SHAREPOINT SYSTEM RELATED PRODUCTS

- A. SharePoint is a Microsoft Windows based software that requires no additional software installation, hardware or other special requirements/applications for the users. There are no costs associated with the use of this system.
- B. Currently the CoM is using SharePoint 2010.
 - 1. SharePoint works best if the user's computer is running Windows versions 7 through 8.1.
 - 2. SharePoint works best when used with Internet Explorer versions 9 - 11 (32 bit).
 - a. At this time SharePoint is not compatible with other internet browsers such as Fire Fox, Google Chrome, and Safari.

PART 3 - EXECUTION

3.1. POST BID-OPENING

- A. After bids have been opened, a successful bidder has been determined, and bid acceptance procedures have been initiated the City Project Manager (CPM) will contact the GC to provide the following information.
 - 1. Project Management Software Tutorial. This tutorial is in a PDF printable format with screen shots and associated instructions on how to access and use the PMT.
 - a. Tutorial instructions will include but not be limited to the following:
 - i. Descriptions of various libraries, documents, and forms that will be used throughout the construction project.
 - ii. Uploading procedures for various types of documents including standardized naming conventions.

- 1 2. A blank Project Directory in an Excel spread sheet format. The contractor shall provide the following
2 information for GC and SC staffs as indicated on the spreadsheet. This will generally be the Project
3 Manager for the GC as well as the Sub-contractors and the GC Site Supervisor.
4 a. Last Name, First Name
5 b. Company Name
6 c. Email address (valid, work related)
7 d. Work Phone Number (required, include area code)
8 e. Cell Phone Number (not required, include area code)
9 3. The GC shall provide the above information for all SC's where the GC is not self-performing the work.
10 4. The GC may provide project foreperson information for work being self-performed if he/she so desires.
11

12 **3.2. POST PRE-CONSTRUCTION MEETING**

- 13 A. The GCPM will return the completed Project Directory spread sheet to the CPM no later than the Pre-
14 construction meeting.
15 B. The CPM is responsible for uploading all project directory data into SharePoint and coordinating with CoM
16 Information Technology (CoM-IT) for creating the logins and passwords of non-city staff (GC/SC staffs).
17 C. All GC/SC staff will be notified through an automated email from CoM IT that logins and passwords are available.
18 It is the responsibility of each GC/SC to call the CoM-IT number provided in the email to receive his/her
19 login/password over the phone. Logins and passwords will not be released via email.
20 D. Once the GCPM has received his/her login/password uploading of contract related documents can begin. This
21 would include but not be limited to project schedules, submittals, RFI's, and other documents as needed.
22 E. All workflows, review of documentation, and general archiving of construction related documentation will be
23 conducted on the PMWS. These documents will generally not be emailed.
24 F. The following documents related to the execution of the contract will not be part of the PMWS:
25 1. All documentation related to executing the contract, such as:
26 a. Sub Contractors list
27 b. Affirmative Action documentation
28 c. Bonding documentation
29 d. Documentation associated with payroll verification
30 e. Final documentation associated with closing out the contract
31 2. Any documentation required/generated by ordinance, code or statute, such as;
32 a. Erosion Control inspections
33 b. Building Inspection Department inspections
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END OF SECTION

**SECTION 01 32 16
CONSTRUCTION PROGRESS SCHEDULES**

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4 PART 1 – GENERAL 1
5 1.1. SCOPE 1
6 1.2. RELATED SPECIFICATIONS 1
7 PART 2 – PRODUCTS – THIS SECTION NOT USED 1
8 PART 3 - EXECUTION 1
9 3.1. OVERALL PROJECT SCHEDULE (OPS) 1
10 3.2. 6 WEEK LOOK-OUT SCHEDULES (LOS) 1
11 3.3. PROJECT MANAGEMENT WEB SITE (PMWS) 2
12

PART 1 – GENERAL

1.1. SCOPE

- 16 A. This specification is to identify various project related schedules associated with indicating construction progress
17 and outlook. The following schedules are the responsibility of the General Contractor (GC).
18 1. Overall Project Schedule
19 2. 6 Week Look-out Schedule
20 B. This specification is not intended to include internal schedules generated by the contractors during their
21 planning and execution of the contract.
22

1.2. RELATED SPECIFICATIONS

- 23 A. Section 01 29 76 Progress Payment Procedures
24 B. Section 01 31 23 Project Management Web Site
25 C. Section 01 31 19 Progress Meetings
26 D. Section 01 74 13 Progress Cleaning
27 E. Section 01 77 00 Closeout Procedures
28 F. Section 01 78 23 Operation and Maintenance Data
29 G. Section 01 78 36 Warranties
30 H. Section 01 78 39 As-Built Drawings
31 I. Section 01 78 43 Spare Parts and Extra Materials
32 J. Section 01 79 00 Demonstration and Training
33 K. Section 01 91 00 Commissioning
34 L. Other specification within the construction documents that may indicate the need for scheduling any event with
35 Owner, Project Architect, Owner Representatives, including any owner provided equipment.
36
37

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. OVERALL PROJECT SCHEDULE (OPS)

- 43 A. The GC shall prepare an OPS that covers the duration of the contract from the pre-construction meeting through
44 the end of construction to final contract closeout.
45 1. The GC shall review Specification 01 77 00 Closeout Procedures to become familiar with definitions,
46 differences, and requirements for closing out the construction and contract including the association with
47 progress payments.
48 B. The GC shall provide copies and lead a discussion on the OPS during the pre-construction meeting.
49 C. The OPS shall indicate start and end dates of each task associated with the project.
50 D. The OPS shall clearly indicate the critical path of the project.
51 E. The GC shall update the OPS as often as necessary during the duration of the project. Updates will be briefed as
52 needed during bi-weekly progress meetings.
53

3.2. 6 WEEK LOOK-OUT SCHEDULES (LOS)

- 54 A. The GC shall prepare the initial LOS to include detail of daily tasks for the first six (6) weeks of construction in
55 depth for the Pre-construction meeting. The LOS shall be compatible and complimentary to the OPS.
56 B. The GC shall provide copies and lead a discussion on the LOS during the pre-construction meeting.
57

- 1 C. The LOS shall indicate start and end dates of each major task, associated related sub-tasks, and required parallel
- 2 or pre-requisite tasks required to complete the major task on time.
- 3 D. The LOS shall also include identifying and scheduling such events as:
- 4 1. Pre-installation meetings and mock-up review meetings.
- 5 2. Quality management reviews of installations before they are covered.
- 6 3. Owner provided equipment as designated by the contract documents.
- 7 4. Work by others as designated by the contract documents.
- 8 5. Critical submittal dates.
- 9 E. The GC shall update the LOS prior to each bi-weekly progress meeting to indicate the next 6 weeks of scheduled
- 10 work. Updates will be briefed during each bi-weekly progress meeting.
- 11

12 **3.3. PROJECT MANAGEMENT WEB SITE (PMWS)**

- 13 A. The GC shall upload all project schedules and updates to the PMWS in an original PDF version of the scheduling
- 14 document. Scans will not be permitted.
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END OF SECTION

**SECTION 01 32 19
SUBMITTALS SCHEDULE**

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4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 1.3. RELATED DOCUMENTS 1
8 1.4. SUBMITTAL DEFINITIONS 1
9 1.5. SUBMITTAL REQUIREMENTS 2
10 1.6. ADMINISTRATIVE SUBMITTALS 2
11 PART 2 – PRODUCTS – THIS SECTION NOT USED 2
12 PART 3 - EXECUTION 2
13 3.1. OVERALL RESPONSIBILITIES OF ALL CONTRACTORS 2
14 3.2. GENERAL CONTRACTORS RESPONSIBILITIES 2
15 3.3. STAFF REVIEW RESPONSIBILITIES 3
16

PART 1 – GENERAL

1.1. SUMMARY

- 20 A. The General Contractor shall submit a complete and comprehensive list of all submittals anticipated during the
21 execution of this contract.
22 B. The GC shall include the Administrative submittals identified in item 1.5 below and shall be required to up load
23 them to the Project Management Web Site.
24 C. The initial Submittals Schedule shall be based on the original contract documents used at the time of bidding and
25 any posted addenda through awarding of the contract.
26 D. The Submittal Schedule may be appended during the execution of the contract based on amendments to the
27 contract in the form of Change Orders, Construction Bulletins, and other related documents that add, or change
28 the scope of the work.
29

1.2. RELATED SPECIFICATIONS

- 30 A. Section 01 29 76 Progress Payment Procedures
31 B. Section 01 31 23 Project Management Web Site
32 C. Section 01 33 23 Submittals
33 D. Section 01 91 00 Commissioning
34
35

1.3. RELATED DOCUMENTS

- 36 A. The following documents shall be used as the basis for initiating the original Submittals Schedule.
37 1. Drawing documents and specifications (including general provisions) as provided with the bid set
38 documents and any published addenda.
39 B. The following documents shall be used to amend the submittals schedule as needed during the execution of this
40 contract.
41 1. Documents associated with revisions or clarifications to number A.1 above after awarding of the
42 contract, including but not limited to:
43 a. Construction Bulletins
44 b. Approved Change Orders
45
46

1.4. SUBMITTAL DEFINITIONS

- 47 A. Administrative Submittal: Any submittal that may be required by a Division 1 Specification and as noted in
48 Section 1.5 below.
49 B. Critical Path Submittal: Any early submittal that needs a priority review due to early construction use or long
50 lead times where a delay could affect the critical path of the construction schedule
51 C. Submittal: Any material, product, equipment, or general requirement as outlined in this and other specifications
52 that require a favorable review or acceptance prior to proceeding with procuring the item or proceeding with
53 the Work.
54
55

1.5. SUBMITTAL REQUIREMENTS

- A. The GC and all Sub-contractors shall review the construction documents including the specifications of their individual Division or Trade to compile a complete list of all materials, products, or equipment that will require a positively reviewed submittal to be completed prior to procurement and installation.
 - 1. Submittals shall include but not be limited to any of the following that may apply:
 - a. Shop Drawings
 - b. Product Data
 - c. Assembly Drawings
 - d. Engineered Drawings
 - e. Product Samples
- B. The following items will require an approved submittal, verify with specifications for specific needs and requirements:
 - 1. Contractor certifications for specialized work such as asbestos removal, well drilling, controls, AV, etc.

1.6. ADMINISTRATIVE SUBMITTALS

- A. The GC shall upload the following submittals within 15 working days of receipt of the City of Madison Start Work Letter. All Administrative Submittals shall be approved prior to requesting Progress Payment Number 1.
 - 1. Contractors Project Directory, see specification 01 31 23, discuss requirements with CPM
 - 2. Schedule of Values, see Specification 01 29 73
 - 3. Submittals Schedule, see Specification 01 32 19
 - 4. Waste Management Plan, see Specification 01 74 19
 - 5. Closeout Requirement Checklist, see Specification 01 77 00
 - 6. Warranty Checklist, see Specification 01 78 36

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. OVERALL RESPONSIBILITIES OF ALL CONTRACTORS

- A. All contractors shall be responsible for reviewing the drawings and specifications within their Divisions of Work to provide a complete and comprehensive list of submittals to the General Contractor.
- B. Each list shall indicate the title of the submittal, the associated specification of the submittal, whether the submittal can be considered an early/middle/late submittal, the anticipated date the submittal will be provided and the anticipated date the submittal needs to be approved.
- C. Contractors shall be aware that the goals for submittal review by the Architect staff and City staff will be as follows:
 - 1. For items on the Critical Path as identified by the GC, five (5) working days
 - 2. For most other submittals ten (10) working days
 - 3. Additional time may be needed for complex submittals or if re-submittals are required.
- D. The general format of the Submittal Schedule shall be tabular as per this example:

<u>Title</u>	<u>Specification</u>	<u>Critical Path (Y or N)</u>	<u>Date provided</u>	<u>Date required</u>	<u>Remarks</u>
Concrete Mix Design	03 30 00	Y	Oct 1, 2014	Oct 15, 2014	
Paint Draw Downs	09 90 00	N	Jan 2, 2015	Jan 20, 2015	

3.2. GENERAL CONTRACTORS RESPONSIBILITIES

- A. The General Contractor shall be responsible for all of the following:
 - 1. Consolidating all submittal lists from individual contractors into one master list.
 - 2. Reviewing all submitted lists for completeness, timing with the overall contract, etc. The GC shall meet with individual contractors to make changes as necessary.
 - 3. Upload the completed Submittals Schedule to the Submittal Library on the Project Management Web Site for review as SD 003.0. See Specification 01 33 23 Submittals for more information on this procedure.
 - 4. Resubmit the schedule as needed after initial reviews have been completed.
- B. The GC shall work with other contractors to amend the Submittals Schedule throughout the execution of the project based on changes and modifications as needed.
- C. The GC and Project Architect shall be responsible for reviewing and briefing the submittal schedule and submittals status at each bi-weekly construction meeting.

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3.3. STAFF REVIEW RESPONSIBILITIES

- A. The Project Architect, consulting staff, Commissioning Agent (CxA), Owner, and city staff will review the Submittal Schedule for completeness per the plans and specifications within their divisions of work. The reviewing staff may provide comments as needed. Some examples might include the following:
 - 1. Submittal not required
 - 2. Provide photos of samples with digital submittal
 - 3. Insure one submittal for complete system
 - 4. Append the schedule to include...
 - 5. See Specification <xyz> for additional requirements
- B. The Project Architect and City Project Manager will finalize review comments regarding the Submittal Schedule. Re-submittal of the submittal schedule may be required.

END OF SECTION

SECTION 01 32 26
CONSTRUCTION PROGRESS REPORTING

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATION SECTIONS 1
7 1.3. PERFORMANCE AND QUALITY ASSURANCE REQUIREMENTS 1
8 PART 2 – PRODUCTS - THIS SECTION NOT USED 1
9 PART 3 - EXECUTION 1
10 3.1. CONTRACTOR JOURNAL 1
11 3.2. CONSTRUCTION PROGRESS MEETINGS 2
12

PART 1 – GENERAL

1.1. SUMMARY

- 16 A. Daily records of project activities, resources used, weather conditions, and other information related to the
17 ongoing progress of the project are extremely important at all levels of Construction Management.
18 B. Daily records provide the base for weekly progress reports and updating progress schedules.

1.2. RELATED SPECIFICATION SECTIONS

- 21 A. Section 01 31 19 Project Meetings
22 B. Section 01 31 23 Project Management Web Site
23 C. Section 01 32 23 Photographic Documentation
24

1.3. PERFORMANCE AND QUALITY ASSURANCE REQUIREMENTS

- 26 A. The General Contractor (GC) shall be responsible for all Construction Progress Reporting as outlined in this and
27 other specifications as noted.
28 B. The GC shall maintain daily progress journals in a format of his/her choosing provided it is legible and contains
29 the information as outlined in Section 3.1 below.
30 C. The journal shall be located in the job trailer and shall be reviewable by the Project Architect or City Project
31 Manager if so requested.
32

PART 2 – PRODUCTS - THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. CONTRACTOR JOURNAL

- 38 A. The GC shall maintain a journal of daily progress on which Work is performed by any employee or entity for
39 which the GC is responsible. Such reports shall include all relevant data concerning the progress of Work
40 activities the GC and Subcontractors are responsible for and the effect of that activity on the time of
41 performance of the Contract.
42 1. Some projects may not require weekly journals be kept instead of daily journals. This is at the sole
43 discretion of the City Project Manager. A daily journal will generally be required when the contract has a
44 significant amount of site work. A weekly journal will generally be used when a contract is interior work
45 only.
46 B. Journal entries shall be made on the Contractor Daily/Weekly Report Form located in the Construction Progress-
47 Daily Journal Library on the Project Management Web Site. The form consists of the following areas:
48 1. Weather; include temperature, humidity, precipitation, wind and other related information such as
49 significant storm events, times, and details.
50 2. Work completed by trade
51 3. Delays encountered
52 4. Deliveries received or delayed
53 5. Hot issues that need to be addressed
54 6. Safety issues
55 7. Photograph progress and upload to the Photo Library on the Project Management Web Site.
56 8. Other including inspections, testing, etc.
57 9. Space for attaching documents

- 1 C. Contractor Daily/Weekly Report Forms shall be completed and signed by the GC's Job Superintendent or other
2 on-site representative authorized by the GC confirming each such report is current, accurate and complete.
3 D. If applicable the GC shall include schedules of quantities and costs, progress schedules, wage rates, reports,
4 estimates, invoices, records and other data as requested by the CPM concerning Work performed or to be
5 performed under this Contract if the CPM determines such information is needed to substantiate Change Order
6 proposals, claims, or to resolve disputes.
7

8 **3.2. CONSTRUCTION PROGRESS MEETINGS**

- 9 A. The GC shall provide a verbal summary of the previous two (2) weeks progress reports at each bi-weekly
10 construction progress meeting.
11

12 **END OF SECTION**
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SECTION 01 32 33
PHOTOGRAPHIC DOCUMENTATION

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PART 1 – GENERAL 1
1.1. SCOPE 1
1.2. RELATED SPECIFICATION SECTIONS 1
PART 2 – PRODUCTS - THIS SECTION NOT USED 1
PART 3 - EXECUTION 1
3.1. REQUIREMENTS FOR DIGITAL PHOTOGRAPHS..... 1
3.2. PICTURE CONTENT 1
3.3. PROJECT MANAGEMENT WEB SITE..... 1

PART 1 – GENERAL

1.1. SCOPE

- A. The General Contractor (GC) shall be required to take weekly digital photographs of construction progress and upload the photos directly to the Project Management Web Site (PMWS).

1.2. RELATED SPECIFICATION SECTIONS

- A. Section 01 31 23 Project Management Web Site
- B. Section 01 32 26 Construction Progress Reporting

PART 2 – PRODUCTS - THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. REQUIREMENTS FOR DIGITAL PHOTOGRAPHS

- A. All digital photographs shall be taken with a good quality digital camera, cell phone, tablet, and other such digital device.
- B. Digital photographs shall be properly zoomed in/out to capture a specific level of detail as necessary.
- C. Digital photographs shall be formatted to achieve a good, clear, and detailed image where the final file size is between 600 KB and 1.2 MB (1200KB).
- D. The camera default naming convention is acceptable. The GC does not need to rename or specifically identify pictures in the title.
- E. All digital photographs shall be saved in a JPEG (.jpg) format and uploaded directly to the PMWS.

3.2. PICTURE CONTENT

- A. The GC shall take exterior photographs from at least two (2) different angles.
 - 1. This requirement shall only be applicable when there is exterior work connected with the project.
 - 2. When applicable this requirement shall begin prior to commencing any site work.
 - 3. This requirement shall end when the exterior work has been substantially completed.
 - 4. This requirement may be suspended due to weather conditions or substantial delays in exterior progress.
- B. The GC shall take interior photographs of interior construction, equipment installation, rough-ins and other such progress that helps document weekly progress reporting. Interior photographs should focus on specific significant installations as well as general progress throughout the progress of the contract.

3.3. PROJECT MANAGEMENT WEB SITE

- A. The GC shall upload the digital photographs to the appropriate progress folder in the Project Images Library.
- B. Progress folders are labeled with the Construction Week Number and the date for Monday of that week.
- C. The GC shall notify the City of Madison Project Manager if additional progress folders need to be created.

END OF SECTION

SECTION 01 33 23
SUBMITTALS

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED REFERENCES 1
7 1.3. SUBMITTAL REQUIREMENTS 1
8 PART 2 – PRODUCTS – THIS SECTION NOT USED 2
9 PART 3 - EXECUTION 2
10 3.1. GENERAL CONTRACTORS PROCEDURES 2
11 3.2. SUBMITTAL REVIEW 3
12 3.3. PROJECT ARCHITECTS REVIEW 3
13

PART 1 – GENERAL

1.1. SUMMARY

- 17 A. The General Contractor (GC) shall be responsible for providing submittals for review of all contractors and sub-
18 contractors as designated in the construction documents. Submittals shall include but not be limited to all of the
19 following:
20 1. Equipment specified and pre-approved in the specification; to ensure quality, construction, and
21 performance specifications have not changed since final design.
22 2. Equipment specified by performance in the specification; to ensure that the intended quality,
23 construction, and performance specified is met by the selected material or product.
24 3. Shop, piece, erection, and other such drawings as indicated in the specifications to ensure all structural,
25 dimensional, and assembly requirements are being met.
26 4. Submittals indicating installation sequencing
27 5. Submittals indicating control sequencing
28 6. Contractor licensing, certification, and other such regulatory documentation when required by a
29 specification.
30 7. Other submittals as may be required by individual specifications.
31 B. The submittal process shall not be used to determine alternates to specified products or equipment. All
32 considerations shall be reviewed during the bidding process and acceptable alternates shall be acknowledged by
33 addendum prior to the closing of bidding. See bidding instructions for the information on submitting alternates
34 for consideration.
35 D. In the event that a manufacturer has significantly changed a product (discontinued a model, changed dimension
36 or performance data changed available colors, etc.) since bid opening the GC shall submit a Request for
37 Information (RFI) to the Project Architect requesting other approved alternates prior to uploading a digital
38 submittal.
39 E. Contractors and sub-contractors shall be responsible for knowing the submittal requirements of ALL sections
40 within their scope of work under the contract. The Owner reserves the right to request documentation on any
41 materials, equipment, or product being installed where a submittal is not on file. If the material, equipment, or
42 product installed is determined not to meet the intent of the specification the contractor/sub-contractor shall be
43 required to remove and replace the items involved. The GC shall be solely responsible for all costs associated
44 with the removal and replacement.
45

1.2. RELATED REFERENCES

- 47 A. Section 01 29 76 Progress Payment Procedures
48 B. Section 01 31 23 Project Management Web Site
49 C. Section 01 32 19 Submittals Schedule
50 D. Section 01 32 26 Construction Progress Reporting
51 E. Section 01 91 00 Commissioning
52 F. All Technical Specifications, contract documents, construction drawings, and any published addendums during
53 the bidding process.
54 G. All contract documents generated during the execution of the contract including but not limited to Requests for
55 Information (RFI) and Construction Bulletins (CB).
56

1.3. SUBMITTAL REQUIREMENTS

- 57 A. A completed submittal shall meet the following requirements:
58

- 1 1. Digital submittal shall be original PDF of manufacturer's data sheets or high quality color scan of the
- 2 same.
- 3 a. Submittals shall not include sales fliers or other similar documents that typically do not provide
- 4 complete manufacturers data.
- 5 2. Documents within the PDF submittal shall be printable to a sized sheet no less than 8-1/2 by 11 inches
- 6 and no larger than 24 by 36 inches.
- 7 3. At the beginning of each submittal the contractor shall identify the plan reference (WC-1, EF-3, etc.) in
- 8 RED block letters that the submittal is for.
- 9 4. Where multiple model numbers appear in a table the contractor shall identify the specific model being
- 10 submitted by using a RED square, box, or other designation to distinguish the correct model from others
- 11 on the page.
- 12 B. A complete submittal will include all information associated with the product or equipment as presented in
- 13 plans, equipment tables, and specifications. Information shall include but not be limited to the following:
- 14 1. Dimensional data
- 15 2. Performance data
- 16 3. Resource requirements, power, water, waste, etc
- 17 4. Clearance and maintenance requirements
- 18 5. Finish information, colors, textures, etc.
- 19 6. Warranty information
- 20 C. Where a submittal includes material samples (carpet, tile, paint draw downs, etc.) the contractor shall do the
- 21 following:
- 22 1. The Contractor shall submit the sample(s) as indicated in the specification.
- 23 2. The Contractor shall include a quality photograph(s) of the product with the digital submittal.
- 24 Photographs shall meet the following requirements:
- 25 a. Formatted to be between 500Kb and 1.0 Mb in file size
- 26 b. Have no glare or flash reflection on the sample
- 27 c. Sample fills the frame of the photo and shows detail as needed. Include multiple photos from
- 28 other angles as needed.
- 29 d. Scanned copies of products or photos are not acceptable.
- 30 D. Uploaded submittals should be relative and related to a specific written specification.
- 31 1. Do not upload submittals under a broad category or division (I.E. HVAC 23 00 00). Always upload by the
- 32 specific specification that identifies a required product or performance to be met.
- 33 2. Group related items together if the specification is written that way. (I.E. all of the plumbing fixtures and
- 34 trim relative to one specific specification should be submitted together).
- 35 3. Submittals shall be grouped and adhere to the divisions in the submittal schedule. Submittals that do not
- 36 conform to the submittal schedule and/or specification divisions will be rejected for re-submittal.

37
38 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

39
40 **PART 3 - EXECUTION**

41
42 **3.1. GENERAL CONTRACTORS PROCEDURES**

- 43 A. All required submittals will be uploaded to the Construction Administration-Submittal Drawings Library on the
- 44 Project Management Web Site (PMWS) by the GC.
- 45 1. The GC shall open a new Submittal Form in the Submittals Drawings Library for each required submittal
- 46 from the Submittals schedule.
- 47 2. Fill in required information on the form that will be used for routing the review and comments.
- 48 3. Attach all documentation as described in Section 1.3 above.
- 49 a. Submit samples under separate cover to the Project Architect when necessary.
- 50 B. Uploading the submittal indicates that the GC has reviewed and approved the submittal against the contract
- 51 document requirements.
- 52 C. The GC shall discuss submittal status at all progress meetings and shall monitor submittal review/approval/re-
- 53 submittal so as to not incur delays in the project schedule.
- 54 D. A completed upload of the submittal to the PMWS initiates the review process workflow.
- 55 E. The GC and sub-contractors shall provide re-submittals as required.
- 56

**SECTION 01 43 50
AIR BARRIER SYSTEMS**

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2
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4 PART 1 – HEADING 1 1
5 1.1. RELATED DOCUMENTS 1
6 1.2. SUMMARY 1
7 1.3. DEFINITIONS 1
8 1.4. PERFORMANCE REQUIREMENTS 1
9 1.5. SUBMITTALS 2
10 1.6. QUALITY ASSURANCE 2
11 1.7. PROJECT CONDITIONS 2
12 PART 2 – PRODUCTS – NOT USED 3
13 PART 3 - EXECUTION 3
14 3.1. FIELD QUALITY CONTROL 3
15 3.2. REPAIR AND PROTECTION 4
16

PART 1 – HEADING 1

1.1. RELATED DOCUMENTS

- 19 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division
20 01 Specification Sections, Division 07 Specification Sections, apply to this Section.
21
22

1.2. SUMMARY

- 23 A. Contractor will engage a qualified consultant(s) to perform tests and inspections prior to the installation of air
24 barrier components.
25 B. This section includes administrative and procedural requirements for accomplishing an airtight building
26 enclosure that controls infiltration or exfiltration of air.
27 C. Related Sections:
28 1. Section 07 25 00: Weather Barriers.
29 2. Requirements of this section relate to the coordination between subcontractors required to provide an
30 airtight building enclosure, customized fabrication and installation procedures, not production of
31 standard products.
32
33

1.3. DEFINITIONS

- 34 A. Air Barrier System: The airtight components of the building enclosure and the joints, junctures and transitions
35 between materials, products, and assemblies forming the air-tightness of the building enclosure.
36 B. Services: Include coordination between the trades, the proper scheduling and sequencing of the work, pre-
37 construction meetings, inspections, tests, and related actions, including reports performed by Contractor, by
38 independent agencies, and by governing authorities. They do not include contract enforcement activities
39 performed by Architect.
40
41

1.4. PERFORMANCE REQUIREMENTS

- 42 A. General Performance: The Contractor shall ensure that the intent of constructing the building enclosure with a
43 continuous air barrier system to control air leakage into, or out of the conditioned space is achieved. The air
44 barrier system shall have the following characteristics:
45 1. It shall be continuous, with all joints sealed.
46 2. It shall be structurally supported to withstand positive and negative air pressures applied to the building
47 enclosure.
48 3. Continuity of the air barrier materials and products with joints to provide complete assemblies.
49 4. Continuity of all the enclosure assemblies with joints and transition materials to provide a whole building
50 air barrier system.
51 B. Connection shall be made between:
52 1. Foundation and walls.
53 2. Walls and windows or doors.
54 3. Different wall systems.
55 4. Wall and roof.
56 5. Wall and roof over unconditioned space.
57 6. Walls, floor and roof across construction, control and expansion joints.
58

- 1 7. Walls, floors and roof to utility, pipe and duct penetrations.
2 C. Air Barrier Penetrations: All penetrations of the air barrier and paths of air infiltration / exfiltration shall be made
3 air-tight.
4 D. Compliance Requirements:
5 1. Assemblies: an air permeance not to exceed 0.03 cfm/ft²p under a pressure differential of 0.3 in. water
6 (1.57psf) (0.15 L/s.m² @ 75 Pa) when tested in accordance with ASTM E 1677.
7 2. Materials: Materials used for the air barrier system in the opaque envelope shall have an air permeance
8 not to exceed 0.004 cfm/ft² under a pressure differential of 0.3 in. water (1.57psf) (0.02 L/s.m² @ 75 Pa)
9 when tested in accordance with ASTM E 2178. Or,
10 3. Entire Building: The air leakage of the entire building shall not exceed 0.15 cfm/sf under a pressure
11 differential of 0.3 in. water (1.57psf) (0.75 L/s.m² @ 75 Pa) when tested according to ASTM E 779.
12

13 **1.5. SUBMITTALS**

- 14 A. Field quality-control reports.
15 B. Testing agency shall submit a certified written report, in duplicate, of each inspection, test, or similar service to
16 the Architect. If the Contractor is responsible for the service, submit a certified written report, in duplicate, of
17 each inspection, test, or similar service through the Contractor.
18 1. Submit additional copies of each written report directly to the governing authority, when the authority so
19 directs.
20 C. Report Data: Written reports of each inspection, test, or similar service include, but are not limited to, the
21 following:
22 1. Date of issue.
23 2. Project title and number.
24 3. Name, address, and telephone number of testing agency.
25 4. Dates and locations of samples and tests or inspections.
26 5. Names of individuals making the inspection or test.
27 6. Designation of the Work and test method.
28 7. Identification of product and Specification Section.
29 8. Complete inspection or test data.
30 9. Test results and an interpretation of test results.
31 10. Ambient conditions at the time of sample taking and testing.
32 11. Comments or professional opinion on whether inspected or tested Work complies with Contract
33 Document requirements.
34 12. Name and signature of laboratory inspector.
35 13. Recommendations on retesting.
36

37 **1.6. QUALITY ASSURANCE**

- 38 A. General Performance: The Contractor shall ensure that the intent of constructing the building enclosure with a
39 continuous air barrier system to control air leakage into, or out of the conditioned space is achieved. The air
40 barrier system shall have the following characteristics:
41 B. Inspection and testing services are required to verify compliance with requirements specified or indicated. These
42 services do not relieve Contractor of responsibility for compliance with Contract Document requirements.
43 1. Qualifications for Air Barrier Testing and Inspection Agencies: Engage Air Barrier inspection and testing
44 service agencies, including independent testing laboratories, that are prequalified and that specialize in
45 the types of air barrier system inspections and tests to be performed.
46 C. Specific quality-control requirements for individual construction activities are specified in the sections of the
47 specifications. Requirements in those sections may also cover production of standard products. It is the
48 Contractor's responsibility to ensure that each subcontractor is adequately and satisfactorily performing the
49 quality assurance documentation, tests and procedures required by each section.
50 D. Specified inspections, tests, and related actions do not limit Contractor's quality-control procedures that
51 facilitate compliance with Contract Document requirements.
52

53 **1.7. PROJECT CONDITIONS**

- 54 A. Contractor Responsibilities: Unless otherwise indicated as the responsibility of another identified entity,
55 Contractor shall provide coordination of the trades, and the sequence of construction to ensure continuity of the
56 air barrier system joints, junctures and transitions between materials and assemblies of materials and products,
57 from substructure to walls to roof. Provide quality assurance procedures, testing and verification as specified
58 herein. Facilitate inspections, tests, and other quality-control services specified elsewhere in the Contract

- 1 Documents and required by authorities having jurisdiction or by the Owner. Costs for these services are included
2 in the Contract Sum.
- 3 B. Organize preconstruction meetings between the trades involved in the whole building's air barrier system to
4 discuss where each trade begins and ends and the responsibility and sequence of installation of all the air-tight
5 joints, junctures, and transitions between materials, products and assemblies of products specified in the
6 different sections, to be installed by the different trades.
- 7 C. Build a mock-up before proceeding with the work, satisfactory to the Architect, of each airtight joint type,
8 juncture, and transition between products, materials and assemblies.
- 9 D. Associated Services: Cooperate with agencies performing required inspections, tests, and similar services, and
10 provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to
11 permit assignment of personnel. Auxiliary services required include, but are not limited to, the following:
12 1. Provide access to the Work.
13 2. Furnish incidental labor and facilities necessary to facilitate inspections and tests.
14 3. Take adequate quantities of representative samples of materials that require testing or assist the agency
15 in taking samples.
16 4. Deliver samples to testing laboratories.
17 5. Provide security and protection of samples and test equipment at the Project Site.
- 18 E. Duties of the Testing and Inspection Agency: The independent agency engaged to perform inspections, sampling,
19 and testing of air barrier materials, components and assemblies specified in individual Sections shall cooperate
20 with the Architect and the Contractor in performance of the agency's duties. The testing agency shall provide
21 qualified personnel to perform required inspections and tests.
22 1. The agency shall notify the Architect and the Contractor promptly of irregularities or deficiencies
23 observed in the Work during performance of its services.
24 2. The agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract
25 Documents or approve or accept any portion of the Work.
26 3. The agency shall not perform any duties of the Contractor.
- 27 F. Coordination: Coordinate the sequence of activities to accommodate required services with a minimum of delay.
28 Coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections
29 and tests.
30 1. The Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar
31 activities.
32

33 **PART 2 – PRODUCTS – NOT USED**

34
35 **PART 3 - EXECUTION**

36
37 **3.1. FIELD QUALITY CONTROL**

- 38 A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.
- 39 B. Tests and Inspections:
- 40 1. Qualitative Testing and Inspection:
- 41 a. Daily reports of observations, with copies to the Owner, Contractor and Architect.
- 42 b. Continuity of the air barrier system throughout the building enclosure with no gaps, holes.
- 43 c. Structural support of the air barrier system to withstand design air pressures.
- 44 d. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions and mortar
45 droppings, with mortar joints struck flush, or as required by the manufacturer of the air barrier
46 material.
- 47 e. Site conditions for application temperature and dryness of substrates.
- 48 f. Maximum length of exposure time of materials to ultra-violet deterioration.
- 49 g. Surfaces are properly primed.
- 50 h. Laps in material are 2" minimum, shingled in the correct direction (or mastic applied on exposed
51 edges), with no fishmouths.
- 52 i. Mastic applied on cut edges.
- 53 j. Roller has been used to enhance adhesion.
- 54 k. Measure application thickness of liquid-applied materials to manufacturer's specifications for the
55 specific substrate.
- 56 l. Materials used for compatibility.
- 57 m. Transitions at changes in direction, and structural support at gaps.

- 1 n. Connections between assemblies (membrane and sealants) for cleaning, preparation and priming
- 2 of surfaces, structural support, integrity and continuity of seal.
- 3 o. All penetrations sealed.
- 4 2. ASTM E 1186/98 "Standard Practices for Air Leakage Site Detection in Building Envelopes and Air
- 5 Retarder Systems."
- 6 a. Infrared scanning with pressurization/depressurization.
- 7 b. Smoke pencil with pressurization/depressurization.
- 8 c. Pressurization/depressurization with use of anemometer.
- 9 d. Generated sound with sound detection.
- 10 e. Tracer gas measurement of decay rate.
- 11 f. Chamber pressurization/depressurization in conjunction with smoke tracers.
- 12 g. Chamber depressurization using detection liquids.
- 13 3. Quantitative Tests: Provide written test reports of all tests performed, with copies to the Owner,
- 14 Contractor and Architect.
- 15 a. Material compliance for maximum air permeance, ASTM E 2178.
- 16 b. ASTM E 283, Determining rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors
- 17 under Specified Pressure Differences Across the Specimen.
- 18 c. Assemblies, ASTM E 1677, test pressure and allowable air leakage rate to be determined by design
- 19 professional for interior design conditions and location of project.
- 20 d. CAN/CGSB 1986 Standard 149.10, Determination of the Airtightness of Building Envelopes by the
- 21 Fan Depressurization Method.
- 22 e. CAN/CGSB 1996 Standard 149.15 Determination of the Overall Envelope Airtightness of Office
- 23 Buildings by the Fan Depressurization Method Using the Building's Air Handling System.
- 24 f. Canadian National Master Specification Sections 07272 Air Barrier Systems for Exterior Walls of
- 25 Low-Rise Buildings.
- 26 g. Canadian National Master Specification 07272.1 : Durability Assessment of Bead-Applied
- 27 Urethane-Based Sealant Foam for Air Barriers.
- 28 h. Whole building, floors, or suites, ASTM E779, Determining Airtightness of Buildings Air Leakage
- 29 Rate by Single Zone Air Pressurization.
- 30 i. Windows and connections to adjacent opaque assemblies, ASTM E783.
- 31 j. Tracer gas testing, ASTM E741.
- 32 k. Pressure test, ASTM E330.
- 33 l. Bond to substrate, ASTM D4541-95.
- 34 m. Minimum dry or wet film thickness for liquid-applied materials are per the manufacturer's
- 35 requirements.

37 **3.2. REPAIR AND PROTECTION**

- 38 A. Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and
- 39 restore substrates and finishes. Comply with Contract Document requirements for Division 1 Section "Cutting
- 40 and Patching."
- 41 B. Protect construction exposed by or for quality-control service activities, and protect repaired construction.
- 42 C. Repair and protection is Contractor's responsibility, regardless of the assignment of responsibility for inspection,
- 43 testing, or similar services.
- 44
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END OF SECTION

SECTION 01 45 16
FIELD QUALITY CONTROL PROCEDURES

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATION SECTIONS 1
7 1.3. PERFORMANCE REQUIREMENTS..... 1
8 1.4. QUALITY ASSURANCE 2
9 1.5. QUALITY MANAGEMENT OBSERVATION REPORT 2
10 PART 2 – PRODUCTS - THIS SECTION NOT USED 2
11 PART 3 - EXECUTION 2
12 3.1. QUALITY MANAGEMENT RESPONSIBILITIES..... 2
13 3.2. RESPONDING TO A QMO..... 3
14 3.3. GENERAL CONTRACTORS FOLLOW-UP..... 3
15 3.4. QMO CLOSEOUT PROCEDURE..... 3
16 3.5. CONSTRUCTION CLOSEOUT 3
17

PART 1 – GENERAL

1.1. SUMMARY

- 21 A. The City of Madison has developed a multi-faceted Quality Management Program that begins with contract
22 signing and runs through contract closeout to ensure the best quality materials, workmanship, and product are
23 delivered for the contracted Work.
24 1. The Progress Management Web Site is a Construction Management tool that provides contractors and
25 staff a single on-line location for the daily operations and progression of the Work.
26 2. The Quality Management Observation (QMO) is an ongoing observation of the construction process as it
27 progresses. The City of Madison does not use a “Punch List” or “Corrections List” as it is typically known
28 throughout the construction industry. The QMO process acts as an “in progress punch list”.
29 a. By using the QMO process the City of Madison’s goal is to have a zero item punch list prior to the
30 90% progress payment and owner occupancy.
31 B. All contractors shall be required to review the specifications identified in Section 1.2 below, and other related
32 specifications identified therein to become familiar with the terminology and expectations of this City of
33 Madison Public Works contract.
34 C. It is the intent of this specification to outline the requirements, expectations, and responsibilities of the General
35 Contractor (GC), Project Architect, and other representatives of the Owner for items of Quality Assurance and
36 Quality Control.
37 1. This specification is not intended to conflict with Specification 01 40 00 Quality Requirements or other
38 specifications requiring testing and inspecting services.
39 2. This specification does not relieve the GC from any requirements associated with regulatory inspections
40 performed by the City of Madison Building Inspection Unit, or inspectors from other agencies as required
41 by code.
42 3. Any testing performed by an Owner’s Representative does not relieve the GC from performing any
43 testing that may be required by the construction documents.
44

1.2. RELATED SPECIFICATION SECTIONS

- 46 A. Section 01 26 13 Request for Information (RFI)
47 B. Section 01 29 76 Progress Payment Procedures
48 C. Section 01 31 13 Project Coordination
49 D. Section 01 31 23 Project Management Web Site
50 E. Section 01 40 00 Quality Requirements
51 F. Section 01 77 00 Closeout Procedures
52 G. Section 01 78 13 Completion and Correction List
53 H. Section 01 91 00 Commissioning
54

1.3. PERFORMANCE REQUIREMENTS

- 56 A. All contractors shall be responsible for a proper quality assurance/quality control (QA/QC) program throughout
57 the execution of the Work defined within the construction documents, including all recognized construction
58 industry standards and all applicable regulatory codes.

- 1 B. The GC shall be responsible for all of the following:
2 1. Monitor the quality of all workmanship, supplies, materials, and products being installed by all
3 contractors and installers to ensure they meet or exceed the minimum requirements set forth by the
4 construction documents.
5 2. Submit a Request for Information (RFI) whenever manufacturers' instructions or referenced standards
6 conflict with the construction documents before proceeding with the Work.
7 3. Ensure that Work requiring special certifications or licensing is being performed by is being performed
8 and supervised by personnel that meet the appropriate requirements.
9 a. Ensure that all certificates and licenses are current throughout the execution of the project.
10 C. The CoM and its representatives shall perform quality assurance and quality control activities throughout the
11 execution of this project. This in no way relieves the GC of maintaining an acceptable QA/QC program. =
12

13 **1.4. QUALITY ASSURANCE**

- 14 A. The GC shall be responsible for the following:
15 1. All materials, equipment, and products shall be new, clean, undamaged, and meet the performance
16 specifications defined within the construction documents including favorably reviewed submittals.
17 a. Any material, equipment, or product that does not meet the requirements of the construction
18 documents shall be removed and replaced, including any adjacent and related work, at the GCs
19 expense.
20 2. All Work shall be performed by persons properly trained and/or qualified to produce workmanship of the
21 quality specified in the construction documents.
22 3. Providing access to updated as-builts, addenda, submittals, bulletins and other related construction
23 documents at the project site.
24 B. The CoM and its representatives may be responsible for any of the following:
25 1. Attend pre-installation meetings
26 2. Attend construction progress meetings
27 3. Review all submittals
28 4. Conduct field visits for QA/QC purposes, provide feedback to the GC and sub-contractors using Quality
29 Management Observation (QMO) reports.
30 5. Review delivered equipment
31 6. Witness equipment installations, startups, testing as specified in other specifications
32

33 **1.5. QUALITY MANAGEMENT OBSERVATION REPORT**

- 34 A. The Quality Management Observation report or QMO is used as a QA/QC tool by those entities responsible for
35 QA/QC activities, including but not limited to, the GC, CoM, PA, CX agent, etc.
36 B. QMOs are designed to be an early observation of non-conforming construction work before it becomes buried
37 by follow on work. As such it is most often used as an "in progress punch list".
38 C. QMO forms are part of the Quality Control Library on the Project Management Web Site.
39

40 **PART 2 – PRODUCTS - THIS SECTION NOT USED**

41
42 **PART 3 - EXECUTION**

43
44 **3.1. QUALITY MANAGEMENT RESPONSIBILITIES**

- 45 A. While making routine progress visits to the construction project the GC, CPM, CxA and A/E, and applicable others
46 shall observe the details of the construction and installations to ensure that the intent of the construction
47 documents is being followed.
48 B. If during the progress visit there is a determination of contract non-conformance a QMO report shall be initiated
49 to begin the documentation process.
50 1. The GC field superintendent shall be informed immediately of any issue that may cause harm, damage to
51 finished work, or be buried prior to properly filing a QMO report.
52 C. The following information when filing a QMO report:
53 1. Open a QMO report in the Quality Control Library on the Project Management Web Site
54 2. Enter the date and time of the field visit
55 2. Provide references to construction documents if any (examples; specification, drawing page, details,
56 approved submittals, RFI, CB, etc)
57 3. Provide a short title for the observation being made
58 4. Provide a detailed description of the observation being made

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5. Select all categories (Sitework, Structure, Enclosure, Interior, etc) from the given list that may apply to the observation being reported.
 - a. For each category selected additional boxes shall open with contractor names associated with each category.
 6. Select all contractors from the lists provided that may need to be aware of the observation.
 7. Provide any attachments that may help provide reference to the observation.
 8. Click the SAVE button before closing the form.
- D. The software for the Project Management Website will email notifications that a QMO report has been initiated. The software will automatically select and notify the following:
1. The GC, PA, and CPM for all observation reports being filed.
 2. Others depending on the observation categories selected.
 3. Contractors based on the selections made in the sub-contractors lists.

3.2. RESPONDING TO A QMO

- A. All contractors receiving email notification of a QMO Observation shall review the details of the observation.
- B. The GC shall be responsible for determining the course of action required to remedy the non-conforming issue and shall coordinate and direct the contractor(s) responsible for any work related to the observation.
- C. All contractors assigned to remedy the observation by the GC shall provide follow-up responses on the QMO report as follows:
 1. Open the QMO report in the Quality Control Library on the Project Management Web Site.
 2. In the "Follow-Up Response" area enter a description of your follow-up response in the box provided.
 - a. Click "Insert Item" if additional boxes are required.
 3. Add attachments (pictures) if needed to show the work has been completed.
 4. Click the SAVE button before closing the form.

3.3. GENERAL CONTRACTORS FOLLOW-UP

- A. The GC shall inspect the work to ensure that all assigned contractors have remedied the observation to the intent of the construction documents.
- B. The GC shall respond with any additional comments in his/her response box.
 1. If no comments are to be made the GC at a minimum must date the response box to trigger the next work flow.
- C. Click the SAVE button before closing the form.
- D. The software will email a notification to the CPM and the person who initiated the QMO that the issue has been remedied.

3.4. QMO CLOSEOUT PROCEDURE

- A. The person who initiated the QMO shall review the remedied work and if properly corrected shall close and date the QMO form.
 1. Click SAVE and the software will email a notification to the CPM that final review of the Observation is required.
 2. In the event there are still issues the Quality Manager can add additional comments in the response area, click SAVE and re-issue the QMO for additional review as needed.
- B. Once the person who initiated the QMO has closed the item the CPM shall review and verify with the PA that the Observation has been properly remedied and provide final closure on the QMO.

3.5. CONSTRUCTION CLOSEOUT

- A. The GC shall note that successful close out QMOs are required for construction closeout as follows:
 1. Certain progress payments as identified in Specification 01 29 76 are contingent QMO reports being properly closed out.
 2. Specification 01 77 00 defines all construction closeout requirements.

END OF SECTION

SECTION 01 45 29
TESTING LABORATORY SERVICES

1
2
3
4 PART 1 – GENERAL 1
5 1.1. REQUIREMENTS INCLUDED 1
6 1.2. RELATED REQUIREMENTS 1
7 1.3. QUALIFICATION OF LABORATORY 1
8 1.4. LABORATORY DUTIES 1
9 1.5. LIMITATIONS OF AUTHORITY OF TESTING LABORATORY 2
10 1.6. CONTRACTOR’S RESPONSIBILITIES 2
11 1.7. SPECIFIC TEST, INSPECTIONS, AND METHODS REQUIRED 2
12 PART 2 – PRODUCTS – THIS SECTION NOT USED 4
13 PART 3 – EXECUTION – THIS SECTION NOT USED 4
14

PART 1 – GENERAL

1.1. REQUIREMENTS INCLUDED

- 17
18 A. The Contractor shall employ and pay for the services of an independent testing laboratory to perform specified
19 services and testing.
20 B. Testing Laboratory inspection, sampling and testing is required for:
21 1. Section 03 30 00: Cast-In-Place Concrete
22 2. Section 05 12 00: Structural Steel Framing
23 3. Section 05 40 00: Cold-Formed Steel Framing
24 4. Section 31 20 00: Earthwork
25

1.2. RELATED REQUIREMENTS

- 26
27 A. Conditions of the Contract: Inspections and testing required by laws, ordinances, rules, regulations, orders or
28 approvals of public authorities.
29 B. Related Requirements Specified in Other Sections:
30 1. Division 22 and 23: Testing of Mechanical Systems
31 2. Division 26: Testing of Electrical Systems
32

1.3. QUALIFICATION OF LABORATORY

- 33
34 A. Meet “Recommended Requirements of Independent Laboratory Qualification” published by American Council of
35 Independent Laboratories.
36 B. Meet basic requirements of ASTM E 329, “Standards of Recommended Practice for Inspection and Testing
37 Agencies for Concrete and Steel as Used in Construction.”
38 C. Authorized to operate in State in which the Project is located.
39

1.4. LABORATORY DUTIES

- 40
41 A. Cooperate with Owner, A/E and Contractor; provide qualified personnel after due notice.
42 B. Perform specified inspections, sampling and testing of materials and methods of construction:
43 1. Comply with specified standards.
44 2. Ascertain compliance of materials with requirements of Contract Documents.
45 C. Promptly notify the Owner, A/E and Contractor of observed irregularities or deficiencies of work or products.
46 D. Promptly submit written report of each test and inspection; one copy each to A/E, Consulting Engineer, Owner
47 and Contractor. Each report shall include:
48 1. Date issued.
49 2. Project Title and number.
50 3. Testing laboratory name, address and telephone number.
51 4. Name and signature of laboratory inspector.
52 5. Date and time of sampling or inspection.
53 6. Record of temperature and weather conditions.
54 7. Date of test.
55 8. Identification of product and specification section.
56 9. Location of sample or test in the Project.
57 10. Type of inspection or test.
58 11. Results of tests and compliance with Contract Documents.

- 1 12. Interpretation of test results, when requested by A/E or the Contractor.
2 E. Perform additional tests as required by Owner, A/E or the Contractor.
3
4 **1.5. LIMITATIONS OF AUTHORITY OF TESTING LABORATORY**
5 A. Laboratory is not authorized to:
6 1. Release, revoke, alter, or enlarge on requirements of Contract Documents.
7 2. Approve or accept any portions of the Work other than those portions of the Work scheduled for testing.
8 3. Perform any duties of the Contractor.
9
10 **1.6. CONTRACTOR'S RESPONSIBILITIES**
11 A. Cooperate with laboratory personnel, provide access to Work and to manufacturer's operations.
12 B. Secure and deliver to the laboratory, adequate quantities of representative samples of materials proposed to be
13 used and which require testing. Submit concrete mix designs to A/E for approval prior to pouring concrete.
14 C. Provide to the laboratory the preliminary design mix proposed to be used for concrete, and other material mixes
15 that require control by the testing laboratory.
16 D. Furnish copies of Product test reports as required.
17 E. Furnish incidental labor and facilities:
18 1. To provide access to Work to be tested.
19 2. To obtain and handle samples at the Project site or at the source of the product to be tested.
20 3. To facilitate inspections and tests.
21 4. For storage and curing of test samples.
22 F. Notify laboratory sufficiently in advance of operations to allow for laboratory assignment of personnel and
23 scheduling of tests.
24 G. Make arrangements with laboratory and pay for additional samples and tests required for Contractor's
25 convenience.
26 H. Employ and pay for the services of a separate, equally qualified independent testing laboratory to perform
27 additional inspections, sampling and testing required when initial tests indicate work does not comply with
28 Contract Documents.
29 I. Temporarily halt the progress of the Work when tested materials do not comply with Contract Documents and
30 promptly notify the Owner or his designated representative and A/E.
31 J. Remove and replace at no cost to the Owner, all defective materials discovered upon testing not to comply with
32 Contract Documents, including cost for retesting and re-inspecting replaced Work that failed to comply with the
33 Contract Documents.
34
35 **1.7. SPECIFIC TEST, INSPECTIONS, AND METHODS REQUIRED**
36 A. **Section 03 30 00: Cast-In-Place Concrete**
37 1. Secure sample of aggregates Contractor proposes to use and test for compliance with Specifications.
38 2. Certify compliance with Specifications of cement proposed for use by the Contractor.
39 3. Review and approve the Contractor's proposed concrete mix proportions for the required concrete
40 strengths using materials Contractor proposed to use on the project. Incorporate specified admixtures
41 and not less than amounts of cement specified.
42 4. Perform appropriate laboratory tests, including compression tests of cylinders and slump test to
43 substantiate mix designs.
44 5. Inspect and test materials during concrete work to substantiate compliance with Specifications and mix
45 requirements.
46 a. Testing:
47 i. Sample and test concrete in accordance with ASTM C 31, ASTM C 143, ASTM C 172, and
48 ASTM C 231.
49 ii. Perform slump tests in accord with ASTM C 143 from same concrete batch used for test
50 cylinders and record results and comments on compression test reports.
51 iii. Perform compression tests in accordance with ASTM C39.
52 iv. When air-entrained concrete is used, a minimum of one (1) air content test shall be
53 performed in accordance with ASTM C 231 for each set of test cylinders taken.
54 v. Identify all test cylinders with symbols to indicate location on the job where concrete test
55 was made. Record on project record drawings.
56 vi. Strength tests shall be made for: each day's pour; each class of concrete; each change of
57 supplies or sources; and for each 100 cubic yards of concrete or fraction thereof.

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATION SECTIONS 1
7 1.3. QUALITY ASSURANCE 1
8 1.4. TEMPORARY UTILITIES 2
9 1.5. TELECOMMUNICATIONS SERVICES AND WI-FI 2
10 1.6. TEMPORARY SANITARY FACILITIES 2
11 1.7. BARRIERS 2
12 1.8. FENCING 2
13 1.9. EXTERIOR ENCLOSURES 3
14 1.10. SECURITY 3
15 1.11. VEHICULAR ACCESS AND PARKING 3
16 1.12. WASTE REMOVAL 3
17 1.13. PROJECT IDENTIFICATION 3
18 1.14. FIELD OFFICES 3
19 PART 2 - PRODUCTS 3
20 2.1. TEMPORARY PARTITIONS 3
21 2.2. EQUIPMENT 3
22 PART 3 - EXECUTION 4
23 3.1. TEMPORARY FIRE PROTECTION 4
24 3.2. COLLECTION AND DISPOSAL OF WASTE 4
25 3.3. ENVIRONMENTAL PROTECTION 4
26 3.4. REMOVAL OF TEMPORARY UTILITIES, FACILITIES, AND CONTROLS 4
27

PART 1 – GENERAL

1.1. SUMMARY

- A. This Section includes general procedural requirements for temporary facilities and controls including, but not limited to the following:
1. Temporary Utilities
 2. Telecommunications Services
 3. Temporary Sanitary Facilities
 4. Barriers
 5. Fencing
 6. Exterior Enclosures
 7. Security
 8. Vehicular Access and Parking
 6. Waste Removal
 7. Project Identification
 8. Field Offices

1.2. RELATED SPECIFICATION SECTIONS

- A. Section 01 31 19 Progress Meetings
B. Section 01 31 23 Project Management Web Site
C. Section 01 74 19 Construction Waste Management and Disposal

1.3. QUALITY ASSURANCE

- A. Regulations: Comply with industry standards and applicable laws and regulations if authorities having jurisdiction, including but not limited to:
1. Building Code requirements
 2. Health and safety regulations
 3. Utility company regulations
 4. Police, Fire Department and Rescue Squad rules
 5. Environmental protection regulations
 6. Joint Commission - Hospital Accreditation Standards

- 1 B. Standards: Comply with NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition
2 Operations," ANSI A10 Series standards for "Safety Requirements for Construction and Demolition," and NECA
3 Electrical Design Library "Temporary Electrical Facilities".
4 C. Electrical Service: Comply with NEMA, NECA, and UL standards and regulations for temporary electric service.
5 Install service in compliance with NFPA 70 "National Electric Code".
6

7 **1.4. TEMPORARY UTILITIES**

- 8 A. Owner will provide the following:
9 1. Electrical power and metering, consisting of existing facilities.
10 2. Water supply, consisting of existing facilities.
11 B. General:
12 1. Existing facilities may be used.
13 2. New permanent facilities may be used.
14 C. Water Service: water is available from existing building services.
15 1. Use trigger-operated nozzles for water hoses, to avoid waste of water.
16 D. Temporary Electric Power Service: Electrical Contractor shall extend temporary power from existing building
17 services.
18 E. Temporary Lighting: Electrical Contractor shall provide temporary lighting with local switching
19 1. Install and operate temporary lighting, minimum of 30 fc, to fulfill security and protection requirements,
20 without operating the entire system, and will provide adequate illumination for all areas of work,
21 including construction operations and traffic conditions.
22 F. Temporary Heat: General Contractor shall provide temporary heat required by construction activities, for curing
23 or drying of completed installations or protection of installed construction from adverse effects of low
24 temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed
25 installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition
26 required and minimize consumption of energy.
27 1. Heating Facilities: Except where use of the permanent system is authorized, provide vented self-
28 contained LP gas or fuel oil heaters with individual space thermostatic control.
29 a. Use of gasoline-burning space heaters, open flame, or salamander type heating units is
30 prohibited.
31

32 **1.5. TELECOMMUNICATIONS SERVICES AND WI-FI**

- 33 A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization through
34 construction closeout.
35 B. Telecommunications services shall include:
36 1. Windows-based personal computer dedicated to project telecommunications.
37 2. Shared access to the internet via WIFI or similar wireless connection.
38 a. Access must be capable to support minimum of 10 wireless devices.
39 3. Email Account/address dedicated for GC Project Manager of GC Supervisor on site.
40

41 **1.6. TEMPORARY SANITARY FACILITIES**

- 42 A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
43 B. Temporary toilets: Comply with regulations and health codes for the type, number, location, operation, and
44 maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs.
45 1. Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Provide
46 covered waste containers for used material.
47 2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy.
48 C. Maintain daily in clean and sanitary condition
49 D. Water: Provide potable water approved by local health authorities
50

51 **1.7. BARRIERS**

- 52 A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be
53 hazardous to workers or the public and to protect existing facilities and adjacent properties from damage from
54 construction operations and demolition.
55

56 **1.8. FENCING**

- 57 A. Construction: Refer to Plan Documents and Specification Section 01 76 00: Fencing Materials and Barricades
58

1 **1.9. EXTERIOR ENCLOSURES**

- 2 A. Provide temporary weather tight closure of exterior openings to accommodate acceptable working conditions
3 and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures
4 identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors
5 with self-closing hardware and locks.
6

7 **1.10. SECURITY**

- 8 A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized
9 entry, vandalism, or theft.
10

11 **1.11. VEHICULAR ACCESS AND PARKING**

- 12 A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for
13 emergency vehicles.
14 B. Coordinate access and haul routes with governing authorities and Owner.
15 C. Provide and maintain access to fire hydrants, free of obstructions.
16 D. Existing parking areas located at 4602 Sycamore Ave, as designated by Streets Division, may be used for
17 construction parking until SYCAMORE AVE PW MAINT FACILITY UPGRADE is occupied by Owner.
18

19 **1.12. WASTE REMOVAL**

- 20 A. See Section 01 74 19 - Waste Management, for additional requirements.
21 B. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
22 C. Provide containers with lids. Remove trash from site periodically.
23 D. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible
24 containers; locate containers holding flammable material outside the structure unless otherwise approved by the
25 authorities having jurisdiction.
26 E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.
27

28 **1.13. PROJECT IDENTIFICATION**

- 29 A. Provide project identification sign of design and construction indicated in Section 01 58 13.
30 B. Erect on site at location determined by Owner .
31 C. No other signs are allowed without Owner permission except those required by law.
32

33 **1.14. FIELD OFFICES**

- 34 A. Office: Weather tight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy
35 furniture, drawing rack and drawing display table.
36 B. Field Office shall be located 4602 Sycamore Avenue, Madison, WI.
37 C. Provide space for Project Meetings with table and chairs to accommodate a minimum of 15 persons.
38

39 **PART 2 - PRODUCTS**

40
41 **2.1. TEMPORARY PARTITIONS**

- 42 A. Provide dustproof partitions to limit dust and dirt migration and to separate occupied areas from fumes and
43 noise.
44 1. Non-fire rated partitions, standard
45 a. Wood stud framing, 6-mil polyethylene
46

47 **2.2. EQUIPMENT**

- 48 A. Temporary Lifts and Hoists: Contractors requiring temporary lifts and hoists shall provide facilities for hoisting
49 materials and employees.
50 B. Electrical Outlets: Electrical Contractor shall provide properly configured NEMA polarized outlets to prevent
51 insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault
52 circuit interrupters, reset button and pilot light, for connection of power tools and equipment.
53 C. Electrical Power Cords: Contractors requiring power cords shall provide grounded extension cords; use "hard-
54 service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate
55 lengths of electric cords, if single lengths will not reach areas where construction activities are in progress. Do
56 not exceed safe length-voltage ratio.

- 1 D. Lamps and Light Fixtures: Electrical Contractor shall provide general service incandescent lamps of wattage
- 2 required for adequate illumination. Provide guard cages or tempered glass enclosures, where exposed to
- 3 breakage. Provide exterior fixtures where exposed to moisture.
- 4 E. Heating Units: General Contractor shall provide temporary heating units that have been tested and labeled by
- 5 UL, FM or another recognized trade association related to the type of fuel being consumed.
- 6 F. First Aid Supplies: General Contractor shall provide first aid supplies complying with governing regulations.
- 7 G. Fire Extinguishers: General Contractor shall provide hand-carried, portable UL-rated, fire extinguishers of NFPA
- 8 recommended classes for the exposures, extinguishing agent and size required by location and class of fire
- 9 exposure.

10
11 **PART 3 - EXECUTION**

12
13 **3.1. TEMPORARY FIRE PROTECTION**

- 14 A. Until fire protection needs are supplied by permanent facilities, General Contractor shall install and maintain
- 15 temporary fire protection facilities of the types needed to protect against reasonably predictable and
- 16 controllable fire losses.
- 17 B. Comply with NFPA 10 "Standard for Portable Fire Extinguishers," and NFPA 241 "Standard for Safeguarding
- 18 Construction, Alterations and Demolition Operations".
- 19 C. Locate fire extinguishers where convenient and effective for their intended purpose.
- 20 D. Store combustible materials in containers in fire-safe locations.
- 21 E. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways
- 22 and other access routes for fighting fires.
- 23 F. Prohibit smoking on the premises.
- 24 G. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition
- 25 according to requirements of authorities having jurisdiction.
- 26 H. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site
- 27 I. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods
- 28 and procedures. Post warnings and information.

29
30 **3.2. COLLECTION AND DISPOSAL OF WASTE**

- 31 A. Collect waste from construction areas and elsewhere daily
- 32 B. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce
- 33 requirements strictly.
- 34 C. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to
- 35 rise above 80 deg F.
- 36 D. Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing
- 37 properly. Dispose of material in a lawful manner.

38
39 **3.3. ENVIRONMENTAL PROTECTION**

- 40 A. Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply
- 41 with environmental regulations, and minimize the possibility that air, waterways and subsoil might be
- 42 contaminated or polluted, or that other undesirable effects might result.
- 43 B. Avoid use of tools and equipment which produce harmful noise.
- 44 C. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms
- 45 near the site.

46
47 **3.4. REMOVAL OF TEMPORARY UTILITIES, FACILITIES, AND CONTROLS**

- 48 A. Remove temporary utilities, equipment, facilities, and materials prior to Substantial Completion inspection.
- 49 B. Remove underground installations to a minimum depth of 2 feet (600 mm). Grade site as indicated.
- 50 C. Clean and repair damage caused by installation or use of temporary work.
- 51 D. Restore existing facilities used during construction to original condition.
- 52 E. Restore new permanent facilities used during construction to specified condition.

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56 **END OF SECTION**

**SECTION 01 60 00
PRODUCT REQUIREMENTS**

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2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 1.3. QUALITY ASSURANCE 1
8 PART 2 – PRODUCTS – THIS SECTION NOT USED 2
9 PART 3 - EXECUTION 2
10 3.1. GENERAL CONTRACTOR REQUIREMENTS 2
11 3.2. BULK MATERIAL 3
12 3.3. DRY PACKAGED MATERIAL 3
13 3.4. STRUCTURAL AND FRAMING MATERIAL 3
14 3.5. EQUIPMENT 3
15 3.6. FINISH PRODUCTS 3
16 3.7. DUCTWORK, PIPING, AND CONDUIT 3
17 3.8. OWNER PROVIDED, CONTRACTOR INSTALLED EQUIPMENT 4
18

PART 1 – GENERAL

1.1. SUMMARY

- 22 A. The purpose of this specification is to provide general guidelines and responsibilities related to the receiving,
23 handling, and storage of all materials and products from arrival on the job site through installation.
24 1. Immediate inspection of delivered goods means a timely replacement if damaged.
25 2. Proper storage helps prevent damage and loss by weather, vandalism, theft, and job site accidents.
26 3. Proper storage helps with job site performance and safety.
27 2. Proper handling helps prevent damage and job site accidents.
28 B. Each Contractor shall be directly responsible for the receiving, handling, and storage of all materials and
29 products associated with the Work of their Division or Trade.
30 C. Each Contractor responsible for Work associated with Owner provided materials or products shall be responsible
31 for the receiving, handling and storage of the material/product as outlined in Section 3.8 below..
32

1.2. RELATED SPECIFICATIONS

- 34 A. Parts of this specification will reference articles within “The City of Madison Standard Specifications for Public
35 Works Construction”.
36 1. Use the following link to access the Standard Specifications web page:
37 <http://www.cityofmadison.com/business/pw/specs.cfm>
38 a. Click on the “Part” chapter identified in the specification text. For example if the specification
39 says “Refer to City of Madison Standard Specification 210.2” click the link for Part II, the Part II
40 PDF will open.
41 b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you
42 to the referenced text.
43 c. City Standard Detail Drawings (SDD) may be located from the index in Part VIII.
44 B. Section 01 57 21 Indoor Air Quality
45 C. Section 01 74 13 Progress Cleaning
46 D. Section 01 76 00 Protecting Installed Construction
47 E. Other Divisions and Specifications that may address more specifically the requirements for the storage and
48 handling of materials and products associated Work of other Divisions or Trades.
49

1.3. QUALITY ASSURANCE

- 51 A. The GC shall be responsible for ensuring that these minimum storage and handling requirements are met by all
52 contractors on the project site including but not limited to the following:
53 1. Receiving deliveries of materials, products, and equipment.
54 a. Inspect all deliveries upon arrival for damage, completeness, and compliance with the
55 construction documents.
56 i. Deliveries shall remain in original packaging or crates, shipping manifest shall be kept with
57 the delivery and the packaging shall have visible identification of the items within the
58 packaging.

- 1 b. Immediately report any damaged products or equipment to the GC, begin arrangements for
2 immediate replacement.
- 3 c. Materials or equipment that have been damaged, are incomplete, or do not comply with the
4 construction documents shall not be permitted to be installed.
- 5 2. All materials and products shall be stored within the designated limits of the project site. Only store the
6 amount of material necessary for upcoming operations so as not to interfere with other construction
7 activities and access to Work by the Owner and Architect. Any offsite storage shall be at the expense of
8 the contractor storing the material or product. All offsite storage requirements shall comply with this
9 specification. All offsite storage of materials is subject to Owner Representative Quality Management
10 review at any time.
- 11 3. Large storage containers may be used but shall be weather tight, securable, placed on concrete blocks,
12 timbers, or jack stands and shall be level.
- 13 4. When lifting equipment is required the equipment rating shall be greater than the loading requirements
14 of the item being lifted. In addition all of the following shall apply as necessary:
- 15 a. Only designated and/or designed lift points shall be used.
- 16 b. Large items shall have tag lines and handlers at all times during lifting operations.
- 17 c. Lift at multiple points as needed to prevent bending.
- 18 5. Materials and products stored inside of the structure shall comply with all of the following:
- 19 a. Storage shall not be allowed to impede the flow of work in progress.
- 20 b. Storage shall not be allowed to hide completed work from review and inspections.
- 21 c. Storage shall not exceed the design loads of the structural components it is being stored upon.
- 22 6. All materials and products shall be stored according the manufacturers minimum recommended
23 requirements. All of the following shall be considered before storing any product or material:
- 24 a. Dust and dirt
- 25 b. Moisture and humidity, including rain and snow
- 26 c. Excessive temperatures, direct sun, etc
- 27 d. Product or material weight and size
- 28 e. Potential for breakage
- 29 f. Product incompatibility with other products such as corrosiveness, chemical reactions,
30 flammability, etc.
- 31 g. Product or material value and replacement cost
- 32 7. The Contractor shall be responsible for providing fully functional tarps or plastic wrap, to protect
33 materials and products from the weather. All coverings shall be free of large holes and tears, and shall be
34 tied, strapped, or weighted down to resist blowing.
- 35 8. The Contractor shall be responsible for any temporary heating, cooling, or other utility requirement that
36 may be associated with the storage of a material or product.
- 37 9. The Contractor shall be responsible for securing materials and products of value such as copper, A/V
38 equipment, etc. Such items shall be stored in securable shipping containers, job trailers or other such
39 storage devices. Container shall be kept secured when not in use.
- 40 B. The GC shall inspect the job site daily to ensure that all products and materials stay weather tight and are
41 secured against vandalism or theft as required by this specification.
- 42 C. The Owners Representative may at any time request improvements regarding storage of any material or product
43 being provided under these construction documents.
- 44

45 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

46

47 **PART 3 - EXECUTION**

48

49 **3.1. GENERAL CONTRACTOR REQUIREMENTS**

- 50 A. Designate material storage and handling areas as needed including all of the following:
- 51 1. Designate specific areas of the site for delivery and storage of materials to be used during the execution
52 of the Work.
- 53 2. Designated areas shall not be located so as to interfere with the installation of any Work including Work
54 by others such as the installation of utilities or the maintenance of existing utilities. This shall include not
55 storing items in active utility easements as designated by the site plan.
- 56 B. Arrange for openings in the building as needed to allow delivery and installation of large items. Openings shall
57 be appropriately sized to include the use of booms, slings, and other such lifting devices that may be larger than
58 the item being installed.

- 1 1. When openings are required in completed Work (new or existing) the GC shall be responsible for
2 providing an appropriate opening and for restoring the opening to the original or better condition upon
3 completion. Restoration shall be weather tight and complete.
4 C. Repeated moving and handling of items being stored shall not be allowed. The GC shall be responsible for any
5 damage and replacement because of mishandling or excessive handling.
6

7 **3.2. BULK MATERIAL**

- 8 A. Bulk material such as sand, gravel, top soil and other types of fill shall be stored away from the construction area
9 and shall be stock piled as follows:
10 1. All bulk material shall be piled safely and efficiently in as small an area as practical. Only store the
11 amount of material necessary for upcoming operations so as not to interfere with other construction
12 activities and access to Work by the Owner and Architect.
13 2. All stock piles shall have silt fence/sock properly installed around the perimeter to prevent erosion and
14 loss of material. Refer to City of Madison Standard Specification Section 210.1(f) and other related
15 specification or details.
16 3. Fine grained material shall be protected with tarps to prevent blowing. Tarps shall be weighted or staked
17 to stay in place.
18 B. Bulk material such as brick, concrete block, stone, and other palletized materials shall be stored on original
19 shipping pallets until ready for use.
20

21 **3.3. DRY PACKAGED MATERIAL**

- 22 A. Dry packaged material such as cement, mortar, etc shall be stored on pallets, on slightly elevated ground or clear
23 stone pad to keep water away from the base of the material being stored. Protect from moisture.
24

25 **3.4. STRUCTURAL AND FRAMING MATERIAL**

- 26 A. All structural and framing material shall be stored in an organized manner arranged by type, size and dimension.
27 Materials shall be stored on pallets or timbers as necessary and shall not be allowed to lie directly on the ground.
28 B. Long and heavy items shall be supported at several points to prevent bending and warping.
29

30 **3.5. EQUIPMENT**

- 31 A. Equipment delivered to the site shall be stored away from all construction activities until the item can either be
32 moved inside or properly installed.
33 B. Equipment shall be stored on slightly elevated ground or clear stone pad to keep water away from the base of
34 the equipment.
35

36 **3.6. FINISH PRODUCTS**

- 37 A. Finish products such as flooring, tile, counters, lockers, toilets, partitions, lighting, and other similar items should
38 not be delivered and stored until the structure has been enclosed, is weather tight, temperature controlled and
39 the contractor is ready for such items to be installed.
40 1. Storage of finished products outside for any length of time shall not be allowed.
41 B. Products that cannot be stored inside the structure shall be stored in secured containers or job trailers until such
42 time as they are ready to be installed.
43 C. Products with a high potential for breakage such as glass, mirrors, tiles, toilet fixtures, etc. shall be stored with
44 additional protection as necessary such as but not limited to the following:
45 1. Store in original shipping containers until ready for installation.
46 2. Do not store in high traffic areas.
47 3. Shield with other materials such as cardboard, plywood, or similar products.
48

49 **3.7. DUCTWORK, PIPING, AND CONDUIT**

- 50 A. All piping and conduit shall be stored horizontally unless otherwise specified by the manufacturer or Division and
51 Trade Specifications.
52 1. Do not store directly on grade.
53 2. Cover metal pipes and tubes to prevent rust and corrosion, allow ventilation to prevent condensation.
54 3. Whenever possible use pipe stands for storing pipe and conduit to prevent tripping and rolling hazards.
55 B. All ductwork shall be stored horizontally or vertically as necessary unless otherwise specified by the
56 manufacturer or Division and Trade Specifications.
57 1. During storage, both ends of each duct shall be protected with plastic sheathing to prevent dust and dirt
58 from getting inside the duct. Sheathing shall be sufficiently taped to the duct.

- 1 2. After installation, free/open ends shall remain protected with taped plastic sheathing and or temporary
2 filters as specified by division or Trade specifications.
3

4 **3.8. OWNER PROVIDED, CONTRACTOR INSTALLED EQUIPMENT**

5 A. Section 3.8.A. shall apply to all equipment being provided to any contractor directly from the Owner for
6 installation under the contract.

7 1. The Owner or Owners Representative shall do the following:

- 8 a. Inspect all deliveries upon receipt and notify manufacturer of any issues directly.
9 b. Review the received shipment with the contractor.

- 10 i. Only provide products or materials to the contractor that were not damaged through
11 shipping or handling.
12 ii. Confirm missing products or materials and anticipated delivery schedule if known.

13 2. The Contractor responsible for the installation of Work associated with Owner provided materials or
14 products shall “take ownership” and provide safe and secure storage and handling as previously
15 described within this specification.

- 16 i. The Contractor shall be liable for the repair or replacement of any material or product
17 damaged after taking ownership of the product from receipt through final acceptance.

18 B. Section 3.8.B. shall apply to all equipment being provided by the Owner but shipped directly to any sub-
19 contractor or the project site for installation under the contract.

20 1. The GC and/or Contractor responsible for the Work associated with the Owner provided materials or
21 products shall do the following:

- 22 a. Inspect all deliveries upon receipt and notify the Owner or Owners Representative of any issues
23 directly.

24 i. Owner or Owners Representative shall notify manufacturer of any issues directly.

- 25 b. Review the received shipment with the Owner or Owners Representative

26 i. Confirm missing products or materials and anticipated delivery schedule if known.

27 2. The Contractor shall “take ownership” and provide safe and secure storage and handling as previously
28 described within this specification.

- 29 i. The Contractor shall be liable for the repair or replacement of any material or product
30 damaged after taking ownership of the product from receipt through final acceptance.
31
32
33

34 **END OF SECTION**
35

**SECTION 01 71 23
FIELD ENGINEERING**

1
2
3
4 PART 1 – GENERAL 1
5 1.1. REQUIREMENTS INCLUDED 1
6 1.2. RELATED REQUIREMENTS 1
7 1.3. PROCEDURES 1
8 1.4. PROJECT SURVEY REQUIREMENTS 1
9 1.5. RECORDS 1
10 PART 2 – PRODUCTS – THIS SECTION NOT USED 1
11 PART 3 – EXECUTION – THIS SECTION NOT USED 1
12

13 **PART 1 – GENERAL**

14
15 **1.1. REQUIREMENTS INCLUDED**

- 16 A. The Contractor shall provide and pay for field engineering services required for the Project:
17 1. Land surveying services required to execute the Work, to include building addition location and layout,
18 and location and layout of pavements and all proposed site improvements.
19 2. Verification of existing building dimensions, elevations, and relationship to proposed additions.
20 3. Professional Engineering services to execute Contractor’s construction methods.
21 4. Registered Professional Engineer in the State of Wisconsin to determine the load capacity of the existing
22 structure for use of Contractors temporary facilities, equipment, lifts, machinery, material storage, etc.
23

24 **1.2. RELATED REQUIREMENTS**

- 25 A. Conditions of the Contract
26

27 **1.3. PROCEDURES**

- 28 A. Surveys shall describe physical characteristics, legal limitations and utility locations for the site of the Project, and
29 a legal description of the site. If information is incomplete, notify Owner to furnish additional information.
30 Verify easement locations, front, side, and rear yard restrictions, if any; and property line locations. Verify
31 control points, and establish bench marks. Locate and layout roads, walks, parking areas and all civil structures
32 and all proposed site improvements.
33 B. Verify locations of underground services, utilities, structures, etc. which may be encountered or affected by the
34 Work.
35

36 **1.4. PROJECT SURVEY REQUIREMENTS**

- 37 A. Using datum, the lot lines and present levels have been established as indicated on the Drawings. Other grades,
38 lines, levels and benchmarks, shall be established and maintained by the Contractor, who shall be responsible for
39 them. As work progresses, the Contractor shall layout on forms and floor, the locations of all partitions, walls
40 and fix column centerlines as a guide to all trades. The Contractor shall make provision to preserve property line
41 stakes, benchmarks, or datum point. If any are lost, displaced or disturbed through neglect of any Contractor,
42 Contractor’s agents or employee, the Contractor responsible shall pay the cost of restoration.
43 B. Establish lines and levels, locate and layout, by instrumentation and similar appropriate means, additions,
44 column locations, floor levels, stakes for walks, etc.
45 C. Provide data to all Subcontractors for their use as applicable.
46 D. From time to time, verify layouts by same methods.
47

48 **1.5. RECORDS**

- 49 A. Maintain a complete, accurate log of all control and survey work as it progresses.
50

51 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

52
53 **PART 3 – EXECUTION – THIS SECTION NOT USED**
54
55

56 **END OF SECTION**

**SECTION 01 73 29
CUTTING AND PATCHING**

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATION SECTIONS 1
7 1.3. DEFINITIONS 1
8 1.4. QUALITY ASSURANCE 1
9 1.5. WARRANTY 2
10 PART 2 - MATERIALS 2
11 2.1. GENERAL 2
12 PART 3 - EXECUTION 2
13 3.1. EXAMINATION 2
14 3.2. PREPARATION 2
15 3.3. PERFORMANCE 2
16 3.4. CLEANUP AND RESTORATION 3
17

PART 1 – GENERAL

1.1. SUMMARY

- 21 A. This Section includes general procedural requirements for cutting and patching including, but not limited to the
22 following:
23 1. Examination
24 2. Preparation
25 3. Performance
26 4. Cleanup and Restoration
27

1.2. RELATED SPECIFICATION SECTIONS

- 29 A. Divisions 02 through 32 Sections for specific requirements and limitations applicable to cutting and patching
30 individual parts of the Work.
31 B. Division 07 Section "Penetration Fire Stopping" for patching fire-rated construction.
32

1.3. DEFINITIONS

- 34 A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.
35 B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other
36 Work.
37 C. Level Alpha
38

1.4. QUALITY ASSURANCE

- 40 A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying
41 capacity or load-deflection ratio.
42 B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results
43 in reducing their capacity to perform as intended or that may result in increased maintenance or decreased
44 operational life or safety.
45 C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that
46 could change their load-carrying capacity that results in reducing their capacity to perform as intended, or that
47 may result in increased maintenance or decreased operational life or safety. Some miscellaneous elements
48 include the following:
49 1. Water, moisture, or vapor barriers
50 2. Membranes and flashings
51 3. Exterior curtain-wall construction
52 4. Equipment supports
53 5. Piping, ductwork, vessels, and equipment
54 6. Noise and vibration control elements and systems
55 D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and
56 patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that
57 would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has
58 been cut and patched in a visually unsatisfactory manner.

1 **1.5. WARRANTY**

- 2 A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting
3 and patching operations, by methods and with materials so as not to void existing warranties.
4 B. All cutting and patching work performed under this contract shall be warranted like new work as defined by the
5 Specification governing the work.
6

7 **PART 2 - MATERIALS**

8
9 **2.1. GENERAL**

- 10 A. Comply with requirements specified within other sections of the Specifications.
11 B. In-Place Materials: Use materials identical to existing in-place materials. For exposed surfaces use materials that
12 visually match in-place adjacent surfaces to the fullest extent possible.
13 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the
14 visual and functional performance of in-place materials.
15

16 **PART 3 - EXECUTION**

17
18 **3.1. EXAMINATION**

- 19 A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
20 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including
21 compatibility with in-place finishes or primers.
22 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.
23

24 **3.2. PREPARATION**

- 25 A. Temporary Support: Provide temporary support of Work to be cut.
26 B. Protection: Protect in-place construction and existing conditions during cutting and patching to prevent damage.
27 Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting
28 and patching operations. If the failure to protect, or the lack of protection, of in-place construction and/or
29 existing conditions results in damage, the contractor shall be responsible for repair to previous condition.
30 C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
31 D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be
32 removed, relocated, or abandoned, bypass such services/systems before cutting to eliminate interruption to
33 occupied areas.
34

35 **3.3. PERFORMANCE**

- 36 A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the
37 earliest feasible time, and complete without delay.
38 1. Cut in-place construction to provide for installation of other components or performance of other
39 construction, and subsequently patch as required to restore surfaces to their original condition.
40 B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations,
41 including excavation, using methods least likely to damage elements retained or adjoining construction. If
42 possible, review proposed procedures with original Installer; comply with original Installer's written
43 recommendations.
44 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and
45 chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance
46 of adjacent surfaces. Temporarily cover openings when not in use.
47 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
48 3. Concrete or Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
49 4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by
50 cutting and patching operations.
51 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap,
52 valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other
53 foreign matter after cutting.
54 6. Proceed with patching after construction operations requiring cutting are complete.
55 C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following
56 performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and
57 comply with installation requirements specified in other Sections.

1 D. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of
2 installation.
3

4 **3.4. CLEANUP AND RESTORATION**

- 5 A. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a
6 manner that will eliminate evidence of patching and refinishing.
- 7 1. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - 8 2. Restore damaged pipe covering to its original condition.
 - 9 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another,
10 patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish,
11 color, texture, and appearance. Remove in-place floor and wall coverings and replace with new
12 materials, if necessary, to achieve uniform color and appearance.
 - 13 4. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch
14 and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats
15 until patch blends with adjacent surfaces.
 - 16 5. Ceilings: Patch, repair, or re-hang in-place ceilings as necessary to provide an even-plane surface of
17 uniform appearance.
 - 18 6. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weather tight
19 condition.
 - 20 7. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint,
21 mortar, oils, putty, and similar materials.
 - 22 8. Any smoke and fire caulking that has been disturbed must be replaced by the Contractor as required by
23 code.
24

25
26
27 **END OF SECTION**
28

**SECTION 01 74 13
PROGRESS CLEANING**

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 1.3. QUALITY ASSURANCE 1
8 PART 2 - PRODUCTS 1
9 2.1. CLEANING MATERIALS AND EQUIPMENT 1
10 PART 3 - EXECUTION 1
11 3.1. SAFETY CLEANING 1
12 3.2. PROJECT SITE CLEANING 2
13 3.3. PROGRESS CLEANING 2
14 3.4. FINAL CLEANING 3
15 3.5. CALL BACK WORK 4
16

PART 1 – GENERAL

1.1. SUMMARY

- 20 A. Throughout the execution of this contract all contractors shall be responsible for maintaining the project site in a
21 standard of cleanliness as described in this specification.
22 B. All contractors shall also comply with the requirements for cleaning as described in other specifications.
23 C. Work included in this specification shall include but not be limited to:
24 1. Safety Cleaning
25 2. Project Site Cleaning
26 3. Progress Cleaning
27 4. Final Cleaning
28

1.2. RELATED SPECIFICATIONS

- 29
30 A. Section 01 35 00 Special Procedures
31 B. Section 01 60 00 Product Requirements
32 C. Section 01 74 19 Construction Waste Management and Disposal
33 D. Section 01 76 00 Protecting Installed Construction
34

1.3. QUALITY ASSURANCE

- 35
36 A. The General Contractor (GC) shall conduct daily inspections, more often if necessary, of the entire project site to
37 ensure the requirements of cleanliness are being met as described within these specifications.
38 B. All contractors shall comply with other regulatory requirements as they apply to waste recycling, reuse, hauling,
39 and disposal requirements of any governmental authority having jurisdiction.
40 C. The Owner reserves the right to have work done by others in the event any contractor fails to perform cleaning
41 as described within these specifications. The cost of any Owner provided cleaning shall be charged to the
42 contractor through a deduct change order.
43

PART 2 - PRODUCTS

2.1. CLEANING MATERIALS AND EQUIPMENT

- 44
45
46 A. The Contractor shall provide all required personnel, equipment, and materials necessary to maintain the
47 required level of cleanliness as described in this specification.
48 B. Use only cleaning materials and equipment that are compatible with the surface being cleaned, as
49 recommended by the manufacturer, or as approved by the A/E.
50 C. Use only cleaning materials, equipment, and methods as recommended in the manufacturers care and use guide
51 of the material, finish or equipment being cleaned.
52
53

PART 3 - EXECUTION

3.1. SAFETY CLEANING

- 54
55
56 A. All Contractors shall be responsible for safety cleaning as required by OSHA and other regulatory requirements
57 as applicable.
58

- 1 B. Safety Cleaning shall include but not be limited to the following:
2 1. All work areas, passageways, ramps, and stairs shall be kept free of debris, scrap materials, pallets, and
3 other large items that would obstruct exiting routes. Small items such as tools, electrical cords, etc are
4 picked up when not in use.
5 2. Form and scrap lumber shall have nails/screws removed or bent over. Lumber shall be neatly stacked in
6 an area designated by the GC.
7 3. Spills of oil, grease, and other such liquids shall be cleaned immediately or sprinkled with sand/oil-dry
8 first, then cleaned.
9 4. Oily, flammable, or hazardous items shall be stored in appropriate covered containers and storage
10 devices unless actively being used.
11 5. Oily, or flammable rags, and other such waste shall only be disposed of in authorized covered containers.
12 6. Disposal by burning shall not be allowed at any time.

13
14 **3.2. PROJECT SITE CLEANING**

- 15 A. This section applies to the general cleanliness of the project site as a whole for the duration of the execution of
16 this contract.
17 B. Exterior Project Site Areas
18 1. The GC and other Contractors as appropriate shall ensure the following levels of cleanliness are applied
19 to the exterior project site areas.
20 a. The overall appearance of the project site is neat and orderly. Defined areas for material storage,
21 material waste, job trailers, and the project area are clean and well maintained.
22 b. The construction fence is maintained, erect with no gaps, and properly posted per all regulatory
23 requirements.
24 c. All erosion control measures are properly maintained, cleaned, and repaired as necessary.
25 d. All loose materials (construction or waste) are properly tied or weighted down to resist blowing.
26 e. All construction materials are properly covered with fully functional tarps or plastic wrap,
27 protected from the weather, coverings are tied, strapped, or weighted down to resist blowing.
28 f. Dust control is applied as necessary or as required by any regulatory requirement.
29 C. Interior Project Site Areas
30 1. All Contractors shall ensure the following levels of cleanliness are applied to the interior project site
31 areas.
32 a. The overall appearance of the project site is neat and orderly. Defined areas for material storage,
33 material waste, and project area are clean and well maintained.
34 b. Stored materials are kept in original shipping containers whenever possible. Stored materials not
35 in shipping containers are properly stored and protected according to other applicable
36 specifications.
37 c. All scraps and debris shall be properly disposed of as often as necessary to keep work areas,
38 passageways, stairs, and ramps free of debris and clear for emergency exiting.
39 d. Boxes, pallets, and other such shipping containers, are broken down, stored in a consolidated area
40 or, disposed of as often as is necessary.
41 e. Hand tools, supplies, materials, electrical cords not being used are picked up and stored in gang
42 boxes, not left as walking hazards in work areas, passageways, etc.
43 D. Job Trailer
44 1. The interior of the job trailer shall be kept clean and available as a work space at all times. The GC shall
45 ensure that the following is provided for within the job trailer:
46 a. Meeting space including tables and chairs.
47 b. Sufficient space for all contractors to access the official construction documents, provide updates,
48 etc.

49
50 **3.3. PROGRESS CLEANING**

- 51 A. This sub-section shall apply to all Progress Cleaning prior to the installation of finishes, fixtures, and trim (IE
52 rough-in).
53 1. For the purposes of this section "clean" shall be defined as a level of cleanliness free of dust and other
54 material capable of being removed by use of reasonable effort using a good quality janitor broom and
55 shop-vac.
56 2. Daily cleanings shall be conducted by all contractors at the end of the work day as follows:
57 a. Debris in excavated areas shall be removed prior to backfill and compaction.
58 b. Debris in wall cavities, chase spaces, etc shall be removed prior to enclosing the spaces.

- 1 c. Large items shall be properly stored, returned to designated areas, or disposed of as necessary.
2 d. Loose materials shall be properly secured.
3 e. Flammable or hazardous materials are properly stored or disposed of.
4 3. Weekly cleaning shall be conducted by all contractors as designated by the GC. Weekly cleanings shall
5 include all the above for a daily cleaning and other necessary cleaning as designated by the GC.
6 B. This sub-section shall apply to Progress Cleaning in preparation for the installation of finishes, fixtures, and trim.
7 a. Surfaces receiving finishes shall be thoroughly cleaned prior to contractors applying finish
8 materials. The GC shall be responsible for inspecting the area and surfaces being cleaned for
9 finish prior to the sub-contractor applying the finish. This shall include but not be limited to the
10 following:
11 i. Wall surfaces shall be wiped clean of dirt and oily residues, vacuumed free of dust, and
12 shall be free of surface imperfections prior to painting or installing wall coverings.
13 ii. Metal surfaces shall be wiped clean of dirt and oily residues, and be free of surface
14 imperfections prior to painting.
15 iii. Flooring shall be broom swept of large and loose items then vacuumed clean of dust and
16 small particles, and damp mopped clean and dried prior to installing any flooring finish.
17 Additional cleaning may be required depending on the preparation requirements
18 recommended by the flooring material manufacturer.
19 C. This sub-section shall apply to Progress Cleaning after the installation of finishes, fixtures, and trim.
20 1. For the purposes of this section "clean" shall be defined as a level of cleanliness free of dust and other
21 material capable of damaging or visually disfiguring finished work, finishes, fixtures, and trim.
22 2. Progress Cleaning at this point in the contract shall be conducted immediately as follows:
23 a. Dust, dirt, etc shall be swept and vacuumed off of finish flooring and trim.
24 b. Liquid spills shall be cleaned up according to the spill type. This shall include drips and spills
25 caused by paint, stain, sealants, and other such items.
26 3. The Contractor(s) at no additional cost to the Owner shall be responsible for replacing any finished work,
27 finishes, fixtures, and trim damaged or disfigured because of inadequate or improper cleaning.
28

29 3.4. FINAL CLEANING

- 30 A. As noted in Specification 01 29 76 Progress Payment Procedures, Progress Payment Milestone Schedule, Final
31 Cleaning shall not be conducted prior to requesting the 90% contract total progress payment and all of the
32 following shall be complete:
33 1. All final regulatory inspections including but not limited to Building Inspection Department and Madison
34 Fire Department inspections have been successfully completed.
35 2. All Quality Management Observation (QMO) reports have been closed out.
36 3. All Demonstration and Training has been completed.
37 4. All Attic Stock has been consolidated and located to its designated area
38 5. All protection for installed construction shall be removed prior to final cleaning by the contractor
39 responsible for providing the protections. This shall include the removal of any adhesive residues left
40 behind from tapes. Contractors shall only use manufacturer authorized cleaning materials for removing
41 adhesives, etc.
42 B. For the purposes of this section "clean" shall be defined as a level of cleanliness generally provided by skilled
43 cleaners using commercial quality building maintenance equipment and materials.
44 C. The GC shall be responsible for ensuring that all requirements under this section are being met.
45 D. General Requirements
46 1. Employ experienced personnel or professional cleaners for final cleaning as necessary for the areas or
47 equipment being cleaned.
48 2. Cleaning equipment used shall be commercial grade equipment commonly used by professional cleaners.
49 3. Cleaning equipment and materials shall be cleaned, rinsed, or replaced to ensure a uniform level of
50 cleanliness is being maintained during the final cleaning. This shall include but not be limited to the
51 following:
52 a. Vacuum cleaner bags and/or filters are changed and/or cleaned as often as necessary.
53 b. Dust & wipe down rags are washed, rinsed, or replaced before starting each room.
54 c. Mopping equipment
55 i. Mop water for washing shall have cleaning solution added to the amount and temperature
56 per manufacturer's recommendations. Mop washing water shall be replaced often to
57 maintain the levels of the cleaning solution and temperature required.
58 ii. Mop water for rinsing shall remain clean, clear, and be replaced as often as necessary.

SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICAITONS 1
7 1.3. CITY ORDINANCES 1
8 1.4. DEFINITIONS..... 1
9 1.5. PERFORMANCE REQUIREMENTS..... 2
10 1.6. SUBMITTALS AND DELIVERABLES..... 2
11 1.7. QUALITY ASSURANCE 3
12 1.8. WASTE MANAGEMENT PLAN 3
13 PART 2 – PRODUCTS – THIS SECTION NOT USED 4
14 PART 3 - EXECUTION 4
15 3.1. PLAN IMPLEMENTATION 4
16 3.2. HAZARDOUS AND TOXIC WASTE 4
17 3.3. GENERAL GUIDELINES FOR ALL WASTES 4
18 3.4. GUIDELINES FOR RECYCLABLE, RE-USABLE, AND SALVAGEABLE WASTE 5
19 3.5. GUIDELINES FOR DISPOSAL OF WASTES 6
20

PART 1 – GENERAL

1.1. SUMMARY

- 24 A. This specification includes administrative and procedural requirements for the recycling, re-use, salvaging, and
25 disposal of non-hazardous construction and demolition waste.
26 B. The General Contractor (GC) shall be fully responsible for complying with all applicable ordinances and other
27 such regulatory requirements during the execution of this contract.
28

1.2. RELATED SPECIFICAITONS

- 29 A. 01 29 76 Progress Payment Procedures
30 B. 01 31 23 Project Management Web site
31 C. 01 32 19 Submittals Schedule
32 D. 01 33 23 Submittals
33 E. 01 77 00 Closeout Procedures
34 F. Other Divisions and Specifications that may address the proper disposal of construction or demolition waste as it
35 pertains to work being conducted under that particular specification.
36
37

1.3. CITY ORDINANCES

- 38 A. There are two (2) Madison General Ordinances (MGO) that the City of Madison has regarding construction and
39 demolition waste.
40 1. MGO 10.185, Recycling and Reuse of Construction and Demolition Debris, describes the requirements
41 associated with this ordinance including definitions, documentation requirements, and penalties.
42 2. MGO 28.185, Approval of Demolition (Razing, Wrecking) and Removal, describes the requirements
43 associated with applying for and receiving a demolition permit.
44 B. All City of Madison, Board of Public Works, contracts being conducted by City Engineering, Facility Management,
45 for construction, remodeling, or demolition shall comply with the above ordinances regardless of project type or
46 size.
47
48

1.4. DEFINITIONS

- 49 A. Clean: Untreated and unpainted material, free of contamination caused by oils, solvents, caulks, and other
50 chemicals.
51 B. Construction and Demolition Debris: Materials resulting from the construction, remodeling, repair, and
52 demolition of utilities, structures, buildings, and roads.
53 C. Disposal: Off-site removal of construction and demolition debris and the subsequent sale, recycling, reuse, or
54 deposit in authorized landfill or incinerator.
55 D. Hazardous: Exhibiting the characteristics of hazardous substance, i.e. ignitability, corrosiveness, toxicity, or
56 reactivity and including but not limited to asbestos containing materials, lead, mercury and PCBs.
57 E. Non-hazardous: Exhibiting none of the characteristics of a hazardous substance.
58

- 1 F. Nontoxic: Not immediately poisonous to humans or poisonous after a long period of exposure.
- 2 G. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured
- 3 into a new product.
- 4 H. Recycle: Any process by which construction or demolition debris is diverted from final disposal as solid waste at
- 5 a permitted landfill and instead is collected, separated, and/or processed into raw materials for new, reused, or
- 6 reconstituted products; or for the recovery of materials for energy production processes.
- 7 I. Recycler: Any recycling facility, transfer station, or other waste handling facility which accepts construction and
- 8 demolition debris for recycling, or for other transferring to a recycling facility.
- 9 J. Recycling: The process of sorting, cleaning, treating, or reconstituting solid waste and other discarded materials
- 10 for the purpose of preparing the material to be recyclable. Recycling does not include burning, incinerating or
- 11 thermally destroying waste.
- 12 K. Return: To give back reusable items or unused products to vendors for credit.
- 13 L. Reuse: Shall mean any of the following:
- 14 1. The on-site use of reprocessed construction and demolitions debris.
- 15 2. The off-site redistribution of a material, for use in the same manner or similar manner at another
- 16 location.
- 17 3. The use of non-toxic, clean wood as an alternative fuel source.
- 18 M. Salvage: To remove a waste material from the project site for resale or reuse by the Owner or others.
- 19 N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- 20 O. Trash: Any product or material unable to be re-used, returned, recycled, or salvaged.
- 21 P. Waste: Extra materials or products that have reached the end of its useful life or its intended use. Waste
- 22 includes salvageable, returnable, recyclable and re-useable construction and demolition materials, and trash.
- 23

24 1.5. PERFORMANCE REQUIREMENTS

- 25 A. The GC shall develop a Waste Management Plan that results in end-of-project rates for salvage/recycling/reuse
- 26 of 95 percent (minimum) by weight of the total waste generated by the Work. Percentages may be adjusted on
- 27 a project by project basis depending on selected LEED goals associated with the project.
- 28 B. The GC shall salvage or recycle 100 percent of all uncontaminated packaging materials including but not limited
- 29 to the following:
- 30 1. Paper
- 31 2. Cardboard
- 32 3. Beverage containers
- 33 4. Boxes
- 34 5. Plastic Sheet and film
- 35 6. Polystyrene packaging
- 36 7. Wood crates and pallets
- 37 8. Plastic pails and buckets
- 38 C. Promote a resourceful use of supplies and materials through proper planning and handling. Generate the least
- 39 amount of waste possible by minimizing errors, poor planning, breakage, mishandling, contamination or other
- 40 similar factors.
- 41 D. Use all reasonable means to divert construction waste from landfills and incinerators through recycling, reuse, or
- 42 salvage as appropriate.
- 43

44 1.6. SUBMITTALS AND DELIVERABLES

- 45 A. The GC shall provide his/her completed Waste Management Plan to the Project Management Web Site as a
- 46 submittal for review by the Project Architect and City Project Manager.
- 47 1. See item 1.8 below for Waste Management Plan submittal requirements.
- 48 2. The Waste Management Plan shall be completed, submitted, and approved as a pre-requisite for
- 49 Progress Payment number 1.
- 50 3. Copies of all documentation required by this specification shall be submitted to the appropriate Project
- 51 Management Web Site Library. Documentation shall be reviewed by the City Project Manager during all
- 52 Progress Payment reviews for compliance and accuracy.
- 53 B. The Waste Management Coordinator shall provide copies of items 1 through 5 below to the appropriate Project
- 54 Management Web Site Library and shall update the Waste Management Summary Log to reflect the records
- 55 being submitted.
- 56 1. Records of Donations: Indicate receipt and acceptance of itemized salvageable waste donated to
- 57 individuals or organizations. Indicate if the organization is tax exempt.

- 1 2. Records of Sales: Indicate receipt and acceptance of itemized salvageable waste sold to individuals or
- 2 organizations. Indicate if the organization is tax exempt.
- 3 3. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by
- 4 recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts and
- 5 invoices.
- 6 4. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and
- 7 incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts and invoices.
- 8 5. Statement of Refrigerant Recovery: The Refrigerant Recovery Technician responsible for recovering
- 9 refrigerant shall provide the GC with a statement indicating all of the following:
- 10 a. All recovery was performed according to EPA Regulations.
- 11 b. All refrigerant present was recovered; indicate the total quantity recovered by unit.
- 12 c. Date of Recovery.
- 13 d. Name, address, company name, and phone number of technician performing the recovery.
- 14 e. Technician shall sign and date the statement.
- 15 C. LEED Submittal: The GC shall provide the following information using the appropriate LEED letter template upon
- 16 project completion: indicating that the requirements of the credit have been met. *NOTE: This requirement shall*
- 17 *only apply to projects having a LEED certification goal.*
- 18 1. Total waste material generated.
- 19 2. Total waste material diverted by diversion method; recycling, salvage, re-use, etc.
- 20 3. Statement that the credit requirements have been met.
- 21 4. GC shall sign the letter.
- 22

23 1.7. QUALITY ASSURANCE

- 24 A. Waste Management Coordinator: The GC shall be responsible for designating a Waste Management
- 25 Coordinator. Coordinator may be the GC Supervisor, GC Project Manager or other member of the GC staff
- 26 having knowledge of proper waste management procedures and all applicable regulations.
- 27 B. Regulatory Requirements: comply with all hauling and disposal regulations of authorities having jurisdiction.
- 28 C. The Waste Management Coordinator shall comply with Specification 01 31 19 Project Meetings, Section 3.7.B.1
- 29 and conduct a Waste Management Conference at the job site. This conference shall be repeated as necessary as
- 30 additional trades are added to the Work. The conference shall include but not be limited to the following:
- 31 1. Identify the Waste Management Coordinator; provide trade contractors with name, phone, and email
- 32 information.
- 33 2. Review and discuss the Waste Management Plan and the roles of the Coordinator.
- 34 3. Review the requirements for documenting and reporting procedures of each type of waste and its
- 35 disposition.
- 36 4. Review procedures for material separation; indicate availability and locations of containers and bins.
- 37 5. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
- 38 6. Review waste management procedures specific to each trade.
- 39 D. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- 40

41 1.8. WASTE MANAGEMENT PLAN

- 42 A. Develop a plan consisting of waste identification, a waste reduction work plan, and cost/revenue analysis.
- 43 Indicate quantities by weight or volume. Use the same units of measure throughout the waste management
- 44 plan.
- 45 1. Waste Identification: Indicate anticipated types and quantities of site clearing, demolition waste, and
- 46 construction waste that will be generated during the execution of this contract. Include assumptions for
- 47 the estimates.
- 48 2. Waste Reduction Work Plan: The work plan shall consist of but not be limited to all of the following:
- 49 a. Identify methods for reducing construction waste. Re-using, framing and forming materials, re-
- 50 planning material cuts to minimize waste, etc.
- 51 b. Identify what types of materials will be recycled. Provide lists of local companies that receive
- 52 and/or process the materials. Include names, addresses, and phone numbers.
- 53 c. Identify what types of materials will be disposed of and whether it will be disposed of in a landfill
- 54 facility or by incineration facility. Provide lists of local companies that receive and/or process the
- 55 materials. Include names, addresses, and phone numbers.
- 56 d. Identify methods to be used on site for separating waste including all of the following:
- 57 i. Sizes of containers to be used.
- 58 ii. Labels to be used on the containers to identify the type of waste allowed in the container.

- 1 2. Inspect containers and bins frequently for contamination and inappropriately sorted materials. Remove
- 2 contaminated materials and resort as necessary.
- 3 3. Stockpile bulk materials such as sand, topsoil, stone, etc., on site away from the construction area and
- 4 without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water, and
- 5 cover to prevent windblown dust. Do not store within the drip lines of existing trees.
- 6 4. Whenever possible store items off the ground and/or protect them from the weather.
- 7

8 **3.4. GUIDELINES FOR RECYCLABLE, RE-USABLE, AND SALVAGEABLE WASTE**

- 9 A. The following guidelines is not a complete or all inclusive list and shall be adjusted as needed by the methods
- 10 and procedures identified in the Waste Management Plan.
- 11 B. Asphalt Paving: Break-up into transportable pieces or grind, transport to an authorized recycling facility.
- 12 C. Carpet and Pad: Separate carpet and pad scraps, containerize and transport to an authorized recycling facility.
- 13 D. Ceiling System Components: Suspended ceiling system components shall be sorted by material type as follows:
- 14 1. Broken, cut, or damaged tiles shall be containerized, transport to an authorized recycling facility.
- 15 2. Damaged, or cut tracks, trim and other metal grid system components shall be sorted with other metals
- 16 of similar types, palletize, transport to an authorized recycling facility.
- 17 E. Clean Fill: When allowed by Division 31 Specifications; concrete, masonry, stone, asphalt pavement, sand and
- 18 other such materials may be used as clean fill on this project site. The GC shall verify with the Project Architect,
- 19 Structural Engineer, or Civil Engineer as necessary prior to using any materials as clean fill. Materials shall be
- 20 processed, placed, and compacted as specified. If not being re-used on site, transport to an authorized recycling
- 21 facility.
- 22 F. Clean Wood Materials: Including but not limited framing cutoffs, wood sheathing or paneling materials,
- 23 structural or engineered wood products, and pallets or crates. Clean Wood shall be free of paints, stains, oils,
- 24 preservatives and other such contaminants.
- 25 1. Useable pieces shall be sorted by type and dimension, bundled and transported off site by the GC or
- 26 returned to the supplier.
- 27 2. Non-useable pieces shall be palletized or containerized, transport to an authorized recycling facility.
- 28 3. Clean, uncontaminated sawdust and wood shavings shall be bagged, transport to an authorized recycling
- 29 facility.
- 30 G. Concrete: Break-up into transportable pieces, remove all reinforcing and other metals, transport to an
- 31 authorized recycling facility.
- 32 H. Glass Products: Shall be sorted by types, do not include light fixture lamps and bulbs. Products broken in
- 33 shipment shall be returned to the supplier. Broken or cracked items still in frames shall be taped to prevent
- 34 further breakage and injury to workers. Transport to an authorized recycling facility.
- 35 I. Gypsum Board: Stack large clean pieces on wooden pallets or container, store in a dry location, transport to an
- 36 authorized recycling facility.
- 37 J. Light Fixture Lamps and Bulbs: Fluorescent tubes shall be containerized, transport to an authorized recycling
- 38 facility.
- 39 K. Masonry and CMU: Remove all metal reinforcing, anchors, and ties, clean undamaged pieces and neatly stack on
- 40 pallets, transport damaged pieces to an authorized recycling facility.
- 41 L. Metals: Sort metals by type as follows, this does not include piping:
- 42 1. Architectural metals including but not limited to siding, soffit, and roofing panels shall be sorted by
- 43 material, palletize or bundle as needed and transport to an authorized recycling facility.
- 44 2. Structural steel, sort by size and type; palletize and transport to an authorized recycling facility.
- 45 3. Miscellaneous metals such as aluminum, brass, bronze, etc shall be sorted by type, containerized or
- 46 palletized as necessary, transport to an authorized recycling facility.
- 47 M. Packaging and shipping materials
- 48 1. Cardboard boxes and containers: Breakdown all cardboard boxes and containers into flat sheets. Bundle
- 49 and store in a dry location until transported for recycling.
- 50 2. Pallets:
- 51 a. Whenever possible require deliveries using pallets to remove them from the project site.
- 52 b. Neatly stack pallets in preparation for reusing them or providing them to other companies for
- 53 salvage or re-use.
- 54 c. Break down pallets into component wood pieces that comply with the requirements for recycling
- 55 clean wood materials. Neatly stack or palletize pieces in preparation for transportation.
- 56 3. Crates: Break down crates into component wood pieces that comply with the requirements for recycling
- 57 clean wood materials. Neatly stack or palletize pieces in preparation for transportation.
- 58 4. Polystyrene Packaging: Separate and bag materials.

- 1 N. Piping and conduit: Reduce all piping and conduit to straight lengths, sort and store by size, material and type.
2 Remove supports, hangers, valves, boxes, sprinkler heads, and other such components, sort and store by size,
3 material and type. Transport to authorized recycling facilities according to material types.
4 O. Roofing: Roofing materials shall be sorted and containerized by type, transport to authorized recycling facilities
5 according to material types.
6 P. Site-Clearing Waste: Sort all site waste by type.
7 1. Only stockpile soils types and quantities required for re-use on the project site. All remaining quantities
8 shall be transported off site to an authorized facility that receives such materials.
9 2. Brush, branches, and trees with no marketable re-use shall be transported to facilities for chipping into
10 mulch.
11 3. Trees with a marketable re-use shall be salvaged and transported to facilities that specialize in processing
12 trees for future use as wood products.
13

14 **3.5. GUIDELINES FOR DISPOSAL OF WASTES**

- 15 A. The following guidelines shall be adjusted as needed by the methods and procedures identified in the Waste
16 Management Plan.
17 B. Any waste that is contaminated, organic, or cannot be recycled, re-used, or salvaged shall be legally disposed of
18 in an authorized landfill or incinerator. Disposal methods shall follow all applicable regulatory requirements.
19 C. No waste material of any kind, except those types designated as clean fill in section 3.4 above, shall be allowed
20 to be buried on the project site at any time.
21 D. No burning of any kind of waste material shall be permitted on this project site at any time.
22 E. Paint and Stain: Paints, stains, and their containers shall be disposed of as follows:
23 1. Whenever possible containers should be thoroughly cleaned immediately after emptying and sorted with
24 as appropriate (metal or plastic) for recycling
25 2. Empty containers, regardless of type or base material, may be disposed of with lids off with general
26 garbage.
27 3. Latex paint may be placed with general garbage if properly solidified as follows:
28 a. Small amounts (an inch or less in can): Remove lids and allow paint to dry out in the can and
29 harden. Protect cans from rain and freezing.
30 b. Large amounts (more than one inch): Mix paint with equal amounts of cat litter, stir and allow to
31 completely dry. Alternate method: mix with commercial paint hardener.
32 4. Oil-based or combustible paints and stains, regardless of liquid or solid, shall be transported to an
33 approved facility that takes such items such as Dane County Clean Sweep Sites.
34 F. Treated Wood Materials: Treated wood materials including but not limited to wood that has been painted,
35 stained, or chemically treated shall not be recycled or incinerated.
36
37
38
39
40

END OF SECTION

SECTION 01 76 00
PROTECTING INSTALLED CONSTRUCTION

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. QUALITY ASSURANCE 1
7 1.3. RELATED SPECIFICATIONS 2
8 PART 2 - PRODUCTS 2
9 2.1. FENCING MATERIALS AND BARRICADES 2
10 2.2. EROSION CONTROL PROTECTION 2
11 2.3. INTERIOR FINISH PROTECTION MATERIALS 2
12 PART 3 - EXECUTION 3
13 3.1. GENERAL EXECUTION REQUIREMENTS 3
14 3.2. PROTECT ADJACENT PROPERTIES..... 3
15 3.3. PROTECT LANDSCAPING FEATURES 3
16 3.4. PROTECT UTILITIES 4
17 3.5. PROTECT PUBLIC RIGHT OF WAY 4
18 3.6. PROTECT STORED MATERIALS..... 5
19 3.7. PROTECT WORK - EXTERIOR..... 5
20 3.8. PROTECT WORK - INTERIOR 5

PART 1 – GENERAL

1.1. SUMMARY

- 25 A. The purpose of this specification is to provide clear responsibilities, guide lines, and requirements related to
26 providing protection to already installed construction.
27 B. Already installed construction shall include but not be limited to the following:
28 1. Any existing site feature such as pavement, curbs, drainage features, utilities, landscaping features (trees,
29 shrubbery, plantings, flagpoles, etc) and other such exterior items not associated with the building
30 whether on or adjacent to the project site.
31 2. Any existing structure on or adjacent to the project site.
32 3. Any existing interior work that may be adjacent to the new work including all paths of ingress/egress to
33 areas associated with accessing the Work.
34 4. Any existing feature of any kind within the public right-of-way that may be on the project site property,
35 adjacent to the project site or across the street from the project site.
36 C. All contractors shall be familiar with the specifications of their Division of Work for specific requirements on
37 protection of the Work.
38 D. The requirements noted within this specification do not relieve any contractor of the responsibility for
39 compliance with any code, statute, ordinance, or other such regulatory requirement having jurisdictional
40 authority over these contract documents.
41

1.2. QUALITY ASSURANCE

- 43 A. It shall be the responsibility of every contractor and worker assigned to the project to be diligent in protecting all
44 existing work, and newly installed construction.
45 B. It shall be the General Contractors' (GC) responsibility under the contract to provide all reasonable protection
46 methods, materials, or precautionary measures required to protect new or existing construction as described in
47 within this specification to the project as a whole.
48 1. The GC shall be responsible to ensure any damaged new or existing construction is repaired or replaced
49 at no additional cost to the Contract.
50 2. The GC at his/her discretion may direct other contractors to provide and maintain protection of
51 completed work associated with their Division of Work. I.E.: The carpet installer may be required by the
52 GC to provide carpet protection along traveled paths, ingress/egress, etc after installation.
53 C. It shall be the responsibility of the GC to ensure that all materials being used to protect installed construction are
54 compatible with, and/or adjacent to, the materials being protected. This shall include but not be limited to the
55 material used as covering, tapes used to fasten protective materials, etc.

1
2 **1.3. RELATED SPECIFICATIONS**

- 3 A. Parts of this specification will reference articles within “The City of Madison Standard Specifications for Public
4 Works Construction”.
- 5 1. Use the following link to access the Standard Specifications web page:
6 <http://www.cityofmadison.com/business/pw/specs.cfm>
7 a. Click on the “Part” chapter identified in the specification text. For example if the specification
8 says “Refer to City of Madison Standard Specification 210.2” click the link for Part II, the Part II
9 PDF will open.
10 b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you
11 to the referenced text.
12 c. City Standard Detail Drawings (SDD) may be located from the index in Part VIII.
- 13 B. Section 01 60 00 Product Requirements
14 C. Section 01 74 13 Progress Cleaning
15

16 **PART 2 - PRODUCTS**

17
18 **2.1. FENCING MATERIALS AND BARRICADES**

- 19 A. For temporary barricade situations, the responsible contractor may provide one of the following that sufficiently
20 provide a sturdy physical barrier and/or visual barrier as necessary for the intended application.
- 21 1. Standard orange construction barrels each with a standard rubber base ring and reflective tape
22 a. Provide flashing amber lights as needed to increase night time visibility
23 2. Steel “T” style fence posts
24 3. 4’0” high standard orange construction fence
25 4. Traffic barricades
26 5. Jersey barriers
27 6. Other types of fencing or barricades typically used in the construction industry
- 28 B. The contractor responsible for providing the fencing materials and barricades shall also be responsible for
29 maintaining them. This shall include but not limited to fixing damaged fencing, standing up barrels that have
30 been knocked over, realigning barrels, and ensuring flashing lights are fully operational at all times.
- 31 C. The following fencing and barricade designations, and their use descriptions shall be used throughout this
32 specification to provide uniformity in describing protection requirements.
- 33 1. Type A, Jersey Barriers, to be used as permanent blocking devices to deny access to alternate project site
34 entrances or exits.
35 2. Type B, Traffic Barricades, to be used as temporary blocking devices to deny access to alternate project
36 site entrances or exits.
37 3. Type C, Construction Barrels without construction fencing shall be used for lane closures, temporary
38 blocking devices to deny access and the protection of single locations (I.E. identify the location of an
39 access structure) that do not require fencing.
40 4. Type D, Construction Barrels with construction fencing where it becomes necessary to surround an object
41 with a complete visual barricade and it is impractical or unacceptable to install fence posts. The surround
42 shall be constructed in such a manner as to provide a buffer zone around and access to the item being
43 protected.
44 5. Not Used
45 6. Type X, Other fencing or barricade types that may be designated and detailed within the construction
46 documents shall use additional alpha numeric designations.
47

48 **2.2. EROSION CONTROL PROTECTION**

- 49 A. Refer to City of Madison Standard Specification 210.2 for authorized materials associated with erosion control
50 materials.
51

52 **2.3. INTERIOR FINISH PROTECTION MATERIALS**

- 53 A. Except where noted in other areas of the construction documents or this specification the responsible
54 contractor:
55 1. Shall not provide the cheapest or least effective method as an effort to meet any protection requirement.
56 2. Shall provide materials of sufficient quality, and durability to provide adequate protection based on the
57 seasonal conditions and the anticipated duration at the time the protection will be needed.
58 3. Shall provide sufficient quantity of protection material to protect the construction as needed.

- 1 B. Prior to installing protective measures the responsible contractor shall propose to the GC, Project Architect (PA)
2 and City Project Manager (CPM) the proposed plan for protection, materials to be used and samples as
3 necessary.
4 1. The PA and CPM reserve the right to disapprove any proposed method and/or material and/or make
5 alternate proposals.
6

7 **PART 3 - EXECUTION**
8

9 **3.1. GENERAL EXECUTION REQUIREMENTS**

- 10 A. The GC shall be responsible for ensuring all of the following procedures and requirements are implemented as
11 needed for the duration of the Work performed under this contract.
12 B. The GC shall also be responsible for the following:
13 1. Reporting any incident of damage to existing property, right-of-way, or utility to the CPM immediately
14 upon rendering the incident safe, and notifying emergency response teams, and emergency utility crews
15 as needed.
16 2. Conduct a site walk through prior to leaving at the end of each day to assess:
17 a. Protection measures are properly in place, provide correction actions as necessary.
18 b. Note damage to existing completed work and schedule repair/replacement as needed.
19 3. Ensure all contractors and workers are being diligent in protecting existing work, and newly installed
20 construction.
21

22 **3.2. PROTECT ADJACENT PROPERTIES**

- 23 A. Whenever possible through the design process the City of Madison shall have previously provided notice to
24 adjacent property owners that work will be occurring on or near their property. The City of Madison shall also
25 have obtained any permanent or temporary easements that may be necessary to complete any Work on
26 adjacent properties.
27 B. It shall be the responsibility of the GC to do the following for all Work under this contract being performed on or
28 adjacent to the property line:
29 1. Contact the adjacent property owner and provide him/her with information on the work to be done,
30 equipment to be used, and estimated duration of the work. Information to be updated and
31 communicated to property owner(s) as construction progresses and site conditions change.
32 a. If any adjacent property is a rented or leased space the GC shall also make contact and provide
33 the same information to the tenants.
34 b. Determine from the owner and/or tenants if there are any concerns for children, pets, special
35 plantings, or other concerns.
36 2. Discuss the following with all contractors performing work on or near the property line.
37 a. Work to be completed and timeline.
38 b. Concerns of adjacent property owners/tenants from item 1 above.
39 c. Which protective measures will be necessary to protect adjacent properties and address the
40 concerns of adjacent property owners/tenants.
41 3. Ensure all protective measures are placed and maintained during the execution of Work on or adjacent to
42 the property line. Interact with the adjacent property owners/tenants as needed.
43 C. Any contractor doing work on or adjacent to the property line shall install and maintain any protective measure
44 identified in the contract documents, this specification, or as directed by the GC.
45 D. The GC shall be responsible for restoring any damage to structure and property located on or adjacent to the
46 property line.
47 1. Restoration shall include but not be limited to repair or replacement using like materials and finishes to
48 its original condition or better.
49 2. Restoration of landscaping materials shall include watering of any seed, sod, or other planting of any kind
50 for a reasonable period of time to encourage germination and root development.
51 E. The GC shall keep the CPM informed directly to any issues pertaining to adjacent property owners and tenants.
52

53 **3.3. PROTECT LANDSCAPING FEATURES**

- 54 A. Except where specifically stated in other areas of the construction documents the following minimal protection
55 requirements shall apply under this section.
56 1. Whenever possible do not install new landscape features until exterior building construction has been
57 completed, equipment such as scaffolding and lifts are no longer needed and have been removed, and
58 heavy equipment operation is no longer required.

- 1 2. Whenever possible remove and temporarily store all existing landscape features such as benches, waste
- 2 receptacles, signage, and other such features that will be within the area of Work that can be removed.
- 3 3. Landscape features that cannot be removed such as flag poles, light poles, light bollards, etc. shall be
- 4 protected with Type D fencing for areas on pavement or Type E fencing for areas on soil.
- 5 4. Planting beds shall be protected using Type E fencing around the exposed perimeter of the planting bed
- 6 as needed.
- 7 5. The City of Madison Standard Specification 107.13 shall apply to all tree protection in and around the
- 8 project site at all times.
- 9

10 **3.4. PROTECT UTILITIES**

- 11 A. The contractor shall be responsible for notifying all utilities to determine emergency response procedures and
- 12 protection requirements prior to installing any construction protection.
- 13 1. This includes requesting utility marking through Diggers Hotline.
- 14 a. Call 811 or 1-800-242-8511 to request a public utility locate
- 15 b. For emergency locate call (262) 432-7910 or (877) 500-9592
- 16 2. Contact the Owner and CPM for any available private utility information on the property that may be
- 17 available prior to calling a private utility locating company.
- 18 B. Except where specifically stated in other areas of the construction documents the following minimal protection
- 19 requirements shall apply under this section.
- 20 1. Hydrants, lamp posts, electrical transformers, and other utility pedestals shall be protected with Type D
- 21 fencing for areas on pavement or Type E fencing for areas on soil. Fence posts shall be located so as to
- 22 not be directly over the utility main.
- 23 2. Storm sewer structures in pavement shall have proper inlet protection according to City of Madison
- 24 Standard Specification 210.1(g) and Type C Construction Barrels when necessary.
- 25 3. Storm sewer structures in turf and other landscaped areas shall have proper inlet protection according to
- 26 City of Madison Standard Specification 210.1(g) and Type E fencing for areas on soil.
- 27 4. Stormwater management features such as greenways, retention/detention ponds, bio-filtration ponds
- 28 and other such features shall be properly protected according to the appropriate erosion control
- 29 measure specified on the Erosion Control Plan. See multiple sections of City of Madison Standard
- 30 Specification 210.1
- 31 a. For the protection of hard to see items such as structures, castings, inlets, etc. in grassy areas
- 32 provide Type E fencing for areas on soil.
- 33 c. For the protection of storm water management features having special soils and plants such as
- 34 bio-filtration ponds provide Type E fencing for areas on soil.
- 35 5. Other structures and covers including but not limited to cleanouts, wiring hand holes, valve boxes, access
- 36 structures, grease trap structures, etc shall be protected as follows:
- 37 a. Provide Type E fencing for areas on soil.
- 38 b. When paving operations are complete provide a construction barrel or cone near structures as
- 39 necessary depending on required heavy construction traffic.
- 40

41 **3.5. PROTECT PUBLIC RIGHT OF WAY**

- 42 A. Except where specifically stated in other areas of the construction documents the following minimal protection
- 43 requirements shall apply under this section.
- 44 1. All public right-of-way (area from behind the sidewalk to the centerline of the street) shall remain open
- 45 and accessible except during periods of active work. At such times the public right of way shall be
- 46 properly closed and signed as referenced in City of Madison Standard Specification 107.9.
- 47 2. Bus stops and bus stop structures shall remain accessible at all times.
- 48 3. Traffic signage and traffic signals, traffic control boxes shall be protected with Type D fencing for areas on
- 49 pavement or Type E fencing for areas on soil.
- 50 a. Protection at traffic signage/signals shall not obstruct the viewing of the sign/signal for its
- 51 intended purpose at any time.
- 52 B. When additional protection for traffic control is required, the use of barricades, guardrails, lane closures and
- 53 other such procedures will be detailed within the construction documents.
- 54 C. When additional protection for overhead sidewalk cover is required the contract documents shall indicate the
- 55 specific location and structural requirements of the protective structure.
- 56

1 **3.6. PROTECT STORED MATERIALS**

- 2 A. All contractors shall refer to Specification 01 60 00 Product Requirements for all storage and protection
3 requirements of building materials and products delivered to the site.
4

5 **3.7. PROTECT WORK - EXTERIOR**

- 6 A. Provide all temporary services that may be required to protect the installed material from heat, cold, humidity,
7 etc, while materials such as concrete, mortar, sealants, paints, etc, are drying and/or curing.
8 B. Open trenches, pits, and other such excavations shall be properly covered, lined, or shored as needed during
9 periods of inclement weather to prevent the caving of soils onto existing work in progress. Refer to the
10 appropriate specifications and/or regulatory requirements governing this type of work as necessary.
11 C. Provide adequate protection at all openings with heavy duty tarps, plastic sheathing, or wood framing and
12 sheathing as needed to protect interior work in progress from inclement weather as needed.
13 D. Protect exterior finishes of all kinds with heavy duty tarps or plastic sheathing as needed while landscaping is
14 being installed through full germination of seeded areas or installation of filter fabric and mulches to keep dust,
15 dirt, and mud off of finished exterior surfaces.
16 E. Designate specific curb mounting points and provide wood blocking where small vehicles, skid loaders and other
17 such equipment may need access to areas being landscaped.
18 F. Provide plywood turning pads for skid loaders to turn on to prevent tire marking on new pavement.
19 G. Do not permit the parking of vehicles with any kind of fluid leaks to park on new pavement.
20 H. The contractor shall be responsible for cleaning, repairing, or replacing any completed work or work in progress
21 under this specification as deemed necessary by the CPM without additional cost to the contract.
22

23 **3.8. PROTECT WORK - INTERIOR**

- 24 A. The GC shall do all of the following:
25 1. Provide all temporary services that may be required to protect the installed material from heat, cold,
26 humidity, etc, while materials such as concrete, mortar, sealants, paints, etc, are drying and/or curing.
27 2. Provide adequate visual and/or physical protection as needed to protect newly completed interior work
28 such as paint, flooring material, sealants, grouts, etc that may be drying and/or curing.
29 3. Provide adequate space and materials for cleaning boots, tool boxes, supplies, and other items coming
30 into the project site once finish work has begun.
31 4. Clean dirtied areas and repair/replace damaged areas immediately.
32 B. The contractors responsible for interior work shall be responsible for protecting their work and finishes from dirt,
33 mud, snow, spills, splatters, and physical damage after installation as follows:
34 1. Protect vinyl composite, rubber composite, painted/stained concrete, and tiled flooring as follows:
35 a. Define foot traffic areas and protect with Ramboard Temporary Floor Protection products as a
36 minimum basis of design or other protection product(s) compatible with installed flooring product
37 if Ramboard is not compatible. Products to be used shall be new.
38 i. Tape all edges, seams, etc with a good quality tape that does not leave sticky residue. Do
39 not allow any debris or other material between the installed flooring and the protection
40 material.
41 ii. Repair tears immediately, replace worn areas with like material as necessary.
42 2. Protect carpeted areas as follows:
43 a. Define foot traffic areas and protect with a minimum of 6mil, clear, polyethylene sheeting 3 feet
44 wide. Products to be used shall be new.
45 i. Tape all edges, seams, etc with a good quality tape that does not leave sticky residue. Do
46 not allow any debris or other material between the installed flooring and the protection
47 material.
48 ii. Repair tears immediately, replace worn areas with like materials as necessary.
49 3. Protect all finished walls in high traffic areas with Ramboard Temporary Wall protection products or
50 approved equal.
51 i. Tape all edges, seams, etc with a good quality tape that does not leave sticky residue. Do
52 not allow any debris or other material between the installed flooring and the protection
53 material.
54 ii. Repair tears immediately, replace worn areas with like materials as necessary.
55 3. Protect counter tops, cabinets, and other finished surfaces with large sheets of thick cardboard or
56 Ramboard products. Do not allow toolboxes, finish materials, parts and other such items to be placed on
57 finished materials.

- 1 C. All protection shall stay in place until the CPM, PA, and GC mutually deem the project is ready for Final Cleaning.
- 2 The contractors responsible for protecting the work shall be responsible for removing the protection and
- 3 removing any adhesive residue at that time. Contractors shall only use manufacturer authorized cleaning
- 4 materials for removing adhesives, etc.
- 5 D. Contractors doing work in un-protected areas of finished work shall be required to provide drop cloths and other
- 6 protection as noted within this specification for the duration of their work.
- 7 1. Finished areas shall be sufficiently covered to accommodate all equipment, and materials being used to
- 8 complete the work being done.
- 9 2. Finished areas shall be sufficiently covered to prevent splatters, over spray, etc when doing touch-up
- 10 work.
- 11 3. Contractors who do not provide sufficient protection under this sub-section shall be responsible for any
- 12 costs associated with cleaning, repairing or replacing already finished construction at no additional cost
- 13 to the contract.
- 14
- 15
- 16
- 17
- 18

END OF SECTION

**SECTION 01 77 00
CLOSEOUT PROCEDURES**

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 1.3. DEFINITIONS 2
8 1.4. QUALITY ASSURANCE – CONSTRUCTION CLOSEOUT 2
9 1.5. QUALITY ASSURANCE – CONTRACT CLOSEOUT 2
10 PART 2 – PRODUCTS – THIS SECTION NOT USED 3
11 PART 3 - EXECUTION 3
12 3.1. CONSTRUCTION CLOSEOUT CHECKLIST 3
13 3.2. CONSTRUCTION CLOSEOUT REQUIREMENTS 3
14 3.3. CONSTRUCTION CLOSEOUT PROCEDURE 4
15 3.4. CONTRACT CLOSEOUT REQUIREMENTS 4
16 3.5. CONTRACT CLOSEOUT PROCEDURE 4
17

PART 1 – GENERAL

1.1. SUMMARY

- 21 A. The purpose of this specification is to clearly define and quantify the requirements associated with closing a City
22 of Madison Public Works Contract for facility related work.
23 B. All contracts have two distinct but related paths. Each path needs to be properly closed independently in order
24 to close the contract as a whole.
25 1. Construction closeout is related to closing out all of the Work associated with the construction
26 documents.
27 a. It shall be the responsibility of all contractors to be fully aware of the required Work and closeout
28 requirements involved in their individual trades.
29 2. Contract closeout is related to closing out all of the administrative aspects of the contract in general.
30 a. It shall be the responsibility of all contractors to be fully aware of the administrative requirements
31 required by the contract and to provide the supporting documentation required.
32 3. Construction Closeout must be completed before Contract Closeout can begin.
33 C. This specification will provide general knowledge associated with the following areas:
34 1. Construction Closeout Requirements
35 2. Construction Closeout Procedure
36 3. Contract Closeout Requirements
37 4. Contract Closeout Procedure
38 5. Final Payment and Certificate of Completion
39

1.2. RELATED SPECIFICATIONS

- 41 A. Contractors shall review all references to other specifications including specifications relating to the execution of
42 the Work associated with their Division or Trade.
43 B. Section 01 29 76 Progress Payment Procedures
44 C. Section 01 31 23 Project Management Web Site
45 D. Section 01 32 26 Construction Progress Reporting
46 E. Section 01 45 16 Field Quality Control Procedures
47 F. Section 01 74 13 Progress Cleaning
48 G. Section 01 45 16 Construction Waste Management and Disposal
49 H. Section 01 76 00 Protecting Installed Construction
50 I. Section 01 78 13 Completion and Correction List
51 J. Section 01 78 23 Operation and Maintenance Data
52 K. Section 01 78 36 Warranties
53 L. Section 01 78 39 As-Built Drawings
54 M. Section 01 78 43 Spare Parts and Extra Materials
55 N. Section 01 79 00 Demonstration and Training
56 O. Section 01 91 00 Commissioning
57 P. Other requirements as noted in the contract documents signed by the General Contractor
58

1 **1.3. DEFINITIONS**

- 2 A. **Substantial Compliance:** A letter provided to the City of Madison Building Inspection and signed by the Project
3 Architect indicating that all Work has been completed to a level that would allow Owner Occupancy and that all
4 construction is in compliance with the construction documents. A copy of this letter is also provided to the
5 State of Wisconsin Department of Health and Safety as necessary to clear plan review requirements. This letter
6 does not represent construction closeout.
- 7 B. **Certificate of Occupancy:** The Regulatory letter from the City of Madison Building Inspection Department
8 indicating that all regulatory requirements and inspections have been completed and the building may now be
9 occupied for its intended use. This letter does not represent construction closeout.
- 10 C. **Certificate of Substantial Completion:** A letter provided by the Department of Public Works, signed by the City
11 Engineer indicating that Construction activities are substantially complete. This letter does represent
12 construction closeout and the date of this letter begins the date of the Warranty Period.
- 13 D. **Construction Closeout:** The point in the contract where all contractual requirements associated the execution of
14 the Work as described in the plans, specifications, and other documents have been successfully met and the
15 items described in 1.3.A, .B, and .C above have been completed.
- 16 E. **Final Progress Payment:** The progress payment associated with achieving Construction closeout as described in
17 1.3.D above. At this point the contractor may request all monies associated with the contract be paid with the
18 exception of held retainage.
- 19 F. **Contract Closeout:** The point in the contract where all contractual requirements associated with the City of
20 Madison, Board of Public Works contract has been successfully met.
- 21 G. **Final Payment:** The final contract payment submittal that may be approved by the City of Madison after all
22 contractual requirements of the Public Works Contract have been met and any remaining monies (retainage)
23 due to the contractor may be released for the Final Payment.
- 24

25 **1.4. QUALITY ASSURANCE – CONSTRUCTION CLOSEOUT**

- 26 A. All contractors shall be responsible for properly executing the construction closeout requirements associated
27 with their Work as described in the specifications governing their Work.
- 28 B. The GC shall be responsible for all of the following:
- 29 1. Ensuring that all contractors have met the construction closeout requirements associated with their
30 Work.
- 31 2. Coordinate the collection of all construction closeout deliverables from all contractors, provide the
32 deliverables to the Project Architect and City Project Manager for review as necessary, and ensure all
33 contractors correct deficiencies of deliverables and resubmit as needed for final acceptance.
- 34 3. Ensure all closeout requirements identified in the Construction Closeout Checklist below have been
35 completed as intended by the construction documents.
- 36

37 **1.5. QUALITY ASSURANCE – CONTRACT CLOSEOUT**

- 38 A. The City of Madison, Department of Civil Rights (DCR) monitors contract compliance for construction and
39 procurement contracts to ensure that local, state and federal regulations are followed by contractors working on
40 City of Madison Public Works (PW) projects. DCR will monitor all PW projects from contract award through the
41 final payment at the close of the project. Contractors will be required to submit reporting paperwork
42 throughout the PW project process.
- 43 1. Contractors are encouraged to visit the web site identified below for additional information, checklists,
44 forms, and other information provided by DCR as it relates to Contract Compliance.
45 <http://www.cityofmadison.com/Business/PW/contractCompliance.cfm>
- 46 2. Questions regarding the process should be directed to parties and offices as identified on the various
47 forms, documents, and instructions or contact:
48 City of Madison, Department of Civil Rights
49 210 Martin Luther King Jr. Blvd., Room 523
50 Madison, WI 53703
51 (608) 266-4910
- 52 B. All Sub-Contractors have submitted the applicable required documents described in item 1.5.D below to the
53 General Contractor (GC) for Contract Closeout.
- 54 C. The GC has submitted the required applicable documents described in item 1.5.D below for all contractors to the
55 appropriate City of Madison Agency per instructions associated with each submittal.
- 56 D. The documents required for submittal to the City of Madison for Contract Closeout may include any/all of the
57 items listed below depending on contract type. It is the sole responsibility of all contractors to know and submit
58 the required and complete documentation in a timely fashion.

- 1 1. Weekly Payroll Reports
- 2 2. Employee Utilization Reports
- 3 3. Agent or Subcontractor Affidavit of Compliance with Prevailing Wage Rate Determination
- 4 4. Prime Contractor Affidavit of Compliance with Prevailing Wage Rate Determination
- 5 5. Documentation required for Small Business Enterprise (SBE) goals
- 6 6. Other documents as maybe required or requested through the Finalization Review Process

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. CONSTRUCTION CLOSEOUT CHECKLIST

- A. All contractors shall be responsible for reviewing the drawings and specifications within their Divisions of Work to provide a complete and comprehensive list of all Construction Closeout Requirements to the GC.
 1. The checklist shall include all items identified within the construction documents that require any of the following (and examples) prior to moving into Contract Closeout Procedures:
 - a. Documents indicating a specified level of performance has been achieved, such as:
 - i. Test reports of all types
 - ii. Startup reports
 - b. Required documentation, such as:
 - i. As-builts and record drawings
 - ii. Operation and maintenance data
 - c. Physical items to be turned over to the owner, such as:
 - i. Attic stock
 - ii. Keys
 - d. Required maintenance completed, such as:
 - i. Ducts cleaned
 - ii. Filters replaced
 - e. Commissioning and LEED related items and submittals
 - f. Owner and Maintenance Training
- B. Each list shall indicate the title of the closeout requirement, the associated specification of the requirement, the required result or deliverable, the responsible contractor(s), and a column to verify the item has been turned in and completed.
- C. The GC shall be responsible for all of the following:
 1. Consolidating all the closeout lists into one master Construction Closeout Checklist.
 - a. The checklist shall be in a tabular data format similar to the sample below
 2. Upload the completed checklist to the Contract Closeout-Miscellaneous Documents Library on the Project Management Web Site for review.
 3. Resubmit the checklist as needed after initial reviews have been completed.
- D. The GC shall work with all contractors to amend the Construction Closeout Checklist throughout the execution of the project based on changes and modifications as necessary.

<u>Title</u>	<u>Specification</u>	<u>Description</u>	<u>Responsibility</u>	<u>Completed</u>
Quality Management Observation Reports	01 45 16	All QMO reports have been properly responded to, reviewed and closed by the CPM.	All, GC	
As-Built Drawings	01 78 39	As-Built drawings have been reviewed and accepted per the specification	All, GC	
Testing and Balancing of HVAC	23 09 23	Provide final TnB reports indicating design performance has been achieved	HVAC	

3.2. CONSTRUCTION CLOSEOUT REQUIREMENTS

- A. The timely submittal or completion of closeout requirements shall go hand in hand with the Progress Payment Milestone Schedule that can be found in Specification 01 29 76 Progress Payments. No payments shall be made until all requirements for that payment have been met.
 1. The GC and all major Subcontractors, PA, and CPM, shall review all requirements for Construction/Contract Closeout during two (2) special meetings.

- 1 a. The first meeting shall be held at the 50% Contract Total Payment milestone. This meeting shall
- 2 discuss the requirements associated with various construction/contract closeout documentation
- 3 and events when they are due with respect to progress payments.
- 4 b. The second meeting shall be held at the 70% Contract Total Payment milestone. This meeting
- 5 shall review the contractors progress regarding the closeout checklist, begin making plans for
- 6 upcoming deadlines such as scheduling training, where to put attic stock, and when they are due
- 7 with respect to progress payments.
- 8 2. The GC, PA, and CPM, shall utilize the Construction Closeout checklist to ensure that all construction
- 9 closeout requirements have been met.

3.3. CONSTRUCTION CLOSEOUT PROCEDURE

- 12 A. Upon successful completion and final acceptance of all Construction Closeout Requirements the GC may submit
- 13 to the CPM and PA the request for Final Progress Payment (100% contract total, less retainage).
- 14 B. The PA will confirm with the design consultants, CPM, and other City of Madison staff that all requirements of
- 15 the Work have been completed and will do the following:
 - 16 1. Approve the final progress payment application
 - 17 2. Provide the required signed payment documents to the CPM
 - 18 3. Provide the required Letter of Substantial Compliance to the following as required:
 - 19 a. State Safety and Building Division
 - 20 b. Local Building Inspection office
 - 21 c. GC
 - 22 d. CPM
- 23 C. The CPM shall draft the City Letter of Substantial Completion for signature by the City Engineer. This letter shall
- 24 state any of the following that may still be tied to the contract and/or warranty:
 - 25 1. Indicate that the date of the letter shall also be the beginning of the Warranty period.
 - 26 2. Indicate any allowed due outs, reasons for them, and anticipated dates of finalization.
 - 27 a. QMO issues such as off season testing of equipment
 - 28 b. Off season training of equipment
- 29 D. The GC and all subcontractors shall finalize all warranty letters associated with their Work using the date noted
- 30 on the City Letter of Substantial Completion, and provide the CPM with all warranties as described in
- 31 Specification 01 78 36 Warranties. Upon receipt and final approval of the Warranties the CPM may initiate final
- 32 processing of the Final Progress Payment (100% contract total, less retainage).

3.4. CONTRACT CLOSEOUT REQUIREMENTS

- 35 A. The GC and all sub-contractors shall follow all requirements associated with documenting contract compliance
- 36 and provide documentation as required or requested by DCR or PW staff. All contractors are encouraged to stay
- 37 current with submissions of the following documentation:
 - 38 1. Weekly Payroll Reports no later than the Progress Payment equal to 50% of the contract total.
 - 39 2. Employee Utilization Reports
 - 40 3. Agent or Subcontractor Affidavit of Compliance with Prevailing Wage Rate Determination
 - 41 4. Prime Contractor Affidavit of Compliance with Prevailing Wage Rate Determination
 - 42 5. Documentation required for Small Business Enterprise (SBE) goals
 - 43 6. Other documents as maybe required or requested through the Finalization Review Process
- 44 B. Near the Progress Payment equal to 80% of the contract total the GC shall request in writing a Finalization
- 45 Review. At that time DCR or PW staff shall prepare a report of all contract documentation submitted to date. A
- 46 list of missing items or outstanding issues will be emailed to the GC. No additional follow-up will be generated
- 47 by DCR or PW Staff.

3.5. CONTRACT CLOSEOUT PROCEDURE

- 50 A. The Contract Closeout Procedure will not begin until the Construction Closeout Procedure has been completed.
- 51 B. When the GC feels he/she has successfully met all of the Contract Closeout Requirements associated with
- 52 Section 3.3 above the GC may submit to the request for Final Payment to the CPM.
- 53 C. The CPM shall sign and submit the Final Payment request for processing.
- 54 D. DCR and PW staff shall do a complete review of all documentation associated with item 3.3.A above.
- 55 E. The GC shall be notified directly by DCR or PW Staff of any documentation that may still be missing, have
- 56 incomplete information, or other outstanding issues. It shall be the responsibility of the GC to continue follow-
- 57 up with DCR and PW staff until all documentation has been successfully submitted and accepted.

- 1 F. When all required documentation associated with Contract Closeout has been successfully submitted and
2 accepted by DCR and PW Staff the City of Madison shall process the Final Payment of any remaining monies
3 including retainage.

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7

END OF SECTION

SECTION 01 78 13
COMPLETION AND CORRECTION LIST

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 PART 2 – PRODUCTS – THIS SECTION NOT USED 1
8 PART 3 – EXECUTION..... 1
9 3.1. QUALITY MANAGEMENT OBSERVATIONS (QMO) 1
10 3.2. PUNCH LIST REVIEW SCHEDULING 2
11 3.3. REVIEWING WORK TO COMPLETE 2
12 3.4. RECORDING WORK TO COMPLETE 2
13 3.5. GENERAL CONTRACTORS RESPONSIBILITIES 2
14 3.6. FINAL REVIEW 3
15

16 **PART 1 – GENERAL**

17
18 **1.1. SUMMARY**

- 19 A. The City of Madison has developed a multi-faceted Quality Management Program that begins with contract
20 signing and runs through contract closeout to ensure the best quality materials, workmanship, and product are
21 delivered for the contracted Work.
22 1. Progress Payment Milestones have been created to ensure the contractor is meeting required
23 administrative milestones associated with the progression of the Work and the Contract at the
24 appropriate time.
25 2. The Progress Management Web Site (SharePoint) is a Construction Management tool that provides
26 contractors, consultants, and staff a single on-line location for the daily operations and progression of the
27 Work.
28 3. The Quality Management Observation (QMO) is an ongoing observation of the construction process as it
29 progresses.
30 4. Closeout Procedures have been implemented to assist the Contractor in closing out both the
31 Construction and Administrative aspects of the Contract.
32 5. The Completion and Correction List (the Punch List) is intended to be the final summary of corrections
33 required by all contractors to close out the construction portion of the contract.
34 B. All contractors shall be required to review the specifications identified in Section 1.2 below, and other related
35 specifications identified therein to become familiar with the terminology and expectations of this City of
36 Madison Public Works contract.
37 C. Work identified as not in compliance with the contract documents by the Project Architect, City Project
38 Manager/Construction Manager, Owner, Owner Representatives, Owner Consultants, etc. shall be resolved
39 immediately at the Contractor’s expense.
40 1. Unresolved issues will be subject to withholding of progress payment(s) until completed.
41

42 **1.2. RELATED SPECIFICATIONS**

- 43 A. Section 01 29 76 Progress Payment Procedures
44 B. Section 01 31 23 Project Management Web Site (SharePoint)
45 C. Section 01 45 16 Field Quality Control Procedures
46 D. Section 01 74 13 Progress Cleaning
47 E. Section 01 77 00 Closeout Procedures
48

49 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

50
51 **PART 3 – EXECUTION**

52
53 **3.1. QUALITY MANAGEMENT OBSERVATIONS (QMO)**

- 54 A. The Quality Management Observation (QMO) process acts as an “in progress punch list” for contractors to
55 review and correct before the work gets buried and difficult to correct.
56 B. All Contractors should become familiar with the QMO process described in detail in specification 01 45 16 Field
57 Quality Control Procedures.
58

1 **3.2. PUNCH LIST REVIEW SCHEDULING**

- 2 A. The General Contractor (GC), Project Architect (PA), City Project Manager (CPM) and City Construction Manager
3 (CCM) shall schedule time for the PA, Consultants, Commissioning Agent (CxA), Owner, and Owner
4 Representatives to walk through the project area for a final review of the Work.
- 5 1. Scheduling shall be determined during the Construction/Contract Closeout Meeting #2 at approximately
6 70% Contract Total (CT, partial payment milestone in Specification 01 29 76 Progress Payment
7 Procedures).
- 8 a. Scheduling shall be of sufficient duration to allow all reviewers and all contractors ample time to
9 review all installations, final performance reports and other required data.
- 10 2. The Punch List Review shall not be conducted prior to achieving the 90% CT. In addition, the following
11 must be completed or in progress at the time of Punch List Review:
- 12 a. Finishes shall be 90% complete or better
13 b. Landscaping shall be at 90% complete or better
14 c. Testing and Balancing has been completed
15 d. Demonstration and Training is in progress
16 e. Large equipment, gang boxes, excess construction materials, and similar items have been
17 removed from the site.
18 f. Progress cleaning shall be maintained to a level of post finish installation as described in
19 Specification 01 74 13 Progress Cleaning, Section 3.3.B or Section 3.4.
- 20 3. The Punch List Review Corrections shall be completed before the 90% CT milestone has been completed.
21 a. Final cleaning shall not begin before corrections list has been completed.

22
23 **3.3. REVIEWING WORK TO COMPLETE**

- 24 A. All Work shall be subject to the Punch List Review for compliance with the intent of the contract documents.
25 B. The intent of the Punch List Review is not to identify every cosmetic irregularity except where it is due to poor
26 workmanship or poor materials.
- 27 1. Minor cosmetic irregularities such as paint scuffs, floor scuffs, dusty finish, etc. may be recorded as a
28 general comment.
- 29 a. The GC and all contractors shall be responsible for protecting all finished Work and repairing
30 damaged Work as often as needed until final acceptance of the Work.

31
32 **3.4. RECORDING WORK TO COMPLETE**

- 33 A. There is no specified format for recording work to complete during the Punch List Review. PA, Consultants, CxA,
34 Owner, and All Contractors may use their own local version provided they meet the following minimum
35 requirements:
- 36 1. Formats shall be tabular in nature (IE. Spread sheet)
- 37 a. Final copies shall be digital files capable of being copied and pasted into other programs
- 38 2. Includes the following fields;
- 39 a. Name of person recording the item
40 b. Floor
41 c. Room Number
42 d. Room Name
43 e. Item Description
44 f. Division of Work associated with item
- 45 3. The City of Madison shall use an excel spreadsheet similar to the sample shown at the end of this
46 specification.
- 47 B. The PA shall be responsible for gathering final punch lists of all consultants under their control.
48 C. The CPM/CCM shall be responsible for gathering final punch lists of City Staff, Owner, and CxA.
49 D. The PA and CPM/CCM shall provide the GC with duplicate copies of punch lists collected.


50
51 **3.5. GENERAL CONTRACTORS RESPONSIBILITIES**

- 52 A. The GC shall ensure that all sub-contractor forepersons or project managers are present at the required time(s)
53 to assist in the punch list review.
- 54 B. The GC shall receive the completed punch list reviews from the PA, CPM/CCM, and all sub-contractors.
- 55 1. The GC shall be responsible for compiling a master roll up of all reviews into a format or software
56 program of the GC's preference.
- 57 a. The master roll up shall remove all duplications.
58 b. Each item shall indicate the contractor or vendor responsible for the item.

- 1 c. Each item shall indicate the date item was completed.
- 2 d. Each item shall include signature/date sign-offs for contractor/vendor, GC, PA/Consultant, CxA,
- 3 CPM/CCM.
- 4 2. The GC shall distribute the master roll up to the PA, Consultants, CPM/CCM, CxA, Owner/Owner Reps,
- 5 and all contractor project managers.
- 6 C. The GC shall schedule a date for completing the punch list corrections with all contractor project managers.
- 7 D. The GC shall notify the PA and CPM/CCM when all punch list corrections have been completed.
- 8

3.6 FINAL REVIEW

- 9
- 10 A. All Punch List Items are subject for final review by the contractor, PA/Consultant, CPM/CCM, CxA, Owner/Owner
- 11 Rep at any time after being notified that the correction has been completed.
- 12 1. If the originator of an item is not satisfied with corrections the item shall not be closed until such time as
- 13 it has been satisfactorily completed.
- 14 2. Work that was not completed at the time of the Punch List Review may be added to the list at this time.
- 15 B. A final walk through will be conducted with the GC, PA, CPM/CCM before issuing the City Letter of Substantial
- 16 Completion will be issued. This walk through shall ensure all elements of the construction closeout procedures
- 17 are completed.
- 18
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 <p>City of Madison <Project Name> <Contract Number> <Name of Reviewer> <Date of Review></p>						
<u>Punch List Work to Complete</u>						
<i>Floor #</i>	<i>Room #</i>	<i>Room Name</i>	<i>Item Description</i>	<i>Division</i>	<i>Remarks</i>	<i>Completed</i>

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END OF SECTION

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**SECTION 01 78 23
OPERATION AND MAINTENANCE DATA**

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 1.3. QUALITY ASSURANCE 1
8 1.4. O&M DATA REQUIREMENTS 1
9 1.5. O&M DATA SUBMITTALS 2
10 PART 2 – PRODUCTS – THIS SECTION NOT USED 2
11 PART 3 - EXECUTION 2
12 3.1. O&M DATA PREPARATION - GENERAL 2
13 3.2. O&M DATA DRAFT SUBMITTAL 3
14 3.3. O&M DATA FINAL SUBMITTAL 3
15 3.4. CONSTRUCTION CLOSEOUT 3
16

PART 1 – GENERAL

1.1. SUMMARY

- A. The purpose of this specification is to provide clear responsibilities and guide lines related to providing well documented and complete Operation and Maintenance (O&M) Data related to general facility use, equipment, systems, finishes, and materials to City of Madison Staff (Owner, Owner Representatives, Maintenance, and Custodial Personnel) as needed.
- B. Operation and Maintenance Data shall apply to both of the following categories except where specific requirements are noted under their separate titles as follows:
1. Operation and Maintenance Data: Generally shall mean the owner manual that provides information on start-up, shut-down, operation, troubleshooting, maintenance, parts, and other such documentation as it pertains to all equipment and systems installed under the Work.
 2. Use and Care instructions: Where applicable use and care instructions shall also be considered O&M for such things as flooring, tile, partitions, and other such finishes and trim related items, installed under the Work.

1.2. RELATED SPECIFICATIONS

- A. Section 01 29 76 Progress Payment Procedures
- B. Section 01 31 23 Project Management Web Site
- C. Section 01 77 00 Closeout Procedures
- D. Section 01 78 13 Completion and Correction List
- E. Section 01 78 19 Maintenance Contracts
- F. Section 01 78 36 Warranties
- G. Section 01 79 00 Demonstration and Training
- H. Section 01 91 00 Commissioning
- I. Other Divisions and Specifications that may address more specifically the requirements for O&M Data.

1.3. QUALITY ASSURANCE

- A. All O&M Data shall meet the requirements identified in Section 1.4 below.
- B. All contractors shall provide O&M Data for each piece of equipment, system, or finish installed during the installation of the Work. O&M Data shall be provided to the General Contractor (GC) for verification and submittal.
- C. The GC shall be responsible for receiving all required O&M Data files from all contractors for verifying that all files submitted meet the requirements in Section 1.4 below.

1.4. O&M DATA REQUIREMENTS

- A. O&M Data shall be provided in digital PDF format as follows:
 1. PDF files shall be complete first generation consumer useable editions of PDF documents as provided by any of the following:
 - a. Product manufacturer
 - b. Supplier of product
 - c. Product manufacturer internet site

- 1 2. Acceptable PDF files shall have the following functionality:
- 2 a. Word searchable
- 3 b. Key areas are bookmarked
- 4 c. Table of Contents and/or Index linked to content is preferred whenever possible.
- 5 3. Scanned printed material, with word searchable capabilities, saved as a PDF, is not acceptable and will be
- 6 rejected without further review.
- 7 B. O&M Data shall include but not be limited to the following manufacturers' published information as appropriate
- 8 for the equipment, system, material, or finish:
- 9 1. Installation instructions
- 10 2. Parts lists, assembly diagrams, explosion diagrams
- 11 3. Wiring diagrams
- 12 4. Start-up, shut-down, troubleshooting and other related operation procedures
- 13 5. Lubrication, testing, parts replacement, and other such maintenance procedures
- 14 6. General use, care, and cleaning instructions
- 15 7. Special precautions and safety requirements
- 16 8. A list of certified equipment vendors, service companies, parts suppliers including company name,
- 17 address, and phone number
- 18 9. A list of the recommended spare parts to have on hand at all times
- 19 10. A list by type of all recommended lubes, oils, packing material, and other maintenance supplies
- 20 11. Copies of final test reports, balance reports, and other related documentation
- 21 12. Warranty information for equipment and systems
- 22

23 1.5. O&M DATA SUBMITTALS

- 24 A. O&M Data shall be prepared as identified in this specification and shall be submitted for review as per the
- 25 schedule identified in Specification Section 01 29 76, Progress Payment Procedures.
- 26 B. O&M Data Draft submittals will be reviewed for content, procedure, and compliance only. A general critique
- 27 with recommendations for improvement will be made but re-submittals will not be required.
- 28 C. O&M Data Final submittals will be reviewed for content, procedure, and compliance. Re-submittals will be
- 29 required until such time as each submittal is accepted.
- 30

31 *NOTE: Acceptance of O&M Data Final submittals is required to be complete prior to scheduling and conducting owner*

32 *related training and construction closeout.*

33

34 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

35 **PART 3 - EXECUTION**

36 3.1. O&M DATA PREPARATION - GENERAL

- 39 A. All contractors shall prepare O&M Data for draft and final submission as follows:
- 40 1. Obtain digital PDF files for each piece of equipment, system, material or finish as described in Sections
- 41 1.4.A.1 and 1.4.A.2 above.
- 42 2. Verify that all information as described in Section 1.4.B above is included with the PDF file. Obtain
- 43 missing information as necessary for a complete submittal.
- 44 B. Rename each individual PDF file as follows.
- 45 1. Do not use special characters such as #, %, &, /, etc. These characters are reserved by the Project
- 46 Management Web Site software the City of Madison uses; however the under-score (or under-bar) '_' is
- 47 an allowed character.
- 48 2. Use the following format and examples for renaming your file:
- 49 a. Format: ***Equipment name_What_SYCAMORE AVE PW MAINT FACILITY UPGRADE_Contract***
- 50 ***number_Year***
- 51 i. *Equipment Name* represents the name of any equipment, system, material or finish as
- 52 designated in the Contract Documents.
- 53 ii. *What* represents what the file is about
- 54 iii. *SYCAMORE AVE PW MAINT FACILITY UPGRADE* represents the title of the project or
- 55 contract. A shortened version of the title may be identified by the City Project Manager to
- 56 be used by all contractors.
- 57 iv. *Contract number* is the specific identification number the Work was bid under and appears
- 58 on the plan set title sheet and in each sheet title block

- 1 v. Year represents the year the contract will be closed out
- 2 b. Examples of file names
- 3 i. AHU 2_Operation Manual_Fire Admin_1234_2015
- 4 ii. CPT 2_Use and Care_MPD West_9876_2011
- 5 C. All contractors shall submit the completed digital PDF files to the GC in sufficient time for the GC to meet the
- 6 O&M Data submission deadlines as described in Specification Section 01 29 76, Progress Payment Procedures.
- 7 D. O&M Data shall be submitted and reviewed as described in sections 3.2 and 3.3 below.
- 8

9 **3.2. O&M DATA DRAFT SUBMITTAL**

- 10 A. All contractors shall prepare and submit the following for an O&M Data Draft review submittal:
 - 11 1. Prepare three (3) complete O&M Data file samples as described in section 3.1 above.
 - 12 2. Review all specifications within his/her Division of Work and prepare a complete O&M Data checklist
 - 13 listing all equipment, systems, materials, or finishes. Checklist shall be in tabular form similar to the
 - 14 example below and shall indicate the title (and plan identifier when applicable) of the O&M Data, the
 - 15 associated specification, and a column to verify the item has been turned in and completed.
- 16 B. The GC shall be required to review all contractors' samples and checklists for compliance with this specification
- 17 and shall return any to the originating contractor that are insufficient for re-submittal.
 - 18 1. When acceptable to the GC, he/she shall upload each O&M Data draft submittal file to the O&M Draft
 - 19 library on the Project Management Web Site.
- 20 C. The Project Architect, City Project Manager, CxA, Consulting Staffs and Owner Representatives shall review the
- 21 O&M Data draft submittals and checklist within fifteen (15) working days as follows:
 - 22 1. Provide general critique comments by Division on O&M Data samples submitted. Critique is intended to
 - 23 provide all contractors with information on strengths and weaknesses of their submittals.
 - 24 a. Re-submittal of the O&M Data samples will not be required.
 - 25 2. Review in detail the O&M Data Checklist for completeness. Provide comments as needed.
 - 26 a. Re-submittal of the O&M Checklist will be required until accepted.
- 27

<u>Title</u>	<u>Specification</u>	<u>Completed</u>
Overhead Door Operator	08 36 00	
Air Handling Unit (AHU-3)	23 00 00	
Water Heater (WH-1)	22 30 00	

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 29 **3.3. O&M DATA FINAL SUBMITTAL**

- 30 A. All contractors shall prepare and submit the following for an O&M Data Final review submittal:
 - 31 1. Prepare complete O&M Data files as described in Section 3.1 above according to their approved checklist
 - 32 as described in Section 3.2 above.
 - 33 2. Submit completed checklist and all final O&M Data files to the GC for final submittal review.
- 34 B. The GC shall be required to spot check all contractors' submittals for completeness against their checklists and
- 35 for compliance with this specification and shall return any to the originating contractor that are insufficient for
- 36 re-submittal.
 - 37 1. When acceptable to the GC, he/she shall upload each O&M Data final submittal file to the O&M Final
 - 38 library on the Project Management Web Site.
- 39 C. The Project Architect, City Project Manager, CxA, Consulting Staffs and Owner Representatives shall review the
- 40 O&M Data final submittals and checklist within fifteen (15) working days as follows:
 - 41 1. Review the files submitted against the checklist and request any missing files through the GC.
 - 42 2. Review in detail all of the O&M Data files for completeness.
 - 43 a. Submittals shall be accepted or rejected as individual PDF files.
 - 44 b. Contractors shall re-submit entire O&M submittal if any portion is rejected or incomplete.
- 45

46 **3.4. CONSTRUCTION CLOSEOUT**

- 47 A. All contractors shall review Specification 01 77 00, Closeout Procedures and Specification 01 79 00
- 48 Demonstration and Training.
 - 49 1. Acceptance of all final O&M Data submittals is required prior to scheduling Demonstration and Training
 - 50 Sessions.
 - 51 2. Completion of all Demonstration and Training Sessions is required to receive the Substantial Compliance
 - 52 for Occupancy Certificate, and to begin Construction Closeout procedures.
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END OF SECTION

SECTION 01 78 36
WARRANTIES

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 1.3. DEFINITIONS 1
8 1.4. GENERAL CONTRACTORS RESPONSIBILITIES 2
9 PART 2 – PRODUCTS - THIS SECTION NOT USED 3
10 PART 3 - EXECUTION 3
11 3.1. WARRANTY CHECKLIST 3
12 3.2. LETTERS OF WARRANTY 3
13 3.3. STANDARD PRODUCT WARRANTY 4
14 3.4. FINAL WARRANTY SUBMITTAL 4
15 3.5. WARRANTY NOTIFICATION, RESPONSE, EXECUTION AND FOLLOW-UP 4
16

PART 1 – GENERAL

1.1. SUMMARY

- 19
20 A. The purpose of this specification is to provide clear responsibilities and guide lines related to providing all
21 Warranties and Guarantees related to the Work, workmanship, materials, equipment, and other such items
22 required by the Construction Documents.
23 B. Manufacturers’ disclaimers and limitations on product warranties do not relieve any contractor of the warranty on
24 the Work that includes the product.
25 C. Manufacturers’ disclaimers and limitations on product warranties do not relieve suppliers, manufacturers and
26 any contractor required to provide special warranties under the contract documents.
27

1.2. RELATED SPECIFICATIONS

- 28
29 A. Section 01 29 76 Progress Payment Procedures
30 B. Section 01 31 23 Project Management Web Site
31 C. Section 01 77 00 Closeout Procedures
32 D. Section 01 78 23 Operation and Maintenance Data
33 E. Section 01 91 00 Commissioning
34 F. Other Divisions and Specifications that may address more specifically the requirements for Warranties related to
35 the installation of all items and equipment installed under the execution of the Work.
36

1.3. DEFINITIONS

- 37
38 A. See specification 01 77 00 for the definitions of the following terms that may also be used in this specification:
39 1. Substantial Compliance
40 2. Certificate of Occupancy
41 3. Certificate of Substantial Completion
42 4. Construction Closeout
43 5. Contract Closeout
44 B. Emergency Repair: The Owner or Owner Representative reserves the right to make emergency repairs as
45 required to keep equipment or materials in operation or to prevent damage to property and injury to persons
46 without voiding the contractors warranty or bond or relieving the contractor of his/her responsibilities during
47 the warranty period.
48 C. Installer: The company or contractor hired to install a finished product that was manufactured and supplied
49 specifically for the Work within this contract. The Installer may or may not be the same company that supplied
50 the product. See the definition for supplier.
51 D. Supplier: Any company that makes a specific finished product for the Work from information within the Contract
52 Documents. Examples of suppliers would include custom cabinets, steel stairs and railings, etc. A supplier would
53 not be a company that distributes items manufactured by others such as an electrical or plumbing supplier.
54 E. Warranty: A written guarantee from the manufacturer to the owner on the integrity of a product and its
55 installation, and the manufacturers’ responsibility to repair or replace the defective product or components
56 within a specified time from the date of ownership. Warranty may also be used interchangeably with
57 Guarantee. The following warranty types may be part of any specification within the Work associated with the
58 Construction Documents:

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1. Expressed Warranty: A warranty that provides specific repair or replacement for covered components of a product over a specified length of time.
 2. Implied Warranty: A warranty that is not stated explicitly by a seller or manufacturer that the product is merchantable and fit for the intended purpose.
 3. Standard Product Warranty: Preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner. Standard warranties may be for any amount of time but shall not be for anything less than one (1) year from the warranty date.
 4. Special Warranty: A written warranty required by the Contract Documents either to extend the time limit provided under a standard warranty or to provide greater rights to the Owner.
- F. Warranty Date: The effective date that begins all warranty periods required for products, installations, and work-manship associated with the execution of the Work for this contract. The Warranty Date shall be set by the CPM.
- G. Related Damages and Losses: When correcting failed or damaged Warranted Work, remove and reinstall (or replace if necessary) the construction that has been damaged as a result of the failure or the construction that must be removed and replaced to obtain access for the correction of Warranted Work.
- H. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected reinstate the warranty by a new written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation unless specifically noted otherwise in a specification.
- I. Replacement Cost: All costs that may be associated with Work being replaced under warranty including but not limited to the following:
1. Related damages and losses
 2. Labor, material and equipment
 3. Permits and inspection fees
 4. This shall be regardless of any benefit the Owner may have had from the Work through any portion of its anticipated useful service life.
- J. Replacement Work: All materials, products, required labor, and equipment necessary to replace failed or damaged warranted to an acceptable condition that complies with the requirements of the original Construction Documents.
- K. Owners Recourse: Expressed warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, and remedies.
1. Rejection of Warranties: The Owner reserves the right to reject any warranty and to limit the selection of products with warranties not in conflict with the requirements of the contract documents.
 2. Where the Contract Documents require a Special Warranty or similar commitment on the Work or product, the Owner reserves the right to refuse acceptance of the Work until the Contractor presents evidence the entities required to countersign such required commitments have done so.

1.4. GENERAL CONTRACTORS RESPONSIBILITIES

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- A. The General Contractor (GC) shall be responsible to remedy, at his/her expense, any defect in the Work and any damage to City owned or controlled real or personal property when the damage is a result of:
1. The GC's failure to conform to Contract Document requirements.
 - a. Any substitutions not properly approved and authorized may be considered defective.
 2. Any defect in workmanship, materials, equipment, or design furnished by the GC or Sub-contractors.
- B. All warranties as described in this specification and these Contract Documents shall take effect on the date established by the CPM, as noted in Section 1.3F above.
1. All warranties shall remain in effect for one (1) year thereafter unless specifically stated otherwise in the Contract Documents or where standard manufacturer warranties are greater.
- C. The GC's warranty with respect to Work repaired or replaced, including restored or replaced Work due to damage, will run for one (1) year from the date of Owner Acceptance of said repair or replacement.
1. This shall be regardless of any benefit the Owner may have had from the Work through any portion of its anticipated useful service life.
- D. Warranty Response
1. See Section 3.5 of this specification.

PART 2 – PRODUCTS - THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. WARRANTY CHECKLIST

- A. All contractors shall be responsible for reviewing the drawings and specifications within their Divisions of Work to provide a complete and comprehensive list of all Warranty Requirements to the GC.
- B. Each list shall indicate the title (and plan identifier when applicable) of the warranted item, the associated specification of the warranted item, the terms of the warranty (years), and a column to verify the item has been turned in and completed.
- C. The GC shall be responsible for all of the following:
 - 1. Consolidating all the warranty lists into one master Warranty Checklist.
 - a. The checklist shall be in a tabular data format similar to the sample below.
 - 2. Upload the completed checklist to the Submittal Library on the Project Management Web Site for review. See Specification 01 33 23 Submittals for more information on this procedure.
 - 3. Resubmit the schedule as needed after initial reviews have been completed.
- D. The GC shall work with all contractors to amend the Warranty Checklist throughout the execution of the project based on changes and modifications as necessary.

<u>Title</u>	<u>Specification</u>	<u>Terms</u>	<u>Completed</u>
Overhead Door Operator	08 36 00	MFR 2yr	
Exterior Bench and Trash Receptacles	12 93 00	MFR 3 year warranty on finish	
Kitchen Sink (SK-1)	22 42 00	MFR 5 year	
Disposal (D-1)	22 42 00	MFR 7 year parts and in-home service	
Toilet (WC-1)	22 42 00	MFR 1 year limited	

3.2. LETTERS OF WARRANTY

- A. All letters of warranty shall be in a typed letter format and provide the following information:
 - 1. The letter shall be on official company stationary including company name, address, and phone number.
 - 2. Indicate SYCAMORE AVE PW MAINT FACILITY UPGRADE, contract number, and contract address the warranty is for on the reference line.
 - 3. Provide a description of the warranty(ies) being provided.
 - a. Include Division, Trade, or Specification information as necessary.
 - b. Only combine warranties of related Divisional Work together. Create new letters for additional Divisions as necessary.
 - 4. Indicate the effective Warranty Date. As noted in Section 1.3.F above, the Warranty Date shall be the date the Certificate of Substantial Completion was signed by the City Engineer.
 - 5. Contractor Letters of Warranty shall only be signed by a principal officer of the company.
 - 6. After signing the letter provide the GC with a high quality color scanned image in PDF format and the original signed letter.
- B. The GC shall be responsible for the Final Warranty submittal as identified in Section 3.4 below.
- C. The GC shall obtain letters of warranty from all of the following:
 - 1. The General Contractor shall provide warranty letters for all Work that was self performed under the contract documents, identify all trades or Divisions of Work.
 - 2. All Sub-contractors shall provide warranty letters for Work performed under the contract documents; identify all trades or Divisions of Work.
 - 3. Suppliers, as required by other specifications within the Construction Documents where the manufacture of a specific product unique to the Work of this contract was required.
 - a. The terms and conditions of the Supplier Letter of Warranty shall be as defined by the specifications associated with the Work but shall not be less than the industry standard of repair, or replace defective materials and workmanship within one (1) year of the warranty date.
 - b. When the supplier is also the installer a single written letter may be submitted identifying both the warranty for the manufacture of the product and the warranty for the installation of the product.
 - 4. Installers as required by other specifications within the Construction Documents where the installation of a specific product unique to the Work of this contract was required.

- 1 1. The terms and conditions of the Installer Letter of Warranty shall be as defined by the
2 specifications associated with the Work but shall not be less than the industry standard of repair,
3 or replace defective materials and workmanship associated with the installation of the product
4 within one (1) year of the warranty date.
5 5. Special Letters of Warranty shall be required from any contractor, supplier, installer or manufacturer who
6 agrees to provide warranty services required by any Division Specification in excess of their Standard
7 Product Warranty.
8

9 **3.3. STANDARD PRODUCT WARRANTY**

- 10 A. All contractors shall be responsible for collecting and providing copies of all standard product warranties for
11 commercially available products purchased and installed under this contract.
12 B. Only one copy of the manufacturers' standard warranty needs to be submitted as representative for all
13 quantities of the same model number used throughout the Work.
14 C. Provide the manufacturers certificate, letter, or other standard documentation for each Standard Product
15 Warranty submitted as follows:
16 1. Whenever possible a PDF version of the document shall be used.
17 a. If a PDF version is used all additional information shall be completed using simple PDF editing
18 tools such as text boxes, highlight, etc.
19 b. If a PDF version is not available and an original document is furnished the additional information
20 shall be neatly hand written and highlighted on the document in such a fashion so that it does not
21 obscure any part of the written warranty.
22 2. Provide the following additional information on each warranty document:
23 a. Contract warranty date.
24 b. Provide the manufacturer name and model number of the product if not specified within the
25 warranty.
26 i. Where the manufacturer name and model number is specified within the warranty it shall
27 be highlighted for visibility.
28 c. Provide the plan identifier (LAV-1, WC-2, etc) when applicable.
29 D. Each completed warranty shall be saved as a digital PDF. The file shall be named using the specification number
30 and item description. I.E. 22 42 00 Toilet (WC-1).pdf
31 a. Where an original certificate was furnished provide a high quality colored scan of the completed
32 document with the additional information. Save the scanned image in PDF format and use the
33 same naming convention as indicated above.
34 E. Provide all PDF files and any original documents to the GC for final consolidation to be provided to the Owner.
35

36 **3.4. FINAL WARRANTY SUBMITTAL**

- 37 A. The GC shall receive all required warranties (digital PDF and any original documents) from all contractors,
38 suppliers, installers and manufacturers.
39 B. The GC shall inventory all received warranties with the Warranty Submittal List to ensure all required warranties
40 have been received and all warranty periods are correct according to the specifications.
41 C. Provide with each Operation and Maintenance Manual a complete copy of any associated warranty.
42 D. Scan all warranties into a single organized electronic PDF file as follows:
43 1. Organize the PDF file into an orderly sequence based on the table of contents of the Specifications.
44 2. Provide a typed Table of Contents for the entire file at the front of the document.
45 3. Provide bookmarks and links to each individual PDF to enable quick navigation through the PDF
46 document.
47 E. Upload the warranty submittal to the appropriate document library on the Project Management Web Site for
48 review by the PA and CPM.
49 F. Correct any deficiencies or omissions and resubmit as necessary.
50

51 **3.5. WARRANTY NOTIFICATION, RESPONSE, EXECUTION AND FOLLOW-UP**

- 52 A. Warranty Notification:
53 1. The City of Madison, Project Management Web Site, uses an email notification system for all warranty
54 related issues. The GC will be required to provide, and keep current during the warranty period, a
55 minimum of two (2) email addresses and phone numbers of current employees to receive email
56 notifications and provide response regarding Work associated with these construction documents.
57 a. In the event a Warranty Issue is deemed by the City of Madison to be an emergency, the GC shall
58 first receive a phone call with a follow-up email from the Project Management Web Site.

- 1 b. The Contract Closeout-Warranty Issue Library on the Project Management Web Site uses a form
2 for each warranty issue that is logged into the system.
- 3 i. The GC shall open each warranty issue form, review the issue description and any attached
4 documentation or photos.
- 5 ii. The GC shall also notify any other sub-contractor, supplier, or installer that may be
6 required to review the warranty issue.
- 7 B. Warranty Response:
- 8 1. The GC shall upon notification by the City of Madison provide warranty response as follows:
- 9 a. Critical Systems or equipment: Where damage to equipment and other building components, or
10 injury to personnel is probable provide immediate emergency shut-down information and an on-
11 site response team as soon as possible but in no case shall on-site response exceed 24 hours.
- 12 b. For non-critical responses where damage or injury is unlikely provide on-site response no later
13 than the next business day.
- 14 c. Where Technical Assistance support is part of the written warranty provide all assistance
15 necessary via phone, text, or internet systems as indicated by the warranty. If issues cannot be
16 resolved provide on-site response no later than the next business day.
- 17 d. If the request cannot be supported in sufficient time as outlined above the Owner (or Owner
18 Representative) reserves the right to contact other contractors or service companies having
19 similar capability to expedite the repair or replacement and shall invoice all associated costs to
20 the Owner back to the GC.
- 21 C. Warranty Execution:
- 22 1. The GC shall provide all repairs or replacements as necessary to restore broken or damaged Work to the
23 original level of acceptance as intended by the Contract Documents.
- 24 a. Provide all materials, equipment, products, and labor necessary to complete the repair or
25 replacement associated with the Warranty Issue.
- 26 b. Provide all cleaning services as may be required before, during, and after the repair or
27 replacement as per Specification 01 74 13 Progress Cleaning.
- 28 c. Provide any protection necessary for existing construction as per Specification 01 76 00 Protecting
29 Installed Construction
- 30 d. Provide new letters of warranty when required.
- 31 D. Warranty Follow-up:
- 32 1. Logged Warranty Issues:
- 33 a. The GC shall provide complete documented responses of all logged Warranty Issues. Responses
34 shall provide a description of work completed, by who, inclusive dates, and photos of completed
35 or repaired work.
- 36 i. Provide call back response if work is not acceptable.
- 37 b. The City Project Manager shall review the submitted response documentation and do a field
38 inspection if necessary.
- 39 i. If work is not acceptable, contact GC to review details and expectations of the repair as
40 needed.
- 41 ii. If work is acceptable close the Warranty Issue.
- 42 2. Quarterly Warranty Reviews:
- 43 a. The GC shall be responsible for scheduling quarterly on-site review with all of the following:
- 44 i. City Project Manager, and other City staff as needed
- 45 ii. Owner and Owner Tenant Representative
- 46 iii. Commissioning Agent (CxA)
- 47 iv. Plumbing, Heating, Electrical Sub-contractors
- 48 v. Other Sub-contractors that may be responsible for open Warranty issues
- 49 b. Quarterly reviews shall be scheduled at 3 months, 6 months, and 11 months after the effective
50 date of the warranty. The review meetings shall:
- 51 i. Review the status of all open Warranty Issues, determine course of action and estimated
52 date of completion.
- 53 ii. In the appropriate quarter, provide shut-down, start-up, testing, and training of off-season
54 equipment as required by the contract documents.
- 55 iii. The 11th month review shall review all open Warranty Issues, final plan for resolution, and
56 all Warranty Issues where a new letter of warranty may have been issued.
- 57
- 58

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END OF SECTION

**SECTION 01 78 39
AS-BUILT DRAWINGS**

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFCAITONS 1
7 1.3. RELATED DOCUMENTS 1
8 1.4. PERFORMANCE REQUIREMENTS 1
9 1.5. QUALITY ASSURANCE 2
10 PART 2 – PRODUCTS 2
11 2.1. OFFICE SUPPLIES 2
12 PART 3 - EXECUTION 2
13 3.1. FIELD DOCUMENT AS-BUILTS 2
14 3.2. SITE SURVEY AS-BUILT 3
15 3.3. MASTER AS-BUILT DOCUMENT SET 3
16 3.4. AS-BUILT REVIEW AND ACCEPTANCE 4
17 3.5. CHANGES AFTER ACCEPTANCE 5
18

PART 1 – GENERAL

1.1. SUMMARY

- 22 A. This specification is intended to provide clear guidelines and identify the responsibilities of all contractors as they
23 pertain to City of Madison contract procedures regarding the accurate recording of the Work associated with the
24 execution of this contract. This shall include but not be limited to work that will be hidden, concealed, or buried.
25 B. Each contractor shall be responsible for maintaining an accurate record of all installations, locations, and
26 changes to the contract documents during the execution of this contract as it may relate to their specific division
27 or trade.
28 C. The General Contractor (GC) shall be responsible for ensuring all contractors provide as-built record information
29 to the Master As-Built Document Set as described in this specification.
30

1.2. RELATED SPECIFCAITONS

- 32 A. 00 31 21 Survey Information
33 B. 01 26 13 Request for Information
34 C. 01 31 23 Construction Bulletin
35 D. 01 32 33 Photographic Documentation
36 E. 01 26 63 Change Orders
37 F. 01 29 76 Progress Payment Procedures
38 G. 01 31 23 Project Management Web Site
39 H. 01 33 23 Submittals
40 I. 01 77 00 Closeout Procedures
41 J. 01 91 00 Commissioning
42 K. Other Divisions and Specifications that may address more specifically the requirements for field recording the
43 installation of all items associated with the execution of this contract by Division or Trade.
44

1.3. RELATED DOCUMENTS

- 46 A. Other related documents shall include but not be limited to the following:
47 1. Bidding documents including drawings, specifications, and addenda.
48 2. Required regulatory documents of conditional approval.
49 3. Field orders, verbal or written by inspectors having regulatory jurisdiction.
50 4. Shop drawings and installation drawings.
51

1.4. PERFORMANCE REQUIREMENTS

- 53 A. The GC shall be responsible for maintaining the “Master As-Built Document Set” in the job trailer at all times
54 during the execution of this contract. This document set shall include all of the following:
55 1. Master As-Built Plan Set
56 2. Master As-Built Specification Set
57 3. Other Document Sets

- 1 B. The GC shall designate one person of the GC staff to be responsible for maintaining the Master As-Built
2 Document Set at the job trailer. This shall include, posting updates, revisions, deletions and the monitoring of all
3 contractors posting as-built information as described in this specification.
4 C. All contractors shall use this specification as a general guideline regarding the requirements for documenting
5 their completed Work. Contractors shall explicitly follow additional specification requirements within their own
6 Division of Trade as it may apply to this specification.
7

8 **1.5. QUALITY ASSURANCE**

- 9 A. The GC shall be responsible for all of the following:
10 a. Spot checking all sub-contractors field documents to insure daily information is being recorded as
11 work progresses.
12 b. Discuss as-built recording to the plan set at weekly job meetings with all sub-contractors on site.
13 c. Schedule time with sub-contractors in the job trailer for recording as-built information to the plan
14 set.
15 d. Insure that all sub-contractors are providing clear and accurate information to the plan set in a
16 neat and organized manner.
17 e. Insure sub-contractors who have completed work have finalized recording all as-built information
18 to the plan set before releasing them from the project site.
19 B. The Project Architect, the City Project Manager, Commissioning Agent and other design team staff will perform
20 random checks of the Master As-Built Document Set during the execution of this contract to ensure as-built
21 information is being recorded in a timely fashion as the Work progresses. An updated and current Master As-
22 Built Document Set is a stipulation for approval of the progress payment.
23

24 **PART 2 – PRODUCTS**

25
26 **2.1. OFFICE SUPPLIES**

- 27 A. The GC shall provide a sufficient supply of office products in the job trailer at all times for all contractors to use in
28 recording as-built information into the plan set. This shall include but not be limited to the following:
29 a. Red ink pens, medium point. Pens that bleed through paper, markers, and felt tips will not be
30 accepted.
31 b. The use of highlighters is acceptable. Assign colors to various trades for consistency in recording
32 information.
33 c. Straight edges of various lengths for drawing dimension, extension and other lines.
34 d. Civil and Architectural scales
35 e. Clear transparent, non-yellowing, single sided tape.
36 f. Correction tape or correction fluid for correcting small errors.
37

38 **PART 3 - EXECUTION**

39
40 **3.1. FIELD DOCUMENT AS-BUILTS**

- 41 A. The GC and all Sub-contractors shall be responsible for keeping their own field set of as-built documents
42 including plans, specifications and published changes.
43 B. Field sets shall be kept dry and in good condition at all times.
44 C. No Work shall be buried, covered, or hidden, by any additional Work, regardless of Contractor or Trade, until
45 locations of all materials and equipment has been properly documented as described below.
46 D. All contractors shall be required to record the following as-built information:
47 a. Notes on the daily installation of materials and equipment.
48 b. Sketches, corrections, and markups indicating final location, positioning, and arrangement of
49 materials and equipment such as pipes, conduits, valves, cleanouts, pull boxes and other such
50 items. Note all final locations on plan sheets, indicate dimension off identifiable building features.
51 Riser diagrams need only be corrected for significant changes in locations, routing or
52 configuration.
53 i. The use of photographs in lieu of hand drawn sketches is acceptable.
54 ii. Photos shall be taken according to Specification 01 32 33 Photographic Documentation
55 iii. Print photo and markup with dimensions or notes as necessary.
56 c. Identify by the use of existing plan symbology and notes the size, type, quantity, and use as
57 applicable of materials such as pipes, valves, conduits, etc.

- 1 d. Note whether horizontal runs are below slab or above ceiling, include dimensions above or below
2 finished floor elevation.
3 E. All contractors shall be responsible for transferring the information from their field set of documents to the
4 Master As-Built Plan Set kept in the GC job trailer. See Section 3.3.D. below for the proper procedure.
5 F. All contractors shall update the GC Master Plan Set as often as necessary, but not less than once per work week.
6

7 **3.2. SITE SURVEY AS-BUILT**

- 8 A. The Land Surveyor Sub-Contractor shall provide digital as-built information including but not be limited to the
9 following:
10 a. For underground buried utility laterals and services of all types locate all of the following that may
11 apply:
12 i. Connection points at all mains
13 ii. Storm discharge points to open air
14 iii. All corners and bends regardless of angle, large radius sweeps shall have multiple point
15 locations sufficient to define the sweep.
16 iv. All vertical drops
17 v. All wells
18 vi. Private buried utilities such as buried electrical cables, irrigation systems, etc.
19 v. Other information that may need to be located in the future by the owner prior to digging
20 b. Record all surface features including but not limited to the following:
21 i. Building corners, pavement edges, and other permanent structural features.
22 ii. All surface covers for inlets, catch basins, cleanouts, access structures, curb stops and
23 other such devices.
24 iii. Other permanent surface features such as hydrants, lamp posts, and other permanent site
25 amenities.
26 c. The following data shall be recorded while locating items in sub-sections 3.2.a and 3.2.b above:
27 i. Flow lines at both ends of pipes
28 ii. Pipe sizes and material types
29 iii. Rim elevations for all covers
30 iv. Sump elevations and invert elevations of all structures
31 v. Spot elevations for all pads, driveways, walks, stoops, and floors
32 B. The Surveyor shall provide the final digital as-built on a media and in a format specified in Specification 00 31 21
33 Survey Information to the GC for turn in to the Project Architect and the Civil Engineer.
34 C. The Surveyor shall provide two printed as-built site plans to the GC for inclusion in the Master As-Built Plan Set
35 as follows:
36 1. One sheet to show all features (but not contour information) with text neatly organized for each item
37 identified.
38 2. One sheet showing contours, contour labels, and features from item 1 above, but with no additional text.
39

40 **3.3. MASTER AS-BUILT DOCUMENT SET**

- 41 A. The GC shall be responsible for maintaining the Master As-Built Document Set in the job trailer at all times.
42 1. The Master As-Built Plan Set (Plan Set) shall begin with one complete bid set of drawings and any
43 additional sheets that were supplied by published addenda during the bidding process. The cover sheet
44 shall be titled as the "Master As-Built Plan Set" in large bold red letters approximately 2" in height and
45 shall not be used for any other purpose.
46 a. The Plan Set shall be kept dry, legible, and in good condition at all times.
47 b. The Plan Set shall be kept up to date with new revisions within two (2) working days of
48 supplemental drawings being issued. Revisions shall be posted as follows:
49 i. Insert new, revised sheets into the plan set. Void old sheets but do not remove them from
50 the plan set. Indicate date received and what document (RFI, CB, CO, etc) caused the
51 change.
52 ii. Insert new, revised individual details into the plan set. Void old details, tape new details
53 over the old details with a "tape hinge" to allow them to be viewed. Indicate date
54 received and what document (RFI, CB, CO, etc) caused the change.
55 iii. Add new details in appropriate white space on relevant sheets. If no space is available use
56 the back side of the previous sheet or insert a new sheet. Indicate date received and what
57 document (RFI, CB, CO, etc) caused the change.

- 1 c. The Plan Set shall be available at anytime for easy reference during progress meetings and for
2 emergency location information of new work already completed.
- 3 2. The Master As-Built Specification Set (Spec Set) shall begin with one complete bid set of specifications
4 and any additional specifications that were supplied by published addenda during the bidding process.
5 The Spec Set shall be provided in three "D" ring type binders of sufficient thickness to accommodate the
6 specification set. Multiple binders are allowed as necessary. Label the front cover and binding edge with
7 "Master As-Built Specifications" in bold red letters. Provide other information as necessary to distinguish
8 the contents of multi-volume sets.
- 9 a. The Spec Set shall be kept dry, legible, and in good condition at all times.
10 b. The Spec Set shall be kept up to date with new revisions within two (2) working days of
11 supplemental drawings being issued.
- 12 c. The Spec Set shall be available at anytime for easy reference during progress meetings.
- 13 3. Other Document Sets may be kept at the GCs option in three "D" ring type binders of sufficient thickness
14 to accommodate the documentation. Other documentation sets may include but not be limited to RFIs,
15 CBs, COs, etc.
- 16 C. The Land Surveyor Sub-Contractor shall be required to use digital surveying for all exterior site surveying, and
17 provide deliverable digital as-builts as specified in Specification 00 31 21 Survey Information. As soon as practical
18 the surveyor shall provide the GC with a preliminary copy of installed buried utilities for inclusion with the plan
19 set in the job trailer. The surveyor shall provide final digital as builts as per section 3.2 above.
- 20 D. All contractors shall be responsible for updating the Plan Set from their field sets at least once per work week.
21 Updates shall include but not be limited to the following procedures:
- 22 a. All updates shall be done only in red ink. Place a "cloud" around small areas of correction to call
23 attention to the change.
- 24 b. Whenever possible place general work notes, field sketches, supplemental details, photos, and
25 other such information on the reverse side of the preceding sheet. Installation notes including
26 dates shall be kept neatly organized in chronological order as necessary.
- 27 c. Accurately locate items on the plan set as follows:
- 28 i. For items that are located as dimensioned provide a check mark or circle indicating the
29 dimension was verified.
- 30 ii. For items that are within 5 feet of the location indicated on the plans leave as shown and:
- 31 • Provide correct dimensions to existing dimension strings or,
32 • Accurately locate with new dimension strings
- 33 iii. For items that are more than 5 feet from the location indicated on the plans
- 34 • Accurately draw the items in the new location as installed and,
35 • Accurately locate with new dimension strings and,
36 • Note that the existing location is void.
- 37 d. Include dimensioned locations for items that will be buried, concealed, or hidden in the ground,
38 under floors, in walls or above ceilings.
- 39 i. Dimensions shall be pulled from identifiable building features, not from centers of columns
40 or other buried features.
- 41 ii. When necessary pull more dimensions as needed from opposing directions to properly
42 locate single items.

3.4. AS-BUILT REVIEW AND ACCEPTANCE

- 45 A. The GC shall provide the Master As-Built Plan Set to the Project Architect (PA), the City Project Manager (CPM),
46 the Commissioning Agent (CxA) and other design team staff for content review prior to the Progress Payment
47 Milestone indicated in Specification 01 29 76 Progress Payment Procedures. The submitted plan set shall include
48 the digital survey information produced under Section 3.2 above.
- 49 1. If the plan set is not approved:
- 50 a. The PA and CPM shall only be required to generalize deficiencies by trade there shall be no
51 requirement or expectation to generate a "punch list" of required corrections.
- 52 b. The GC and Sub-contractors as necessary shall be responsible for inspecting the installation and
53 correcting the drawings as needed.
- 54 c. The GC shall re-submit the plan set for review.
- 55 2. If the plan set is approved the PA shall take possession of the plan set to be used in providing the owner
56 with digital CAD record drawings. Upon completion of transferring the information to CAD the PA shall
57 provide the Owner with CAD record drawings, record PDFs, and the Master As-Built Plan Set.
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3.5. CHANGES AFTER ACCEPTANCE

- A. No Contractor shall be responsible for making changes to the As-Built record documents after acceptance by the PA and CPM except when necessitated by changes resulting from any Work made by the Contractor as part of his/her guarantee.

END OF SECTION

**SECTION 01 78 43
SPARE PARTS AND EXTRA MATERIALS**

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICAITONS 1
7 1.3. DEFINITIONS 1
8 1.4. PERFORMANCE REQUIREMENTS 1
9 1.5. QUALITY ASSURANCE 1
10 PART 2 – PRODUCTS – THIS SECTION NOT USED 2
11 PART 3 - EXECUTION 2
12 3.1. PACKAGING 2
13 3.2. LABELING 2
14 3.3. INVENTORY 2
15 3.4. STORAGE 3
16 3.5. CLOSEOUT PROCEDURE 3
17

PART 1 – GENERAL

1.1. SUMMARY

- 21 A. This specification is intended to provide clear guidelines and identify the responsibilities of all contractors as they
22 pertain to City of Madison contract procedures regarding spare parts, special tools, special materials, and extra
23 materials.
24 B. Each contractor shall be responsible for knowing the specific requirements of their Division Specifications as they
25 may relate to the general information provided in this specification.
26 C. The General Contractor (GC) shall be responsible for ensuring all contractors provide spare parts and extra
27 materials as described in this specification.
28

1.2. RELATED SPECIFICAITONS

- 29
30 A. 01 29 76 Progress Payment Procedures
31 B. 01 31 23 Project Management Web Site
32 C. 01 77 00 Closeout Procedures
33 D. Other Divisions and Specifications that may address more specifically how to proceed with spare parts, special
34 tools, special materials, and extra materials.
35

1.3. DEFINITIONS

- 36
37 A. Spare Parts: Any component of a product or assembly that comes pre-packaged or was specially ordered for the
38 explicit use of the product or assembly. This shall include but not be limited to fastening devices, mounting
39 brackets, replacement parts, wheels, pulleys, wiring, alternate assembly pieces, etc.
40 B. Special Tools: Any tool of any kind that was pre-packaged or specially ordered, and is required to be used for the
41 installation or maintenance of an installed product or assembly as part of this contract.
42 C. Special Materials: Any oil, lubricant, glue, touch-up paint, or other such material that comes pre-packaged or
43 was specially ordered and is required to be used for the installation or maintenance of an installed product or
44 assembly as part of this contract.
45 D. Extra Materials (Attic Stock): Any surplus materials in new and useable condition that was installed a part of this
46 contract. Attic Stock shall include but not be limited to the following: ceiling tiles, paint, stain, floor coverings,
47 ceramic tiles, light bulbs/lamps, filters, strainers, etc. Attic Stock shall include partially opened bulk items and
48 additional unopened quantities as directed by other specifications.
49

1.4. PERFORMANCE REQUIREMENTS

- 50
51 A. All contractors shall be responsible for consolidating spare parts, special tools, special materials, and attic stock
52 as it pertains to the specific Work within their Division or Trade.
53 B. All contractors shall use this specification as a general guideline regarding the requirements for turning spare
54 parts, special tools, special materials, and attic stock over to the owner. Contractors shall explicitly follow
55 specification requirements within their own Division of Trade.
56

1.5. QUALITY ASSURANCE

- 57
58 A. The General Contractor (GC) shall be responsible for all of the following:

1. Coordinate the location for and the delivery of all spare parts, special tools, special materials, and attic stock being provided by all contractors under this contract to one centralized location as designated by the Owner.
2. Verify that all items being delivered are:
 - a. Clean, new, and in a usable condition.
 - b. Properly sealed, protected, and labeled
 - c. Properly documented

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. PACKAGING

- A. Whenever possible all surplus items should remain in their original packaging such as parts envelopes.
- B. Package small parts in re-sealable plastic bags (Ziploc) or envelopes with clasp fasteners. Do not use envelopes that seal with glue or tape envelopes closed. Do not leave packaging unsealed.
- C. Package like parts together for products or assemblies. I.E. keep all spare parts for flushometers together.
- D. Many small packages may be grouped together into a larger container by trade.
- E. Do not use unrelated boxes or containers for packaging spare items. I.E. do not use a light fixture box for spare breakers, or flushometers parts.

3.2. LABELING

- A. Whenever possible the original labeling indicating part numbers and other pertinent information shall remain on the original packaging.
- B. If original labeling is not available the contractor shall label all parts and packages using tape or labels and permanent black markers. Tape or labels being used shall absorb the permanent marker without bleeding or allowing ink to be smeared or rubbed off.
- C. Labels shall include the name of the product or equipment the item belongs to, part number and/or name, and any other information that would assist maintenance personnel in identifying the piece and related product.
- D. Labels shall include plan or specification designations (WC-1, LAV-3, DF-2, CPT-1, etc) that identify the particular product or finish material it represents.
- E. Labels for parts stored in clear re-sealable plastic bags may be placed inside the bag. Label shall face out and be able to be read from one side. Multiple bags shall be numbered individually for identification.
- F. Label the outside of large containers with the trade name (Plumbing, Electrical, etc).

3.3. INVENTORY

- A. All contractors shall provide the GC with complete inventories of all spare parts, special tools, special materials, and attic stock that they are providing at the end of the contract. The inventories shall be organized as follows:
 1. The cover sheet shall indicate the Contractors name, address, phone number, identify that the document is the "Spare Parts and Extra Materials Inventory", and identify the Division or Trade the inventory is for.
 2. Provide an inventory in a tabular format of all items being provided under this and other specifications. The minimum information to be provided for each item on the inventory shall be as follows:
 - a. Bag or container number, all items of one bag or container shall be grouped together on the inventory
 - b. Item description
 - c. Item size (if applicable)
 - d. Total quantity provided
 - e. Identify if item is a spare part, tool, special material, or attic stock
- B. The GC shall consolidate inventories from all sub-contractors into one tabular data sheet organized by Division or Trade of Work.
 1. Upon completing the consolidated list the GC shall upload the completed inventory to the Contract Closeout-Attic Stock Library on the Project Management Web Site.
 2. The GC shall notify the Project Architect and City Project Manager that the scans have been uploaded.
 3. Consulting Staff and Owner Staff shall review the inventories prior to Final Review to verify that minimum required quantities have been met. Deficiencies shall be noted and returned back to the GC for corrective action.

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3.4. STORAGE

- A. Prior to the 80% Progress Payment milestone the GC shall coordinate with the City Project Manager and Maintenance Personnel where spare parts, special tools, special materials, and attic stock shall be stored.
- B. The GC shall instruct all contractors as to the location and proper storage procedures.
- C. The GC shall be responsible for ensuring the storage area is kept neat and orderly as follows:
 - 1. Like items are stored together by material, product, or trade as necessary.
 - 2. Liquids are stored in sealable containers and the lids have been properly installed to prevent drying out, spillage, etc.
 - 3. All labels are clearly visible and provide the required information.
- D. Large items shall be stored so as not to damage other items. Do not stack heavy items or items with distinct shapes/outlines on softer items that may get crushed or imprinted.

3.5. CLOSEOUT PROCEDURE

- A. Prior to the 90% Progress Payment milestone the GC shall review all attic stock already stored by the contractors to ensure the following:
 - 1. Materials are stored in the proper location(s).
 - 2. All boxes, containers and items are properly labeled according to the submitted/approved inventory.
 - 3. Quantities are correct according to the submitted/approved inventory.
- B. The GC shall ensure that all deficiencies are corrected prior to conducting Demonstration and Training Sessions.
- C. The GC shall review with Maintenance Staff all inventories and labeling during the scheduled Demonstration and Training Sessions.
- D. Any discrepancies associated with Attic Stock shall be resolved and verified prior to the CPM releasing the 90% CT progress payment.

END OF SECTION

**SECTION 01 79 00
DEMONSTRATION AND TRAINING**

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 1.3. QUALITY ASSURANCE 1
8 PART 2 – PRODUCTS – THIS SECTION NOT USED 2
9 PART 3 - EXECUTION 2
10 3.1. GENERAL REQUIREMENTS..... 2
11 3.2. COORDINATING AND SCHEDULING THE TRAINING..... 2
12 3.3. TRAINING OBJECTIVES..... 2
13 3.4. DEMONSTRATION AND TRAINING PROGRAM PREPARATION 3
14 3.5. CONDUCTING A DEMONSTRATION AND TRAINING SESSION 3
15 3.6. CLOSEOUT PROCEDURE 4
16

PART 1 – GENERAL

1.1. SUMMARY

- 19
20 A. The purpose of this specification is to provide clear responsibilities and guidelines related to providing
21 Demonstration and Training (D&T) Sessions related to general facility use, equipment, systems, finishes, and
22 materials to City of Madison Staff (Owner, Owner Representatives, Maintenance, and Custodial Personnel) as
23 needed.
24 B. All D&T shall be coordinated through the General Contractor (GC), Project Architect (PA) and City Project
25 Manager (CPM), and will be based on or customized to the needs of City of Madison Staff being trained. New
26 equipment and systems may have complete D&T sessions as described in this specification while equipment or
27 systems staff is familiar with may have sessions more focused on maintenance only.
28

1.2. RELATED SPECIFICATIONS

- 29
30 A. Section 01 29 76 Progress Payment Procedures
31 B. Section 01 78 13 Completion and Correction List
32 C. Section 01 78 19 Maintenance Contracts
33 D. Section 01 78 23 Operation and Maintenance Data
34 E. Section 01 78 36 Warranties
35 F. Section 01 78 39 As-Built Drawings
36 G. Section 01 78 43 Spare Parts and Extra Materials
37 H. Section 01 91 00 Commissioning
38 I. Other Divisions and Specifications that may address more specifically the requirements for D&T sessions related
39 to the installation of all items and equipment installed under the execution of the Work.
40

1.3. QUALITY ASSURANCE

- 41
42 A. All contractors shall have the responsibility of preparing for and conducting D&T sessions as determined by this
43 and other Division or Trade related specifications, Owner Operation and Maintenance Manuals, and other such
44 documentation related to the Work.
45 B. The GC shall have responsibility for:
46 1. Ensuring that all contractors required to conduct a D&T session have successfully completed all of the
47 following:
48 a. Turned in all required documentation for review and documentation has been approved/accepted
49 prior to scheduling D&T sessions.
50 b. Other required documentation as needed is available and ready for use during the D&T session.
51 c. All systems have been started, tested, and running as per appropriate specification and/or
52 manufacturers recommendations prior to scheduling D&T sessions.
53 d. All contractors are sufficiently prepared for their D&T session
54 e. Documents the D&T session including date, time, contractor and company name, attendees and
55 other information regarding the session
56 2. Organizing the coordination and scheduling of all D&T sessions between all contractors and the
57 appropriate representatives of the Owner. These representatives may include any of the following
58 depending on the Work of the Contract:

- 1 a. Owner – end users
- 2 b. Facility Maintenance personnel
- 3 i. Facility general operation procedures including custodial services
- 4 ii. Electrical
- 5 iii. Mechanical
- 6 iv. Plumbing
- 7 v. Site
- 8 c. Information Technology (IT) Department
- 9 d. Traffic Engineering – Radio Shop
- 10 e. Architects, Engineers and Facility Management staff as project completion overview
- 11

12 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

13

14 **PART 3 - EXECUTION**

15

16 **3.1. GENERAL REQUIREMENTS**

- 17 A. The GC shall develop a specific D&T plan to be scheduled and conducted as described below but no sooner than
- 18 the meeting discussed in 3.2.A.2 below.
- 19 C. The GC shall not schedule D&T sessions to preclude required personnel from attending multiple sessions.
- 20

21 **3.2. COORDINATING AND SCHEDULING THE TRAINING**

- 22 A. The GC, PA, CxA and CPM, shall review all Training and Demonstration requirements during two (2) special
- 23 meetings.
- 24 1. The first meeting shall be held at the 50% Contract Total Payment. During this meeting the following
- 25 shall be discussed:
- 26 a. Preliminary schedule of training dates to be completed prior to beginning construction closeout.
- 27 b. List of documentation and items that need to be completed and available before and during the
- 28 training session.
- 29 c. Who (Owner, Maintenance, etc) will be attending what training session(s).
- 30 2. The second meeting shall be held at the 80% Contract Total Payment. This meeting shall review due outs
- 31 that have not yet been completed for the 90% Contract Total Payment and the requirements necessary
- 32 for Construction Closeout. All Demonstration and Training sessions shall be completed prior to receiving
- 33 the 90% progress payment and beginning Construction Closeout Procedures (see Specification 01 77 00).
- 34 a. This does not include any requirement associated with off season equipment preparation and/or
- 35 demonstration and Training Sessions.
- 36 B. All of the Construction Work shall be operationally ready prior to conducting training as follows:
- 37 1. All contractors shall have their As-Built Drawing Records available for reviewing locations of system
- 38 components during training.
- 39 2. All final and approved Operations and Maintenance Data shall be completed no less than two (2) full
- 40 weeks prior to the scheduled training.
- 41 3. All systems shall have been started, functionally tested, balanced, and fully operational, and all piping
- 42 and equipment labeling complete at least two (2) days prior to the scheduled training.
- 43 a. Seasonal equipment shall not be trained out of season. Contractors having seasonal equipment
- 44 shall work with the GC and CPM for coordinating additional training sessions as appropriate for
- 45 seasonal equipment.
- 46 C. Correction list items that prevent a piece of equipment or system from being fully operational for training shall
- 47 be corrected prior to conducting the training.
- 48

49 **3.3. TRAINING OBJECTIVES**

- 50 A. For each piece of equipment or system installed train on the following objectives/topics as applicable:
- 51 1. System design, concept, and capabilities
- 52 2. Review of related contractor as-built drawings
- 53 3. Facility walkthrough to identify key components of the system
- 54 4. System operation and programming including weekly, monthly, annual test procedures
- 55 5. System maintenance requirements
- 56 6. System troubleshooting procedures
- 57 7. Testing, inspection, and reporting requirements associated with any regulatory requirements
- 58 8. Identification of any correction list items still outstanding

- 1 9. Review of system documentation including the following:
- 2 a. Operation and maintenance data
- 3 b. Warranties
- 4 c. Valve charts, tags, and pipe identification markers
- 5 B. For each piece of specialty equipment train on the following objectives/topics as applicable:
- 6 1. Manufacturers operations instructions
- 7 2. Manufacturers use and care instructions
- 8 3. Manufacturers maintenance and troubleshooting instructions
- 9 4. System operation and programming including weekly, monthly, annual test procedures
- 10 5. Identification of any correction list items still outstanding
- 11 6. Review of system documentation including the following:
- 12 a. Operation and maintenance data
- 13 b. Warranties
- 14 C. End User Orientation
- 15 1. Facility walkthrough
- 16 2. Security and emergency features
- 17 3. General facility operation procedures
- 18 D. Facility General Use and Custodial Services – if requested
- 19 1. Facility walkthrough
- 20 2. Security and emergency features
- 21 3. General facility operation procedures
- 22 4. Care and maintenance of specialty items, finishes, etc as requested
- 23 5. Attic stock inventory and material designations
- 24

25 **3.4. DEMONSTRATION AND TRAINING PROGRAM PREPARATION**

- 26 A. Each contractor having a responsibility for providing D&T sessions shall meet with the GC, CPM, and other City
- 27 Staff as needed to review the extent of the Training Objectives in section 3.3 above needed for each piece of
- 28 equipment, system, finish, etc. This meeting shall occur no less than four (4) weeks prior to the anticipated
- 29 training session.
- 30 B. The contractor shall use the information from item 3.4.A above to prepare a formal training program for each
- 31 piece of equipment or system based on the Training Objectives in 3.3 above.
- 32 1. The formal training program shall include the following information:
- 33 a. Session title
- 34 b. List of systems, equipment, use, care, etc to be covered during the session
- 35 c. Provide the following for each systems, equipment, use, care, etc to be covered during the session
- 36 i. Name and affiliation of each instructor to be used. As needed and discretion of the Owner
- 37 the GC to require attendance by the installing technician, installing Contractor and the
- 38 appropriate trade or manufacturer’s representative.
- 39 ii. Qualifications of each instructor to be used. Practical building operation expertise as well
- 40 as in-depth knowledge of all modes of operation of the specific piece of equipment as
- 41 installed in this project is required by the training personnel. If Owner determines training
- 42 was not adequate, the training shall be repeated until acceptable to Owner.
- 43 iii. A checklist of all documentation and system/equipment requirements necessary to
- 44 complete a successful training session and the current status of each
- 45 iv. Any additional documents, training aids, video or other items to be used to complete the
- 46 training
- 47 v. Any special requirements or needs associated with item iv above to complete the training
- 48 d. The intended audience for the training
- 49 e. The approximate duration of each objective or topic to be covered
- 50 2. Submit the completed training program to the GC for review and approval by the PA and CPM.
- 51 C. The PA and CPM shall work with staff as necessary to ensure all points of anticipated training needs have been
- 52 met. The PA and CPM will approve the program as submitted or recommend changes for re-submittal as
- 53 necessary.
- 54

55 **3.5. CONDUCTING A DEMONSTRATION AND TRAINING SESSION**

- 56 A. All contractors shall conduct their required D&T Sessions as follows:
- 57 1. Begin with a classroom session
- 58 a. Provide a sign in sheet indicating all training to be conducted, instructors, etc.

**SECTION 01 91 00
COMMISSIONING**

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 1.3 REFERENCES 1
8 1.4 DEFINITIONS 1
9 1.5 DESCRIPTION 2
10 1.6 RESPONSIBILITIES 3
11 1.7 SYSTEMS TO BE COMMISSIONED 4
12 PART 2 – PRODUCTS 4
13 2.1 TEST INFORMATION 4
14 PART 3 - EXECUTION 4
15 3.1 COMMISSIONING TEAM 4
16 3.2 SCHEDULING AND MEETINGS 4
17 3.3 REPORTING 4
18 3.4 RECORD DRAWINGS 5
19 3.5 CONSTRUCTION COMMISSIONING PROCEDURES 5
20 3.6 SENSOR AND ACTUATOR CALIBRATION 6
21 3.7 NON-CONFORMANCE 7
22 3.8 SAMPLE DOCUMENTS 9
23

PART 1 – GENERAL

1.1. SUMMARY

- 27 A. Purpose: Define the responsibilities of the parties involved and the procedures related to the commissioning
28 process
29

1.2. RELATED SPECIFICATIONS

- 31 A. Section 01 31 13 Project Management and Coordination
32 B. Section 01 31 19 Project Meetings
33 C. Section 01 31 23 Project Management
34 D. Section 01 32 26 Construction Progress Reporting
35 E. Section 01 33 23 Submittals
36 F. Section 01 45 16 Field Quality Control
37 G. Section 01 77 00 Closeout Procedures
38 H. Section 01 78 23 Operation and Maintenance Data
39 I. Section 01 78 39 As-Built Drawings
40 J. Section 01 79 00 Demonstration and Training
41 K. Section 01 81 13 Sustainable Design Requirements
42 L. Section 01 95 00 Measurement & Verification
43 M. Section 23 05 93 Testing, Adjusting, and Balancing for HVAC
44 N. Section 23 09 00 Instrumentation and Control for HVAC
45 O. Section 23 09 23 Direct Digital Control (DDC) System for HVAC
46 P. Section 23 09 93 Sequence of Operations for HVAC DDC
47

1.3 REFERENCES

- 49 A. ASHRAE Guideline 1.1-2007, "HVAC&R Technical Requirements for The Commissioning Process".
50 B. ASHRAE Guideline 0-2005, "The Commissioning Process".
51 C. NEBB – Procedural Standards for Building Systems Commissioning.
52

1.4 DEFINITIONS

- 54 A. Acceptance Phase. Phase of construction after startup and initial checkout when functional performance tests
55 are performed.
56 B. Commissioning Authority (CxA). An independent entity, not otherwise associated with the A/E team members or
57 the Contractor and reports directly to the Owner. The CxA directs and coordinates the commissioning activities.

- 1 C. Commissioning Plan (Cx Plan). An overall plan, developed before or after bidding, that provides the structure,
2 schedule and coordination planning for the commissioning process. The Cx Plan is included in the bid documents
3 and is to be reviewed by all contractors before submitting their bid.
- 4 D. Contract Documents. The documents binding on parties involved in the construction of this project (drawings,
5 specifications, change orders, amendments, contracts, Cx Plan, etc.).
- 6 E. Construction Checklist (CC). a list of items to inspect and test equipment and components to verify proper
7 installation of equipment. The CCs are provided by the CxA to the Sub.
- 8 F. Datalogging. - Monitoring flows, currents, status, pressures, etc. of equipment using stand-alone dataloggers
9 separate from the control system.
- 10 G. Deferred System Performance Tests. SPT's that are performed later, after substantial completion, due to partial
11 occupancy, equipment, seasonal requirements, design or other site conditions that prevent the tests from being
12 performed earlier.
- 13 H. Deficiency. A condition in the installation or function of a component, piece of equipment or system that is not in
14 compliance with the Contract Documents (that is, does not perform properly or is not complying with the
15 Owner's Project Requirements).
- 16 I. Factory Testing. Testing of equipment on-site or at the factory by factory personnel with an Owner's
17 representative present.
- 18 J. Indirect Indicators. Indicators of a response or condition, such as a reading from a control system screen
19 reporting a damper to be 100% closed.
- 20 K. Manual Test. Using hand-held instruments, immediate control system readouts or direct observation to verify
21 performance (contrasted to analyzing monitored data taken over time to make the "observation").
- 22 L. Monitoring. Recording parameters (flow, current, status, pressure, etc.) of equipment operation using
23 dataloggers or the trending capabilities of control systems.
- 24 M. Over-written Value. Writing over a sensor value in the control system to see the response of a system (e.g.,
25 changing the outside air temperature value from 75F to 50F to verify economizer operation). See also "Simulated
26 Signal."
- 27 N. Owner's Project Requirements (OPR). A document that describes what the Owner and stakeholders want to
28 achieve with this project and what expectations they have of the completed project.
- 29 O. Sampling. Reviewing or testing only a fraction of the total number of identical or near identical pieces of
30 equipment.
- 31 P. Seasonal Performance Tests. SPT's that are deferred until the system(s) will experience conditions closer to their
32 design conditions.
- 33 Q. Simulated Condition. Condition that is created for the purpose of testing the response of a system (e.g., applying
34 a hair blower to a space sensor to see the response in a VAV box).
- 35 R. Simulated Signal. Disconnecting a sensor and using a signal generator to send an amperage, resistance or
36 pressure to the transducer and DDC system to simulate a sensor value.
- 37 S. System Performance Test (SPT). Dynamic testing of entire systems (rather than just components of the system)
38 under full operation.
- 39 T. Trending. Monitoring of control points using the building automation system.

41 1.5 DESCRIPTION

- 42 A. General: Commissioning (Cx) is a systematic process of verifying that all building systems perform interactively to
43 meet the Owner's Project Requirements (OPR). This is achieved by beginning in the planning phase with
44 documenting the OPR and continuing through design, construction, acceptance, and the warranty period with
45 verification of performance. The Cx process shall encompass and coordinate the traditionally separate functions
46 of system documentation, equipment startup, control system calibration, tesTing and balancing, performance
47 testing and training. Cx during the construction phase is intended to achieve the following specific objectives
48 according to the Contract Documents:
 - 49 1. Verify that applicable equipment and systems are installed according to the manufacturer's
50 recommendations and to industry accepted minimum standards and that they receive adequate
51 operational checkout by installing contractors.
 - 52 2. Verify and document proper performance of equipment and systems.
 - 53 3. Verify that O&M documentation is complete.
 - 54 4. Verify that the Owner's operating personnel are adequately trained.
- 55 B. The Cx process does not take away from or reduce the responsibility of the system designers or installing
56 contractors to provide a finished and fully functioning product.
- 57 C. The commissioning authority (CxA) has no authority to change, modify or direct any work. The CxA can only
58 provide comments and suggestions.

- 1 D. Commissioning Plan. The Cx Plan provides guidance in the execution of the Cx process. The CxA will update the
2 Cx Plan regularly as the project progresses. The Drawings and Specifications will take precedence over the Cx
3 Plan.
4

5 **1.6 RESPONSIBILITIES**

6 A. General Contractor (GC) and Subcontractors (Subs)

7 1. Construction and Acceptance Phase

- 8 a. Provide assistance to the Construction Manager CM in the coordination of the Cx work by
9 the CxA, and with the CM and CxA ensure that Cx activities are being scheduled into the
10 master schedule.
11 b. Provide an updated construction schedule to the CxA any time the schedule changes.
12 c. Include the Cx activities in the contract.
13 d. Furnish a copy of all submittals and shop drawings pertaining to the commissioned
14 systems for review concurrently with the Architect and Engineers.
15 e. Furnish a copy of all construction meeting agendas and minutes to the CxA.
16 f. In each purchase order or subcontract written, include requirements for submittal data,
17 O&M data, Cx tasks and training.
18 g. GC will ensure that all Subs execute their Cx responsibilities according to the Contract
19 Documents and schedule.
20 h. A representative from the GC and each sub associated with the Cx process shall attend the
21 Cx pre- construction meeting and the regular Cx meetings scheduled by the CxA to
22 facilitate the Cx process.
23 i. Coordinate and execute the training of Owner personnel.
24 j. Prepare O&M manuals, according to the Contract Documents, including clarifying and
25 updating the original sequences of operation to as-built conditions.
26 k. Prepare and submit draft forms, including but not limited to start-up procedures, Testing
27 and Balancing (TAB) forms, calibration forms, etc. for review by the CxA before execution.
28 l. Submit test reports to the CxA of all tests performed on components and equipment to be
29 commissioned that are not included as part of the Construction Checklist and SPT
30 procedures.
31 m. Complete all construction checklist and functional performance test forms as required by
32 the Cx process.
33 n. Support the CxA with verification of the completion of construction checklist and
34 functional performance tests as outlined in PART 3.
35 o. Complete and inspect all installations. Certify that all components and systems are
36 operating as intended per Contract Documents.
37 p. Remedy all deficiencies immediately as they are identified throughout construction.
38 q. Demonstrate functionality of all systems and equipment.
39 r. Maintain an updated set of record drawings (on a daily basis) on the construction site.
40 s. Provide support and instrumentation to verify TAB reports, start-up reports, calibration
41 reports, and any other report pertinent to the commissioned equipment and systems.
42 t. Notify the CxA no less than 21 days before all testing, start-up, and training.
43 u. Update the CxA on a weekly basis on the progress of the Cx activities.
44 v. Submit trend data in electronic format or allow access to trending data by internet
45 connection as requested by the CxA.
46 w. Install access points by every sensor such that the sensor can be calibrated without
47 removal (P/T plugs, plugged holes in ducts etc.).
48 2. Warranty Period
- 49 a. Execute seasonal or deferred functional performance testing, witnessed by the CxA,
50 according to the specifications.
51 b. Correct deficiencies and make necessary adjustments to O&M manuals and record
52 drawings for applicable issues identified in any seasonal testing.

53 B. Equipment Suppliers

- 54 1. Provide all requested submittal data, including detailed start-up procedures and specific
55 responsibilities of the Owner to keep warranties in force.
56 2. Assist in equipment testing per agreements with Subs.
57 3. Include all special tools and instruments (only available from vendor, specific to a piece of
58 equipment) required for testing equipment according to these Contract Documents in the base

- 1 bid price to the Contractor, except for stand-alone data logging equipment that may be used by
2 the CxA.
3 4. Provide information requested by CxA regarding equipment sequence of operation and testing
4 procedures.
5 5. Review test procedures for equipment installed by factory representatives.
6

7 **1.7 SYSTEMS TO BE COMMISSIONED**

- 8 A. The entire Heating, Ventilation and Air Conditioning (HVAC) system as installed per the construction documents
9 (boilers, chillers, pumps, piping and air distribution systems)
10 B. Building Automation System (BAS) for the HVAC system
11 C. Building envelope and roofing system as it pertains to HVAC
12 D. Lighting and Lighting Controls
13 E. Solar electric (PV) System
14 F. Solar hot water (SHW) System (if applicable)
15 G. Emergency Power System
16

17 **PART 2 – PRODUCTS**

18
19 **2.1 TEST INFORMATION**

- 20 A. All instruments needed to verify sensor readings, component performance, and system performance will be
21 provided by GC and Subs and be available to the CxA. These instruments will not be beyond what the contractors
22 need to complete the work specified in these construction documents. Any data logging equipment required in
23 addition to the BAS will be provided by the CxA.
24 B. All instruments shall be of sufficient quality and accuracy to test and/or measure system performance with the
25 tolerances specified in the Contract Documents. Refer to specification section 23 05 93- Testing, Adjusting, and
26 Balancing for required instrument tolerances.
27

28 **PART 3 - EXECUTION**

29
30 **3.1 COMMISSIONING TEAM**

- 31 A. The members of the commissioning team consist of the Commissioning Authority (CxA), the Owner's Project
32 Manager (PM), the designated representative of the Owner's Construction Management team (CM), the General
33 Contractor (GC or Contractor), the architect and design engineers, the Mechanical Contractor, the Electrical
34 Contractor, the TAB Contractor, the Controls Contractor, any other installing subcontractors or suppliers of
35 equipment.
36 B. Each Cx Team member shall designate one person who is responsible for coordinating the commissioning efforts
37 with the CxA.
38

39 **3.2 SCHEDULING AND MEETINGS**

- 40 A. Scheduling. The CxA will work with the other members of the Cx Team according to established protocols to
41 schedule the Cx activities. The CxA will provide sufficient notice to the Cx Team for scheduling Cx activities. The
42 GC will integrate all Cx activities into the master schedule. All parties will address scheduling problems and make
43 necessary notifications in a timely manner in order to expedite the Cx process.
44 B. The CxA will provide the initial schedule of primary Cx events at the Cx pre-construction meeting. The Cx Plan
45 provides a format for this schedule. As construction progresses more detailed schedules are developed by the
46 CxA. The Cx Plan also provides a format for detailed schedules.
47 C. Pre-Construction Meeting. Within 60 days of selection of the GC, the CxA will schedule, plan, and conduct a Cx
48 pre-construction meeting with the entire Cx team in attendance. Meeting minutes will be distributed to all
49 parties by the CxA. Information gathered from this meeting will allow the CxA to revise the Cx Plan which will
50 also be distributed to all parties.
51 D. Meetings. The Cx meetings will be scheduled approximately once a month during construction. These meetings
52 will be scheduled directly before or after the regular construction meetings if practical. These meetings will cover
53 coordination, deficiency resolution and planning issues with particular Subs. The CxA will plan these meetings
54 and will minimize unnecessary time being spent by Subs
55

56 **3.3 REPORTING**

- 57 A. The CxA will provide regular reports to the Owner as construction and Cx progresses. Standard forms are
58 provided and referenced in the Cx Plan.

- 1 B. The CxA will regularly communicate with all members of the Cx team, keeping them apprised of Cx progress and
2 scheduling changes through memos, progress reports, etc.
3 C. Testing or review approvals and non-conformance and deficiency reports are made regularly with the review and
4 testing as described in later sections.
5

6 **3.4 RECORD DRAWINGS**

- 7 A. The CxA will verify that the record drawings are updated throughout the construction. If a discrepancy is found
8 between the record drawings and the installations, the CxA will notify the GC immediately. It is the GC and
9 subcontractors responsibility to then inspect the installations and immediately and completely update the record
10 drawings such that they accurately reflect the installation.
11

12 **3.5 CONSTRUCTION COMMISSIONING PROCEDURES**

- 13 A. The following procedures apply to all equipment to be commissioned.
14 B. General. Construction checklists are important to ensure that the equipment and systems are hooked up and
15 operational. It ensures that system performance testing (in-depth system checkout) may proceed without
16 unnecessary delays. Each piece of equipment receives full checkout. No sampling strategies are used. All
17 construction checklists for a given system must be successfully completed prior to formal system performance
18 testing of equipment or subsystems of the given system.
19 C. Construction Checklists.
20 1. The primary purpose of the construction checklists is to provide the individual workers with the
21 key criteria for a successful installation. The secondary purpose is to track the progress of the
22 delivery and installation.
23 2. The CxA will develop construction checklists for all commissioned equipment and distribute these
24 to the responsible contractor. The GC and Subs will review the construction checklists for each
25 equipment type and provide comments to the CxA. The CxA will then print and distribute the
26 construction checklist for each individual component.
27 3. The GC and Subs are responsible for all requirements in the specification, not only the
28 requirements listed on the checklists.
29 4. The checklists answer format will be to circle yes /no or provide a brief answer such as providing
30 the model or serial numbers.
31 5. These checklists are provided by the CxA to the GC. The GC determines which trade is responsible
32 for executing and documenting each of the line item tasks and notes that trade on the form. Each
33 form may have more than one trade responsible for its execution. A sample checklist for a VAV
34 box is provided at the end of this specification section.
35 6. The construction checklists shall be completed as delivery is completed and the installation
36 progresses.
37 7. Only individuals who have direct knowledge and witnessed that a line item task on the
38 construction checklist was actually performed shall initial or check that item off. It is not
39 acceptable for supervisors without direct knowledge or who have not witnessed the line item task
40 on the construction checklist to fill out these forms.
41 8. Any negative response shall immediately be brought to the attention of the CxA. All negative
42 replies shall be explained in detail on the construction checklist.
43 9. The GC and Subs are responsible for recording the completion of the checklists. Checklists shall be
44 submitted electronically to SharePoint in .pdf format in separate files by Division. Each file shall be
45 bookmarked by checklist tag.
46 10. Non-itemized installations such as wiring, ductwork, piping etc. will not have checklists to be
47 completed, but the GC and Subs will be provided the key criteria for successful installation.
48 11. The CxA will verify the construction checklist completion by a sampling of the delivered and
49 installed equipment. The sampling process will be described in the Cx Plan.
50 D. Sensor Calibration. Calibration of all sensors shall be included as part of the construction checklists performed by
51 the Contractors. Calibration information is provided in specification Section 23 09 23 - Direct Digital Control
52 System for HVAC
53 E. Deficiencies, Non-Conformance and Approval in Checklists and Startup.
54 1. The Subs shall clearly list any outstanding items of the construction checklist that were not
55 completed successfully, at the bottom of the procedures form or on an attached sheet. The
56 procedures form and any outstanding deficiencies are provided to the CxA within two days of task
57 completion.

- 1 6. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum
- 2 and verify at the building automation system.
- 3 7. Record all values and recalibrate controller as necessary to conform with specified control ramps,
- 4 reset schedules, proportional relationship, reset relationship and P/I reaction.
- 5 8. Reconnect sensor.
- 6 9. Make a reading with a calibrated test instrument within 6 inches (150 mm) of the site sensor.
- 7 10. Verify that the sensor reading, via the permanent thermostat, gage or building automation
- 8 system, is within the tolerances in the table below of the instrument-measured value.
- 9 11. If not, replace sensor and repeat.
- 10 12. For pressure sensors, perform a similar process with a suitable signal generator.
- 11 F. Sensor Tolerances for Standard Applications: Plus/minus the following maximums:
- 12 1. Watt/hour, Voltage, Amperage: 1 percent of design.
- 13 2. Pressure, Air, Water, Gas: 3 percent of design.
- 14 3. Air Temperatures (Outside Air, Space Air, Duct Air): 0.4 degrees F (0.2 degree C).
- 15 4. Relative Humidity: 4 percent of design.
- 16 5. Barometric Pressure: 0.1 inch of Hg (340 Pa).
- 17 6. Flow Rate, Air: 10 percent of design.
- 18 7. Flow Rate, Water: 4 percent of design.
- 19 8. Flow Rate, Steam: 3 percent of design.
- 20 9. AHU Wet Bulb and Dew Point: 2.0 degrees F (1.1 degrees C).
- 21 10. Hot Water Coil and Boiler Water Temperature: 1.5 degrees F (0.8 degrees C).
- 22 11. Cooling Coil, Chilled and Condenser Water Temperatures: 0.4 degrees F (0.2 degree C).
- 23 12. Combustion Flue Temperature: 5.0 degrees F (2.8 degrees C).
- 24 13. Oxygen and CO2 Monitors: 0.1 percentage points.
- 25 14. CO Monitor: 0.01 percentage points.
- 26 15. Natural Gas and Oil Flow Rate: 1 percent of design.
- 27 G. Critical Applications: For some applications more rigorous calibration techniques may be required for selected
- 28 sensors. Describe any such methods used on an attached sheet.
- 29 H. Valve/Damper Stroke Setup and Check:
- 30 1. For all valve/damper actuator positions checked, verify the actual position against the control
- 31 system readout.
- 32 2. Set pump/fan to normal operating mode.
- 33 3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero
- 34 signal as required.
- 35 4. Command valve/damper to open; verify position is full open and adjust output signal as required.
- 36 5. Command valve/damper to a few intermediate positions.
- 37 6. If actual valve/damper position does not reasonably correspond, replace actuator
- 38 I. Isolation Valve or System Valve Leak Check: For valves not associated with coils.
- 39 1. With full pressure in the system, command valve closed.
- 40 2. Use an ultra-sonic flow meter to detect flow or leakage.

3.7 NON-CONFORMANCE

- 43 A. All deficiencies or non-conformance issues shall be noted and reported by the GC to the CM on a standard non-
- 44 compliance form.
- 45 B. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such
- 46 cases the deficiency and resolution will be documented on the procedure form.
- 47 C. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not
- 48 compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient
- 49 work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to
- 50 do so at the request of the CM and the Owner.
- 51 D. As tests progress and a deficiency is identified, the CxA discusses the issue with the executing contractor.
- 52 1. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:
- 53 a. The CxA documents the deficiency and the Sub's response and intentions and they go on
- 54 to another test or sequence. After the day's work, the CxA submits the non-compliance
- 55 reports to the CM for signature, if required. A copy is provided to the Sub and CxA. The
- 56 Sub corrects the deficiency, signs the statement of correction at the bottom of the non-
- 57 compliance form certifying that the equipment is ready to be retested and sends it back to
- 58 the CxA.

1 **3.8 SAMPLE DOCUMENTS**
2 A. The two documents after this section (Sample Construction Checklist and Sample System Performance Test) are
3 included to demonstrate the level of effort and quality expected of the contractors. These documents will be
4 revised as necessary as the project progresses.

5
6
7

END OF SECTION

**SECTION 01 95 00
MEASUREMENT AND VERIFICATION**

1
2
3
4 PART 1 – GENERAL 1
5 1.1 SUMMARY 1
6 1.2 DEFINITIONS 1
7 1.3 MECHANICAL CONTRACTOR RESPONSIBILITIES 1
8 1.4 ELECTRICAL CONTRACTOR RESPONSIBILITIES 1
9 1.5 CONTROLS CONTRACTOR RESPONSIBILITIES 2
10 1.6 M&V PROVIDERS RESPONSIBILITIES 2
11 PART 2 – PRODUCTS – THIS SECTION NOT USED 2
12 2.1 METERS AND SUB-METERS 2
13 PART 3 - EXECUTION 2
14 3.1 METER 2
15 3.2 SUB-METERS 2
16 3.3 NATURAL GAS 2
17 3.4 DOMESTIC HOT WATER 2
18 3.5 TEMPORARY MONITORING 3
19 3.6 DDC TRENDS 3
20

PART 1 – GENERAL

1.1 SUMMARY

A. Purpose: This section includes general requirements that apply to implementation of measurement and verification.

B. RELATED WORK AND REQUIREMENTS

1. Section 01 31 13 Project Coordination
2. Section 01 31 19 Project Meetings
3. Section 01 31 23 Project Management Web Site
4. Section 01 91 00 Commissioning
5. Section 23 09 00 Instrumentation and Control for HVAC
6. Section 23 09 23 Direct Digital Control (DDC) System for HVAC
7. Section 23 09 93 Sequence of Operations for HVAC DDC
8. Section 26 24 13 Switchboards
9. Section 26 24 16 Panelboards

1.2 DEFINITIONS

- A. BAS - Building Automation System
- B. DHW - Domestic Hot Water
- C. M&V - Measurement and Verification
- D. kW - Electric power read from utility meter
- E. KWh - Electric energy consumption read from utility meter
- F. Plug Loads – Electric power and consumption from wall receptacles

1.3 MECHANICAL CONTRACTOR RESPONSIBILITIES

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform M&V activities including, but not limited to, the following:
1. Follow activities identified in the M&V Plan.
 2. Coordinate connection of gas and DHW monitoring equipment with BAS.
 3. Cooperate with the M&V Provider and Controls Contractor for resolution of issues related to data collection.
 4. Attend team meetings during construction and post-construction M&V period (1 year).

1.4 ELECTRICAL CONTRACTOR RESPONSIBILITIES

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform M&V activities including, but not limited to, the following:
1. Follow activities identified in the M&V Plan.
 2. Coordinate connection of electrical monitoring equipment with BAS

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3.5 TEMPORARY MONITORING

- A. Provide easy access to allow for the temporary installation of split-core current sensors and voltage sensors for the electrical measurement and datalogging on the following systems:
 - 1. Lighting
 - 2. Plug loads
 - 3. HVAC equipment including chillers, fans, circulation pumps, and air handling units
 - 4. DHW equipment

3.6 DDC TRENDS

- A. The Controls Contractor is to provide provision for remote access to BAS to view status of building and the ability to download trendable points.

END OF SECTION

SECTION 02 41 16
STRUCTURAL DEMOLITION

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SCOPE 1
6 1.2. RELATED REQUIREMENTS 1
7 1.3. REFERENCE STANDARDS 1
8 1.4. SUBMITTALS 1
9 1.5. PRE-INSTALLATION MEETINGS 1
10 1.6. SEQUENCING 1
11 1.7. QUALITY ASSURANCE 1
12 PART 2 - PRODUCTS 1
13 2.1. MATERIALS 2
14 PART 3 - EXECUTION 2
15 3.1. STRUCTURAL DEMOLITION 2
16 3.2. GENERAL PROCEDURES AND PROJECT CONDITIONS 2
17 3.3. EXISTING UTILITIES 2
18 3.4. SELECTIVE DEMOLITION FOR ALTERATIONS 3
19 3.5. SELECTIVE DEMOLITION FOR ALTERATIONS 3
20

PART 1 – GENERAL

1.1. SCOPE

- A. Demolition of structural bearing elements.
- B. Pollution Control during building demolition, including noise control.
- C. Removal and legal disposal of all demolition materials and all tipping fees paid by the demolition contractor.

1.2. RELATED REQUIREMENTS

- A. Section 01 26 57 – Change Order Requests
- B. Section 01 31 19 – Project Meetings
- C. Section 01 31 23 – Project Management Web Site
- E. Section 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling
- F. Section 01 76 00 – Protecting Installed Construction

1.3. REFERENCE STANDARDS

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2009.

1.4. SUBMITTALS

- A. Schedule: Submit for approval the structural demolition schedule.
- B. Schedule: Submit for approval the structural demolition schedule.
- C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.5. PRE-INSTALLATION MEETINGS

- A. Convene minimum two weeks prior to starting any structural demolition.

1.6. SEQUENCING

- A. Immediate areas of work will not be occupied during structural demolition.
- B. No responsibility for buildings and structures to be demolished will be assumed by the owner.

1.7. QUALITY ASSURANCE

- A. Codes and Regulations: Comply with all governing codes and regulations. Use experienced workers.

PART 2 - PRODUCTS

1 **2.1. MATERIALS**

2 A. REPAIR MATERIALS

- 3 1. This will apply to all existing site improvements that are scheduled to remain.
4 2. Use repair materials identical to existing materials.
5 a. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that
6 visually match existing adjacent surfaces to the fullest extent possible.
7 b. Use materials whose installed performance equal or surpasses that of existing materials.
8

9 **PART 3 - EXECUTION**

10
11 **3.1. STRUCTURAL DEMOLITION**

- 12 A. Refer to contract documents for locations and quantities.
13

14 **3.2. GENERAL PROCEDURES AND PROJECT CONDITIONS**

15 A. STRUCTURAL DEMOLITION

- 16 1. Demolition Operations: Do not damage improvements indicated to remain. Items of salvage value will be
17 removed from the building per the Construction and Waste Management and Disposal Plan. Storage or sale
18 of items at the project site is prohibited.
19 2. Remove other items indicated in the Construction and Waste Management and Disposal Plan from the
20 premises per the Reuse & Recycling Plan.
21 3. All other materials from the demolition of the existing structure are to be properly disposed of offsite
22 by the contractor including removal of abandoned utilities and wiring systems.
23 4. Comply with applicable codes and regulations for demolition operations and safety of adjacent
24 structures and the public.
25 5. Obtain required permits.
26 6. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed;
27 do not allow worker or public access within range of potential collapse of unstable structures.
28 7. Provide, erect, and maintain temporary barriers and security devices.
29 8. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
30 9. Conduct operations to minimize effects on and interference with adjacent structures and
31 occupants.
32 10. Do not close or obstruct roadways or sidewalks without permit.
33 11. Conduct operations to minimize obstruction of public and private entrances and exits; do not
34 obstruct required exits at any time; protect persons using entrances and exits from removal operations.
35 12. Obtain written permission from owners of adjacent properties when demolition equipment will
36 traverse, infringe upon or limit access to their property.
37 13. Protect existing structures and other elements that are not to be removed.
38 14. Cease operations if public safety or remaining structures are endangered. Perform temporary
39 corrective measures until operations can be continued properly.
40 15. Stop work immediately if adjacent structures appear to be in danger.
41 16. Provide adequate protection against accidental trespassing. Secure project after working hours.
42 17. Restore finishes of any areas damaged during demolition that were noted to remain.
43 a. All existing site improvements and building ground floor slab are to remain.
44 18. Hazardous materials have been removed under prior separate contract. If hazardous materials are
45 discovered during removal operations, stop work and notify Architect and Owner; hazardous materials
46 include regulated asbestos containing materials, lead, PCB's, and mercury.
47 19. Perform demolition in a manner that maximizes salvage and recycling of materials.
48 20. Comply with requirements of Section 01 74 19 - Waste Management.
49 21. Dismantle existing construction and separate materials.
50 22. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or
51 point of reuse.
52

53 **3.3. EXISTING UTILITIES**

- 54 A. Protect existing utilities to remain from damage.
55 B. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written
56 notification to Owner.
57 C. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior

1 written notification to Owner.

2 D. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type;
3 protect from damage due to subsequent construction, using substantial barricades if necessary.

4 E. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or
5 design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written
6 report to Architect.

7 **3.4. SELECTIVE DEMOLITION FOR ALTERATIONS**

8 A. Drawings showing existing construction and utilities are based on casual field observation and existing record
9 documents only.

10 1. Verify that construction and utility arrangements are as shown.

11 2. Report discrepancies to City Construction Manager before disturbing existing installation.

12 3. Engage a professional engineer to survey condition of building to determine whether removing
13 any element might result in structural deficiency or unplanned collapse of any portion of structure or
14 adjacent structures during selective demolition operations.

15 4. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent
16 upon examination prior to starting demolition.

17 5. Perform surveys as the Work progresses to detect hazards resulting from selective
18 demolition activities.

19 B. Remove existing work as indicated and as required to accomplish new work.

20 1. Remove items indicated on drawings.

21 C. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and
22 Telecommunications): Remove existing systems and equipment as indicated.

23 1. Maintain existing active systems that are to remain in operation; maintain access to
24 equipment and operational components.

25 2. Where existing active systems serve occupied facilities but are to be replaced with new services,
26 maintain existing systems in service until new systems are complete and ready for service.

27 3. Verify that abandoned services serve only abandoned facilities before removal.

28 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible
29 ceilings; remove back to source of supply where possible, otherwise cap stub and tag with
30 identification.

31 D. Protect existing work to remain.

32 1. Prevent movement of structure; provide shoring and bracing if necessary.

33 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.

34 3. Repair adjacent construction and finishes damaged during removal work.

35 4. Patch as specified for patching new work.

36

37 **3.5. SELECTIVE DEMOLITION FOR ALTERATIONS**

38 A. Remove debris, junk, and trash from site.

39 B. Remove from site all materials not to be reused on site; comply with requirements of Section 01 7419 –
40 Waste Management.

41 C. Leave site in clean condition, ready for subsequent work.

42 D. Clean up spillage and wind-blown debris from public and private lands.

43

44

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46

END OF SECTION



City of Madison APPLICATION FOR ALTERATION OF EXISTING CONDITIONAL USE

FOR OFFICE USE ONLY	
Date:	_____
LNDMAC:	_____
Parcel #	_____

TO ZONING ADMINISTRATOR:

The undersigned owner (contract owner) of property herein described hereby applies for approval to make minor alterations to an existing conditional use.

Location of Property/Street Address: 4602 Sycamore Ave. Ald. District: District 17
Madison, WI 53704 Zoning District: Industrial - Limited District

Existing Conditional Use: An addition in excess of 5,000 square feet of floor area to an existing building.

Proposed Alteration (Describe): The project proposes an office remodel and replacement of three (3) exterior doors. In addition the project will provide multiple MEP upgrades, Fire Safety upgrades, and a new Solar Hot Water Panel installation located on an existing roof.

This application must be accompanied by four (4) sets of construction and plot plans indicating the proposed alteration, if there are no exterior changes to the site or parking lot. Eight (8) sets of construction and parking lot plans are required, if exterior changes are proposed to the site or parking lot. An Adobe Acrobat PDF File of the submitted plans, either on a non-returnable CD or USB flash drive, or emailed to zoning@cityofmadison.com, must also be submitted. The application fee is \$100, in addition to applicable site plan review fees.

Section 28.183(8). states: "No alteration of a conditional use shall be permitted unless approved by the City Plan Commission provided, however, the Zoning Administrator following consideration by the alderperson of the district, may approve minor alterations or additions which are approved by the Director of Planning and Community and Economic Development and are compatible with the concept approved by the Plan Commission and the standards in subsection 28.183(6)."

Respectfully submitted,

Name Brent Pauba Address City County Building, Room 115. 210 Martin Luther King, Jr. Blvd. Madison WI 53703
Telephone 608 266 4092 Email BPauba@CityofMadison.com

ALDER'S RECOMMENDATION:

ZONING ADMINISTRATOR'S COMMENTS:

Occupancy Certificate Status _____
Outstanding Orders _____
Conditions of Approval Met _____
Compatibility of Proposed Alteration with Concept Approved By Plan Commission _____ _____
Compatibility of Proposed Alteration with Standards 28.183(6) _____ _____

Approved according to 28.183(8).	<input type="checkbox"/> Director of Planning & Community & Economic Development/Date
	<input type="checkbox"/> Director of Planning & Community & Economic Development/Date
Disapproved – Refer to Plan Commission	<input type="checkbox"/> Director of Planning & Community & Economic Development/Date
	<input type="checkbox"/> Director of Planning & Community & Economic Development/Date



TITLE
Sycamore Ave. Public Works Maintenance Facility Upgrades

ADDRESS
4602 Sycamore Ave.
Madison, WI 53704

PROJECT TYPE
Public Building

CONDITIONAL USE
Yes (documents available digitally)

ORIGINAL CONSTRUCTION
1976

BUILDING AREA
~149,000 sf

PROJECT AREA
~11,200 SF + System(s) upgrade

PROJECT DESCRIPTION
Sycamore Ave. Public Works Maintenance Facility Upgrades (SER) is primarily an office remodel for the following City agencies: Streets, Parks, and Weights & Measures. In addition the project will provide multiple MEP upgrades, Fire Safety upgrades, and a new Solar Hot Water Panel installation (to be placed on Unit D's roof). The building's enclosure will go through minimal alteration, though the project intends to replace 3 existing exterior doors, add 1 new exterior door, and provide multiple solar tubes to Unit B's roof. The project schedule anticipates construction to start May/June of 2019.

PARCEL NUMBER
251/0810-342-0240-8

ACCESS DANE URL
<https://accessdane.countyofdane.com/Parcel/Index/081034202408>

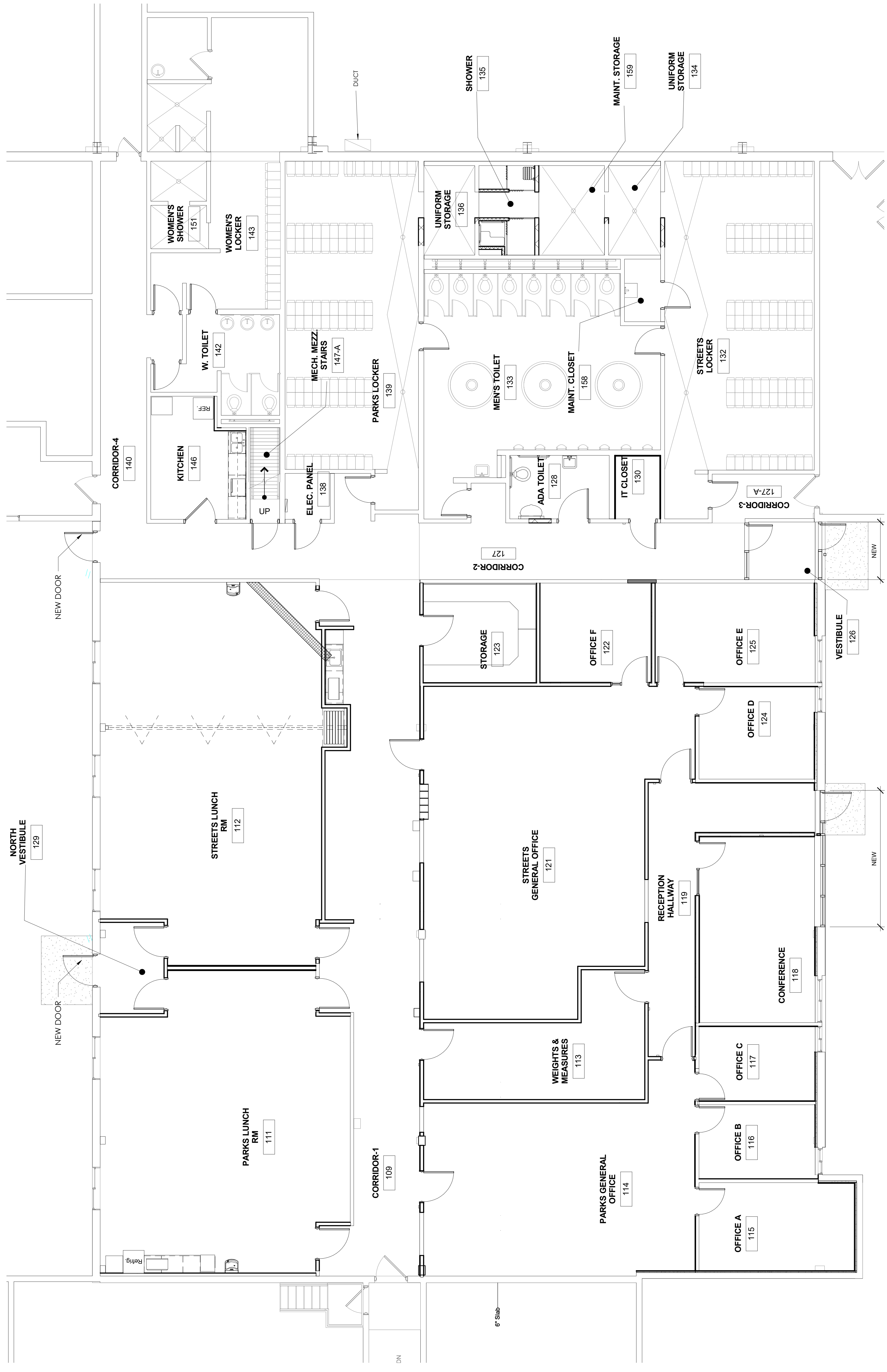
City of Madison Project URL
<https://www.cityofmadison.com/engineering/projects/sycamore-re-ave-public-works-maint-facility-upgrades>

City Staff contact
Brent Pauba
Department of Public Works
Engineering Division
City County Building, Room 115
210 Martin Luther King, Jr. Blvd.
Madison WI 53703-3342
bpauba@cityofmadison.com
608 266 4092

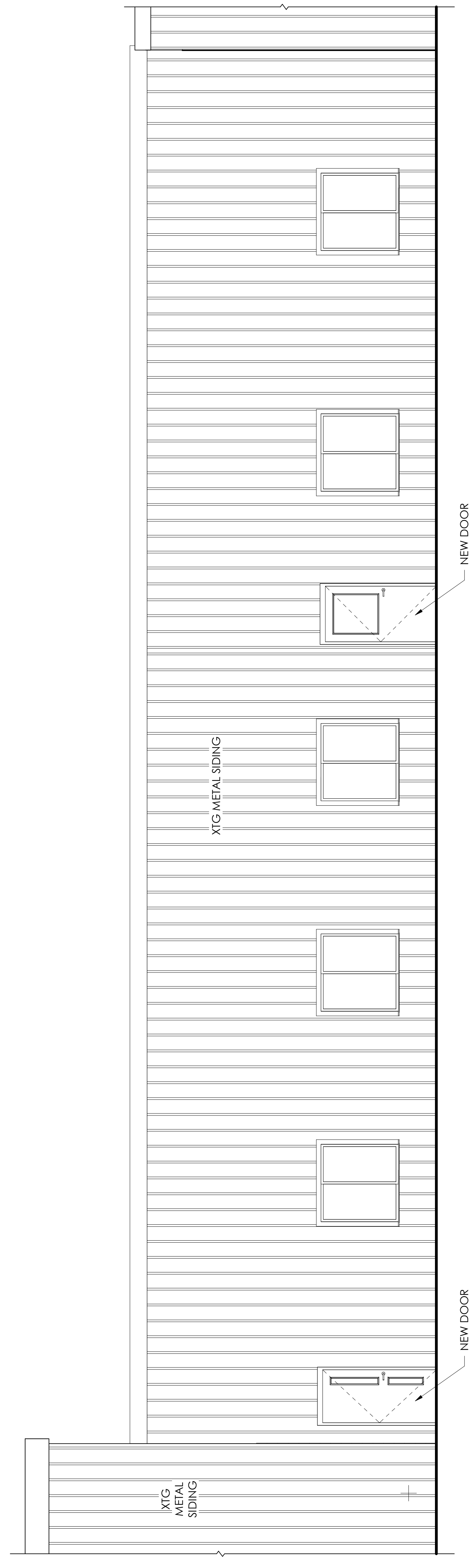
EAST STREET OFFICE REMODEL EXISTING EXTERIOR ELEVATIONS

4602 SYCAMORE AVE., MADISON, WI 53704

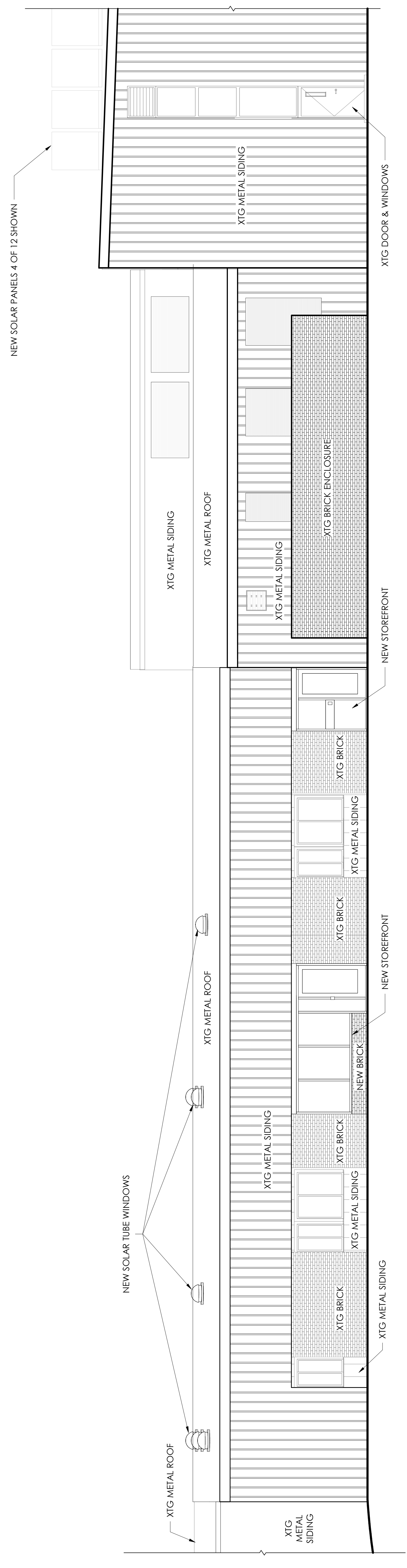
PROJECT NUMBER: 171118.00



① FIRST FLOOR OFFICE REMODEL - BASIC
1/31/16" = 1'-0"



1 NORTH WALL
SCALE: 1/4" = 1'-0"



2 SOUTH
SCALE: 3/16" = 1'-0"

PART A

Conditional Use \$300
Rezoning \$600 (+\$100
per acre or \$8.00 per unit)

FEE PAID # \$300^{cu} *

VOUCHER NO. * SEE ATTACHED MEMO

DATE 5.24.91

APPLICATION FOR PLAN COMMISSION APPROVAL PLANNING AND DEVELOPMENT - 266-4551

The following information is required for ALL conditional use applications, planned development applications, rezoning applications, demolition permits, comprehensive design reviews for signage and buildings in an Urban Design District.

1. Address of site: 4602 Sycamore Avenue
Name of Project: Addition to ESPWMF

2. Name and address of owner: (Please include partnerships - all owners)
City of Madison Phone 266-4681

3. Owner's authorization signature *R. Mc Gooden*
(If offer to purchase, contract owner, please explain. Usually architect's real estate agent's, contractor's or tenant's signature is not adequate.)
 Owner Offer to Purchase Other (Check one)

4. Please include or attach legal description -- metes and bounds or recorded plat, lot and block number only, by surveyor, engineer, title company, etc. Any extra cost to the City because of legal description problems are to be paid by the applicant.

See attached

5. Describe in detail the intended use or purpose: Streets Division addition to City Maintenance Facility to accommodate ever increasing vehicle fleet. Fleet has recently expanded at a rapid rate due to the new recycling program. Facility was designed for a 90 foot wide by 325 foot long addition on the east end of the building. The proposed project is for the pre-planned expansion of the building.

6. This is an application for (check at least one):
 rezoning from _____ to _____
 conditional use
 planned development
 demolition permit
 building in an Urban Design District
 Other

7. Is there a building on this site? *Yes What is the present zoning of this site? M1
8. Do you intend to use the existing building? Yes
9. What exterior changes are proposed? (existing building) 90' x 325' addition to east side of building.
10. What interior changes are proposed? (existing building) Minimal access between existing building and new addition.
11. Will the proposal require a new building or addition? Yes
When do you wish to occupy this site or building? February 1992
12. Does this proposal involve any development in the public right-of-way?
No * Yes Explain.
13. Seven copies of the following material is required for all applications.
- a. A Letter of Intent describing everything known about this application including the construction schedules; names of people involved (contractor, architect, landscaper); hours of operation; square footage or acreage of the site; number of units; number of bedrooms; and number of employees, etc.
 - b. Seven copies of a site plan showing the lot lines, building elevations, building location, building additions or changes, new utility locations, location of any new signs, parking areas, driveways, sidewalks, landscaping. This plan must be drawn to scale and include all dimensions.
14. **It is extremely important that you inform the alderperson of this district about your proposal as soon as possible. Have you?**
Yes * No By copy of this application

For conditional use application, the zoning ordinance states:

"Section 28.12(10)(g). Standards. No application for a conditional use shall be granted by the City Plan Commission unless such commission shall find all of the following conditions are present:

- a. That the establishment, maintenance or operation of the conditional use will not be detrimental to or endanger the public health, safety, morals, comfort or general welfare.
- b. That the uses, values and enjoyment of other property in the neighborhood for purposes already permitted shall be in no foreseeable manner substantially impaired or diminished by the establishment, maintenance or operation of the conditional use.

- c. That the establishment of the conditional use will not impede the normal and orderly development and improvement of the surrounding property for uses permitted in the district.
- d. That adequate utilities, access roads, drainage and other necessary site improvements have been or are being provided.
- e. That adequate measures have been or will be taken to provide ingress and egress so designed as to minimize traffic congestion in the public streets.
- f. That the conditional use shall, except for yard requirements, conform to all applicable regulations of the district in which it is located."

The undersigned applicant or authorized agent of the applicant hereby certifies that he or she has read all of the information contained in this application and that the same is true and correct.

The undersigned further understands and agrees that any review approval, recommendation or permit, based upon any statement, drawings, plans, evidence or information furnished by the applicant or any agent of the applicant to the Plan Commission or Urban Design Commission with respect to the project which is the subject of this application and which at the time made is misleading, inaccurate, untrue or incorrect in any material respect, shall be declared null and void by the Commission issuing written notice thereof to the applicant or its designated agent without public hearing.

x *R. M. Coode* 5/22/91
Applicant (Owner or contract owner) Date

The deadline for all applications is 12:00 Noon on the filing day. Applications received after 12:00 Noon will not be scheduled. If you have questions regarding this application or the procedure involved, please feel free to ask us. We will make every effort to provide you with the information you need to work your proposal through the approval process.

PLANNING UNIT REPORT
DEPARTMENT OF PLANNING AND DEVELOPMENT
June 10, 1991

CONDITIONAL USE APPLICATION:

1. Requested Action: Approval of the expansion of the City of Madison Streets Division maintenance facility located at 4602 Sycamore Avenue.
2. Applicable Regulations: No building permit shall be issued for any addition to a building in excess of 5,000 sq. ft. in floor area that is directly across the street from a city park without the applicant first obtaining conditional use review and approval.

GENERAL INFORMATION:

1. Applicant: City of Madison Streets Department.
2. Status of Applicant: Owner.
3. Development Schedule: Summer 1991.
4. Parcel Location: North side of Sycamore Avenue between Bultman Road and Walsh Road - 17th Aldermanic District.
5. Parcel Size: Approximately 40 acres.
6. Existing Zoning: M1 - Limited Manufacturing District.
7. Existing Land Use: City of Madison East Side Public Works Maintenance Facility building.
8. Surrounding Land Use and Zoning:

North - City of Madison lands zoned M1. Vacant land in the Town of Burke; lumber company in the Town of Burke zoned Commercial.

East - Recently approved final plat zoned R3, R4 and R1.

South - Former landfill now Sycamore Park zoned Conservancy.

West - Vacant land and sand and gravel processing and storage zoned M1.
9. Adopted Land Use Plan: I - Industrial District.

PUBLIC UTILITIES AND PUBLIC SERVICES:

The full range of urban services are available to this site at this time.

STANDARDS FOR REVIEW:

The zoning code states that: "No application for a conditional use shall be granted by the City Plan Commission unless such Commission shall find all of the following conditions are present:

1. That the establishment, maintenance or operation of the conditional use will not be detrimental to or endanger the public health, safety, morals, comfort or general welfare.
2. That the uses, values and enjoyment of other property in the neighborhood for purposes already permitted shall be in no foreseeable manner substantially impaired or diminished by the establishment, maintenance or operation of the conditional use.
3. That the establishment of the conditional use will not impede the normal and orderly development and improvement of the surrounding property for uses permitted in the district.
4. That adequate utilities, access roads, drainage and other necessary site improvements have been or are being provided.
5. That adequate measures have been or will be taken to provide ingress and egress so designed as to minimize traffic congestion in the public streets.
6. That the conditional use shall, except for yard requirements, conform to all applicable regulations of the district in which it is located.
7. That when applying the above standards to any new construction of a building or an addition to an existing building, the City Plan Commission:
 - a. Shall bear in mind the statement of purpose for the zoning district, such that the proposed building or addition at its location does not defeat the purposes and objective of the zoning district; and
 - b. May require the applicant to submit plans to the Urban Design Commission for comments and recommendations; and
 - c. May consider the use of the proposed building as it relates to the City's Land Use Plan."

ANALYSIS, EVALUATION AND CONCLUSION:

The Streets Division is seeking approval to construct a 90-foot by 325-foot addition to their existing maintenance facility. The area proposed for the addition is presently used as an asphalt parking/storage area. New construction or additions to existing buildings directly adjacent or across the street from parkland require Plan Commission review and approval. Staff concludes that this new addition will have virtually no impact on the existing Sycamore Park located along the south side of Sycamore Avenue. There is an existing berm and landscaping that separates this site from the adjacent residentially zoned area that is under development to the east of this facility.

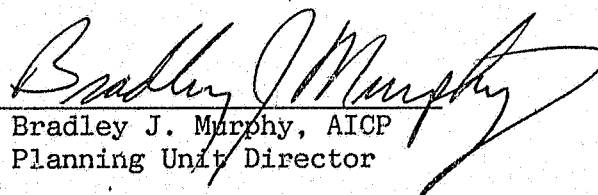
RECOMMENDATION:

The Planning Unit recommends that the Plan Commission find that the conditional use standards are met and approve this conditional use application.



Bill Roberts
Planner III

APPROVED FOR DISTRIBUTION


Bradley J. Murphy, AICP
Planning Unit Director

BR:jlj/12

CITY OF MADISON
INTERDEPARTMENTAL
CORRESPONDENCE

Date: June 11, 1991

TO: Bill Roberts, Planner III
FROM: Kathy Voock, Assistant Zoning Administrator *KAV.*
SUBJECT: CONDITIONAL USE - 4602 SYCAMORE AVENUE

Present Zoning District: M1

Proposed Use: City of Madison Public Works Facility

Reason for Conditional Use: 28.04(21)(b) An addition in excess of 5,000 square feet of floor area to an existing building is a conditional use.

Zoning Criteria

	<u>Required</u>	<u>Proposed</u>
Bulk Requirements		
Lot area	6,000 sq. ft.	1,730,828 sq. ft.
Lot width	50'	1,330'
Front yard	0	87'
Side yards - 0' left side, 6' right side Adjacent to temporary R3		110'
Rear yard	10'	
Floor area ratio	2	
Site Design		
Number parking stalls	(1)	
Handicapped stalls		(2)
Number bike parking stalls	15	0
Landscaping	As shown on plan.	Sufficient

Other Critical Zoning Items

Landfill proximity	YES
Urban Design	NO
Historic District	NO
Landmark building	NO
Flood Plain	NO
Official Map	NO
Utility Easements	NO
Water front development	NO
Adjacent to park	YES
Barrier free (IND. 52.04) state setback requirements	YES

Except for handicapped and bicycle parking stalls, the proposed project complies with all of the above requirements.

(1) The addition will not add to the parking requirement because the parking requirement is based on the number of employees. This proposal would not add to the number of employees using the facility. Therefore, the existing parking that is provided is adequate.

(2) Three handicap parking stalls shall be provided and shown on the plan.

3/2/91
KAV:nap

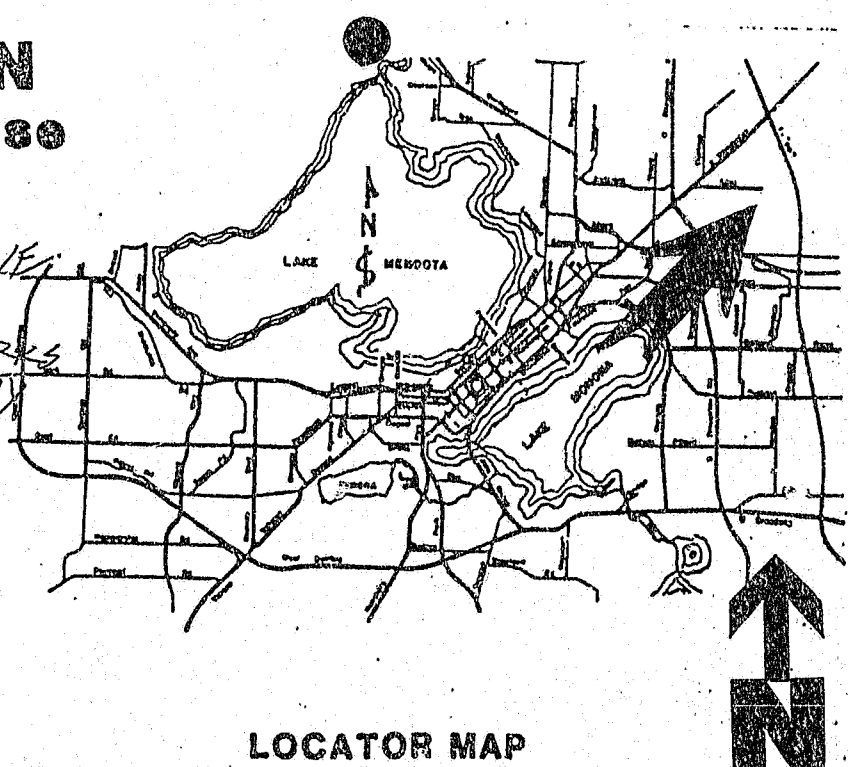
CITY OF MADISON

Proposed Conditional Use

LOCATION 4602 SYLAMORE AVE

EXISTING USE EAST SIDE PUBLIC WORKS MAINTENANCE FACILITY

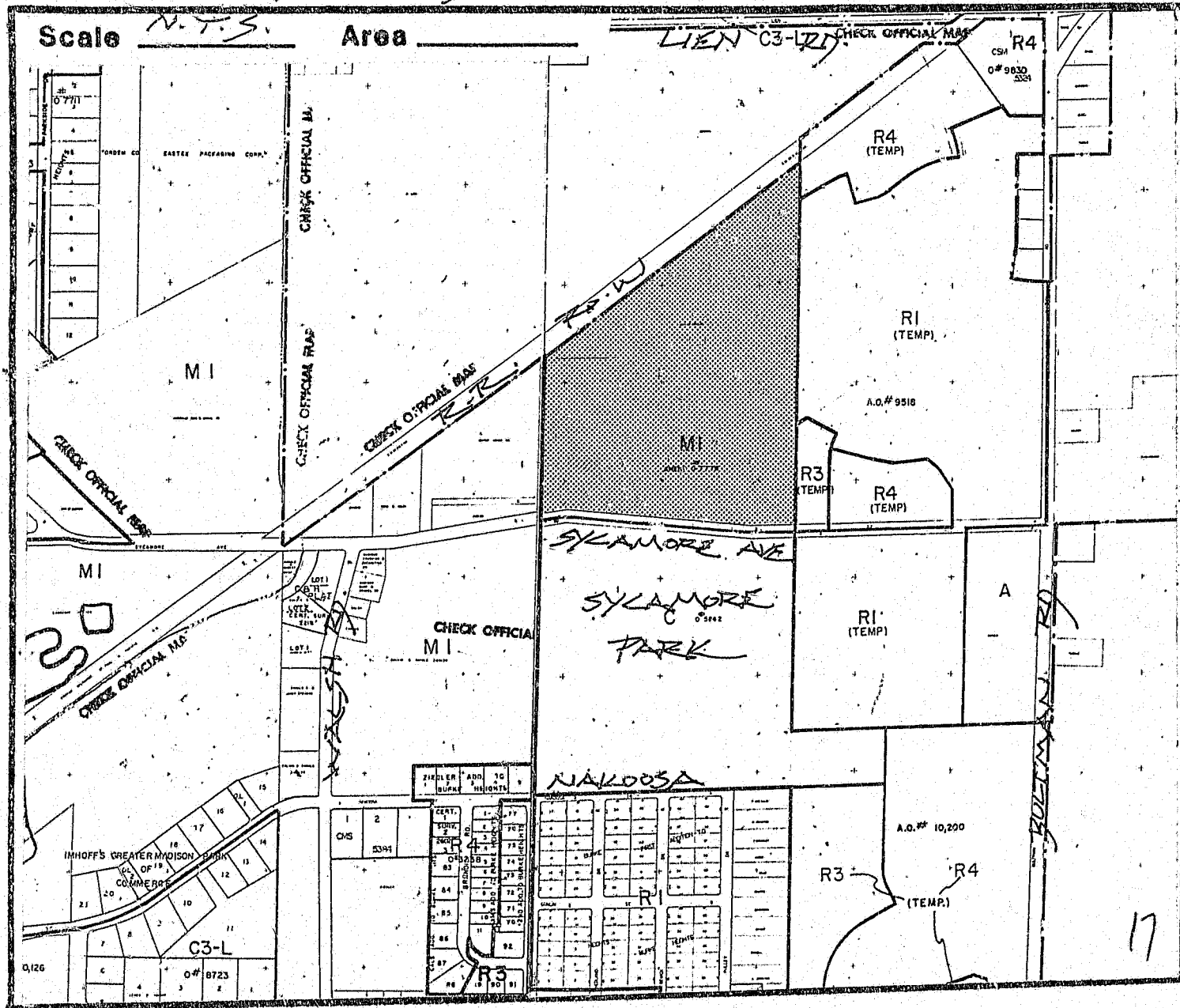
PROPOSED USE A 29250 SQ. FT. ADDITION



PUBLIC HEARING DATE:
Plan Commission 6-17-91

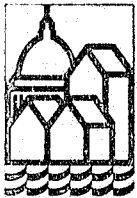
LOCATOR MAP

Applicant CITY OF MADISON



Department of Planning
and Development
Planning Unit

City of
Madison



Madison Municipal Building
215 Martin Luther King, Jr. Boulevard
Madison, Wisconsin 53710
608 266 4635

June 25, 1991

Department of Planning & Development
Inspection Unit
c/o Mr. Peter Blossom, City Architect
215 Martin Luther King Jr. Blvd.
Madison, WI 53710

SUBJECT: Addition to the Eastside Public Works Maintenance
Facility

Pete
Dear Mr. Blossom:

The Plan Commission at its June 17, 1991 meeting, determined that the conditional use standards are met subject to the conditions below, and conditionally approved your application for a conditional use for a building addition at 4602 Sycamore Avenue.

The conditions of approval are:

1. Three handicap parking stalls shall be provided and shown on the plan.
2. The Fire Department has no objection to the proposal provided all codes and ordinances are complied with. Additional comments and requirements may follow upon review of final building plans.

To satisfy the conditional use approval, the following procedure is to be utilized:

1. Revise plans per the above conditions and submit five (5) sets of the final parking facility plans (including drainage and landscaping plans) to the Zoning Administrator.
2. After obtaining parking facility approval, applicant is to bring in the original drawings or plans (tracings) to the Planning & Development to obtain signatures on the cover sheet. This letter shall be signed by the applicant to acknowledge the conditions of approval and returned to the Zoning Administrator when requesting cover sheet approval.
3. Applicant shall then furnish a set of the signed plans to the Zoning Administrator to fulfill the conditional use approval.

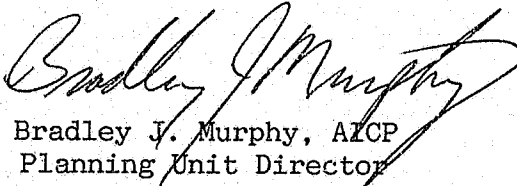
Mr. Blossom
June 25, 1991
Page 2

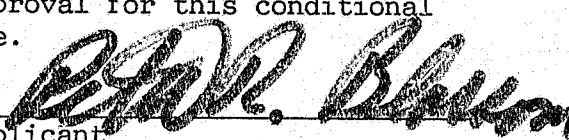
4. No alteration of this conditional use shall be permitted unless approved by the City Plan Commission provided, however, the Zoning Administrator may issue permits for minor alterations. This conditional use approval shall become null and void within twelve months of the date of Plan Commission approval unless the use is commenced, construction under way, or a valid building permit is issued and construction commenced within six months of the date of issuance of the permit (28.12)(10)(h)(3). The Plan Commission shall retain jurisdiction over this conditional use for the purpose of resolving complaints against this approved conditional use.

If you have any questions regarding this approval, please call Al Martin at 266-4635.

Sincerely,

I hereby acknowledge that I understand and will comply with the above conditions of approval for this conditional use.


Bradley J. Murphy, AICP
Planning Unit Director


Applicant

BJM:jlj/12.1

cc: Zoning Administrator
Fire Department

**SECTION 02 41 19
SELECTIVE DEMOLITION, ALTERATION, AND PATCHING**

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
1. Selective demolition at and within the existing building.
 2. Restoration of surfaces altered by demolition.

1.3 SUBMITTALS

- A. Submit to A/E, permits and notices authorizing demolition if required.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with governing state or local government agency regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.5 PROTECTION

- A. Do not interfere with use and operation of existing adjacent work areas. Maintain free and safe passage to and from.
- B. Cease operations and notify Owner and A/E immediately if safety of adjacent work areas appears to be endangered. Do not resume operations until safety is restored.
- C. Protect existing work not indicated or scheduled to be altered. Promptly repair damages at no cost to the Owner.
- D. Provide, erect and maintain safety devices as required to protect general public, workers, and adjoining work area employees.

PART 2 – PRODUCTS

1.6 MATERIALS

- A. Except for items or materials indicated to be reused, salvaged, or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site. Store items as directed by Owner.

1.7 SALVAGED MATERIALS

- A. Conform to requirements specified in Division One – General Requirements– Alteration Project Procedures.

1.8 PRODUCTS FOR PATCHING

- A. Provide as required to match adjacent surfaces or as indicated.

PART 3 EXECUTION

1.9 DEMOLITION

- A. Demolish in an orderly and careful manner as required to salvage products indicated.
- B. Perform demolition in accordance with applicable authorities having jurisdiction.
- C. Repair all demolition performed in excess of that required at no cost to the Owner.
- D. Remove demolished materials, tools and equipment from site upon completion of work. Leave site in a condition acceptable to A/E.

1.10 SALVAGE

- A. Carefully remove, salvage, and turn over to Owner items designated on the Drawings to be salvaged, including but not limited to the following items:
1. Doors

- 1 **1.11 PATCHING**
- 2 A. Comply with installation requirements specified elsewhere for products used.
- 3 B. Patch all damaged surfaces with products to match adjacent finishes.
- 4
- 5 **END OF SECTION**

SECTION 06 01 10
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
1. Wood furring and grounds.
 2. Plywood backing panels.

1.3 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

1.4 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood).
1. Use Exterior type for exterior locations and where indicated.
 2. Use Interior Type A, High Temperature (HT) for enclosed roof framing and where indicated.
 3. Use Interior Type A, unless otherwise indicated.
- B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Application: Treat all rough carpentry, unless otherwise indicated.
1. Plywood backing panels.

1.5 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Furring.
 2. Grounds.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content of any species.
- C. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

1.6 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, Exterior, AC, fire-retardant treated, in thickness indicated or, if not indicated, not less than **1/2-inch (13-mm)** nominal thickness.

1.7 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
- B. Power-Driven Fasteners: NES NER-272.
- C. Wood Screws: ASME B18.6.1.

PART 2 - EXECUTION

2.1 INSTALLATION, GENERAL

- A. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

2.2 WOOD BLOCKING INSTALLATION

- A. Install level and plumb with cut edges treated. Secure to resist anticipated loading of equipment and casework.

- 1 **2.3 WOOD FURRING INSTALLATION**
2 A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of
3 finish work.
4
5 **END OF SECTION**

SECTION 06 01 20
FINISH CARPENTRY

PART1-GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Standing and Running trim.
- B. Related Sections include the following:
 - 1. Section 060110: Rough Carpentry
 - 2. Section 064100: Architectural Woodwork

1.3 SUBMITTALS

- A. Submit samples and shop drawings in accordance with the General Requirements.
- B. Product Data: For each type of product indicated, including cabinet hardware and accessories.
- C. Samples:
 - 1. 6" length of each type, profile, and surface finish.
- D. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 - 1. Indicate materials, component profiles, fastening, jointing details, and accessories.
- E. Quality Assurance: Perform finish carpentry work in accordance with recommendations of the Millwork Standards of the Architectural Woodwork Institute.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Installer shall advise Prime Contractor of temperature and humidity requirements for finish carpentry installation areas. Do not install finish carpentry until a minimum of 60 deg. F and relative humidity of 25-55 percent have been stabilized and will be maintained in installation areas.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General
 - 1. Nominal sizes are indicated, except as shown by detailed dimensions, Provide dressed or worked and dressed lumber, as applicable, manufactured to the actual sizes as required by PS 20 or to actual sizes and patterns as shown, unless otherwise indicated.
 - 2. Optimum Moisture Content: Kiln-dry finish carpentry woodwork to an average moisture content of 8 percent, or as otherwise recommended by applicable AWI Quality Standards for the regional climatic conditions involved.
- B. Interior Finish Carpentry:
 - 1. Standing and Running Trim: AWI Premium Grade
 - a. Species: Match Existing
 - b. Finish: Match Existing
 - 2. Miscellaneous lumber for blocking, furring: Provide materials and comply with provisions specified in Section 06100.
 - 3. Particleboard: NPA 1-M-2
 - 4. Hardboard: AHA A135.4

- 1 C. Fasteners and Anchorages:
2 1. Provide all nails, spikes, screws, lag screws, steel angles, hangers, bolts, nuts, washers, and other
3 anchoring devices of the type, size, material, and finish required for application indicated to provide
4 secure attachment, concealed where possible, and complying with applicable Federal Specifications.

5 **2.2 FABRICATION**

- 6 A. Fabricate Interior Standing and Running Trim to dimensions, profiles, and details indicated for intended use in
7 accordance with AWI Section 300, Premium Grade
8

9 **PART 2 - EXECUTION**

10 **2.3 PREPARATION**

- 11 A. Field Measurements: Before proceeding with woodwork required to be fitted to other construction, obtain
12 measurements and verify dimensions to assure accurate fit.
13 B. Preparation of Surfaces: Deliver materials and fabrications to Section 09912 contractor for back priming and/or
14 pre-finishing prior to installation. Back prime wood materials for painted finish exposed to moisture and high
15 relative humidity.
16 C. Condition wood materials to average prevailing humidity conditions in installation areas prior to installing.
17

18 **2.4 INSTALLATION**

- 19 A. Quality Standard: Install standing and running trim, interior frames and jambs, and other finish carpentry work to
20 comply with AWI section 1700 for the same grade specified in Part 2 of this section for type of finish carpentry
21 work involved.
22 B. Apply all nails, spikes, screws, lag screws, steel angles, hangers, bolts, nuts, washers, anchors, and other items of
23 hardware required for the assembling and securing of this work. Use best suitable type of nails and anchors for
24 various types of carpentry. Use annular nails and other special nails where required. Correct and defective work
25 caused by inadequate nailing, holding power or nails used and the use of nails which result in the staining of
26 other materials. All finish work shall have nails set for puttying. Recess all screws and bolt heads and provide
27 flush hardwood plugs where exposed.
28 C. Discard units of material which are unsound, warped, bowed, twisted, improperly treated, not adequately
29 seasoned or too small to fabricate work with minimum of joints or optimum jointing arrangements, or which are
30 of defective manufacturer with respect to surfaces, sizes or patterns.
31 D. Install the work plumb, level, true and straight with no distortions. Shim as required using concealed shims.
32 Install to a tolerance of 1/8 inch in 8 feet for plumb and level countertops; and with 1/16 inch maximum offset in
33 flush adjoining surfaces and 1/8 inch maximum offsets in revealed adjoining surfaces.
34 E. Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.
35 F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from
36 maximum lengths of lumber available) to the greatest extent possible. Stagger joints in adjacent and related
37 members. Cope at returns, miter at corners, to produce tight fitting joints with full surface contact throughout
38 length of joint. Use scarf joints for end-to-end joints. Use construction adhesives of type recommended by
39 manufacturer for use intended. Sort trim to achieve close match of graining for each assembly, especially if
40 splicing is required.
41 G. Countertops: Cut, fit, scribe and secure in place.
42

43 **2.5 ADJUSTING AND CLEANING**

- 44 A. Repair damaged and defective finish carpentry work wherever possible to eliminate defects functionally and
45 visually; where not possible to repair properly, replace woodwork at no cost to Owner. Adjust joinery for
46 uniform appearance.
47 B. Cleaning: Clean all work of this Section prior to acceptance by Owner, including installed work furnished by
48 others.
49 C. Adjustment: Adjust all hardware for proper operation.
50 D. Protection: Protect all work of this Section until acceptance by Owner. Advise GC of final protection and
51 maintained conditions necessary to ensure that work will be without damage or deterioration at time of
52 acceptance.
53

END OF SECTION

SECTION 06 41 00
ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
1. Cabinets
 2. Counter Tops
- B. Related Sections include the following:
1. Section 06100: Rough Carpentry
 2. Section 06200: Finish Carpentry

1.3 DEFINITIONS

- A. Exposed Surfaces: Exposed surfaces shall include portions of casework surfaces visible when doors and drawers are closed; bottoms of casework 48 inches or more above finish floor; tops of casework less than 72 inches above finish floor; visible surfaces in open casework or behind glass doors; portions of casework visible when fixed equipment is installed; and front edges of cabinet body members visible though a gap greater than 1/8 inch with doors and drawers closed
1. For the purpose of finishing, both sides of cabinet doors shall be considered "exposed"
- B. Semi-Exposed Surfaces: Semi-exposed surfaces shall include portions of casework surfaces visible when doors and drawers are in the open position; bottoms of casework are between 30 inches and up to 48 inches above finish floor; and front edges of shelving behind doors.
- C. Concealed Surfaces: Concealed surfaces shall include portions of casework surfaces not visible after installation; bottoms of casework less than 30 inches above finish floor; tops of casework over 72 inches above finish floor; stretchers, blocking and components are concealed by drawers; and corners are created by tall, wall, or base cabinets, and shall be non-accessible.

1.4 SUBMITTALS

- A. Submit samples and shop drawings in accordance with the General Requirements.
- B. Product Data: For each type of product indicated, including cabinet hardware and accessories.
- C. Samples:
1. For each type of Plastic Laminate, 8x8 for each type, color, and surface finish.
- D. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
- E. Quality Submittals:
1. Product Data: For installation adhesives, including printed statement of VOC content.
 2. Product Data:
 - a. Composite wood manufacturer's product data for each composite wood product used indicating that the bonding agent contains no urea formaldehyde.
 - b. For each adhesive used, documentation indicating that the adhesive contains no urea formaldehyde.
 3. Quality Certification: Submit woodwork fabricator's certification, stating that fabricated woodwork complies with quality grades and other requirements indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.6 PROJECT CONDITIONS

- 1 A. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other
2 construction by field measurements before fabrication, and indicate measurements on Shop Drawings.
3 Coordinate fabrication schedule with construction progress to avoid delaying the Work.
4 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements
5 before being enclosed, and indicate measurements on Shop Drawings.
6

7 **PART 2 -PRODUCTS**

8 **1.7 MATERIALS**

- 9 A. General:
10 1. Provide materials that comply with requirements of the AWI quality standard for each type of woodwork
11 and quality grade indicated and, where the following products are part of interior woodwork, with
12 requirements of the referenced product standards that apply to product characteristics indicated.
13 B. Optimum moisture content: kin-dry architectural woodwork to an average moisture content of 8 percent or as
14 otherwise recommended by applicable Quality Standards for the regional climatic conditions involved.
15 C. Softwood Plywood: APA A-B EXT-Group 1
16 D. Fiberboard: Medium density complying with ANSI A208.2
17 E. Fasteners and Anchorages: Provide all nails, screws, bolts, nuts, washers, and other anchoring devices of the
18 type, size, material, and finish required for application indicated to provide secure attachment, concealed where
19 possible, and complying with applicable Federal Specifications.
20 F. Miscellaneous lumber for blocking, furring, cabinet bases: Provide materials and comply with provisions as
21 specified in Section 06100.
22

23 **1.8 MODULAR LAMINATE CLAD ARCHITECTURAL CABINETS**

- 24 A. Quality Standards: Comply with AWI Section 1600 "Modular Cabinets" and as specified herein.
25 1. Type of Cabinet Construction: Flush overlay.
26 2. Core Material: ANSI A208.1, Type M-3 particleboard.
27 B. Laminate Cladding: High pressure decorative laminate complying with NEMA LD3 and as follows:
28 1. Exposed Surfaces (other than edges): HPL VGP (0.027 inch nominal thickness)
29 2. Semi-exposed Surfaces (other than edges): Decorative surface of thermally fused polyester or melamine
30 laminated to core under pressure and complying with NEMA LD3 GP28 and LD3 CL20 standards. Vinyl
31 overlays not acceptable. Painted material not acceptable.
32 3. Exposed Edges of Laminated Components:
33 a. Body Members and Shelves: HPL to match exposed faces
34 b. Doors and drawers: HPL to match exposed faces.
35 4. Concealed Laminate: Where balancing sheet is indicated or required by referenced quality standards,
36 provide backer type laminate, grade designation BK-20 (0.020 inch nominal thickness) complying with
37 NEMA LD3 CL20 standards.
38

39 **1.9 CUSTOM LAMINATE CLAD ARCHITECTURAL CABINETS**

- 40 A. Quality Standards: Comply with AWI Section 400 "Architectural Cabinets" and Section 400B "Laminate Cabinets"
41 1. Grade: Custom
42 2. Type of Cabinet Construction: Flush overlay.
43 3. Core Material: ANSI A208.1, Type M-3 particleboard.
44 B. Laminate Cladding: High pressure decorative laminate complying with NEMA LD3 and as follows:
45 1. Exposed Surfaces:
46 a. Horizontal Surfaces: HGS (0.048 inch nominal thickness)
47 b. Postformed Surfaces: HGP (0.039 inch nominal thickness)
48 c. Vertical Surfaces: HPL VGP (0.027 inch nominal thickness)
49 2. Semi-exposed Surfaces (other than edges): Decorative surface of thermally fused polyester or melamine
50 laminated to core under pressure and complying with NEMA LD3 GP28 and LD3 CL20 standards. Vinyl
51 overlays not acceptable. Painted material not acceptable.
52 3. Exposed Edges of Laminated Components:
53 a. Body Members and Shelves: HPL to match exposed faces
54 b. Doors and drawers: HPL to match exposed faces.
55 4. Concealed Laminate: Where balancing sheet is indicated or required by referenced quality standards,
56 provide backer type laminate, grade designation BK-20 (0.020 inch nominal thickness) complying with
57 NEMA LD3 CL20 standards.

1.10 THICKNESS AND MATERIALS FOR LAMINATE CLAD CABINET COMPONENTS:

COMPONENT	MATERIAL	MIN. THICKNESS
Body Member	Panels	3/4 inch
Rails	Solid Lumber or Panel	3/4 inch
Shelves	Panels (Medium density particle or fiberboard)	3/4 inch(span up to 32 inch) 5/4 inch (span up to 42 inch)
Backs	Panels	3/8 inch
Drawer Sides,	Solid Lumber or Particleboard Panel	1/2 inch Lumber
Backs, Subfronts		1/2 inch (50# density or more)
Drawer Bottoms	Panels	3/8 inch
Drawer Fronts	Panels	3/4 inch
Doors	Panels	3/4 inch(up to 30 inch by 80 inch) 1 inch (over 30 inch by 80 inch)

- A. Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. Manufacturer: Pionite
 2. Pattern: AG331-S
 3. Color: Stonedust Crepe

1.11 PLASTIC-LAMINATE COUNTERTOPS

- A. Quality Standards: Comply with AWI Section 400 "Architectural Cabinets" and Section 400C "Countertops"
- B. Laminate Clad Tops:
1. Grade: Custom
 2. Core Material: ANSI A208.1, Type 2-M-2 particleboard (1 inch thick, unless otherwise indicated on Drawings). Provide blancing sheet (BK-20) on all tops, and on all surfaces of window stools which do not have high pressure decorative laminate.
- C. Laminate Cladding: High Pressure decorative laminate complying with NEMA LD3 and as follows:
1. Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - a. Manufacturer: Pionite
 - b. Pattern: MB0601-S
 - c. Color: Vermont Granite
 2. Horizontal Surfaces: HGS (0.048 inch nominal thickness)
 3. Postformed Surfaces: HGP (0.039 inch nominal thickness)
 4. Edge Treatment:
 - a. General: Same as laminate cladding on horizontal surfaces.
 - b. Transaction Counter: Red oak, clear, plain sawn.

1.12 CABINET HARDWARE AND ACCESSORIES

- A. Manufacturer's specified below to indicate quality and function. Other manufacturer's equivalent products may be used.
1. Drawer Slides: Accuride 7432; except Accuride 3640 Series for drawers over 24 inches wide.
 2. Pulls: Stanley 4484 (26D)
 3. Hinges: Grass 3903 Series, self-closing, number of hinges per door as follows:
 - a. 2 per door up to 24 inches wide by 35-1/2 inches high
 - b. 3 per door up to 24 inches wide by 63 inches high
 - c. 4 per door up to 24 inches wide by 78-3/4 inches high
 - d. 5 per door up to 24 inches wide by 94-1/2 inches high
 4. Shelf Support: Double pin design with anti-tip shelf restraints, equivalent to Bainbridge Manufacturing 3220CL. Phone (800)255-4702.
 5. Catches: Stanley SP41
 6. Locks: KV986NP (each lock keyed alike by room and master keyed)
 7. Closet Rod: KV770-5 CHR with KV 764/766 CHR flanges
 8. Shelf Standards: KV87 ANO
 9. Shelf Brackets: KV187LL ANO
 10. Label Holder: 3 inch by 3/4 inch card holder at each opening on mailboxes; Finish: to be determined by Owner.

- 1 B. Back-Mounted Wire Pulls: BHMA A156.9, B02011. 4 inch centers.
2 C. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA
3 finish number indicated.
4 1. Satin Stainless Steel: BHMA 630.
5

6 **1.13 MISCELLANEOUS MATERIALS**

- 7 A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent
8 moisture content.
9 B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide
10 nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as
11 required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
12 C. Adhesives, General: Do not use adhesives that contain urea formaldehyde.
13 D. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits
14 for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
15 1. Wood Glues: 30 g/L.
16 2. Contact Adhesive: 250 g/L.
17 E. Adhesive for Bonding Plastic Laminate: Water based contact cement, white glue PVA.
18 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.
19

20 **1.14 FABRICATION**

- 21 A. General:
22 1. Fabricate architectural woodwork to dimensions, profiles, and details indicated with openings and
23 mortises precut, where possible, to receive hardware and other items and work.
24 2. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to
25 project site to maximum extent possible. Disassemble components only as necessary for shipment and
26 installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and
27 fitting.
28 B. Precut Openings: Fabricate architectural woodwork with pre-cut openings, where possible, to receive hardware,
29 appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately from on-site
30 dimensions and use templates or roughing-in diagrams for proper size and shape. Smooth edges of cutoffs and,
31 where located in countertops and similar exposures seal edges of cutouts with a water-resistant coating.
32 C. Measurements: Before proceeding with fabrication of woodwork required to be fitted to other construction,
33 obtain field measurements and verify dimensions and shop drawing details as required for accurate fit.
34

35 **1.15 JOINERY AND FASTENING OF CASE BODY MEMBERS**

- 36 A. Fixed case body members (shelves, bottoms, tops and rails which are fastened to sides, ends and dividers) shall
37 be joined using concealed dado, or dowel matched or interlocking mechanical fasteners. Where the concealed
38 dado and dowel methods are employed, cases shall be assembled utilizing glue and pressure. The dad method
39 must be reinforced with blind nailing or screwing.
40 B. No nails, screws or other fastenings may be visible on exposed surfaces. On semi- exposed surfaces, mechanical
41 fasteners may be visible.
42 C. Rails or top panels must be provided where case will have separate top in order to permit concealed fastening of
43 the separate top through such rails.
44 D. Where not in violation of design, surfaces of intersecting body members may be set back not exceed 1/8 inch,
45 provided setback is constant.

46 **1.16 PREPARATION FOR FINISHING**

- 47 A. Shop Finishing: Set exposed nails and screws. Apply wood filler in exposed nail and screw. Comply with
48 referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar
49 preparations for finishing architectural woodwork edge treatment, as applicable to each uti of work.
50 B. General:
51 1. Comply with AWI Section 1500, unless otherwise indicated. Provide finishes of same grades as items to
52 be finished.
53 2. Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup,
54 cleaning and polishing until after installation.
55 C. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of
56 woodwork. Apply 2 coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-

1 clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset
2 decorative overlay.

3 D. Finish System:

4 1. Wood Edge treatment: AWI Finish System TR04: Conversion varnish, satin.
5

6 **PART 3 - EXECUTION**

7 **1.17 General:**

8 A. Condition woodwork to average prevailing humidity conditions in installation areas prior to installing.

9 B. Quality Standard: Install woodwork to comply with AWI Section 1700 for the same grade specified in PART 2 of
10 this section for type of woodwork involved.
11

12 **1.18 INSTALLATION**

13 A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of
14 type of woodwork involved.

15 B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in
16 Part 2, to extent that it was not completed in the shop.

17 C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and
18 plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

19 D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

20 E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk,
21 concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing
22 screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if
23 transparent finish is indicated.

24 F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned.
25 Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete
26 installation of hardware and accessory items as indicated.

27 1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation
28 from a straight line.

29 2. Maintain veneer sequence matching of cabinets with transparent finish.

30 3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm)
31 o.c..

32 G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into
33 underside of countertop.

34 1. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation
35 from a straight line.

36 2. Secure backsplashes to walls with adhesive.

37 3. Calk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."

38 H. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching
39 filler where exposed.
40

41 **1.19 ADJUSTING AND CLEANING**

42 A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not
43 possible to repair, replace woodwork. Adjust joinery for uniform appearance.

44 B. Clean, lubricate, and adjust hardware.

45 C. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or
46 soiled areas.
47

48 **END OF SECTION**

**SECTION 07 21 00
BUILDING INSULATION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
1. Glass-fiber blanket sound control insulation.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
1. For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content.
2. Documentation indicating formaldehyde free manufacturing.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2- PRODUCTS

1.6 GLASS-FIBER BLANKET SOUND CONTROL INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CertainTeed Corporation.
2. Johns Manville.
3. Owens Corning.
- B. UnFaced, Glass-Fiber Blanket Insulation: ASTM C 665
- C. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.
- D. Products:
1. CertainTeed Corp:
a. Batts. 30% recycled content, some from curbside recycling. Batts with polypropylene wrap to contain any particulates. Available in standard unfaced or faced. Insulsafe contain no toxic binders.
2. Johns Manville:
a. Fiberglass blankets, batts. Formaldehyde-free, low-emission Grid-SHIELD Rx batts and rolls. Perforated polyethylene wrapped. 20% to 30% recycled glass. SCS Certified and Environmental Choice Program. R-1 1 to R-25 batts.
3. Owens-Corning:
a. Non-offgassing, less toxic fiberglass in rolls rated R-13 and R-25. Rolls and batts. 30% recycled glass, some from curbside pickup. SCS certified.

PART 2 - EXECUTION

2.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

- 1 D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and
2 lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise
3 shown or required to make up total thickness.
4

5 **2.2 INSTALLATION OF INSULATION**

- 6 A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If
7 no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide
8 permanent placement and support of units.
9 B. Glass-Fiber Blanket Insulation: Install in cavities formed by framing members according to the following
10 requirements:
11 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is
12 required to fill the cavities, provide lengths that will produce a snug fit between ends.
13 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and
14 adjoining framing members.
15 3. Maintain **3-inch (76-mm)** clearance of insulation around recessed lighting fixtures not rated for or protected
16 from contact with insulation.
17 4. For metal-framed wall cavities where cavity heights exceed **96 inches (2438 mm)**, support unfaced blankets
18 mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
19

20 **END OF SECTION**

**SECTION 07 84 10
THROUGH-PENETRATION FIRESTOP SYSTEMS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
1. Penetrations in fire-resistance-horizontal and vertical assemblies.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
1. For penetration firestopping, including printed statement of VOC content and chemical components.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."
- B. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- C. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
b. Classification markings on penetration firestopping correspond to designations listed by the following:
1) UL in its "Fire Resistance Directory."

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.
- C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

1.7 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

- 1 B. Fire Rated Construction Design Requirements: Maintain barrier and structural floor fire resistance ratings
2 including resistance to cold smoke at all penetrations, connections with other surfaces or types of construction,
3 at separations required to permit building movement and sound or vibration absorption, and at other
4 construction gaps.
5 1. Latex and acrylic based sealants are not acceptable. Use only urethanes or silicone base materials.
6 C. Smoke Barrier Construction Design Requirements: Maintain barrier and structural floor resistance to cold smoke
7 at all penetrations, connections with other surfaces and types of construction and at all separations required to
8 permit building movement and sound or vibration absorption, and at other construction gaps.
9 D. Assembly designs are specified generally under UL system categories by penetrating item. Manufacturers'
10 product applications must have specific UL system designations.

Penetrating Item	Concrete	Gypsum	Wood
Plastic Pipe	CAJ2000	WL2000	FC2000
	FA2000		
Metal Pipe	CAJ1000	WL1000	FC1000
	WJ1000		
	FA1000		
Insulated Metal Pipe	CAJ5000	WL5000	FC5000
	CBJ5000		
	FA5000		
Insulated Cable	CAJ2000	WL2000	
	CAJ3000	WL3000	FC3000
	CBJ3000		
	FA3000		
Cable Tray	CAJ4000	WL4000	
	CBJ4000		
Busway	CAJ6000		
	FA6000		
Glass Pipe Blank	CAJ2000	WL2000	
	CAJ0000		
	CBJ0000		
	FA0000		
Construction Gap	FF-S-1000		
	WW-S-1000		
	W-S-1000		
Mixed Penetrating Items	CAJ8000	WL8000	
	CBJ8000		
	FA8000		
Misc. Mechanical (Vent Ducts)	CAJ7000		

- 42 E. VOC Content: Provide penetration firestopping that complies with the following limits for VOC content when
43 calculated according to 40 CFR 59, Subpart D (EPA Method 24):
44 1. Architectural Sealants: 250 g/L.
45 2. Sealant Primers for Nonporous Substrates: 250 g/L.
46 3. Sealant Primers for Porous Substrates: 775 g/L.
47 F. Accessories: Provide components for each penetration firestopping system that are needed to install fill
48 materials and to maintain ratings required. Use only those components specified by penetration firestopping
49 manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

PART 3 - EXECUTION

1.8 EXAMINATION

- 53 A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening
54 configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
55 B. Proceed with installation only after unsatisfactory conditions have been corrected.

1 **1.9 PREPARATION**

- 2 A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with
3 manufacturer's written instructions and with the following requirements:
4 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could
5 interfere with adhesion of penetration firestopping.
6 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing
7 optimum bond with penetration firestopping. Remove loose particles remaining from cleaning
8 operation.
9 3. Remove laitance and form-release agents from concrete.
10 B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's
11 recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration
12 onto exposed surfaces

13
14 **1.10 INSTALLATION**

- 15 A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and
16 published drawings for products and applications indicated.
17 B. Install forming materials and other accessories of types required to support fill materials during their application
18 and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings
19 indicated.

20
21 **1.11 IDENTIFICATION**

- 22 A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces
23 adjacent to and within 6 inches (150 mm) of firestopping edge so labels will be visible to anyone seeking to
24 remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with
25 adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following
26 information on labels:
27 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any
28 Damage."
29 2. Contractor's name, address, and phone number.
30 3. Designation of applicable testing and inspecting agency.
31 4. Date of installation.
32 5. Manufacturer's name.
33 6. Installer's name.

34
35 **1.12 CLEANING AND PROTECTION**

- 36 A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning
37 materials that are approved in writing by penetration firestopping manufacturers and that do not damage
38 materials in which openings occur.
39 B. Provide final protection and maintain conditions during and after installation that ensure that penetration
40 firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection,
41 damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration
42 firestopping and install new materials to produce systems complying with specified requirements.
43

44 **END OF SECTION**

SECTION 07 92 00
JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
1. Elastomeric joint sealants.
 2. Latex joint sealants.
 3. Acoustical joint sealants.
- B. Related Sections:
1. Division 9 Section "Gypsum Board" for sealing perimeter joints.
 2. Division 9 Section "Acoustical Panel Ceilings" for sealing edge moldings at perimeters with acoustical sealants.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
1. For sealants and sealant primers used inside the weatherproofing system, including printed statement of VOC content.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- C. Samples: Submit manufacturer's color chart of not less than 30 colors for initial selection purposes. Upon request, submit cured strip samples of actual product of each color selected by A/E.
- D. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

1.5 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
 2. When joint substrates are wet.
 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

- A. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 3. Mechanical damage caused by individuals, tools, or other outside agents.
 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time and mixing instructions for multicomponent materials.
- B. Store and handle material to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.
- C. Do not use caulking materials that have been stored for a period of time exceeding the maximum recommended shelf life of the materials.

1 1.8 PROJECT/SITE CONDITIONS

- 2 A. Examine Drawings and verify that all joints are properly detailed and proportioned for expansion and/or control
3 as recommended in writing by the sealant manufacturer. Immediately notify A/E of any deviation.
4

5 **PART 2 - PRODUCTS**

6 1.9 MATERIALS, GENERAL

- 7 A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another
8 and with joint substrates under conditions of service and application, as demonstrated by joint-sealant
9 manufacturer, based on testing and field experience.
- 10 B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing
11 system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59,
12 Subpart D (EPA Method 24):
13 1. Architectural Sealants: 250 g/L.
14 2. Sealant Primers for Nonporous Substrates: 250 g/L.
15 3. Sealant Primers for Porous Substrates: 775 g/L.
- 16 C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied
17 joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses
18 related to exposure and joint substrates.
- 19 D. Stain-Test-Response Characteristics: Where sealants are specified to be non-staining to porous substrates,
20 provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint
21 substrates indicated for Project.
- 22 E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with
23 food, provide products that comply with 21 CFR 177.2600.
- 24 F. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.
25

26 1.10 ELASTOMERIC JOINT SEALANTS

- 27 A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base
28 polymer indicated which complies with ASTM C 920 requirements, including those referenced for Type, Grade,
29 Class, and Uses.
30 1. Type-1: Multi-part nonsag urethane sealant, Type M, Grade NS, Class 25, Uses NT, M, A, and as
31 applicable to joint substrates indicated, O. Equivalent to Tremco DyMeric 240FC.
32 2. Type-2: Multi-part pourable urethane sealant, Type M, Grade P, Class 25, Uses NT, M, A, and as
33 applicable to joint substrates indicated, O. Equivalent to Tremco THC-900/901.

34 1.11 LATEX JOINT SEALANTS

- 35 A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
36 1. Products: Subject to compliance with requirements, provide the following:
37 a. Bostik, Inc.; Chem-Calk 600.
38 b. Pecora Corporation; AC-20+.
39 c. Tremco Incorporated; Tremflex 834.
40

41 1.12 ACOUSTICAL JOINT SEALANTS

- 42 A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with
43 ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in
44 building construction as demonstrated by testing representative assemblies according to ASTM E 90.
45 1. Products: Subject to compliance with requirements, provide the following:
46 a. Pecora Corporation; AC-20 FTR.
47 b. USG Corporation; SHEETROCK Acoustical Sealant.

48 1.13 JOINT SEALANT BACKING

- 49 A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates,
50 sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer
51 based on field experience and laboratory testing.
- 52 B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type O (open-cell
53 material) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by
54 joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and
55 otherwise contribute to producing optimum sealant performance.
- 56 C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for
57 preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint.
58 Provide self-adhesive tape where applicable.

1 **1.14 MISCELLANEOUS MATERIALS**

- 2 A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint
3 substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
4 B. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to
5 joints.
6 C. Cleaners for Non Porous Surfaces: Provide nonstaining, chemical cleaners of type which are acceptable to
7 manufacturers of sealants and sealant backing materials, which are not harmful to substrates and adjacent
8 nonporous materials, and which do not leave oily residues or otherwise have a detrimental effect on sealant
9 adhesion or in-service performance.

10
11 **PART 3 - EXECUTION**

12 **1.15 EXAMINATION**

- 13 A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for
14 joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
15 B. Proceed with installation only after unsatisfactory conditions have been corrected.

16
17 **1.16 PREPARATION**

- 18 A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-
19 sealant manufacturer's written instructions and the following requirements:
20 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant,
21 including dust, paints (except for permanent, protective coatings tested and approved for sealant
22 adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water
23 repellents, water, surface dirt, and frost.
24 a. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a
25 combination of these methods to produce a clean, sound substrate capable of developing
26 optimum bond with joint sealants. Remove loose particles remaining after cleaning operations
27 above by vacuuming or blowing out joints with oil-free compressed air.
28 B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by
29 preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant
30 manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or
31 migration onto adjoining surfaces.
32 C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces
33 that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to
34 remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

35
36 **1.17 INSTALLATION OF JOINT SEALANTS**

- 37 A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications
38 indicated, unless more stringent requirements apply.
39 B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as
40 applicable to materials, applications, and conditions indicated.
41 C. Install sealant backings of kind indicated to support sealants during application and at position required to
42 produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum
43 sealant movement capability.
44 1. Do not leave gaps between ends of sealant backings.
45 2. Do not stretch, twist, puncture, or tear sealant backings.
46 3. Remove absorbent sealant backings that have become wet before sealant application and replace them
47 with dry materials.
48 D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of
49 joints.
50 E. Install sealants using proven techniques that comply with the following and at the same time backings are
51 installed:
52 1. Place sealants so they directly contact and fully wet joint substrates.
53 2. Completely fill recesses in each joint configuration.
54 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant
55 movement capability.
56 F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool
57 sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of

1 configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of
2 joint.

- 3 1. Remove excess sealant from surfaces adjacent to joints.
- 4 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or
5 adjacent surfaces.
- 6 G. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at
7 perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical
8 sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply
9 with ASTM C 919 and with manufacturer's written recommendations.

10
11 **1.18 CLEANING**

- 12 A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with
13 cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

14
15 **1.19 PROTECTION**

- 16 A. Protect joint sealants during and after curing period from contact with contaminating substances and from
17 damage resulting from construction operations or other causes so sealants are without deterioration or damage
18 at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and
19 remove damaged or deteriorated joint sealants immediately so installations with repaired areas are
20 indistinguishable from original work.

21
22 **1.20 JOINT-SEALANT SCHEDULE**

- 23 A. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 24 1. Joint Locations:
 - 25 a. Vertical joints on exposed surfaces of partitions.
 - 26 b. Perimeter joints between interior wall surfaces and frames of interior doors.
 - 27 2. Joint Sealant: Latex.
- 28 B. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 29 1. Joint Sealant Location:
 - 30 a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
- 31 C. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces.
 - 32 1. Joint Location:
 - 33 a. Acoustical joints where indicated.
 - 34 2. Joint Sealant: Acoustical.

35
36 END OF SECTION

SECTION 08 11 00
STEEL FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
1. Standard hollow metal frames.
- B. Related Sections:
1. Division 8 Section "Flush Wood Doors" for doors installed in hollow metal frames.
 2. Division 8 Section "Door Hardware" for door hardware for hollow metal doors.
 3. Division 9 Sections "Interior Painting" for field painting hollow metal doors and frames.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.
- B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data substantiating that products comply with requirements.
- B. Shop Drawings: Submit for fabrication and installation of steel frames. Include details of each frame type, conditions at openings, details of constructions, and details of joints and connections. Provide full-size details of cutout stops. Show anchorage and accessory items.
- C. Schedule: Submit schedule of frames using same reference numbers for details and openings as those on the Drawings.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (102-mm-) high wood blocking. Do not store in a manner that traps excess humidity.

1.7 PROJECT CONDITIONS

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

1.8 COORDINATION

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

PART 2 - PRODUCTS

1.9 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- C. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

- 1 E. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers
2 manufactured from slag or rock wool with 6- to 12-lb/cu. ft. (96- to 192-kg/cu. m) density; with maximum flame-
3 spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion
4 characteristics.
5

6 **1.10 STANDARD HOLLOW METAL FRAMES**

- 7 A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
8 B. Interior Frames: Fabricated from cold-rolled steel sheet with metallic-coated sheet required at insulated doors
9 frames.
10 1. Fabricate frames with mitered or coped corners.
11 2. Fabricate frames as full profile welded unless otherwise indicated.
12 3. Frames for Wood Doors: 0.053-inch- (1.3-mm-) thick steel sheet.
13 C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same
14 material as frames.
15

16 **1.11 FRAME ANCHORS**

- 17 A. Jamb Anchors:
18 1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm)
19 thick.
20

21 **1.12 STOPS AND MOLDINGS**

- 22 A. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless
23 otherwise indicated.
24

25 **1.13 FABRICATION**

- 26 A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required
27 sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in
28 manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be
29 permanently factory assembled before shipment.
30 B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
31 C. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide
32 alignment plates or angles at each joint, fabricated of same thickness metal as frames.
33 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and
34 invisible.
35 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise
36 indicated.
37 3. Jamb Anchors: Provide number and spacing of anchors as follows:
38 a. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of
39 frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
40 1) Three anchors per jamb up to 60 inches (1524 mm) high.
41 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
42 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
43 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or
44 fraction thereof above 96 inches (2438 mm) high.
45 5) Two anchors per head for frames above 42 inches (1066 mm) wide and mounted in metal-
46 stud partitions.
47 4. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep
48 holes clear during construction.
49 a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
50 b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
51 D. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel
52 sheet.
53 E. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include
54 cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates
55 furnished as specified in Division 8 Section "Door Hardware."
56 1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
57 2. Reinforce frames to receive non-templated, mortised and surface-mounted door hardware.

- 1 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for
2 preparation of hollow metal work for hardware.
3 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 16 Sections.
4 F. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and
5 moldings with butted or mitered hairline joints.
6 1. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
7 2. Provide loose stops and moldings on inside of hollow metal work.
8 3. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation
9 indicated.

10 **1.14 STEEL FINISHES**

- 11 A. Apply manufacturer's standard primer immediately after cleaning and pretreating.
12 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with
13 ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible
14 with substrate and field-applied coatings despite prolonged exposure.
15

16 **PART 3 - EXECUTION**

17 **1.15 EXAMINATION**

- 18 A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for
19 installation tolerances and other conditions affecting performance of the Work.
20 B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
21 C. Proceed with installation only after unsatisfactory conditions have been corrected.
22

23 **1.16 PREPARATION**

- 24 A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and
25 dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
26

27 **1.17 INSTALLATION**

- 28 A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with
29 Drawings and manufacturer's written instructions.
30 B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
31 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set.
32 After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
33 a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at
34 approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth,
35 flush, and invisible on exposed faces.
36 b. Install frames with removable glazing stops located on secure side of opening.
37 c. Remove temporary braces necessary for installation only after frames have been properly set and
38 secured.
39 d. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to
40 comply with installation tolerances.
41 2. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
42 3. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the
43 following tolerances:
44 a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from
45 jamb perpendicular to frame head.
46 b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to
47 plane of wall.
48 c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel
49 lines, and perpendicular to plane of wall.
50 d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
51 C. Glazing: Comply with installation requirements in Division 8 Section "Glazing" and with hollow metal
52 manufacturer's written instructions.
53 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches
54 (230 mm) o.c. and not more than 2 inches (50 mm) o.c. from each corner.
55

56 **1.18 ADJUSTING AND CLEANING**

- 57 A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply
58 touchup of compatible air-drying, rust-inhibitive primer.

1
2

END OF SECTION

SECTION 08 21 00
WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
1. Solid-core doors with wood-veneer faces.
 2. Factory finishing flush wood doors.
 3. Factory fitting flush wood doors to frames and factory machining for hardware.
- B. Related Sections:
1. Division 8 Section "Steel Doors and Frames" for hollow metal frames.
 2. Division 8 Section "Glazing" for glass view panels in flush wood doors.

1.3 SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.
1. Chain-of-custody certificates certifying that flush wood doors comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by a third party certification body.
 2. For adhesives and composite wood products, documentation indicating that product contains no urea formaldehyde.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
1. Indicate dimensions and locations of mortises and holes for hardware.
 2. Indicate dimensions and locations of cutouts.
 3. Indicate requirements for veneer matching.
 4. Indicate doors to be factory finished and finish requirements.
- C. Samples for Verification:
1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish.
- D. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Source Limitations: Obtain flush wood doors and wood paneling from single manufacturer.
- C. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."
- D. Forest Certification: Provide doors made with cores not less than 70 percent of wood products obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during the remainder of the construction period.

1 **1.7 WARRANTY**

- 2 A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that
3 fail in materials or workmanship within specified warranty period.
4 1. Failures include, but are not limited to, the following:
5 a. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
6 b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm)
7 span.
8 2. Warranty shall also include installation and finishing that may be required due to repair or replacement
9 of defective doors.
10 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

11
12 **PART 2 - PRODUCTS**

13 **1.8 MANUFACTURERS**

- 14 A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
15 1. Algoma Hardwoods, Inc.:
16 2. Marshfield Door Systems, Inc.
17 3. VT Industries Inc.
18

19 **1.9 DOOR CONSTRUCTION, GENERAL**

- 20 A. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain
21 urea formaldehyde.
22 B. WDMA I.S.1-A Performance Grade: Standard Duty.
23

24 **1.10 VENEERED-FACED DOORS FOR TRANSPARENT FINISH**

- 25 A. Interior Solid-Core Doors :
26 1. Grade: Premium, with Grade AA faces.
27 2. Species: To Match Existing.
28 3. Cut: Plain sliced (flat sliced).
29 4. Match between Veneer Leaves: Book match.
30 5. Assembly of Veneer Leaves on Door Faces: Balance match.
31 6. Room Match: Provide door faces of compatible color and grain within each separate room or area of
32 building.
33 7. Exposed Vertical Edges: Applied wood-veneer edges of same species as faces and covering edges of
34 faces.
35 8. Core: Glued wood stave.
36 9. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before
37 veneering. Faces are bonded to core using a hot press.
38

39 **1.11 FABRICATION**

- 40 A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced
41 quality standard for fitting unless otherwise indicated.
42 B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3.
43 Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware
44 templates.
45 C. Openings: Cut and trim openings through doors in factory as indicated or scheduled.
46 1. Light Openings: Trim openings with moldings of material and profile indicated.
47 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable
48 requirements in Division 8 Section "Glazing."
49

50 **1.12 FACTORY FINISHING**

- 51 A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting
52 doors for openings and machining for hardware that is not surface applied, before finishing.
53 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and
54 bottom edges, edges of cutouts, and mortises.
55 B. Finish doors at factory.
56 C. Transparent Finish: Match existing doors.
57 1. Grade: Premium.
58 2. Finish: WDMA TR-6 catalyzed polyurethane.

- 1 3. Staining: Match existing.
- 2 4. Effect: Match existing.
- 3 5. Sheen: Match existing.
- 4

5 **PART 3 - EXECUTION**

6 **1.13 EXAMINATION**

- 7 A. Examine doors and installed door frames before hanging doors.
- 8 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics
- 9 and have been installed with level heads and plumb jambs.
- 10 2. Reject doors with defects.
- 11 B. Proceed with installation only after unsatisfactory conditions have been corrected.
- 12

13 **1.14 INSTALLATION**

- 14 A. Hardware: For installation, see Division 8 Section "Door Hardware."
- 15 B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced
- 16 quality standard, and as indicated.
- 17 C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- 18 D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.
- 19

20 **1.15 ADJUSTING**

- 21 A. Operation: Rehang or replace doors that do not swing or operate freely.
- 22 B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be
- 23 repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.
- 24
- 25

END OF SECTION

**SECTION 08 71 00
DOOR HARDWARE**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes:
1. Mechanical door hardware for the following:
 - a. Swinging doors.
 2. Cylinders for door hardware specified in other sections.
 3. Electrified door hardware

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Warranty: Special warranty specified in this Section.
- C. Door Hardware Schedule
1. Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 2. Content: Include the following information:
 - a. Identification number, location, hand, fire rating, size, and material of each door and frame.
 - b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - d. Retain first subparagraph below for electrified door hardware.
 - e. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
- D. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks.
- E. Samples: Upon request, provide to A/E one sample of each item of door hardware that is to be furnished for this project. Sample need not be of specified finish unless requested by A/E. Samples will be returned to contractor upon completion of Project.

1.4 QUALITY ASSURANCE

- A. Supplier Qualifications: The hardware supplier shall be a corporate member in good standing of The Door and Hardware Institute (DHI), employing at least one Architectural Hardware Consultant (AHC) who is currently participating in DHI's continuing education program (CEP).
- B. Source Limitations: Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- C. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated. Provide positive latching and self-closing, regardless if specified in sets.
- D. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.
- E. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- F. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- G. Accessibility Requirements: For door hardware on doors in an accessible route, comply with ICC/ANSI A117.1.

- 1 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that
- 2 operate with a force of not more than 5 lbf (22.2 N).
- 3 2. Comply with the following maximum opening-force requirements:
- 4 a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
- 5 b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
- 6 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
- 7 4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3
- 8 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.
- 9 H. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project
- 10 Management and Coordination."
- 11 I. Items of hardware not definitely specified herein but necessary for completion of the work shall be provided.
- 12 Such items shall be of type and quality suitable to the service required and comparable to the adjacent
- 13 hardware. Where size and shape of members is such as to prevent the use of types specified, hardware shall be
- 14 furnished of suitable types having as nearly as practicable the same operation and quality as the type specified.
- 15 Sizes shall be adequate for the service required.
- 16 J. Include such nuances as strike type, strike lip length, raised barrel hinges, mounting brackets, blade stop spacers,
- 17 special templates, fasteners, shims, and coordination between conflicting products. All doors shall be provided
- 18 with a stop.
- 19

1.5 WARRANTY

- 20
- 21 A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace
- 22 components of door hardware that fail in materials or workmanship within specified warranty period.
- 23 1. Warranty Period: Manufacturers' standard warranty
- 24

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- 25
- 26
- 27 A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with
- 28 requirements in this Section.
- 29 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers'
- 30 products
- 31 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface
- 32 with other building control systems indicated.
- 33

2.2 HINGES

- 34
- 35 A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-
- 36 metal frames.
- 37 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 38 a. Hager Companies.
- 39 b. IVES Hardware; an Allegion company.
- 40 c. Stanley Commercial Hardware.
- 41 2. Interior Door Hinges: Steel, 0.134 inch minimum thickness except as noted. Provide heavyweight 0.180
- 42 inch minimum thickness on doors wider than 3'0".
- 43 3. Exterior Door Hinges: Stainless steel, provide heavyweight 0.180 inch minimum thickness unless noted
- 44 otherwise.
- 45 4. Hinge Size: 4-1/2" x 4-1/2" unless noted otherwise.
- 46 5. Hinge Options:
- 47 a. Nonremovable Pins: Provide set screw in hinge barrel that when tightened into a groove in hinge
- 48 pin, prevents removal of pin while door is closed; for outswinging exterior doors, outswinging
- 49 lockable corridor doors and doors with access control components.
- 50 b. Corners: Square.
- 51 6. Provide quantity as follows unless otherwise indicated.
- 52 7. For doors up to 60 inches in height, provide 1 pair hinges; for doors 60 inches to 90 inches in height, provide
- 53 1-1/2 pairs of hinges; for doors over 90 inches and up to 120 inches in height, provide 1 additional hinge for
- 54 each 30 inches of height

1 **2.3 CONTINUOUS HINGES**

- 2 A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall
3 width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with
4 components finished after milling and drilling are complete.
- 5 B. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-
6 aluminum channel cap; with concealed, self-lubricating thrust bearings.
- 7 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
8
9 a. Hager Companies.
10 b. IVES Hardware; an Allegion company.
11 c. Select Products Limited.

12
13 **2.4 MECHANICAL LOCKS AND LATCHES**

- 14 A. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements
15 indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to
16 match lock or latch.
- 17 B. Bored Locks: BHMA A156.2; Grade 1; Series 4000.
- 18 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
19 a. Falcon; an Allegion Company.
20 b. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
21 c. Schlage Commercial Lock Division; an Allegion company.

22
23 **2.5 AUXILIARY LOCKS**

- 24 A. Push-Button Combination Locks: BHMA A156.5; cylindrical; Grade 1; lock opens by entering a one- to five-digit
25 code by pushing correct buttons in correct sequence; automatically relocks when door is closed; with strike that
26 suits frame.
- 27 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
28 a. Kaba Ilco Corp.; a Kaba Group company.
29 b.

30 **2.6 AUTOMATIC AND SELF-LATCHING FLUSH BOLTS**

- 31 A. Automatic and Self-Latching Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising
32 into door edge.
- 33 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
34
35 a. Door Controls International, Inc.
36 b. IVES Hardware; an Allegion company.
37 c. Rockwood Manufacturing Company.
38 d. Trimco.

39
40 **2.7 EXIT DEVICES AND AUXILIARY ITEMS**

- 41 A. Exit Devices and Auxiliary Items: BHMA A156.3.
- 42 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
43
44 a. Falcon; an Allegion Company.
45 b. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
46 c. Von Duprin; an Allegion company.

47
48 **2.8 LOCK CYLINDERS**

- 49 A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
- 50 1. Manufacturer: Same manufacturer as for locking devices.

51
52 **2.9 KEYING**

- 53 A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions
54 made in keying conference.
- 55 1. Existing System:
56 a. Master key or grand master key locks to Owner's existing Schlage C key system.
57 b. Keys: Brass.

- 1 2. Stamping: Permanently inscribe each key with a visual key control number and include the following
2 notation:
3 a. Notation: Information to be furnished by Owner.
4 3. Quantity: In addition to one extra key blank for each lock, provide the following:
5 a. Cylinder Change Keys: Three.
6 b. Master Keys: Five.
7 c. Grand Master Keys: Five.
8
9 **2.10 OPERATING TRIM**
10 A. Operating Trim: BHMA A156.6; stainless steel, unless otherwise indicated.
11 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
12 a. Hager Companies.
13 b. IVES Hardware; an Allegion company.
14 c. Rockwood Manufacturing Company.
15 d. Trimco.
16
17
18 **2.11 ACCESSORIES FOR PAIRS OF DOORS**
19 B. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated
20 from steel with nylon-coated strike plates; with built-in, adjustable safety release; and with internal override.
21 C. Astragals: BHMA A156.22.
22
23 **2.12 SURFACE CLOSERS**
24 A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled
25 by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size
26 of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-
27 sized closers, adjustable to meet field conditions and requirements for opening force.
28 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
29 a. Falcon; an Allegion Company.
30 b. LCN Closers; an Allegion company.
31 c. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
32
33 **2.13 AUTOMATIC OPERATORS**
34 A. Automatic Operators: BHMA A159.19, Grade 1.
35 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
36 a. Motion Access.
37 b. Stanley.
38
39 **2.14 MECHANICAL STOPS AND HOLDERS**
40 A. Wall- and Floor-Mounted Stops: BHMA A156.16; stainless steel base metal.
41 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
42 a. Hager Companies.
43 b. IVES Hardware; an Allegion company.
44 c. Rockwood Manufacturing Company.
45 d. Trimco.
46
47 **2.15 OVERHEAD STOPS AND HOLDERS**
48 A. Overhead Stops and Holders: BHMA A156.8.
49 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
50 a. Glynn-Johnson; an Allegion company.
51 b. Rockwood Manufacturing Company.
52 c. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
53
54 **2.16 DOOR GASKETING**
55 A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack
56 length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal
57 strips that are easily replaceable and readily available from stocks maintained by manufacturer.
58 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1 a. Hager Companies.
- 2 b. National Guard Products.
- 3 c. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
- 4 d. Zero International.
- 5

6 **2.17 THRESHOLDS**

- 7 A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
- 8 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 9 a. Hager Companies.
- 10 b. National Guard Products.
- 11 c. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
- 12 d. Zero International.
- 13

14 **2.18 METAL PROTECTIVE TRIM UNITS**

- 15 A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; with
- 16 manufacturer's standard machine or self-tapping screw fasteners.
- 17 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 18 a. Hager Companies.
- 19 b. IVES Hardware; an Allegion company.
- 20 c. Rockwood Manufacturing Company.
- 21 d. Trimco.
- 22

23 **2.19 AUXILIARY DOOR HARDWARE**

- 24 A. Auxiliary Hardware: BHMA A156.16.
- 25 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 26 a. Hager Companies.
- 27 b. Rockwood Manufacturing Company.
- 28 c. Trimco.
- 29

30 **2.20 FABRICATION**

- 31 A. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood,
- 32 and sheet metal screws. Provide screws that comply with commercially recognized industry standards for
- 33 application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished
- 34 heads to match surface of door hardware, unless otherwise indicated.
- 35 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units
- 36 already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut
- 37 on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where
- 38 through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
- 39 2. Fire-Rated Applications:
- 40 a. Wood or Machine Screws: For the following:
- 41 a. Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors
- 42 and frames.
- 43 b. Strike plates to frames.
- 44 c. Closers to doors and frames.
- 45 b. Steel Through Bolts: For the following unless door blocking is provided:
- 46 a. Surface hinges to doors.
- 47 b. Closers to doors and frames.
- 48 c. Surface-mounted exit devices.
- 49 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
- 50 4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood
- 51 Doors."
- 52 5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.
- 53

54 **1.6 FINISHES**

- 55 A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- 56 B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective
- 57 covering before shipping.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
- C. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- D. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- E. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- F. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- G. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- I. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- J. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.
- K. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.2 DOOR HARDWARE SCHEDULE

HARDWARE SET 1

EA	HINGES	AS SPECIFIED	652	HAG
1 EA	PUSH PLATE	70F 8" X 16"	630	ROC
1 EA	PULL PLATE	BF111 X 70C 4" X 16"	630	ROC
1 EA	CLOSER	4040XP H	689	LCN
1 EA	KICK PLATE	8" X 2" LDW	630	ROC
1 EA	WALL STOP	409	630	ROC

HARDWARE SET 2

EA	HINGES	AS SPECIFIED	652	HAG
1 EA	OFFICE	ND53PD SPA	626	SCH
1 EA	CLOSER	4040XP H	689	LCN
1 EA	KICK PLATE	8" X 2" LDW	630	ROC
1 EA	WALL STOP	409	630	ROC

HARDWARE SET 3

EA	HINGES	AS SPECIFIED	652	HAG
1 EA	OFFICE	ND53PD SPA	626	SCH
1 EA	OVERHEAD HOLDER	450H	630	ROC
1 EA	CLOSER	4040XP	689	LCN
1 EA	KICK PLATE	8" X 2" LDW	630	ROC

1	<u>HARDWARE SET 4</u>				
2	EA	HINGES	AS SPECIFIED	652	HAG
3	1 EA	OFFICE	ND53PD SPA	626	SCH
4	1 EA	WALL STOP	409	630	ROC
5					
6	<u>HARDWARE SET 5</u>				
7	EA	HINGES	AS SPECIFIED	652	HAG
8	1 EA	ELECTRIC STRIKE	REUSE EXISTING HES STRIKE		
9	1 EA	OFFICE	ND53PD SPA	626	SCH
10	1 EA	CLOSER	4040XP H	689	LCN
11	1 EA	KICK PLATE	8" X 2" LDW	630	ROC
12	1 EA	WALL STOP	409	630	ROC
13	1 EA	REMOTE RELEASE	REUSE EXISTING		
14					
15	<u>HARDWARE SET 6</u>				
16	1 EA	CONTINUOUS HINGE	780-224HD	628	HAG
17	1 EA	STOREROOM	ND80PD SPA	626	SCH
18	1 EA	CLOSER	4040XP SCUSH	689	LCN
19	1 EA	KICK PLATE	8" X 2" LDW	630	ROC
20	1 EA	THRESHOLD	8425	719	NGP
21	1 EA	SWEEP	200NA	628	NGP
22	1 SET	WEATHERSTRIPPING	9700A	628	NGP
23					
24	<u>HARDWARE SET 7</u>				
25	EA	HINGES	AS SPECIFIED	652	HAG
26	1 EA	PUSH BUTTON LOCK	LL1021 B	626	KAB
27	1 EA	IC CORE	AS REQUIRED	626	SCH
28	1 EA	OVERHEAD STOP	450S	630	GLY
29					
30	<u>HARDWARE SET 8</u>				
31	EA	HINGES	AS SPECIFIED	652	HAG
32	1 EA	PRIVACY	ND40S SPA	626	SCH
33	1 EA	WALL STOP	409	630	ROC
34					
35	<u>HARDWARE SET 9</u>				
36	EA	HINGES	AS SPECIFIED	652	HAG
37	1 EA	STOREROOM	ND80PD SPA	626	SCH
38	1 EA	WALL STOP	409	630	ROC
39					
40	<u>HARDWARE SET 10</u>				
41	EA	HINGES	AS SPECIFIED	652	HAG
42	1 EA	PUSH PLATE	70F 8" X 16"	630	ROC
43	1 EA	PULL PLATE	BF111 X 70C 4" X 16"	630	ROC
44	1 EA	OVERHEAD HOLDER	450H	630	GLY
45	1 EA	CLOSER	4040XP	689	LCN
46	1 EA	KICK PLATE	8" X 2" LDW	630	ROC
47					
48	<u>HARDWARE SET 11</u>				
49	EA	HINGES	AS SPECIFIED	652	HAG
50	1 EA	PASSAGE	ND10S SPA	626	SCH
51	1 EA	OVERHEAD STOP	450S	630	GLY
52					
53					
54					
55					
56					
57					
58					

1	HARDWARE SET 12				
2	1 EA	CONTINUOUS HINGE	780-112HD	628	HAG
3	1 EA	EXIT DEVICE	CD99NL	626	VON
4	2 EA	CYLINDER	AS REQUIRED	626	SCH
5	1 EA	AUTOMATIC OPERATOR	MAC-LL1C-R	628	MOT
6	1 EA	ACTUATOR	10PBS1	630	BEA
7	1 EA	ACTUATOR	10PBDGP1	630	BEA
8	2 EA	MOUNTING BOX	10BOX475SQSM	BLK	BEA
9	1 EA	WEATHER RING	10WRSQ475		BEA
10	1 EA	RECEIVER	10RD433		BEA
11	3 EA	TRANSMITTER	10TD433PB9V		BEA
12	1 EA	THRESHOLD	8424	719	NGP
13	1 EA	SWEEP	200NA	628	NGP
14	1 SET	WEATHERSTRIPPING	BY DOOR AND FRAME MANUFACTURER		
15					
16	HARDWARE SET 13				
17	1 EA	CONTINUOUS HINGE	780-112HD	628	HAG
18	1 EA	DUMMY BAR	330 X 990DT	626	VON
19	1 EA	AUTOMATIC OPERATOR	MAC-ML1C-R	628	MOT
20	1 EA	ACTUATOR	10PBS1	630	BEA
21	1 EA	MOUNTING BOX	10BOX475SQSM	BLK	BEA
22	1 EA	RECEIVER	10RD433		BEA
23	1 EA	TRANSMITTER	10TD433PB9V		BEA
24	1 EA	WALL STOP	409	630	ROC
25	1 SET	WEATHERSTRIPPING	BY DOOR AND FRAME MANUFACTURER		
26					
27	HARDWARE SET 14				
28	1 EA	CONTINUOUS HINGE	780-224HD	628	HAG
29	1 EA	EXIT DEVICE	CD99NL	626	VON
30	2 EA	CYLINDER	AS REQUIRED	626	SCH
31	1 EA	CLOSER	4040XP SCUSH	689	LCN
32	1 EA	KICK PLATE	8" X 2" LDW	630	ROC
33	1 EA	THRESHOLD	8425	719	NGP
34	1 EA	SWEEP	200NA	628	NGP
35	1 SET	WEATHERSTRIPPING	9700A	628	NGP
36					
37					
38					
39	HARDWARE SET 15				
40	EA	HINGES	AS SPECIFIED	652	HAG
41	1 EA	STOREROOM	ND80PD SPA	626	SCH
42	1 EA	OVERHEAD STOP	450S	630	GLY
43	1 EA	KICK PLATE	8" X 2" LDW	630	ROC
44					
45	HARDWARE SET 16				
46	EA	HINGES	AS SPECIFIED	652	HAG
47	1 EA	AUTO FLUSHBOLT	2848	626	ROC
48	1 EA	STOREROOM	ND80PD SPA	626	SCH
49	1 EA	COORDINATOR	COR X FL	628	IVE
50	2 EA	MOUNTING BRACKET	MB	689	IVE
51	2 EA	CLOSER	4040XP SCUSH	689	LCN
52					
53	HARDWARE SET 17				
54	EA	HINGES	AS SPECIFIED	652	HAG
55	1 EA	STOREROOM	ND80PD SPA	626	SCH
56	1 EA	CLOSER	4040XP	689	LCN
57	1 EA	KICK PLATE	8" X 2" LDW	630	ROC
58	1 EA	WALL STOP	409	630	ROC

1	HARDWARE SET 18					
2	1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
3	1	EA	EXIT DEVICE	CD99NL	626	VON
4	2	EA	CYLINDER	AS REQUIRED	626	SCH
5	1	EA	AUTOMATIC OPERATOR	MAC-LL1C-R	628	MOT
6	1	EA	ACTUATOR	10PBS1	630	BEA
7	1	EA	ACTUATOR	10PBDGP1	630	BEA
8	2	EA	MOUTNING BOX	10BOX475SQSM	BLK	BEA
9	1	EA	WEATHER RING	10WRSQ475		BEA
10	1	EA	RECEIVER	10RD433		BEA
11	3	EA	TRANSMITTER	10TD433PB9V		BEA
12	1	EA	THRESHOLD	8425	719	NGP
13	1	EA	SWEEP	200NA	628	NGP
14	1	SET	WEATHERSTRIPPING	9700A	628	NGP
15						
16	HARDWARE SET 19					
17	1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
18	1	EA	DUMMY BAR	330 X 990DT	626	VON
19	1	EA	AUTOMATIC OPERATOR	MAC-ML1C-R	628	MOT
20	1	EA	ACTUATOR	10PBS1	630	BEA
21	1	EA	MOUTNING BOX	10BOX475SQSM	BLK	BEA
22	1	EA	RECEIVER	10RD433		BEA
23	1	EA	TRANSMITTER	10TD433PB9V		BEA
24	1	EA	WALL STOP	409	630	ROC
25						
26						
27	END OF SECTION					

SECTION 08 81 00
GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
1. Doors
 2. Interior borrowed lights
- B. Related Sections:
1. Section 08210: Wood Doors.
 2. Section 08872: Architectural Window Film

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

1.5 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Samples: 12 inch x 12 inch glass
- C. Product Certificates: For glass and glazing products, from manufacturer.
- D. Preconstruction adhesion and compatibility test report.
- E. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. GANA Publications: GANA's "Glazing Manual."
 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- D. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- E. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1
2 **1.8 WARRANTY**

- 3 A. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass
4 manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period.
5 Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to
6 glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions.
7 Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
8 1. Warranty Period: 10 years from date of Substantial Completion.
9

10 **PART 2 - PRODUCTS**

11 **1.9 GLASS PRODUCTS, GENERAL**

- 12 A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lights in thicknesses as needed to
13 comply with requirements indicated.
14 All interior glass shall be tempered.
15

16 **1.10 GLASS PRODUCTS**

- 17 A. Safety Glass, Type I, Class 1, Quality Q3, Kind FT- fully tempered, 1/4 inch thick.
18

19 **1.11 GLAZING GASKETS**

- 20 A. Dense Compression Gaskets: Molded or extruded dense EPDM or neoprene gaskets, complying with ASTM C
21 864, of profile and hardness required to maintain watertight seal.
22

23 **1.12 GLAZING SEALANTS**

- 24 A. General: Provide products of type indicated, complying with the following requirements.
25 1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials
26 they will contact, including glass products, and glazing channel substrates, under conditions of service
27 and application, as demonstrated by sealant manufacturer based on testing and field experience.
28 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing
29 sealants suitable for applications indicated and for conditions existing at time of installation.
30 3. Colors of Exposed Glazing Sealants: As selected by A/E from manufacturer's full range of colors.
31 B. Elastomeric Glazing Sealant: Equivalent to Tremco Proglaze one-part, moisture curing, silicone elastomeric
32 sealant complying with ASTM C 920, FS-TT-S-001543A, FS-TT-S-00230C.
33

34 **1.13 GLAZING TAPES**

- 35 A. Back-Bedding Mastic Glazing Tapes: Performed, butyl-based elastomeric tape with a solids content of 100
36 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as
37 recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a
38 release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below.
39 1. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
40

41 **1.14 MISCELLANEOUS GLAZING MATERIALS**

- 42 A. General: Provide products of material, size, and shape complying with referenced glazing standard,
43 requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven
44 record of compatibility with surfaces contacted in installation.
45 B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
46 C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
47 D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain
48 glass lites in place for installation indicated.
49 E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
50

51 **1.15 FABRICATION OF GLAZING UNITS**

- 52 A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge
53 and surface conditions, and bite complying with written instructions of product manufacturer and referenced
54 glazing publications, to comply with system performance requirements.
55 B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers
56 at junctions of edges and faces.
57 C. Grind smooth and polish exposed glass edges and corners.

1 **PART 3 - EXECUTION**

2 **1.16 COORDINATION**

- 3 A. Coordinate the work of this Section with Section 08210 contractors.

4
5 **1.17 EXAMINATION**

- 6 A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
- 7 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 8 2. Presence and functioning of weep systems.
 - 9 3. Minimum required face and edge clearances.
 - 10 4. Effective sealing between joints of glass-framing members.
- 11 B. Proceed with installation only after unsatisfactory conditions have been corrected.

12
13 **1.18 PREPARATION**

- 14 A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings
15 not firmly bonded to substrates.
- 16 B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and
17 interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed
18 work.

19
20 **1.19 GLAZING**

- 21 A. General:
- 22 1. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing
23 materials, unless more stringent requirements are indicated, including those in referenced glazing
24 publications.
 - 25 2. Adjust glazing channel dimensions as required by Project conditions during installation to provide
26 necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with
27 reasonable tolerances.
 - 28 3. Protect glass edges from damage during handling and installation. Remove damaged glass from Project
29 site and legally dispose of off Project site. Damaged glass is glass with edge damage or other
30 imperfections that, when installed, could weaken glass and impair performance and appearance.
 - 31 4. Apply primers to joint surfaces where required for adhesion of sealants, as determined by
32 preconstruction testing.
 - 33 5. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications,
34 unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable
35 for heel bead.
 - 36 6. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
 - 37 7. Provide spacers for glass lites where length plus width is larger than **50 inches (1270 mm)**.
 - 38 a. Locate spacers directly opposite each other on both inside and outside faces of glass. Install
39 correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are
40 used that have demonstrated ability to maintain required face clearances and to comply with
41 system performance requirements.
 - 42 b. Provide **1/8-inch (3-mm)** minimum bite of spacers on glass and use thickness equal to sealant
43 width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
 - 44 8. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing
45 channel, as recommended in writing by glass manufacturer and according to requirements in referenced
46 glazing publications.
 - 47 9. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
 - 48 10. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

49
50 **1.20 TAPE GLAZING**

- 51 A. Dry/Dry:
- 52 1. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or
53 protrude slightly above sightline of stops.
 - 54 2. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make
55 them fit opening.
 - 56 3. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal
57 framing joints by applying tapes to jambs and then to heads and sills.

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4. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
 5. Do not remove release paper from tape until just before each glazing unit is installed.
 6. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work towards centers of openings.

8 **1.21 CLEANING AND PROTECTION**

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- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
 - B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
 - C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
 - D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
 - E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION

**SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
1. Interior gypsum wallboard.
 2. Non-load-bearing steel framing.

1.3 DEFINITIONS

- A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.

1.5 QUALITY ASSURANCE

- A. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.
1. STC-Rated Assemblies: Indicated by design designations from GA-600, "Fire Resistance Design Manual."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

Part 2 - PRODUCTS

1.8 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Steel Framing and Furring:
 - a. Dietrich Industries, Inc.
 - b. National Gypsum Company.
 - c. Unimast, Inc.
 2. Gypsum Board and Related Products:
 - a. G-P Gypsum Corp.
 - b. Certainteed ProRoc.
 - c. United States Gypsum Co.

1.9 STEEL PARTITION FRAMING

- A. Components, General: As follows:
1. Comply with ASTM C 754 for conditions indicated.
 2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G40, hot-dip galvanized zinc coating.
- B. Steel Studs and Runners: ASTM C 645.
1. Minimum Base Metal Thickness: 0.027 inch (22 gauge).

- 1 2. Deflection Limit: L/240, unless otherwise indicated.
- 2 3. Depth and Spacing: As indicated.
- 3 C. Cold-Rolled Channel Bridging: 0.0538-inch bare steel thickness, with minimum 1/2-inch- wide flange.
- 4 1. Depth: 1-1/2 inches, unless otherwise indicated.
- 5 2. Clip Angle: 1-1/2 by 1-1/2 inch , 0.068-inch- thick, galvanized steel.
- 6 D. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties
- 7 required to fasten steel members to substrates.
- 8
- 9

10 **1.10 INTERIOR GYPSUM WALLBOARD**

- 11 A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and
- 12 correspond with support system indicated.
- 13 B. Gypsum Wallboard: ASTM C 36, 100 percent post-industrial recycled content (synthetic) gypsum shall be used to
- 14 manufacture the board materials. The synthetic gypsum shall be a byproduct of the flue gas desulfurization
- 15 (FGD) process, which removes sulfur dioxide from the emissions of coal-burning electrical power plants. One
- 16 local source of the gypsum board materials may be obtained from the USG Gypsum Plant in East Chicago, IN or
- 17 GP Gypsum, Wheatfield, IN.
- 18 1. Regular Type:
- 19 a. Thickness: 5/8 inch, unless otherwise indicated.
- 20 b. Long Edges: Tapered.
- 21 c. Location: As indicated.

22 **1.11 TRIM ACCESSORIES**

- 23 A. Interior Trim: ASTM C 1047.
- 24 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
- 25 2. Shapes:
- 26 a. Cornerbead: Use at outside corners, unless otherwise indicated.
- 27 b. L-Bead: L-shaped; exposed long leg receives joint compound.
- 28 c. Expansion (Control) Joints.
- 29

30 **1.12 JOINT TREATMENT MATERIALS**

- 31 A. General: Comply with ASTM C 475.
- 32 B. Joint Tape:
- 33 1. Interior Gypsum Wallboard: Paper.
- 34 2. Tile Backing Panels: As recommended by panel manufacturer.
- 35 C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other
- 36 compounds applied on previous or for successive coats.
- 37 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
- 38 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use
- 39 setting-type taping compound.
- 40 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
- 41 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
- 42 5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.
- 43 D. Joint Compound for Tile Backing Panels:
- 44 1. Cementitious Backer Units: As recommended by manufacturer.
- 45

46 **1.13 ACOUSTICAL SEALANT**

- 47 A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work
- 48 include, but are not limited to, the following. Refer to Division 7 Section "Joint Sealants" for applicable general
- 49 requirements.
- 50 1. Acoustical Sealant for Exposed and Concealed Joints:
- 51 a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
- 52 b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
- 53 B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant complying
- 54 with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in
- 55 building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- 56

1 **1.14 AUXILIARY MATERIALS**

- 2 A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's
3 written recommendations.
4 B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
5 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch
6 thick.
7 2. For fastening cementitious backer units, use screws of type and size recommended by panel
8 manufacturer.
9 C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining
10 thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
11 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
12

13 **Part 3 - EXECUTION**

14 **1.15 EXAMINATION**

- 15 A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors,
16 and structural framing, for compliance with requirements and other conditions affecting performance. Proceed
17 with installation only after unsatisfactory conditions have been corrected.
18

19 **1.16 PREPARATION**

- 20 A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure
21 to ensure that inserts and other provisions for anchorages to building structure have been installed to receive
22 ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.
23 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time
24 needed for coordination and construction.
25

26 **1.17 INSTALLING STEEL FRAMING, GENERAL**

- 27 A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.
28 B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support
29 fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
30 Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none
31 available, with United States Gypsum's "Gypsum Construction Handbook."
32 C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by
33 structural movement.
34 D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of
35 joints independently.
36

37 **1.18 INSTALLING STEEL PARTITION**

- 38 A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut
39 other construction.
40 1. Where studs are installed directly against exterior walls, install asphalt-felt isolation strip between studs
41 and wall.
42 B. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where
43 partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and
44 openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
45 1. Cut studs 1/2 inch short of full height to provide perimeter relief.
46 C. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached
47 to open (unsupported) edges of stud flanges first.
48 D. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written
49 recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door
50 frames; install runner track section (for cripple studs) at head and secure to jamb studs.
51 1. Install two studs at each jamb, unless otherwise indicated.
52 2. Extend jamb studs through suspended ceilings and attach to underside of top plate.
53 E. Frame openings other than door openings the same as required for door openings, unless otherwise indicated.
54 Install framing below sills of openings to match framing required above door heads.
55

56 **1.19 APPLYING AND FINISHING PANELS, GENERAL**

- 57 A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.

- 1 B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after
- 2 panels have been installed on one side.
- 3 C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting
- 4 end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one
- 5 framing member.
- 6 D. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not
- 7 more than 1/16 inch of open space between panels. Do not force into place.
- 8 E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum
- 9 board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends.
- 10 Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of
- 11 framed openings.
- 12 F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported)
- 13 edges of stud flanges first.
- 14 G. Attach gypsum panels to framing provided at openings and cutouts.
- 15 H. Form control and expansion joints with space between edges of adjoining gypsum panels.
- 16 I. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.),
- 17 except in chases braced internally.
- 18 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be
- 19 accomplished with scraps of not less than 8 sq. ft. in area.
- 20 2. Fit gypsum panels around ducts, pipes, and conduits.
- 21 3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting
- 22 below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists,
- 23 and other structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- 24 J. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide
- 25 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum
- 26 panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- 27 K. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion joints, and at openings
- 28 and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of
- 29 partitions at perimeters and through penetrations. Comply with ASTM C 919 and manufacturer's written
- 30 recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board
- 31 assemblies, including sealing partitions above acoustical ceilings.
- 32 L. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and
- 33 manufacturer's written recommendations.
- 34 M. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.

35 36 **1.20 PANEL APPLICATION METHODS**

- 37 A. Single-Layer Application:
- 38 1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible
- 39 and at right angles to framing, unless otherwise indicated.
- 40 2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or
- 41 required by fire-resistance-rated assembly, and minimize end joints.
- 42 a. Stagger abutting end joints not less than one framing member in alternate courses of board.
- 43 b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or
- 44 required by fire-resistance-rated assembly.
- 45 3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate
- 46 edge joints over furring members.
- 47 B. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.

48 49 **1.21 INSTALLING TRIM ACCESSORIES**

- 50 A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for
- 51 panels. Otherwise, attach trim according to manufacturer's written instructions.
- 52 B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for
- 53 visual effect.

54 55 **1.22 FINISHING GYPSUM BOARD ASSEMBLIES**

- 56 A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads,
- 57 surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove
- 58 residual joint compound from adjacent surfaces.

- 1 B. Prefill open joints and damaged surface areas.
2 C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
3 D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations
4 indicated:
5 1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a
6 higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
7 2. Level 3 is suitable for surfaces receiving medium- or heavy-textured finishes before painting or heavy
8 wallcoverings where lighting conditions are not critical.
9 a. Level 3: Embed tape and apply separate first and fill coats of joint compound to tape, fasteners, and trim
10 flanges.
11 3. Level 4 is suitable for surfaces receiving light-textured finish wallcoverings and flat paints. It is generally
12 the standard exposed finish.
13 a. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape,
14 fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise
15 indicated.
16 4. Level 5 is suitable for surfaces receiving gloss and semigloss enamels and surfaces subject to severe
17 lighting. It is considered a high-quality gypsum board finish.
18 a. Level 5 (For large uninterrupted surfaces where the Architect determines that Level 4 finish is
19 unacceptable): Embed tape and apply separate first, fill, and finish coats of joint compound to
20 tape, fasteners, and trim flanges, and apply skim coat of joint compound over entire surface at
21 extensive uninterrupted wall or ceiling surfaces including but not limited to curved walls and
22 soffits.
23 E. Texture Finish: By Section 09 91 23 contractor.

24
25
END OF SECTION

SECTION 09 51 10
ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.

1.3 SUBMITTALS

- A. Product Data:
1. Submit manufacturer's product data and installation instructions for each type of acoustical material and suspension system required.
 2. Submit manufacturer's written instructions for recommended maintenance practice for each type of acoustical ceiling system required. Include recommendation for cleaning and refinishing acoustical units and precautions against materials and methods that may be detrimental to finishes and acoustical performances.
- B. Samples:
1. Submit 6" x 6" samples of each type. Provide 12" long suspension system and edge molding samples.
 2. Submit Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special molding.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

1.8 ACOUSTICAL PANELS

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance, unless otherwise indicated.
- B. Acoustical Panel Colors and Patterns
1. **(ACT-1) Armstrong Calla Tiles** Total Recycled Content: 76%.
 - a. Size: 2 by 2.
 - b. Color: White.
 - c. Edge: Square Tegular.
 - d. NRC: .85
 - e. CAC: 35
 - f. LR: .86
 2. **(ACT-2) Armstrong Kitchen Zone**
 - a. Size: 2 by 2.
 - b. Color: White.
 - c. Edge: Square.
 - d. NRC: m/a
 - e. CAC: 33
 - f. LR: .89

1 **1.9 METAL SUSPENSION SYSTEMS, GENERAL**

- 2 A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types,
3 structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
4 B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for
5 recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of
6 system indicated.
7 C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise
8 indicated.
9

10 **1.10 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING**

- 11 A. Grid for **ACT-1 & ACT-2** Wide-Face, Capped, Double-Web, Hot-Dip Galvanized, G60 (Z180), Steel Suspension System: Main and
12 cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A 653/A 653M, G60 (Z180)
13 coating designation, with prefinished, cold-rolled, 15/16-inch- (24-mm-) wide, aluminum caps on flanges.
14 1. Structural Classification: Intermediate-duty system.
15 2. Face Design: Flat, flush.
16 3. Face Finish: Painted white.
17

18 **1.11 ACOUSTICAL SEALANT**

- 19 A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex
20 sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying
21 with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building
22 construction as demonstrated by testing representative assemblies according to ASTM E 90.
23

24 **PART 3 - EXECUTION**

25 **1.12 EXAMINATION**

- 26 A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with
27 Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and
28 anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel
29 ceilings.
30 1. Proceed with installation only after unsatisfactory conditions have been corrected.
31

32 **1.13 PREPARATION**

- 33 A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling.
34 Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.
35

36 **1.14 INSTALLATION**

- 37 A. General: Install acoustical panel ceilings to comply with ASTM C 636 per manufacturer's written instructions and CISCA's
38 "Ceiling Systems Handbook."
39 B. Suspend ceiling hangers from building's structural members and as follows:
40 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of
41 supporting structure or of ceiling suspension system.
42 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter splaying,
43 or other equally effective means.
44 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with
45 location of hangers at spacings required to support standard suspension system members, install supplemental
46 suspension members and hangers in form of trapezes or equivalent devices.
47 4. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other
48 supplemental support for attachment of hanger wires.
49 5. Do not attach hangers to steel roof deck. Attach hangers to structural members.
50 6. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless
51 otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
52 7. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by
53 referenced standards and publications.
54 C. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented,
55 bent, or kinked members.
56 D. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe
57 and cut panels at borders and penetrations to provide a neat, precise fit.
58 1. Arrange directionally patterned acoustical panels as follows:
59 a. As indicated on reflected ceiling plans.
60 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and
61 moldings.
62 3. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top
63 surface of runner flanges.

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- 4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

- 5. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.

1.15 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 09 65 00
RESILIENT FLOORING, WALL BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
1. Resilient Base
 2. Preparation of substrate surfaces

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
1. For adhesives, including printed statement of VOC content.
- B. Samples: Submit samples for verification purposes for each color of flooring and base.
- C. Maintenance Instructions: Submit 2 copies of manufacturer's recommended maintenance practices for each type of resilient flooring and accessory required.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Installer's Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing resilient products similar to those required for this Project and with a record of successful in-service performance.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.6 PROJECT CONDITIONS

- A. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

1.7 RESILIENT BASE

- A. Resilient Base:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Johnsonite.
 - B. Resilient Base Standard: ASTM F 1861.
 1. Material Requirement: Type TP (rubber, thermoplastic).
 2. Manufacturing Method: Group I (solid, homogeneous).
 3. Style: Straight.
 - C. Minimum Thickness: 0.125 inch (3.2 mm).
 - D. Height: 6 inches (102 mm).
 - E. Lengths: Coils in manufacturer's standard length.
 - F. Outside Corners: Job formed or preformed.
 - G. Inside Corners: Job formed or preformed.
 - H. Color: Burnt Umber.

1.8 RESILIENT TRANSITION

- A. 1/8 inch thick, homogenous vinyl or rubber composition, tapered or bullnose edge, not less than 1 inch wide.
Color: Black

1 **1.9 INSTALLATION MATERIALS**

- 2 A. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate
3 conditions indicated.
4 1. Use adhesives that comply with the following limits for VOC content when calculated according to
5 40 CFR 59, Subpart D (EPA Method 24):
6 a. Cove Base Adhesives: Not more than 50 g/L.
7

8 **PART 3 - EXECUTION**

9 **1.10 EXAMINATION**

- 10 A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content
11 and other conditions affecting performance of the Work.
12 B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and
13 that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with
14 adhesion of resilient products.
15 C. Proceed with installation only after unsatisfactory conditions have been corrected.
16

17 **1.11 PREPARATION**

- 18 A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
19

20 **1.12 INSTALLATION**

- 21 A. RESILIENT BASE INSTALLATION
22 1. Comply with manufacturer's written instructions for installing resilient base.
23 2. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other
24 permanent fixtures in rooms and areas where base is required.
25 3. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent
26 pieces aligned.
27 4. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous
28 contact with horizontal and vertical substrates.
29 5. Do not stretch resilient base during installation.
30 6. Retain first paragraph below if required or revise to suit Project.
31 7. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with
32 manufacturer's recommended adhesive filler material.
33 8. Preformed Corners: Install preformed corners before installing straight pieces.
34 9. Job-Formed Corners:
35 a. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing
36 discoloration (whitening) at bends.
37 b. Inside Corners: Use straight pieces of maximum lengths possible.
38

39 **1.13 CLEANING AND PROTECTION**

- 40 A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
41 B. Perform the following operations immediately after completing resilient product installation:
42 1. Remove adhesive and other blemishes from exposed surfaces.
43
44

END OF SECTION

**SECTION 09 91 23
INTERIOR PAINTING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following interior substrates:
1. Gypsum board.
 2. Hollow metal frames.
 3. Stain finish for wood windows and doors.
 4. Miscellaneous interior surfaces.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
1. Product Data: For paints, including printed statement of VOC content and chemical components.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.
1. Submit Samples on rigid backing, **8 inches (200 mm)** square.
 2. Label each Sample for location and application area.

1.4 QUALITY ASSURANCE

- A. MPI Standards:
1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" and "MPI Maintenance Repainting Manual" for products and paint systems indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than **45 deg F (7 deg C)**.
1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between **50 and 95 deg F (10 and 35 deg C)**.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than **5 deg F (3 deg C)** above the dew point; or to damp or wet surfaces.
- C. Before painting is started in any area, broom clean and remove excessive dust.
- D. After painting operations begin in a given area, broom cleaning will not be allowed; cleaning shall be done only with commercial vacuum cleaning equipment.
- E. Provide adequate illumination in all areas where painting operations are in progress.

PART 2 - PRODUCTS

1.7 MANUFACTURERS

- A. Manufacturer:
1. Sherwin Williams
 2. Mautz
 3. Rosco

1.8 PAINT, GENERAL

- A. Provide all painting materials of the best quality and approved by the Owner. They shall bear identifying labels on the containers with the manufacturer's instructions printed thereon. Paint containers not bearing manufacturer's identifying labels or bearing identifying labels of the manufacturers not approved by the Owner will not be permitted on the project site.
- B. Paint shall not be badly settled, cakes, or thickened in the container, shall be readily dispersed with a paddle to a smooth consistency and shall have excellent application properties.

- 1 C. Deliver paint to the job color-mixed except for tinting of undercoats and possible thinning.
- 2 D. Tinting materials shall be recommended by the manufacturer for the particular material tinted.
- 3 E. Insure that all mixed colors match the color selection made by the A/E prior to application of the coating.
- 4 F. Material Compatibility:
 - 5 1. Provide materials for use within each paint system that are compatible with one another and substrates
 - 6 indicated, under conditions of service and application as demonstrated by manufacturer, based on
 - 7 testing and field experience.
 - 8 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat
 - 9 for use in paint system and on substrate indicated.
- 10 G. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following
- 11 limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59,
- 12 Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a
- 13 fabrication or finishing shop:
 - 14 1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
 - 15 2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
- 16 H. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive
- 17 and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these
- 18 requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
 - 19 1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total
 - 20 aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 - 21 2. Restricted Components: Paints and coatings shall not contain any of the following:
 - 22 a. Acrolein.
 - 23 b. Acrylonitrile.
 - 24 c. Antimony.
 - 25 d. Benzene.
 - 26 e. Butyl benzyl phthalate.
 - 27 f. Cadmium.
 - 28 g. Di (2-ethylhexyl) phthalate.
 - 29 h. Di-n-butyl phthalate.
 - 30 i. Di-n-octyl phthalate.
 - 31 j. 1,2-dichlorobenzene.
 - 32 k. Diethyl phthalate.
 - 33 l. Dimethyl phthalate.
 - 34 m. Ethylbenzene.
 - 35 n. Formaldehyde.
 - 36 o. Hexavalent chromium.
 - 37 p. Isophorone.
 - 38 q. Lead.
 - 39 r. Mercury.
 - 40 s. Methyl ethyl ketone.
 - 41 t. Methyl isobutyl ketone.
 - 42 u. Methylene chloride.
 - 43 v. Naphthalene.
 - 44 w. Toluene (methylbenzene).
 - 45 x. 1,1,1-trichloroethane.
 - 46 y. Vinyl chloride.
 - 47 l. Colors: as indicated in Schedule.

48
49 **1.9 PRIMERS/SEALERS**

- 50 A. Interior Latex Primer/Sealer:
 - 51 1. Safecoat New Wallboard Primecoat HPV
 - 52 2. Safecoat Transitional Primer
 - 53 3. AFM MetalCoat Acrylic Metal Primer

54
55 **1.10 LATEX PAINTS**

- 56 A. Institutional Low-Odor/VOC Latex (Low Sheen): MPI #144 (Gloss Level 2).
 - 57 1. VOC Content: E Range of E3.
- 58 B. Institutional Low-Odor/VOC Latex (Eggshell): MPI #145 (Gloss Level 3).

- 1 1. VOC Content: E Range of E3.
2 C. Institutional Low-Odor/VOC Latex (Semigloss): MPI #147 (Gloss Level 5).
3 1. VOC Content: E Range of E3.
4

5 **PART 3 - EXECUTION**

6 **1.11 EXAMINATION**

- 7 A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum
8 moisture content and other conditions affecting performance of work.
9 B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
10 1. Gypsum Board: 12 percent.
11 C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
12 D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
13 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.
14

15 **1.12 PREPARATION**

- 16 A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting
17 Specification Manual" applicable to substrates indicated.
18 B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is
19 impractical or impossible because of size or weight of item, provide surface-applied protection before surface
20 preparation and painting.
21 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that
22 were removed. Remove surface-applied protection if any.
23 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance
24 rating, or nomenclature plates.
25 C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible
26 paints and encapsulants.
27 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce
28 paint systems indicated.
29 D. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.
30
31 E. Wood Surfaces:
32 1. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended
33 know sealer before application of primer. After priming, fill holes and imperfections in finish surfaces
34 with putty or plastic wood filler. Sand smooth when dried.
35 2. Prime, stain, or seal wood to be painted immediately upon delivery. Prime edges, ends, faces,
36 undersides, and backsides of wood.
37

38 **1.13 APPLICATION**

- 39 A. Apply paints according to manufacturer's written instructions.
40 1. Use applicators and techniques suited for paint and substrate indicated.
41 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final
42 installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
43 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to
44 match exposed surfaces.
45 B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are
46 to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of
47 undercoats to distinguish each separate coat.
48 C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform
49 paint finish, color, and appearance.
50 D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking,
51 runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
52 1. All metal surfaces to have paint spray applied.
53 E. Painting Mechanical and Electrical Work: Paint items exposed in occupied spaces including, but not limited to,
54 the following:
55 1. Mechanical Work:
56 a. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
57 2. Electrical Work:
58 a. Electrical equipment that is indicated to have a factory-primed finish for field painting.

1 **1.14 CLEANING AND PROTECTION**

- 2 A. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or
3 other methods. Do not scratch or damage adjacent finished surfaces.
4 B. Protect work of other trades against damage from paint application. Correct damage to work of other trades by
5 cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
6 C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted
7 surfaces.
8

9 **1.15 INTERIOR PAINTING SCHEDULE**

- 10 A. Surfaces to be painted are listed in the Room Finish Schedule, and indicated on the Drawings
11 B. Steel Substrates:
12 1. Institutional Low-Odor/VOC Latex System: MPI INT 5.1S.
13 a. Prime Coat: Rust-inhibitive primer (water based).
14 b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
15 c. Topcoat: Institutional low-odor/VOC interior latex semi gloss as scheduled.
16 C. Gypsum Board Substrates:
17 1. Institutional Low-Odor/VOC Latex System: MPI INT 9.2M.
18 a. Prime Coat: Interior latex primer/sealer.
19 b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
20 c. Topcoat: Institutional low-odor/VOC interior latex as scheduled with the following sheen:
21 1) Walls, ceilings and soffits: (eggshell).
22 2) Walls requiring clean-down, as scheduled: (semi gloss).
23 D. Stained Wood Substrates:
24 1. Moisture-Cured Clear Polyurethane Over Stain System: MPI INT 6.3Y.
25 a. Stain Coat: Interior wood stain (semitransparent).
26 b. Two Finish Coats: Moisture-cured clear polyurethane (flat).
27 E. Miscellaneous Finishes
28 1. Finish mechanical piping and electrical conduits, boxes; sprinkler piping and brackets; ductwork and
29 accessories scheduled to receive wall and ceiling finishes with 2 spray coats Interior Latex Satin Dryfall I-
30 1450(waterborne Acrylic Dryfall B42 Series) over appropriate primer.
31
32

END OF SECTION

**SECTION 10 22 00
PARTITION SYSTEMS**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. General
 - 1. Furnish and install self-support truss system for use with operable partitions.

1.2 RELATED WORK BY OTHERS

- A. Preparation of opening will be by General Contractor. Any deviation of site conditions contrary to approved shop drawings must be called to the attention of the architect
- B. All header, blocking, lateral bracing, surrounding insulation, and sound baffles as required in 1.04 Quality Assurance.
- C. Paint or otherwise finishing all trim and other materials adjoining the Unispan.

1.3 SUBMITTALS

- A. Complete shop drawings are to be provided prior to fabrication indicating construction and installation details. Shop drawings must be submitted within 60 days after receipt of signed contract.
- B. Submit material samples.

1.4 QUALITY ASSURANCE

- A. Preparation of the opening shall conform to the criteria set forth per ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.
- B. The Unispan system shall be validated by calculations performed by a licensed Professional Engineer.

PART 2 - PRODUCTS

1.5 ACCEPTABLE MANUFACTURERS

- A. Upon compliance with all of the criteria specified in this section, Manufacturers wishing to bid products equal to the product specified must submit to the architect 10 days prior to bidding complete data in support of compliance and a list of three past installations of products similar to those listed. The submitting manufacturer guarantees the proposed substituted product complies with the performance items specified and as detailed on the drawings.

1.6 MATERIALS

- A. Product to be Hufcor Series U900 Unispan as manufactured by Hufcor Inc.
 - 1. The supporting truss shall be factory fabricated of steel and aluminum. Unispan is attached to the building structure for lateral support only. The load of the truss and partition is supported by the Unispan column posts. Bolt together truss has anodized aluminum top and bottom cords with integral anodized aluminum track and steel web-members.
 - 2. Posts. End columns shall be 2-1/2" x 5" [63.5 x 127] clear anodized aluminum posts. Posts shall be attached to the truss with steel brackets and bolts. Posts shall be anchored to the floor with concealed fasteners. Posts shall be located approximately 1-1/2" [38] from adjacent wall surfaces. The space between the post and the adjacent wall shall be fitted with a vinyl gasket to inhibit sound.
 - 3. Ceiling anchors provide lateral support and shall be set at intervals across the span of the beam. Blocking for ceiling anchors to be provided by others in accordance with the plans.
- B. Weight of the system
 - 1. The horizontal truss shall weigh 10-12 lbs. per lineal foot of width.
 - 2. The support columns shall weigh 3.5 lbs. per foot of height each.
 - 3. The floor shall support a maximum of 360 psi at each post.
- C. Finishes
 - 1. Exposed trim and track shall be of clear anodized architectural grade extruded aluminum alloy 6063-T6.
 - 2. Posts shall be of clear anodized architectural grade extruded aluminum alloy 6063-T6.
- D. Available Accessories/Options
 - 1. Medium Density Fiberboard Header Side Panels (to cover sides of truss if it is below the ceiling).
 - a. Vinyl covered. Color to be selected from partition manufacturer's standard line.
 - b. Carpet covered. Color to be selected from partition manufacturer's standard line.
 - c. Fabric covered. Color to be selected from partition manufacturer's standard line.
 - d. Mineral wool insulation for sound retardation.

- e. The truss may be shipped in sections and assembled on site for use in areas with limited access.

1.7 OPERATION

- A. Operable partitions installed in the Unispan system shall be manually operated.
- B. Unispan may be disassembled and relocated to an alternate location as needed.

PART 3 - EXECUTION

1.8 INSTALLATION, GENERAL

- A. Installation. The complete installation of the Unispan self-support system shall be by an authorized factory-trained installer and be in strict accordance with the approved shop drawings and manufacturer's standard printed specifications, instructions, and recommendations.
- B. Cleaning
 - 1. All surfaces shall be wiped clean and free of handprints, grease, and soil.
 - 2. Cartoning and other installation debris shall be removed from the job site.

END OF SECTION

**SECTION 10 26 13
CORNER GUARDS**

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
1. Corner guards systems for wall protection.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
B. Samples: Submit 8" long, in full size profiles of each type and color indicated in the finish schedule.
C. Installation Instructions: Printed installation instructions for each corner guard.

1.4 QUALITY ASSURANCE

- A. Provide corner guard systems that conform to the following requirements of regulatory agencies and the quality control of IPC Door and Wall Protection Systems, InPro Corporation.
- B. Fire Performance Characteristics:
1. Provide UL Classified corner guards conforming with NFPA Class A fire rating. Surface burning characteristics, as determined by UL-723 (ASTM E-84), shall be flame spread of 10 and smoke development of 350 - 450.
2. Surface burning characteristics, as determined by CAN/ULC-S102.2, shall be flame spread of 15 and smoke developed of 35.
- C. Self Extinguishing:
1. Provide corner guards with a CC1 classification, as tested in accordance with the procedures specified in ASTM D-635-74, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position, as referenced in UBC 52-4-1988. Impact Strength: Provide rigid vinyl profile materials that have an Impact Strength of 30.2 ft-lbs/inch of thickness as tested in accordance with the procedures specified in ASTM D-256-90b, Impact Resistance of Plastics.
- D. Chemical and Stain Resistance:
1. Provide corner guards that show resistance to stain when tested in accordance with applicable provisions of ASTM D-543.
- E. GREENGUARD Certified:
1. Provide GREENGUARD Certified material. Profiles shall meet the requirements of GREENGUARD Certification Standards for Low-Emitting Products and GREENGUARD Product Emission Standard for Children & Schools.
- F. Fungal and Bacterial Resistance:
1. Provide rigid vinyl that does not support fungal or bacterial growth as tested in accordance with ASTM G-21 and ASTM G-22.
- G. Color Consistency:
1. Provide components matched in accordance with SAE J-1545 - (Delta E) with a color difference no greater than 1.0 units using CIE Lab, CIE CMC, CIE LCh, Hunter Lab or similar color space scale systems.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in unopened factory packaging to the jobsite. Inspect materials at delivery to assure that specified products have been received. Store in original packaging in a climate controlled location away from direct sunlight.

1.6 PROJECT CONDITIONS

- A. Environmental Requirements: Products must be installed in an interior climate controlled environment.
B. WARRANTY Standard IPC Limited Lifetime Warranty against material and manufacturing defects.

PART 2 - PRODUCTS

1.7 CORNER GUARDS

- 1 A. Base of Design:
- 2 1. IPC Door and Wall Protection Systems, InPro Corporation, Vinyl Corner guard.
- 3 B. Standard:
- 4 1. Provide all corner guards and wall protection from a single source.
- 5 C. Corner Guard Profile: Tape-on Corner Guards 3" x 3" 90 degree
- 6 D. Lengths: 4'.
- 7 E. Color: Taupe.
- 8 F. Finish: 060
- 9

10 **1.8 COMPONENTS**

- 11 A. Attachment Tape: Factory applied double faced foam tape.
- 12 B. Adhesive: Field applied heavy duty adhesive.
- 13

14 **PART 3 - EXECUTION**

15 **1.9 EXAMINATION**

- 16 A. Examine areas and conditions in which the corner guard systems will be installed.
- 17 B. Complete all finishing operations, including painting, before beginning installation of corner guard system
- 18 materials.
- 19

20 **1.10 PREPARATION**

- 21 A. Wall surface shall be dry and free from dirt, grease and loose paint.
- 22

23 **1.11 INSTALLATION**

- 24 A. Locate the corner guard as indicated on the approved detail drawing for the appropriate substrate and in
- 25 compliance with the IPC installation instructions. Install corner guard level and plumb at the height indicated on
- 26 the drawings.
- 27 B. Installation of Tape-on Corner Guards:
- 28 1. Surface must be clean, dry and properly sealed.
- 29 2. Installation with factory applied foam tape - Remove release paper from the foam tape.
- 30 3. Installation with Heavy Duty Adhesive - Cut the smallest opening possible in the spout. Apply a
- 31 continuous bead of adhesive on each wing of the corner guard.
- 32 4. Position the corner guard on the substrate corner.
- 33 5. Starting at the bottom, press into place, working upward until entire corner guard is in place.
- 34 6. Roll surface with IPC Extension Roller.
- 35

36 **1.12 CLEANING AND PROTECTION**

- 37 A. At completion of the installation, clean surfaces in accordance with the IPC clean-up and maintenance
- 38 instructions
- 39

END OF SECTION

SECTION 21 00 00 - FIRE PROTECTION SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

- A. The work indicated on this project involves modification of an existing automatic fire sprinkler system. The contractor shall coordinate all work, including system drainage, with building facility personnel.
- B. Fire Protection Contractor shall furnish all required calculations, design, drawings, material, equipment, labor and related items required to complete the work indicated on drawings and specifications.
 - 1. Fire Protection Contractor shall secure necessary approvals for work with Madison Fire Department and other local authorities prior to starting work.
- C. The work under this Section includes, but is not limited to the following:
 - 1. Provide all components for modification of the existing NFPA 13 wet automatic sprinkler system. Include, as required, shutoff valves, drain valve, test valve(s), piping, and all necessary components to leave a complete, operational, and approved system.
 - 2. Draining of existing fire protection system serving affected area(Section B) to accomplish work required.
 - 3. The modified existing wet automatic sprinkler system to provide complete, NFPA 13 compliant and approved automatic sprinkler system(s) to give fire suppression coverage to all remodeled areas and rooms.
 - 4. Coordination of work with all other trades.
- D. The Fire Protection Contractor shall acquire all approvals, as necessary, from Fire Department, and Local and State Agencies, along with payment of any plan approval fees.

1.2 RELATED WORK

- A. Applicable provisions of Division 1 shall govern work under this section.

1.3 REFERENCE STANDARDS

- A. Local and State Codes and Regulations.
 - 1. National Fire Codes (NFC) published by NFPA; latest edition of standards listed: NFPA 13 -Sprinkler Systems
 - 2. Local City of Madison Fire Department requirements.

1.4 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Division 1 of the Project Manual.

1.5 DESIGN STANDARDS

- A. Sprinkler system shall be designed and hydraulically calculated by the Contractor.
- B. Hydraulically calculate the sprinkler system pipe sizing to provide densities as listed on the drawings.

SECTION 21 00 00 - FIRE PROTECTION SYSTEMS

1.7 SUBMITTALS

A SHOP DRAWINGS

Submit shop drawings of all fire sprinkler system components.

B. PLANS

Submit contractor-prepared plans/drawings indicating:

1. Submit electronic PDF prints per NFPA 13 of complete, installation plans, working plans, shop drawings, hydraulic calculations, and manufacturer's data on devices, etc., indicating by model and number to be used, to the Architect/Engineer for review and approval.
2. Contractor shall obtain the necessary insurance underwriters, State and Local Fire Department approvals prior to submitting shop drawings.
3. Submittals shall be sent to the local Fire Chief or Fire Marshal for review prior to the Architect/Engineer along with plan approval fees paid by Fire Protection Contractor. Include copy of approval letter in submission to Architect/Engineer.
4. No work shall commence until all plan approvals have been obtained. Contractor to allow sufficient time for the approvals.
5. Prepare drawings at minimum scale of 1/8" per foot for plans and 1/4" per foot or larger for details. Show all piping, lighting, equipment, ductwork, sprinklers, hangers, roof construction and occupancy of each area, including ceiling and roof heights.
6. Installation shall be coordinated with the latest architectural, structural, mechanical, plumbing and electrical drawings.
7. Contractor shall submit drawings to Engineer which have been reviewed and stamped "approved" by the authority having jurisdiction (Madison Fire Department). No work shall commence until all approvals have been obtained. Allow sufficient time for the approvals.

C. AS-BUILT DRAWINGS

1. Maintain at the site an up-to-date marked set of as-built drawings which shall be corrected and delivered to the Architect upon completion of the work.
2. Furnish the Architect one(1) reproducible print and electronic PDF copy of corrected shop drawings, including plans, revised to show "as built" conditions.

PART 2 - PRODUCTS

2.1 PIPE

- A. Carbon steel pipe, black, thickness per NFPA 13, conforming to ASTM A53, A135, A795.
- B. Fire rated CPVC piping with solvent joints where approved by NFPA 13.
- C. Flexible stainless steel piping at sprinkler head terminations, UL listed and conforming to NFPA 13.

2.2 FITTINGS

- A. Malleable iron, Class 150, threaded, ANSI B16.3.
- B. Malleable or ductile iron, grooved end, 1000 lb/in² working pressure rating, UL listed or FM approved for automatic sprinkler.

SECTION 21 00 00 - FIRE PROTECTION SYSTEMS

- C. Ductile or malleable iron, plain end with EPDM gasket, carbon steel bolts or locking lugs UL listed or FM approved for automatic sprinkler, Grinnell "Sock-it" or Victaulic "FIT"
- D. Carbon steel, butt-welded, class 150, ASTM A234.
- E. Carbon steel, Class 150, flanged, ASTM A105.
- F. Fire rated CPVC, where applicable and approved by NFPA.

2.3 JOINTS

- A. Tapered pipe threads, with Teflon tape, ANSI B2.1.
- B. Mechanical coupling, EPDM gasket, UL listed or FM approved for automatic sprinkler.
- C. Solvent welded CPVC joints, where applicable and approved by NFPA.

2.4 SPRINKLERS

A. GENERAL

- 1. Manufacturer: Products of the following manufacturers determined to be equal by the Architect/Engineer will be accepted: Central Sprinkler Corporation, Tyco, Reliable, Star Sprinkler, Victaulic and Viking.
- 2. Fusible link or glass bulb type, cast brass or bronze construction. Provide heads with nominal 1/2" discharge orifice except where greater than normal density requires large orifice.
- 3. Select fusible link or glass bulb temperature rating to not exceed maximum ambient temperature rating allowed under normal conditions at installed location. Provide ordinary temperature (165 degree) glass bulb type.
- 4. White finished brass cover plate on concealed heads rated for 200 degree and 165 degree with cap.

B. FINISHED AREAS

- 1. Provide semi-recessed sprinkler heads in all office areas as shown, centered in lay-in ceiling tiles.
- 2. White color finish.

C. UNFINISHED AREAS

- 1. Provide upright sprinkler heads in all areas without suspended ceiling systems.

D. RATINGS

- 1. Provide standard response, light hazard 165 degree rated heads in finished areas as indicated.
- 2. Ordinary hazard 165 degree rated heads in mechanical areas.
- 3. Use higher temperature-rated sprinkler heads in areas near heat sources, elevator equipment rooms, and elevator shafts.

E. VALVES

SECTION 21 00 00 - FIRE PROTECTION SYSTEMS

1. Manufacturers: Kennedy, Milwaukee, Nibco, Stockham, Victaulic, Viking, and Watts.

F. BALL VALVES:

1. 2" and smaller: Bronze, 2-piece, threaded or sweat ends, standard port, blowout proof stem, chrome plated ball, glass reinforced seats, UL approved @ 250 psi. Watts No. B-6000 UL.

G. GATE VALVES:

1. 2" and smaller: Outside screw and yoke gate valves, 175 psig, bronze body, bronze mounted, screwed bonnet, rising stem, solid wedge, with normally open tamper switch with double wire leads.
2. 2-1/2" and larger: Outside screw and yoke gate valves, 175 psig, cast iron body, bronze mounted, bolted bonnet, rising stem, solid wedge, with normally open tamper switch with double wire leads.

H. BUTTERFLY VALVES:

1. 2" and smaller: Bronze body butterfly valve, 175 psig, geared operator, visible position indicator, normally open tamper switch with double wire leads, Buna or Viton seat, stainless steel disc and stem.

I. DRAIN VALVES:

1. 3/4" min. two or three piece bronze body ball valve; threaded ends, chrome plated bronze ball; glass filled teflon seat; teflon packing and threaded packing nut; blowout-proof stem; 400 psig WOG, with hose thread outlet and cap.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install new portions of sprinkler system in accordance with requirements of NFPA 13 and local regulations of the local fire marshal.
- B. Modified system shall meet local regulations of the local fire marshal and NFPA 13 requirements.

3.2 TESTING

- A. Hydro-statically pressure test the fire sprinkler system piping as required in NFPA 13. Keep records of all testing for submission in Operation and Maintenance Manuals.

END OF SECTION

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SECTION 22 05 00
PLUMBING GENERAL PROVISIONS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Plumbing work includes:

1. Furnish all labor and materials necessary for the complete installation of plumbing system as shown on the drawings and/or specified herein.
2. Drawings: Refer to S-Series drawings for graphic representations, schedules and notations showing Plumbing/Solar work.
3. Specifications: Applicable portions of Division 1 govern all work under this Section. Refer to Division 22 Sections for primary technical specifications of Plumbing work, as listed below:

22 05 00	Plumbing General Provisions
22 05 90	Test, Adjust and Balancing
22 06 00	Pipe and Pipe Fittings
22 06 10	Natural Gas Piping
22 06 30	Piping Specialties
22 09 10	Supports and Anchors
22 10 00	Valves
22 14 00	Pumps
22 25 00	Mechanical Insulation
22 45 10	Mechanical Equipment
22 63 00	Water Treatment
22 70 00	Solar Water Heating Systems
4. Control wiring (less than 100 volts) for Plumbing equipment.
5. Equipment structural supports, prime painted. Anchor bolts, metal shapes and templates required to be cast into concrete or to support mechanical equipment.
6. Motors for all Plumbing equipment.
7. Final fuel, waste and water piping connections to Plumbing equipment.
8. Secure and pay all fees necessary for execution and completion of work.
9. Test, adjust and balance Plumbing systems.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.

B. Related Work by Plumbing Contractor:

1. Field painting of all exposed piping, hangers, supports and related metal work throughout.
2. Building cutting and patching for all opening, recesses and chases intended as equipment space for piping in existing construction.
3. Lintels and openings for piping through walls, floors and ceilings.
4. All new plumbing openings through existing walls and roofs shall require confirming acceptability by the General Contractor and Structural Engineer.

C. Work by Others:

1. Final roof flashings, patching and sealing at roof penetrations shall be provided by a certified Roofing Contractor to maintain existing roofing warranty and paid by the Plumbing Contractor. Refer to Division 7 requirements for further details.

2. Line voltage (greater than 100 volts) wiring, conduit and connections by the Electrical Contractor.
3. All equipment starters not furnished as integral part of plumbing equipment shall be provided by the Electrical Contractor.
4. All low-voltage temperature control work shall be provided by the HVAC Temperature Control Contractor at no cost to the Plumbing Contractor.

1.3 QUALITY ASSURANCE

- A. Qualifications of Installers: For the actual fabrication, installation and testing of work under this Section, use only thoroughly trained and experienced workmen completely familiar with the items required and the manufacturer's current recommended methods of installation.
- B. In acceptance or rejection of installed work, the Architect/Engineer will make no allowance for lack of skill on the part of the workmen.
- C. Reference Standards: Specifically, for Plumbing work in addition to standards specified in individual work section, the following standards are imposed, as applicable to work in each instance:
 1. American National Standards Institute - ANSI.
 2. American Society for Testing and Materials - ASTM.
 3. American Water Works Association- AWWA.
 4. Manufacturers Standardization Society of the Valve and Fittings Industry - MSS.
 5. National Electrical Manufacturers Association - NEMA.
 6. National Electrical Code - NEC.
 7. National Fire Protection Association - NFPA.
 8. National Sanitation Foundation - NSF
 9. Cast Iron Soil Pipe Institute – CISPI
 10. Underwriters' Laboratories - UL.
 11. International Building Code - IBC
 12. International Mechanical Code - IMC
 13. International Fuel Gas Code - IFC
 14. Wisconsin Plumbing Code - SPS 382-386
 15. Local and State Building Codes; Plumbing, Mechanical, etc.
 16. American Society of Heating, Refrigerating and Air Conditioning Engineers - ASHRAE.

1.4 LAWS, PERMITS AND REGULATIONS

- A. Obtain and pay for all licenses and permits, pay all fees and/or charges for meters and associated devices, pay all charges for connection to outside services. Comply with all laws, ordinances, regulations and code requirements applicable to this work. It is assumed that the Contractor is familiar with all laws; codes and ordinances governing his work and that all work done by him will be approved by authorities having jurisdiction over his work.
 1. City of Madison Plumbing Code amendments.
- B. All work shall be performed in compliance with all applicable Laws, Codes and Regulation of the governmental Bodies having jurisdiction over the site.

1.5 MEASUREMENTS

1 A. All measurements must be verified from actual observations at the project site. The
2 Contractor is responsible for all his work fitting into place in approved, satisfactory, and
3 workmanlike manner in every particular.
4

5 **1.6 SPECIFICATION TERMINOLOGY**

6

7 A. "Provide", as used in these Specifications, means furnish all material labor, sub-contracts, and
8 appurtenances required, including mark-up and install to a complete, operating, finished
9 condition.
10

11 B. "Furnish" means to purchase material as shown and specified, including moving the material
12 to an approved location at the site or elsewhere as noted or agreed, to be installed by
13 supporting trades.
14

15 C. "Install" means to set in place and connect; ready for use and in complete, operating, finished
16 condition, material that has been furnished.
17

18 D. "Rough-in and Connect Only" means provide an appropriate system connection such as
19 supplied with stops, continuous wastes with traps, shut-off valves required and all piping
20 connections, testing, etc., for proper operation, and to install equipment furnished. Equipment
21 furnished is received, assembled and set in place by supporting trades unless they make prior
22 arrangements to hire the Plumbing installer for this work.
23

24 E. "Accessible" means arranged so that a service person may approach the areas in question with
25 the tools and products necessary for the service work intended, and may then position himself
26 to properly perform the task to be accomplished without disassembly or damage to the
27 surrounding installation.
28

29 F. "Serviceable" means arranged so that the component or product in question may be properly
30 removed, and replaced without disassembly, destruction or damage to surrounding
31 installation or piece being serviced.
32

33 G. "Product" is a generic term, which includes materials, equipment, fixtures and any physical
34 items used on the product.
35

36 H. "A/E" means Architect/Engineer.
37

38 **1.7 DIAGRAMMATIC DRAWINGS**

39

40 A. Drawings and specifications are complementary, each to the other; what is shown on one is as
41 binding as if called for both. The Drawings are partly diagrammatic and do not show all
42 offsets in piping or exact location of piping ducts, etc.
43

- 44 1. The drawings do not necessarily show in minute detail all features of the installation;
45 however, provide a complete and satisfactorily working installation.
- 46 2. Provide all work shown on the drawings and specified, unless otherwise stated.
- 47 3. For additional details, the Contractor is referred to the Architectural, HVAC,
48 Electrical and other trade Drawings.
- 49 4. If errors, omissions, or conflicts between the drawings and/or specifications occur,
50 the Contractor shall obtain clarification from the Architect/Engineer prior to bidding.
51

52 **1.8 REVIEW OF MATERIALS AND EQUIPMENT SUBMITTALS**

53

- 1 A. Submittals: Provide submittals for all products and systems described in Division 22 and
2 shown on the Drawings to demonstrate compliance with the requirements of the projects.
3
- 4 1. Furnish equipment submittals in the manner described elsewhere in these
5 Specifications
6
- 7 B. Substitutions: If the Architect/Engineer and Owner approve a substitution, the approval is
8 given with the understanding that the Contractor guarantees the article or material substituted
9 to be equal to or better in every respect than the article or material specified. The Contractor
10 shall also assume complete responsibility that the article or material will fit the job as far as
11 space, access and service requirements.
12
- 13 C. Data Required for Review: Mark submittal literature and show drawings clearly. Bind 8 1/2"
14 x 11" literature in loose-leaf binders by individual set and include all equipment and material
15 shown on Drawings and specified. Indicate the following:
16
- 17 1. Specification reference and/or drawings reference for which literature is submitted
18 for review with an index following specifications format, and item-by-item
19 identification.
20 2. Manufacturer's name and address, and supplier's name, address and phone number.
21 3. Catalog designation or model number.
22 4. Rough-in data and dimensions.
23 5. Performance curves and rated capacities.
24 6. Motor characteristics and wiring diagrams.
25 7. Operation characteristics.
26 8. Complete customized listing of characteristics, equipment, accessories, etc.,
27 specified. Indicate whether item is "As Specified" or "Proposed Substitution".
28 Indicate any deviation on submittal. Mark out all non-applicable items. The
29 terminology "As Specified" used without this customized listing is not acceptable.
30 9. Wiring diagrams for the specific system operation.
31 10. Working construction drawings (Shop Drawings).
32 11. Contractor shall submit for approval, six(6) copies of Shop Drawings, Literature and
33 Equipment List, including control wiring diagrams.
34 12. Submit prior to fabrication or delivery.
35
- 36 D. Partial Submittals: If other than a complete submittal is made, the Contractor may make
37 partial submittals separated into complete specification section classifications. Unclear
38 submittals, and submittals not organized by specification section will be returned without
39 review.
40
- 41 E. Submittal review is for general design and arrangements only and does not relieve the
42 Contractor from any of the requirements of the Contract Documents. Submittals will not be
43 checked for quantity, dimensions, fit or proper technical design or manufacture equipment.
44 Where deviations of substitute product or systems performance have not been specifically
45 noted in the submittals by the Contractor, provision of a complete and satisfactory working
46 installation is the sole responsibility of the Contractor.
47

48 **1.9 SHOP DRAWINGS**

- 49
- 50 A. Prepare and submit working construction drawings as requested, specified, or otherwise
51 necessary to demonstrate proper planning for installation and arrangement or work.
52
- 53 1. Layout drawings to scale and show dimensions where accuracy of location is
54 necessary for coordination of communication purposes.

- 1 2. Show work of all trades, including Architectural, Structural, HVAC and Electrical
- 2 items, which may be pertinent to proper and accurate coordination.
- 3 3. Provide shop drawings for all products, systems, system components, and special
- 4 supports, which are not, a standard catalog product, which may be fabricated for the
- 5 Contractor or by the Contractor.
- 6

7 **1.10 PROJECT RECORD DRAWINGS**

- 8
- 9 A. Reference requirements stated in Division 1 Requirements.
- 10
- 11 B. In addition to other requirements, mark-up a clean set of drawings as the work progresses, to
- 12 show the dimensioned location and routing of all Mechanical work, which will become
- 13 permanently concealed.
- 14
- 15 1. Show routing and location of items cast iron concrete or buried underground.
- 16 2. Show routing of work in permanently concealed blind spaces within the building.
- 17 3. Work located in spaces with access, or above suspended ceilings, is not considered
- 18 permanently concealed.
- 19 4. Show complete routing and sizing of any significant revisions to the systems shown.
- 20
- 21 C. Show the location of all valves and their appropriate tag identification.
- 22
- 23 D. At completion of project, deliver record drawings to the Architect/Engineer and obtain
- 24 written receipt.
- 25
- 26 C. Piping: Identify piping once every 30 feet at each branch, at termination of lines, minimum
- 27 one per room, and near valve or equipment connections. Place flow directional arrows at
- 28 each pipe or duct identification. Provide 2" high letters on wrap-around siphonage, adhesive-
- 29 backed labels.
- 30
- 31 D. Valve Tags: Tag all valves with 1-1/2" dia. brass valve tags engraved with readily legible
- 32 black lettering 1/4" high indicating fluid in pipe and 1/2" numbers. Securely fasten to the
- 33 valve stem or bonnet with beaded chain.
- 34
- 35 1. Provide a framed, typewritten directory under glass, and install where directed.
- 36

37 **1.11 PLUMBING SYSTEM IDENTIFICATION**

- 38
- 39 A. General: Provide adequate marking of HVAC system and control equipment to allow
- 40 identification and coordination of maintenance activities and maintenance manuals. Tag and
- 41 label HVAC equipment located in exposed or in accessible areas to conform to ANSI A13.
- 42 After painting and/or covering is complete, identify all equipment, piping and ductwork by its
- 43 abbreviated generic name as shown/scheduled/specified.
- 44
- 45 B. Equipment: Identify all major HVAC equipment with plastic-laminate signs or 2" minimum
- 46 high painted stencils and contrasting background. Provide text of sufficient clarity and
- 47 lettering to convey adequate information at each location and mount permanently. Identify
- 48 control equipment by 1-1/2" x 4" plastic nameplates with 1/2" high lettering.
- 49
- 50 C. Piping and Ductwork: Identify piping and ductwork once every 30 feet at each branch, at
- 51 termination of lines, and near valve or equipment connections. Place flow directional arrows
- 52 at each pipe or duct identification. Provide 2" minimum high letters on wrap-around
- 53 siphonage, adhesive-backed or paint stenciled.
- 54

- 1 D. Valves: Identify all valves with 1-1/2" minimum polished brass stamp-engraved or plastic
2 laminate tags. Prefix or color-code tags for each generic piping service. Prepare and submit
3 valve tag schedule, listing location, service and tag description, incorporate in Instruction
4 Manual. Mount valve tag schedule behind glass in mechanical room at location determined
5 by Owner.
6
- 7 E. Operational Tags: Where needed for proper or adequate information on operation and
8 maintenance of HVAC systems, provide tags of plasticized or laminated card stock,
9 typewritten to convey the message.

10
11 **1.12 ELECTRICAL WORK**
12

13 A. Related Work Specified Elsewhere:
14

- 15 1. Electrical Specifications: Division 26.
16
- 17 B. Unless otherwise indicated on the Electrical Drawings or the Electrical Specifications,
18 provide all Plumbing equipment motors, motor starters, disconnect switches, thermal
19 overload switches, control relays, time clocks, thermostats, motor valves, float controls
20 damper motors, electrical-pneumatic and pneumatic electrical switches, electrical components
21 wiring and other miscellaneous Division 23 controls.
22
- 23 1. All motors, electrical equipment, low voltage controls, line voltage controls for all
24 Plumbing equipment shall be provided complete by the Plumbing Contractor.
25 2. The Electrical Section will provide wiring from current source to all starters and from
26 starter to motors, except in the case of factory installed wiring in packaged
27 equipment. The Electrical Section will wire to the line side of pre-wired equipment,
28 to the control panel, and to fuel burning and control equipment. Electrical Section
29 will provide all motor interlock wiring unless otherwise stipulated.
30

31 C. Motors:
32

- 33 1. Motors up to and including 1/2 HP shall be 120 volt for 60-cycle operation. Motors
34 larger than 1/2 HP shall be 3-phase for 60-cycle operation (Unless otherwise
35 indicated).
36 2. Motors shall have sealed ball bearings. Motors shall be designed for continuous
37 duty, direct or belt drive and be designed for quiet operation.
38 3. Motors on or in equipment on roof or exposed to weather shall be totally enclosed.
39

40 D. Starters and Protection:
41

- 42 1. Each motor shall be equipped with overload and under-voltage protections.
43 2. Provide 3-phase protection.
44 3. 120-volt motors shall have thermal protection consisting of manual starter switch,
45 one pole toggle operated with pilot light with thermal overload element.
46 4. 3-phase motors shall have across-the-line starter with thermal overload and under
47 voltage protection of each phase.
48

49 E. Carefully coordinate all work with the electrical work shown and specified elsewhere in these
50 documents.
51

52 F. Motors: Furnish electric motors designed for the specific application and duty applied, and to
53 deliver rated horsepower without exceeding temperature ratings when operated on power

- 1 systems with a combined variation in voltage and frequency not more than plus or minus 10
2 percent.
3
4 G. Verify from the drawings and specifications the available electrical supply characteristics and
5 furnish equipment that will perform satisfactorily under the conditions shown and specified.
6
7 H. Size motors for 1.15 service, factor, and not to exceed 40 degrees C. temperature rise above
8 ambient.
9
10 I. Provide self-resetting thermal overload switch for fractional horsepower motors.
11
12 J. All motors to be high-efficiency or premium-efficiency motors, as scheduled or noted
13 elsewhere, complying with NEMA test standards MEL-12.53a, (IEEE test procedure 112,
14 method B) using accuracy improvement by segregated loss determination including stray load
15 measurements. Motors shall meet Federal EPACT qualifying standards.
16

17 **1.13 TESTS AND INSPECTIONS**

- 18
19 A. Schedule, obtain, and pay for all fees and/or services required by local authorities and by
20 these specifications, to test the Plumbing systems as specified in these specification.
21
22 B. Request for Tests: Notify the Engineer a minimum of 24 hours in advance of tests. In the
23 event the inspecting authority does not witness the test, certify in writing that all specified
24 tests have been made in accordance with the specifications.
25
26 C. Deficiencies: Immediately correct all deficiencies, which are evidenced during the tests and
27 repeat tests until system is approved. Do not cover or conceal piping, equipment or other
28 portions of the mechanical installation until satisfactory tests are made and approved.
29
30 D. Operating Tests: Upon request from the inspecting authority, place the entire Plumbing
31 installation and/or any portion thereof, in operation to demonstrate satisfactory operation.
32
33 E. Completion: Upon completion of the Plumbing installation, demonstrate to the
34 Architect/Engineer satisfaction that the systems have been installed in a satisfactory manner
35 in accordance with the plans, specifications, and applicable Codes.
36
37 1. Demonstrate dynamic operation of all systems.
38 2. Show that all controls are operable and are properly adjusted in accordance with the
39 requirements of the final systems balance, that all equipment operates properly,
40 strainers are clean, and that all components of all systems are installed and adjusted
41 for proper operation.
42

43 **1.14 OPERATING INSTRUCTIONS**

- 44
45 A. Prior to final acceptance, instruct an authorized representative of the Owner for 8 hours on
46 the proper operation and maintenance of all Plumbing systems, equipment, and controls
47 under this contract. Make available a qualified technician for each component of the
48 installation for the instruction. Give these operating instructions after the operation and
49 maintenance manuals have been furnished to the Owner. Submit written certifications,
50 signed by the Contractor and an authorized representative of the Owner, that this has been
51 completed.
52
53 1. Operating Sequence and Procedures:

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- a. General: Describe the procedures necessary for personnel; to operate the system and equipment covered in that chapter.
- b. Typewritten Operation Procedures: Write procedures for start-up operation, emergency operation and shutdown.
 - 1) Start-up: Give complete step-by-step instructions for energizing equipment making initial setting and adjustments whenever applicable.
 - 2) Shut-down Procedures: Include instructions for stopping and securing the equipment after operation. If a particular sequence is required, give step-by-step instructions.
- 2. Maintenance Instructions:
 - a. Provide a schedule of preventive maintenance of each product. Recommend frequency of performance for each preventive maintenance task; i.e., cleaning, inspection, etc.
 - b. Provide instructions and schedules for all routing cleaning, lubrication and inspection with recommended lubricants for all equipment and systems. Schedule times of the year that inspection and maintenance should be performed.
 - c. Provide instructions for minor repairs or adjustments required for preventive maintenance routines, limited to repairs and adjustments which may be performed without special tools or test equipment and which require no extensive special training or skills.
 - d. Special Maintenance: Provide all information of a maintenance nature covering warranty items, etc., which have not been discussed elsewhere.
- 3. Manufacturer's Brochures: Include manufacturer's descriptive literature covering all appurtenances used in each system, together with illustrations, exploded views and renewal parts lists.
- 4. Shop Drawings: Provide a copy of all corrected, approved shop drawings covering equipment for the project either with the manufacturer's brochures or properly identified in a separate subsection.
- 5. Equipment Parts Lists: Include a complete list of all equipment furnished for project, with a tabulation of descriptive data of all the equipment replacement parts proposed for each type of equipment or system. Properly identify each part of part number and manufacturer.
- 6. Other Items:
 - a. Name Plate Directory: Provide list of all major equipment name plates giving manufacturer's name plate data, name plate designation, location of equipment, area served, switch location, normal position of switch, and equipment label designation specified. Submit directory for review and obtain approval prior to substantial completion of project.
 - b. Label all pages to assure correct placement in manual.
 - c. Mark out all non-applicable items or "Highlight" all applicable items.

1.15 WARRANTY

- A. Warrant materials and workmanship in accord with the General and Supplementary Conditions.
- B. Provide written guarantees, which exceed one (1) year.
- C. Warrant period to extend from date of Substantial Completion. Refer to General Conditions and Supplementary Conditions.

1.16 COORDINATION OF WORK

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- A. Keep informed about the work of all other trades engaged in the project and execute the work in such a manner as not to delay or interfere with the progress of other contractors. This Contractor shall schedule his work so that no other contractor is delayed in the execution of his work. Complete cooperation of all trades is expected. Employ a competent foreman on job throughout the entire project to ensure that coordination is maintained.
- B. Schedule and coordinate the work of this Division with the schedule of the General Contractor to progress the work expeditiously, and to avoid any unnecessary delays.
- C. Examine fully the Drawings and Specifications for other Contractors for other trades, and coordinate the installation of this work with the work of the other Contractors. The Division 22 Contractor shall participate in the coordination drawing process as specified in Division 1 where coordination drawings are required. The Division 22 Contractor shall prepare the coordination drawings.
- D. Any proposed changes from the systems layout, on the drawings, shall be done in accordance with the design criteria specified in the applicable codes and shall be subject to the review and acceptance of the Engineer.
- E. Utility installation in congested areas is dependent on the sequence of utility installation as much as it is dependent on the physical size of the utilities. The Contractor shall use the coordination process and the coordination drawings process to properly sequence the installation of utilities as appropriate to ensure the above ceiling and congested area utility installation at satisfactory. All Contractors and subcontractors shall participate in the coordination process and the coordination drawings process.

1.17 REMODELING REQUIREMENTS

- A. Prebid Survey: Plumbing Contractor shall survey the job site before submitting his bid to determine the extent of areas requiring demolition, relocating and remodeling. The extent of equipment and materials to be removed. Routings for existing and new piping services and systems. Examine accessibility, material storage and working space available.
- B. Maintenance of Service: The building will be continuously occupied during the construction period except as noted. Special efforts shall be made to avoid interference with building functions. Consult with the Owner prior to performing work in public areas of building or to turn off services, so that Owner can advise as to most suitable time for the necessary interruptions. All such work and interruptions to services shall be performed at times which are approved by the Owner.
- C. Demolition: Carefully examine the present building site, together with all of the drawings and specifications. Within areas involving remodeling, each Contractor shall be responsible for removal of, relocation of, or revisions to existing equipment, wiring, piping, fixtures and all other existing facilities under appropriate headings of his work, which is necessary to accomplish the final arrangement indicated on the Architect's plans. To assist the Contractor in meeting the above requirement, the drawings note certain of these items, but the absence of such notes shall not limit the responsibility of each Contractor to perform all work as described in this paragraph.
- D. Disposition of Demolition Materials and Equipment: Materials demolished or removed shall become the property of the Contractor and shall be removed from the site, except items, which are to be reused or are specifically noted as remaining the property of the Owner.

- 1 E. Cutting or Patching Existing Facility:
 - 2
 - 3 1. Contractor will be required to do all remodeling, cutting and/or construction removal
 - 4 and all patching or construction replacement as required for his work except for
 - 5 specific cutting and patching described in the documents as being performed by a
 - 6 specific Contractor.
 - 7 2. Contractor shall not endanger any work by any demolition, cutting, digging or
 - 8 otherwise. Any cost caused by defective or ill-timed work shall be borne by the
 - 9 contractor responsible.
 - 10 3. Contractor requiring cutting and patching shall hire men skilled in such cutting and
 - 11 patching to do the work.
 - 12 4. All new work in existing areas shall match existing work in material, quality, texture,
 - 13 finish and color unless specifically noted or scheduled otherwise.
 - 14

15 **1.18 DEMOLITION**

- 17 A. The Contractor is responsible for removal and relocation of all existing plumbing equipment
- 18 and related items affected by the remodeling area.
- 19
- 20 B. To assist the Contractor in meeting the above design intent, the drawings note certain of these
- 21 items, but the absence of such notes shall not limit responsibility of the Contractor to perform
- 22 all demolition work as required to accomplish new design plan.
- 23
- 24 C. Contractor shall coordinate his remodeling efforts with the building functions and avoid
- 25 interference wherever possible. All such interruptions of existing services shall be performed
- 26 at times which are pre-approved by the Owner.
- 27

28 **PART 2 - PRODUCTS**

29 --- NOT USED ---

31 **PART 3 - EXECUTIONS**

32 -- NOT USED --

33 **END OF SECTION**

34

35

SECTION 22 05 00
TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. General Requirements: Contractor shall be responsible for providing complete test-adjust-balance (TAB) work of all hydronic systems including distribution systems and the equipment and apparatus connected.
- B. Work Included:
1. The extent of TAB work is indicated by the requirements of this section, and also by drawings and schedules, and is defined to include, but is not necessarily limited to, hydronic and air distribution systems, and associated equipment and apparatus of Plumbing/Solar work.
 2. The work consists of setting speed and volume (flow) adjusting facilities provided for the systems, recording data, conducting tests, preparing and submitting reports, and recommending modifications to the work as required by the Contract Documents.
 3. The component types of testing, adjusting and balancing specified in this section include but are not limited to the following Plumbing/Solar equipment:
 - a. Solar water distribution.
 - b. Non-potable water recirculation.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
1. 22 06 00 Piping Specialties
 2. 22 14 00 Pumps
 3. 23 90 00 Controls and Instrumentation
 4. 23 95 10 Control Sequence

1.3 QUALITY ASSURANCE

- A. Tester: Performed by an Independent Trade who is specifically and actively engaged in the balancing business and regularly does such work. Certified by the NEBB (National Environmental Balancing Bureau), AABC (Associated Air Balance Council) or approved equal in those testing and balanced disciplines similar to those required for this project.
- B. Reference Standards: Comply with AABC's Pub. No. 12173, "National Standards for Field Measurements and Instrumentation, Total System Balance", as applicable to HVAC air and hydronic distribution system and associated equipment and apparatus.
- C. Industry Standards: Comply with ASHRAE recommendations pertaining to measurements, instruments and testing, adjusting and balancing, except as otherwise indicated.
- D. Submittals:

- 1 1. Submit certified test reports and types of instruments used and their most recent calibration
2 data with submission of final test report.
3 2. Final test report shall bear the name of the person who recorded the data and the seal of the
4 supervisor of the balancing trade.
5
6 E. Guarantee: Guarantee that all TAB work be performed in accordance with NEBB or AABC
7 standards and that all air systems operate within plus or minus 10 percent of the design flow rates as
8 shown on the plans and/or as scheduled.
9

10 **1.4 JOB CONDITIONS**

- 11
12 A. Do not proceed with testing, adjusting and balancing work until the work to be TAB'ed has been
13 completed and is operable. Ensure that there is no latent residual work still to be completed.
14
15 1. Do not proceed until the work scheduled for TAB'ing is clean and free from debris, dirt and
16 discarded building materials.
17
18

19 **PART 2 - PRODUCTS**

20 **2.1 MATERIALS**

- 21 A. Patching Materials:
22
23 1. Except as otherwise indicated, use same products as used by original Installer for patching
24 holes in insulation, ductwork and housing which have been cut or drilled for test purposes,
25 including access for test instruments, attaching jigs, and similar purposes.
26 2. At Tester's option, plastic plugs with retainers may be used to patch drilled holes in ductwork
27 and housing.
28
29 B. Test Instruments: Utilize test instruments and equipment for the TAB work required, of the type,
30 precision and capacity as recommended for the following TAB standards: AABC's National
31 Standards for Field Measurements and Instrumentation, Total Balance System.
32
33
34
35

36 **PART 3 - EXECUTION**

37 **3.1 ADJUSTMENT AND TESTING**

- 38 A. Tester must examine the installed work and conditions under which testing is to be done to ensure
39 that work has been completed, cleaned and is operable. Notify the Contractor in writing of conditions
40 detrimental to the proper completion of the test-adjust-balance work. Do not proceed with the TAB
41 work until unsatisfactory conditions have been corrected in a manner acceptable to the Tester.
42
43 B. Test, adjust and balance the environmental systems and components, as indicated, in accordance with
44 the procedures outlined in the applicable standards.
45
46 C. Prepare report of the test results including instrumentation calibration reports in format recommended
47 by the applicable standards.
48
49 D. Patch holes in insulation, ductwork and housings, which have been cut or drilled for test purposes, in
50 a manner recommended by the original Installer.
51
52

- 1 E. Mark equipment settings, including damper control positions, valve indicators, fan speed control
2 levers, and similar controls and devices, to show final settings at completion of TAB work. Provide
3 markings with paint or other suitable permanent identification materials.
4

5 **3.2 HYDRONIC SYSTEMS**

6

- 7 A. Test, adjust and balance system in accordance with following procedures:
8

9 1. Preliminary:

- 10 a. List all mechanical specifications of tested equipment verify against contract
11 documents. Check all system components for proper installation and operations.
12 Clean all screens.
13 b. Open all line valves to full open position. Close coil bypass stop valves, then set
14 mixing control valve to full coil flow.
15 c. For each pump, verify rotation, test and record pump shut-off head and test and
16 record pump wide-open head.
17 d. Verify proper water level in expansion tanks and in the system.
18 e. Verify that air vents in high points of water systems are installed and operating
19 freely.
20 f. Verify that all instruments are accurately calibrated and maintained.

21 2. Central Equipment:

- 22 a. Set and record hot water pumps to proper flow quantity.
23 b. Adjust and record flow through equipment to design quantities.
24 c. Observe and record leaving water temperature and return water temperatures at
25 specific equipment and water distribution loops. Reset to correct design
26 temperatures.
27 d. Record pump operating suction and discharge pressures. Determine final dynamic
28 head.

29 3. Distribution:

- 30 a. Balance and record flow to each water hydronic zone and terminal unit.
31 b. Adjust and record terminal unit flow rates and pressure drops.
32 c. Adjust and record coil flow rates and pressure drops. Verify entering and leaving
33 water temperatures at terminals.
34

35 **3.4 AUTOMATIC CONTROL SYSTEM**

36

- 37 A. Temperature control manufacturer's representative sets and adjusts automatically operated devices to
38 achieve required sequence of operations.
39
40 B. Testing organization verifies all controls for proper calibration and list those controls requiring
41 adjustment by temperature control system installer.
42
43

44 **END OF SECTION**

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**SECTION 22 06 00
PIPE AND PIPE FITTINGS**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of pipe and pipe fitting work is indicated on drawings and by the requirements of this section.
- B. Types of pipe and pipe fittings required for this project include the following:
 - 1. Solar hot water.
 - 2. Potable water.
 - 3. Non-potable water.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 22 05 00 Plumbing General Provisions
 - 2. 22 06 30 Piping Specialties
 - 3. 22 09 10 Supports and Anchors
 - 4. 22 10 00 Valves
 - 5. 22 63 00 Water Treatment

1.3 QUALITY ASSURANCE

- A. American National Standards Institute, ANSI:
 - 1. B31.1: Power Piping.
- B. Welder Qualifications:
 - 1. Prior to starting any metallic welding, Contractor shall submit his Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section IX of the ASME Boiler and Pressure Vessel Code and/or the National Certified Pipe Welding Bureau.
- C. Employ piping materials meeting the latest revision of ASTM specifications as listed in this specification.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Where possible, store pipe and tube inside and protected from weather. When necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.
- B. Prevent dirt and construction debris from accumulating inside the pipe and pipe fittings, cap open ends whenever possible. Store plastic pipe out of direct exposure to sunlight and support to prevent sagging and bending.

1 **1.5 SUBMITTALS**

- 2
- 3 A. Submit schedule of pipe and pipe fittings showing manufacturer and catalog number.
- 4
- 5 B. Submittal may be in the form of a typewritten list, with proper references, indicating service and pipe
- 6 or pipe fitting specifications.
- 7
- 8

9 **PART 2 - PRODUCTS**

10

11 **2.1 SOLAR HOT WATER SYSTEM**

12

13 A. 2" and smaller:

- 14
- 15 1. ASTM B88 seamless, Type L, hard temper copper tube with wrought copper 95-5 solder-
- 16 joint fittings.

17

18 **2.2 POTABLE WATER**

19

20 A. 2" and smaller:

- 21
- 22 1. ASTM B88 seamless, Type L, hard temper copper tube with wrought copper 95-5 solder-
- 23 joint fittings.

24

25 **2.3 NON-POTABLE WATER**

26

27 A. 2" and smaller:

- 28
- 29 1. ASTM B88 seamless, Type L, hard temper copper tube with wrought copper 95-5 solder-
- 30 joint fittings.

31

32 **2.4 DIELECTRIC UNIONS**

- 33
- 34 A. 1" and smaller: ASTM A197/ANSI B16.3 WOG malleable insulating unions with vulcanized fiber
- 35 insulating sleeve and neoprene gasket, equal to Stockam Figure 693-1/2, or EPCO model FX or FB
- 36 dielectric unions with Epconite No. 2 gasket, 250 PSIG at 210 degrees F.

- 37
- 38 B. 1-1/2" and larger: EPCO model GX dielectric flange with Epconite No. 2 gasket, 175 PSIG at 210
- 39 degrees F.

- 40
- 41 C. Clear flow dielectric fittings may be used in lieu of dielectric unions for pipe sizes 2" and smaller.

42

43 **2.5 UNIONS AND FLANGES**

44

45 A. 2" and smaller:

- 46
- 47 1. ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron
- 48 on black steel piping and galvanized malleable iron on galvanized steel piping. Copper
- 49 unions with all copper piping. Stainless steel unions with all stainless steel pipings.
- 50 2. Use unions of a pressure class equal to or higher than specified for the fittings of the
- 51 respective piping service.
- 52
- 53

1 **PART 3 - EXECUTION**

2
3 **3.1 PREPARATION**

- 4
5 A. Set pipe on end and hammer sides to remove foreign materials before erection. Ream ends of all
6 piping to remove burrs.
7

8 **3.2 ERECTION**

- 9
10 A. Install all piping parallel to building walls and ceilings and at such heights not to obstruct any portion
11 of window, doorway, stairway, or passageway. Where interferences develop in the field, offset or
12 reroute piping as required to clear such interferences. In all cases, consult drawings for exact location
13 of pipe spaces, ceiling heights, door and window openings or other architectural details before
14 installing piping.
15
16 B. Provide anchors, expansion joints, swing joints and expansion loops so that piping may expand and
17 contract without damage to itself, equipment or building.
18
19 C. Mitered ells, notches tees and "orange peel" reducers are not acceptable. On threaded piping,
20 bushings are not acceptable.
21
22 D. "Weld-o-lets" and "Thread-o-lets" may be used for branch takeoff up to one half (1/2) the diameter of
23 the main.
24
25 E. Install drains throughout the systems to permit complete drainage of the entire system.
26
27 F. Do not install piping through dedicated electrical rooms or spaces unless the piping is serving this
28 room or space.
29
30 G. Install 2" deep galvanized sheet metal drain pans below piping which passes over electrical switching
31 apparatus. Pipe drain pans to an accessible location with a drain valve and hose bibb adapter such
32 that the system may be drained without damage to other equipment, insulation or finished spaces.
33
34 H. Install all valves, control valves and piping specialties, including items furnished by others, as
35 specified and/or detailed. Make connections to all equipment installed by others where that
36 equipment requires the piping services indicated in this section.
37

38 **3.3 INSTALLATION OF PIPE**

- 39
40 A. Run pipe lines straight and true, parallel to building lines with minimum use of offsets and couplings.
41
42 B. Provide only such offsets as may be required to provide necessary head room or clearance and to
43 provide necessary flexibility in pipe lines.
44
45 C. Changes:
46
47 1. Changes in direction of pipe lines made only with fittings or pipe bends.
48 2. Changes in size shall be made only with fittings.
49 3. Do not use miter fittings, face of flush bushings or street elbows.
50 4. All fittings of long radius type, unless otherwise indicated.
51
52 D. Use full and double lengths wherever possible:
53

- 1 1. Cut pipe to exact measurement and install without springing or forcing except in case of
2 expansion loops where cold springing is indicated.
- 3 2. Take particular care to avoid creating, even temporarily, undue loads, forces, or strains on
4 valves, equipment or building elements either piping connections or piping supports.
- 5
- 6 E. Install piping to allow for expansion and contraction without stressing pipe or equipment connected.
- 7
- 8 F. Provide clearance for installation of insulation and for access to valves, air vents, drains, and unions.
- 9
- 10 G. Sizing:
- 11
- 12 1. Unless otherwise indicated, install all supply piping, including shut-off valves and strainers,
13 to coils, pumps, and other equipment at line size with reduction in size being made only at
14 inlet to control valve or pump.
- 15 2. Install supply piping from outlet of control valve at full size connection in equipment served.
- 16 3. Install outlet piping including dirt pockets or mud legs from equipment full size of connection
17 in equipment served.
- 18 4. Install piping, check valves, strainers, and shut-off valves in these equipment outlet or return
19 lines beyond dirt pockets size of tapping in trap or if no trap, size of equipment connection.
- 20
- 21 H. Make reductions in water pipes with eccentric reducing fittings installed to provide drainage and
22 venting.
- 23
- 24 I. Branch Take-Offs:
- 25
- 26 1. Liquids: From top, bottom, or side of mains or headers at either 45 degrees or 90 degrees
27 from horizontal plane.
- 28 2. Use main sized saddle type branch connections or directly connecting branch lines to mains
29 in steel piping if main is at least 1 pipe size larger than branch for up to 6 inch mains.
- 30 3. Do not project branch pipes inside main pipe.
- 31 4. Provide flanges or unions at all final connections to equipment, traps and valves to facilitate
32 dismantling.
- 33 5. Arrange piping and piping connections so that equipment being served may be serviced or
34 totally removed without disturbing piping beyond final connections and associated shut-off
35 valves.
- 36
- 37 J. Pipe Drainage Provision:
- 38
- 39 1. Slope water piping 1 inch in 40 feet and arrange to drain at low points.
- 40 2. Closed Systems:
- 41 a. Equip low points with 3/4 inch valves and hose nipples.
- 42 b. At high points, provide collecting chambers and high capacity float-operated
43 automatic air vents or manual air vents.
- 44

45 **3.4 THREADED PIPE JOINTS**

- 46
- 47 A. Cut threads so that no more than three threads remain exposed after the joint is made. Ream all pipe
48 ends after cutting and clean before erection. Use a thread lubricant when making joints; no hard
49 setting pipe thread cement or caulking will be allowed.
- 50

51 **3.5 COPPER PIPE JOINTS**

- 52
- 53 A. Remove all slivers and burrs remaining from the tube cut by reaming and filing both pipe surfaces.
54 Clean fitting and tube with emery or sand cloth. Remove residue from the cleaning operation, apply

1 flux and assemble joint. Use solder or brazing to secure joint as specified for the specific piping
2 service.

3 4 **3.6 WATER SYSTEMS**

- 5
6 A. Pitch horizontal mains up at 1 inch in 40 feet in the direction of flow. Install manual air vents at all
7 high points where air may collect. If vent is not in an accessible location, extend air vent piping to
8 the nearest code acceptable drain location with vent valve located at the drain.
9
10 B. Main branches and runouts to terminal equipment may be made at the top, side or bottom of the main
11 provided that there are drain valves suitably located for complete system drainage and manual air
12 vents are located as described above.
13
14 C. Use top connection to main for upfeed risers and bottom connection to main for downfeed risers.
15 Connections at a main may be made with a tee and a 45 degree elbow.
16
17 D. Use a minimum of two elbows in each pipe line to a piece of terminal equipment to provide flexibility
18 for expansion and contraction of the piping system. Offset pipe connections at equipment to allow
19 for service, such as removal of the terminal device.
20
21 E. Use eccentric fittings for changes in horizontal pipe sizes with the fittings installed for proper air
22 venting. Concentric fittings may be used for changes in vertical pipe sizes.
23
24 F. When other specification sections or piping details do not require a strainer upstream of each control
25 valve, install bottom connections to a main with a capped dirt leg.
26
27 G. Where copper piping is allowed for heating hot water or solar hot water systems, secure all joints and
28 fittings with 95-5 tin-antimony solder or brazing alloys.
29
30 H. Where mechanically formed tee fittings are allowed, form mechanically extracted collars in a
31 continuous operation, consisting of drilling a pilot hole and drawing out the tube surface to form a
32 collar having a height of not less than three times the thickness of the tube wall. The collaring device
33 shall be adjustable.
34
35 I. Notch and dimple the branch tube. Braze the joint. Apply heat properly so that pipe and tee does not
36 distort. Remove distorted connections.
37

38 **3.7 CHEMICAL TREATMENT**

- 39
40 A. Install chemical treatment piping as indicated on the drawings, as detailed, and as recommended by
41 the supplier of the chemical treatment equipment.
42

43 **3.8 VENTS AND RELIEF VENTS**

- 44
45 A. Install vent line and relief valve discharge lines as indicated on the drawings, as detailed, and as
46 specified for each specific valve or piping specialty item.
47

48 **3.9 DIELECTRIC UNIONS**

- 49
50 A. Install insulating or dielectric unions or flanges at each point where a copper to steel pipe connection
51 is required in the following systems.
52
53 1. Cold water or non-potable make-up water lines.
54 2. Hot water system.

3. Dielectric unions shall not be used at terminal heating/cooling devices.

3.10 UNIONS AND FLANGES

A. Install a union or flange, as required, at each automatic control valve and at each piping specialty or piece of equipment which may require removal for maintenance, repair or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve.

1. Concealed unions or flanges are not acceptable.

3.11 PIPE SYSTEM LEAK TESTS

- A. Conduct pressure test with test medium of air or water unless specifically indicated. If leaks are found, repair the area with new materials and repeat the test; caulking will not be acceptable.
- B. No systems to be insulated until it has been successfully tested. If required for the additional pressure load under test, provide temporary restraints at expansion joints or isolate them during the test. Minimum test time shall be as scheduled below plus such additional time as may be necessary to conduct the examination for leakage.
- C. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges. Measure and record test pressure at the high point in the system.
- D. For air tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. The piping system exclusive of possible localized instances at pump or valve packing shall show no evidence of leaking. Perform the leak tests as follows:

System	Test Pressure	Medium	Duration
Potable & Non-Potable Water	60 PSIG	Water	24 hours

3.12 PIPE CLEANING

- A. Flush all water and condensate systems clear of all dirt and foreign matter with all pumps bypassed and all strainers removed from strainer bodies. Provide circulation by means of Trade Supplied portable pumping apparatus.
- B. After initial flushing of a system, use portable pumping apparatus for a continuous 24 hour circulation of a cold water detergent equal to Nalco 2567 cleaner. Flush detergent clear with continuous draining and raw water fill for an additional 12 hours or until all cleaner is removed from the system. Replace strainers and reconnect permanent pumping apparatus.

3.13 INITIAL SYSTEM FILL AND VENT

- A. Fill and vent all systems with proper working fluids.
- B. Fluids to be chemically treated as specified in Water Treatment Section 22 63 00.

END OF SECTION

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**SECTION 22 06 10
NATURAL GAS PIPING**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of natural gas piping system work, is indicated on drawings and schedules and by requirements of this section.
1. Building gas distribution piping after gas meter to locations as indicated on the Drawings, shall be installed by this Contractor to service new equipment as indicated on the Drawings.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
1. 22 05 00 Plumbing General Provisions

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of natural gas piping products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 3 years of successful installation experience on projects with natural gas piping system work similar to that required for project.
- C. ANSI Code Compliance: Comply with applicable provisions of ANSI B31.2 "Fuel Gas Piping".
- D. Natural Fuel Gas Code Compliance: Comply with applicable provisions of NFPA 54 (ANSI Z223.1) "National Fuel Gas Code" and International Fuel Gas Code IFC.
- E. Local Utility Compliance: Comply with requirements of local gas utility company.

PART 2 - PRODUCTS

2.1 NATURAL GAS PIPING MATERIALS AND PRODUCTS

- A. General: Provide piping material and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements.
1. Provide materials and products complying with ANSI B31.2 where applicable, base pressure rating on natural gas piping system maximum design pressures.
2. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in natural gas piping systems.

- 1 3. Where more than one (1) type of materials or products are indicated, selection is
2 installer's option.
3

4 **2.2 BASIC IDENTIFICATION**

- 5
6 A. General: Provide identification complying with Division 22 Plumbing General Provisions, in
7 accordance with the following listing:
8

- 9 1. Label all interior exposed gas piping and identify the gas pressure.
10

11 **2.3 BASIC PIPE, TUBE AND FITTINGS**

- 12
13 A. General: Provide pipe, tube, and fittings complying with Division 15A Basic Materials and
14 Methods ", in accordance with the following listing:
15

- 16 1. Building Distribution Piping: (Exposed Pipe Only)
17 a. Pipe Size 2" and smaller: Black steel pipe.
18 b. Pipe Weight: Schedule 40.
19 c. Fittings: Malleable iron threaded.
20
21 2. Pipe Size 2.5" and Larger: Black steel pipe.
22 a. Pipe Weight: Schedule 40.
23 b. Fittings: Wrought-butt welding.
24

25 **2.4 SPECIAL VALVES**

- 26
27 A. General: Special valves required for natural gas piping systems include the following types:
28

29 B. Gas Cocks:

- 30
31 1. Gas Cocks 2" and Smaller: 150 psi non-shock WOG, bronze straightway cock, flat
32 or square head, threaded ends.
33 2. Gas Cocks 2.5" and Larger: 125 psi non-shock WOG, iron body bronze mounted,
34 straightway cock, square head, flanged ends.
35

- 36 C. Pressure Regulating Valves: 150psi WOG non-shock, cast iron body, threaded ends,
37 aluminum spring and nitrite diaphragm, vent port.
38

- 39 1. Ventless pressure regulators may be used were approved.
40

- 41 D. Available Manufacturers: Subject to compliance with requirements, manufacturers offering
42 gas cocks which may be incorporated in the work include, but are not limited to the
43 following:
44

- 45 1. DeZurik;
46 2. Watts;
47 3. NIBCO;
48 4. Maxitrol;
49
50

51 **PART 3 - EXECUTION**

52 **3.1 INSTALLATION OF BASIC IDENTIFICATION**

53
54

- 1 A. General: Install mechanical identification in accordance with Division 22 Plumbing General
2 Provisions.
3
- 4 **3.2 INSTALLATION OF NATURAL GAS PIPING**
5
- 6 A. General: Install natural gas distribution piping in accordance with Division 15A Basic
7 Materials and Methods, and in accordance with applicable codes and local utility company
8 requirements.
9
- 10 B. Use sealants on metal gas piping threads, which are chemically resistant to natural gas. Use
11 sealants sparingly, and apply to only male threads of metal joints.
12
- 13 C. Remove cutting and threading burrs before assembling piping.
14
- 15 D. Do not install defective piping or fittings. Do not use pipe with threads, which are chipped,
16 stripped or damaged.
17
- 18 E. Plug each gas outlet, including valves, with threaded plug or cap immediately after
19 installation and retain until continuing piping, or equipment connections are completed.
20
- 21 F. Install drip-legs in gas piping where required by code or regulation.
22
- 23 G. Install "Tee" fitting with bottom outlet plugged or capped, at bottom of pipe risers.
24
- 25 H. Use dielectric unions where dissimilar metals are joined together.
26
- 27 1. Install piping with 1" drop in 60' pipe run (0.14%) in direction of flow.
28
- 29 I. Vent gas regulators to outside discharge per manufacturer's recommendation and per IFC.
30
- 31 **3.3 INSTALLATION OF PIPING SPECIALTIES**
32
- 33 A. Install piping specialties in accordance with Division 15A Basic Materials and Methods.
34
- 35 **3.4 INSTALLATION OF SUPPORTS, ANCHORS AND SEALS**
36
- 37 A. Install supports, anchors, and seals in accordance with Division 15A Basic Materials and
38 Methods.
39
- 40 **3.5 INSTALLATION OF VALVES**
41
- 42 A. Gas Cocks: Provide at connection to gas train for each gas-fired equipment item, and also on
43 risers and branches, where indicated.
44
- 45 B. Locate gas cocks where easily accessible, and where they will be protected from possible
46 injury.
47
- 48 **3.6 EQUIPMENT CONNECTIONS**
49
- 50 A. General: Connect gas piping to each gas-fired equipment item, with drip leg and shutoff gas
51 cock. Comply with equipment manufacturer's instructions.
52
- 53 B. Vent pressure-regulating valves to exterior.
54

1 **3.7 PIPING TESTS**

2

3 A. Test natural gas piping in accordance with ANSI B31.2, IFC, and local utility requirements.

4

5

6

END OF SECTION

**SECTION 22 06 30
PIPING SPECIALTIES**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Thermometers, sockets and test wells.
- B. Pressure gauges.
- C. Pipeline strainers.
- D. Manual and automatic air vents.
- E. Calibrated balance valves.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 22 05 90 Testing, Adjusting and Balancing
 - 2. 22 06 00 Pipe and Pipe Fittings

1.3 QUALITY ASSURANCE

- A. Standards:
 - 1. American National Standards Institute, ANSI: B31.1: Power Piping.
 - 2. ANSI/ASHRAE 15, "Safety Code for Mechanical Refrigeration".

1.4 SUBMITTALS

- A. Submit shop drawings for all items including all data concerning dimensions, capacities, materials of construction, ratings, ranges, pressure drop and appropriate identification.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Construct devices for the highest pressures and temperatures existing in the respective systems in accordance with ANSI specifications.

2.2 THERMOMETERS

- A. Manufacturers: Marsh, Taylor, Trerice, U.S. Gauge, Weksler or Weiss.
- B. Pipeline mounted: Thermometers shall be mercury reading, 9" scale cast aluminum case industrial thermometers with clear acrylic plastic window front and adjustable angle stem to permit easy reading

1 from the floor or operating platform. Furnish with extended necks suitable for insulated piping as
2 required. Thermometers shall be compatible with sockets as specified herein.

3
4 C. Panel or remote mounted: Thermometers shall be mercury vapor actuated dial type with remote bulb.
5 Casing shall be 3-1/2" minimum diameter cast metal with double front. Sensing bulbs shall be of
6 length to suit pipe diameter with extended necks as required for insulated piping, suitable for insertion
7 in separable brass sockets as specified herein.

8
9 D. The range of thermometers shall be:

<u>Service</u>	<u>Scale Range</u>	<u>Increment</u>
Hot Water	30 deg. F to 240 deg. F	2 deg. F

10
11
12
13
14 E. Thermometers by the temperature control manufacturer meeting the above specification will be
15 acceptable.

16 17 **2.3 THERMOMETER SOCKETS AND TEST WELLS**

18
19 A. Sockets and test wells shall be brass with threaded connections suitable for thermometer bulbs and
20 control sensing devices. Socket and test wells length shall be suitable for pipe diameter with
21 extended necks as required to suit pipe insulation.

22 23 **2.4 PRESSURE GAUGES**

24
25 A. Manufacturers: Ashcroft, U.S. Gauge, Marsh, Taylor, Trerice, Weksler or Weiss.

26
27 B. All gauges shall be suitable for the pressure service intended, with minimum 4-1/2" diameter dial cast
28 aluminum case, double strength glass window, phosphor bronze bourdon tube with bronze bushed
29 brass movement, and recalibration from the front of the gauge dial, 99% accuracy over the middle
30 half of the scale.

- 31
32 1. Gauges shall meet ANSI grade A specifications.
33 2. Gauges by the temperature control manufacturer meeting these specifications will be
34 acceptable.
35 3. The range of pressure gauges shall be:

	<u>Scale Range</u>	<u>Decrement</u>
Hot Water	0 PSIG to 100 PSIG	1 PSIG

36
37
38
39 C. Pressure snubbers shall be 1/4" size and of all bronze construction, 300 PSIG working pressure. Coil
40 siphons shall be 1/4" size and of bronze construction, 150 PSIG working pressure.

41
42 D. Brass needle type gauge valves, Trerice model 735-2 or other approved product.

43 44 **2.5 PIPELINE STRAINERS**

45
46 A. Manufacturers: Metraflex, Mueller Steam Specialty, Hoffman, Armstrong, Trane, Sarco, Keckley,
47 Illinois.

48
49 B. Strainers 2" and smaller: Full pipeline size, "Y" type, 250 psi W.P. bronze body, with screwed ends.
50 Furnish stainless steel strainer with a removable plug type screen retainer unless otherwise indicated
51 on the drawings.
52

- 1 C. Liquid service: Screens to be stainless steel with 1/32" diameter perforation for sizes thru 2" and
2 1/16" diameter perforation for sizes over 2" for closed piping systems and 1/8" diameter perforation
3 for open piping systems. Maximum pressure drop to be 4 feet W.G. in clean strainer.
4

5 **2.6 AIR VENTS**

6

- 7 A. Manual air vents for components and pipe, Bell & Gossett Model 4V or other approved product, 125
8 PSIG at 210 deg. F. Use 1/2" gate valve for main pipes.
9
- 10 B. Automatic air vents shall be pilot operated. Spirovent model spirotop, Thrush-Amtrol model 720,
11 Watson McDaniel model 830, B&G model 107 or other approved product.
12
- 13 1. Cast iron or bronze body with non-ferrous internal parts, designed to vent air automatically
14 with float control.
15
- 16 C. Vents shall be constructed of metal for maximum operating pressure of 150 psi and maximum
17 operating temperature of 250 deg. F and all working parts shall be noncorrosive.
18
- 19 D. Vents shall have minimum air elimination rate of 36 CFM at 80 PSIG and shall be fully open for the
20 removal of air at all pressures in the operating range from 2 to 150 psi. It shall be tightly sealed
21 against loss of system water and prevent entrance of air in negative pressure situations.
22

23 **2.7 CALIBRATED BALANCE VALVES**

24

- 25 A. Calibrated Balancing Valves:
26
- 27 1. 2" and smaller: Construct valves of all bronze with threaded connections for sizes 2" and
28 below and for 125 PSIG working pressure at a maximum temperature of 250 deg. F. Provide
29 valve with quick disconnect taps with built-in check valve for pressure differential
30 measurement and integral valve setting index.
31
- 32 2. Select valves for size and pressure drop shown on the drawing and/or schedules. Tag valve
33 plan mark number, flow and pressure drop as specified.
34
- 35 3. Manufacturers: B&G CB plus calibrated balance valves or approved equal.
36

37 **PART 3 - EXECUTION**

38 **3.1 PIPELINE STRAINERS**

39

- 40 A. Install strainers in steam and water systems on the entering side of all automatic valves and as shown
41 on the drawings and details.
42
- 43 B. Install strainers in water systems on the suction side of all pumps and elsewhere as indicated on the
44 plans and/or as scheduled.
45
- 46 C. Install drain valve with hose adapter in each blow off connection and extend drain piping to nearest
47 floor drain.
48

49 **3.2 THERMOMETERS**

50

- 51 A. Install thermometers in thermometer sockets in locations indicated on the drawings and details.
52

- 1 B. Install sockets at each point where a temperature sensing device is required under Section 15900B -
2 Controls and Instrumentation, and a thermometer location as shown on the piping drawings and
3 details.
4

5 **3.3 PRESSURE GAUGES**
6

- 7 A. Install pressure gauges where indicated on the drawings and details.
8
9 B. Install gauges for water service with pressure snubbers and gauge valves.
10

11 **3.4 PRESSURE GAUGE TAPPING**
12

- 13 A. Install tappings at each point where sensing device is required under Section 15900B - Controls and
14 Instrumentation and at gauge locations as shown on the drawings and details.
15
16 B. Install tappings for water service with pressure snubbers and gauge valves.
17

18 **3.5 AIR VENTS**
19

- 20 A. Install manual air vents where indicated on the drawings, details and at all high points in water
21 systems where air may collect.
22
23 B. Install automatic air vent at the top of the air separator and where shown on drawings with a shut-off
24 valve between air separator and air vent.
25

26 **3.6 FLOW SENSORS**
27

- 28 A. Install flow sensors as indicated on the drawings and/or schedules and in accordance with the
29 manufacturer's recommendations.
30
31
32

33 **END OF SECTION**

**SECTION 22 09 10
SUPPORTS AND ANCHORS**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Pipe hangers and supports for mechanical system piping.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 govern work under this section.

- B. Specified Elsewhere:

- | | | |
|----|----------|------------------------|
| 1. | 22 06 00 | Pipe and Pipe Fittings |
| 2. | 22 06 10 | Natural Gas Piping |
| 3. | 22 06 30 | Piping Specialties |
| 4. | 22 25 00 | Mechanical Insulation |

1.3 QUALITY ASSURANCE

- A. Standards:

- | | |
|----|----------------------------------|
| 1. | <u>ANSI B31.1</u> : Power Piping |
| 2. | MSS SP58 & SP69 |

1.4 SUBMITTALS

- A. Submit shop drawings for the following:

1. Schedule of all manufactured hanger and support devices, indicating type of device for each pipe size range and type of service, including shielding devices as specified.

1.5 MANUFACTURERS

- A. Grinnell, Fee and Mason, Michigan Hanger, B-Line or Elcen, or approved equal.

- B. Grinnell figures listed as reference only.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58 and SP-69 unless otherwise specified.

- B. Design supports of strength and rigidity to suit loading, service, and in manner, which will not unduly stress the building construction. Where support is from concrete construction, take care not to weaken concrete or penetrate waterproofing. Fasten supports and hangers to building steel framing whenever practical. Do not use perforated iron, chain or wire as hangers.

- 1
2 C. Where piping can be conveniently grouped to allow the use of trapeze type supports, the supporting
3 steel shall be by means of standard structural shapes or continuous insert channels. Where continuous
4 insert channels are used, pipe-supporting devices made specifically for use with the channels may be
5 substituted for the specified supporting devices provided that similar types are used and all data is
6 submitted for approval.
7

8 **2.2 EQUIPMENT SUPPORTS**

9

- 10 A. Provide all supporting steel, not indicated on the structural drawings, that is required for the
11 installation of mechanical equipment and materials, including angles, channels, beams, etc. to
12 suspend or floor support tanks and equipment.
13
14 B. Refer to Drawing details for further requirements.
15

16 **2.3 PIPE HANGERS AND SUPPORTS**

17

- 18 A. Manufacturers: Grinnell, Fee and Mason, Michigan Hanger, B-Line or Elcen similar to the Grinnell
19 figures listed.
20
21 B. Pipe Hangers Application:
22
23 1. 2" and smaller: Adjustable, swivel split ring type Grinnell Fig. 104 or lightweight,
24 adjustable clevis type Grinnell Fig. 65.
25 2. 2-1/2" and larger: Adjustable clevis type Grinnell Fig 260.
26
27 C. Hangers for copper pipe without insulation shall be either copper plated or PVC coated.
28
29 D. Hot piping 2" and smaller: Hanger may be secured directly to the pipe with insulation system around
30 hanger.
31
32 E. Roof Supports: Haydon HBS series roof supports with galvanized uni-strut pipe mount on top.
33 100% recycled UV resistant rubber construction.
34

35 **2.4 INSULATION PROTECTION SHIELDS**

36

- 37 A. Application: Insulation protection shields are required on the following piping systems:
38
39 1. Cold piping (under 60 deg. F): All sizes.
40 2. Hot piping (over 120 deg. F): 2-1/2" and larger piping.
41
42 B. Insulation Protection Shields: Grinnell Fig. 167, Fee & Mason or Elcen or other approved product,
43 constructed of galvanized carbon steel. Select shield to accommodate outer diameter of insulation.
44 Shield lengths and gauge shall be as follows:
45

<u>Pipe Size</u>	<u>Length</u>	<u>Gauge</u>
1/2" thru 2-1/2"	12"	18
3" thru 6"	18"	16

46
47
48
49

50 **2.5 HANGER SUPPORT INSULATION**

51

- 52 A. Application: Piping 2-1/2" diameter and larger in conjunction with insulation protection shields to
53 resist compression of insulation system.

- 1
2 B. Hanger insulation system shall cover bottom half of pipe at the same thickness as pipe insulation
3 system.
4

5 **2.6 PIPE HANGER RODS**
6

- 7 A. Support rods shall conform to the latest MSS standards except as modified herein.
8
9 B. Size rods for individual hangers and trapeze support as indicated in the following schedule:

<u>Pipe size</u>	<u>Maximum Rod Diameter</u>	<u>Load (lbs.)</u>
Up to 2"	3/8"	610
2-1/2" and 3"	1/2"	1130
4" and 5"	5/8"	1810
6"	3/4"	2710
8" thru 12"	7/8"	3770

- 17
18 C. Furnish rods complete with adjusting and lock nuts.
19
20 D. In piping 4 inches and larger, each valve shall be supported.
21

22 **2.7 HANGERS AND SUPPORT SPACING**
23

- 24 A. Space pipe hangers and supports in accordance with the following schedule, with exceptions as
25 indicated herein:
26

<u>Pipe size</u>	<u>Steel</u>	<u>Copper</u>
Up thru 1-1/4"	8'-0"	6'-0"
1-1/2" and 2"	10'-0"	8'-0"
2-1/2" and 3"	12'-0"	10'-0"
4" and 5"	14'-0"	10'-0"
6" to 12"	14'-0"	10'-0"

- 33
34 B. Place hangers to meet the requirements of the piping section of this specification, with regard to pitch
35 for drainage and venting, and clearance between services.
36
37 C. Place hangers within one foot of each elbow and at each valve and strainer for piping 4" and above.
38

39 **2.8 BEAM CLAMPS**
40

- 41 A. Grinnell Fig. 87 Series beam clamps with retaining clip for hanger rods to 5/8". Maximum load 440
42 lbs.
43
44 B. Grinnell Fig. 228 beam clamps with links for hanger rods 3/4" and above.
45

46 **2.9 RISER CLAMPS**
47

- 48 A. Grinnell Fig. 261 for steel pipe, CT-121 for copper tubing.
49

50 **2.10 CONCRETE INSERTS**
51

- 52 A. Grinnell Fig. 285, 281 or 282, poured concrete ceiling insert, suitable for rod diameter and weight
53 supported.

- 1
2 B. Inserts drilled and placed after concrete pour shall have steel shell with expander plug, not depending
3 on soft lead for holding power.
4
5

6 **PART 3 - EXECUTION**
7

8 **3.1 INSTALLATION**
9

- 10 A. Install supports to provide for free expansion of the pipe. Support all piping from the structure using
11 concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and
12 wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.
13
14 B. Coordinate hanger and support installation to properly group piping of all trades.
15

16 **3.2 INSULATION PROTECTION SHIELDS**
17

- 18 A. Install insulation protection shields at support points for insulated piping as scheduled herein.
19
20 B. Spacing shall be 10'-0" maximum based on insulation with a compressive strength of 15 psi. For
21 insulation with compressive strengths greater than 15 psi, span may be increased proportionally up to
22 a maximum allowable as listed under hanger and support spacing in this section.
23
24

END OF SECTION

**SECTION 22 10 00
VALVES**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Valves for mechanical system piping.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 govern work under this section.

B. Specified Elsewhere:

- | | | |
|----|----------|----------------------------------|
| 1. | 22 05 90 | Testing, Adjusting and Balancing |
| 2. | 22 06 00 | Pipe and Pipe Fittings |
| 3. | 22 06 30 | Piping Specialties |

1.3 SUBMITTALS

- A. Submit shop drawings for all valves including all data concerning dimensions, materials of construction and pressure/temperature ratings.
- B. Mark shop drawings clearly for each system and note with the correct cross reference number.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturers: Powell, Crane, Nibco, Hammond, Stockham, Lunkenheimer, Milwaukee.
1. Valves shall be of same manufacturer, unless otherwise approved by A/E.
- B. Acceptable manufacturer and Fig. No. are listed under each valve type as the standard for equal quality from approved manufacturers.
- C. Manufacturer's name and pressure ratings clearly mounted on outside of valve body.

2.2 WATER SYSTEMS VALVES

A. Globe Valves:

1. Valves 2-1/2" and smaller: Bronze body, screwed pattern, renewable composition disc, union or screw-over bonnet, malleable iron hand wheel, 300 psi W.O.G., Mueller Fig. 203-AP or Metraflex No. 700.

B. Check Valves:

1. 2-1/2" and smaller: Bronze body, screwed, regrinding type, horizontal swing, renewable seat and disc, 150 SWP - 200 WOG rated. Nibco Fig. T-413-Y.

1
2 C. Spring Loaded Check Valves:

- 3
4 1. Valves 2-1/2" and smaller: Bronze or iron body, bronze trim, stainless steel spring, screwed,
5 250 psi WOG, Nibco Fig. T-480Y, Mueller Fig. 203-AP or Metraflex No. 700.

6
7 D. Balancing Valves(non-calibrated):

- 8
9 1. Valves 2-1/2" and smaller: Use eccentric plug valves or ball valves with memory stops.

10
11 E. Balancing Valves(calibrated):

- 12
13 1. Valves 2-1/2" and smaller: Refer to Section 23 06 30, Piping Specialties, under Flow Sensors
14 and Meters.

15
16 F. Ball Valves:

- 17
18 1. Valves 2-1/2" and smaller: Bronze body, screwed, brass or stainless steel ball, full or
19 conventional port, Teflon seat rings, blowout-proof stem, two-piece construction, 600 psi
20 WOG, Apollo No. 70 Series, Milwaukee BA 100/150, Nibco T/S 585-70.
21 2. Provide valve neck extensions with sufficient length to allow for insulation where insulation
22 is specified.

23
24 G. Drain Valves:

- 25
26 1. Bronze, screwed, Buna-N seat discs, hose thread adapter, 125 psi WOG, Nibco Fig 74, or ball
27 valve as specified above with hose thread adaptor.
28 2. Minimum drain valve size - 3/4" except where strainer blowdown valves are indicated, drain
29 valve same as blowdown connection size.

30
31 H. Combination Shut-off, Check and Balancing Valves:

- 32
33 1. 2" and smaller: Provide check valve and balance valve in series at pump discharge.
34 2. Design valves to permit repacking under full line pressure.

- 35
36 I. Shut-off and Check Valves: Provide spring-loaded check valve and shut-off (ball or butterfly) valve
37 in series at pump discharge.

38
39 **2.3 WATER RELIEF VALVES**

- 40
41 A. Manufacturers: Kunkle, Consolidated, Thrush, Watts, Cash-Acme, or B&G. Valves shall be iron or
42 bronze body, diaphragm operated, with non-ferrous seat and designed for a maximum working
43 pressure of 125 PSIG.

- 44
45 B. Relief valves shall conform to State requirements and each valve shall have an ASME stamp.

46
47 **2.4 GAUGE VALVES**

- 48
49 A. Trerice Fig. 735, 1/4" brass needle valve, threaded ends, 300 WOG rated.

50
51
52 **PART 3 - EXECUTION**

53
54 **3.1 GENERAL**

- 1
2 A. Install valves as shown on plans, details and according to the valve manufacturer's installation
3 recommendations. Install valves with stems upright or horizontal.
4
5 B. Install all temperature control valves furnished under Section 15900B - Controls and Instrumentation.
6

7 **3.2 SHUT-OFF VALVES**
8

- 9 A. Install shut-off valves at all equipment, at each branch take-off from mains, and at each automatic
10 valve for servicing.
11

12 **3.3 THROTTLING VALVES**
13

- 14 A. Install globe or angle valves for throttling service and control device or PRV station bypass.
15
16 B. Install gate valves for throttling in steam systems sizes 8 inches and larger.
17

18 **3.4 BALL VALVES**
19

- 20 A. Ball valves shall be used for water system shut-off valves.
21

22 **3.5 BALANCING VALVES**
23

- 24 A. Provide balancing valves for complete balancing of water systems. Furnish calibrated balance valves
25 and flow meters as specified in Section 23 06 30, Piping Specialties, under Flow Meters.
26

27 **3.6 DRAIN VALVES**
28

- 29 A. Provide drain valves where specified, detailed and at all low points of piping systems for complete
30 drainage of the systems.
31

32 **3.7 WATER RELIEF VALVES**
33

- 34 A. Install relief valves as shown on drawings.
35
36 B. Unless otherwise indicated, provide one relief valve in each closed water system in the pump inlet
37 piping.
38

39 **3.8 SPRING LOADED CHECK VALVES**
40

- 41 A. Provide a spring loaded check valve in each pump discharge line.
42

43 **3.9 COMBINATION SHUT-OFF, CHECK AND BALANCING VALVES**
44

- 45 A. Install combination or triple-duty (shut-off, check and balancing) valve in lieu of providing separate
46 shut-off valve, check valve and balancing valve at water circulation pump discharge line.
47

48 **3.10 WATER RELIEF VALVES**
49

- 50 A. Install water relief valves on closed system hydronic heating systems to relief rated system input
51 capacity. Extend relief outlet to safe location near floor drain.
52
53

END OF SECTION

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**SECTION 22 14 00
PUMPS**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Types of pumps specified in this section include the following:

1. Inline Pumps

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 govern work under this section.

B. Specified Elsewhere:

1. 22 05 90 Testing, Adjusting and Balancing
2. 22 06 30 Piping Specialties
3. 22 10 00 Valves

1.3 QUALITY ASSURANCE

A. UL and NEMA Compliance: Provide electric motors and products which have been listed and labeled by Underwriters Laboratories and comply with NEMA Standards.

1.4 SUBMITTALS

A. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve, when applicable.

B. Submit all data concerning dimensions, materials of construction, ratings, and other relevant product data.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide factory tested pumps, thoroughly cleaned, and painted with one coat of machinery enamel prior to shipment. Type, size, and capacity of each pump are listed on pump schedule. Provide pumps of same type by same manufacturer.

B. Pump shall meet or exceed the operating efficiencies scheduled.

C. Select motor with sufficient horsepower rating for non-overloading operation over the entire pump curve.

D. All pumps shall operate without objectionable noise or vibration.

2.2 INLINE CENTRIFUGAL PUMPS

- 1 A. General: Provide in-line pipe-mounted, single suction, centrifugal type pumps where
2 indicated, and of capacities as scheduled.
3
- 4 B. Acceptable Manufacturers:
5
6 1. Bell and Gossett
7 2. Grundfos
8
- 9 C. Casing: Stainless steel or bronze with a working pressure of 175 PSIG and operating
10 temperature of 225 degrees F continuous, 250 degrees F intermittent. Provide tapped and
11 plugged openings for vent, drain, suction and discharge gauge connections.
12
- 13 D. Shaft: stainless steel with integral thrust collar.
14
- 15 E. Bearings: Sealed ball bearings.
16
- 17 F. Seal: Mechanical single unbalanced type with Buna-N/Carbon rotating element and ceramic,
18 Ni-resist stationary seat or other approved product.
19
- 20 G. Impeller: Single-suction enclosed type, hydraulically and dynamically balanced, and keyed
21 to shaft, stainless steel or bronze Construction.
22
- 23 H. Motor: Non-overloading at any point on pump curve, open, drip-proof, oil-lubricated journal
24 bearings, resilient mounted construction, built-in thermal overload protection on single phase
25 motors.
26
- 27 1. Motor shall be non-overloading over the entire pump curve.
28 2. Premium efficiency motor per IEEE Standard 112, Method B and EPACT
29 requirements.
30
- 31 I. Nameplate: Each pump and motor shall be provided with a nameplate displaying the
32 manufacturer's name, serial number of pump, capacity in GPM, and head in feet at design,
33 horsepower, voltage, frequency, speed and full load current.
34
- 35 1. Permanently identify exact impeller size of pump on nameplate.
36
- 37 J. ECM Motor and Controller: Where scheduled, inline pump shall be equipped with an ECM
38 motor with integral controller for constant pressure control of pump output as setup integrally
39 on motor-mounted controller.
40
- 41 1. 0-10 VDC signal inputs for remote speed control.
42
43

44 **PART 3 - EXECUTION**

45 **3.1 INSTALLATION OF PUMPS**

- 46 A. Install pumps where indicated, in accordance with manufacturer's published installation
47 instructions, with recommended clearance provided for service and maintenance.
48
- 49 B. Install in-line pumps supported from piping system, located for access to oil cups, service and
50 maintenance. Pipe to be free of all movement.
51
52
53

- 1 C. Provide piping, accessories, hangers, supports, and anchors, valves, meters and gauges,
2 vibration isolation, and equipment supports, as indicated for completion installation. All
3 valves and piping specialties are to be full line sizes as indicated on drawings.
4
- 5 D. Ensure that pump units are wired properly, with rotation in correct direction, and that pump
6 and motor grounding have been provided.
7
- 8 E. Start-Up Services and Inspection Report: Manufacturer's representative shall inspect pump
9 installation and start-up pump to verify proper installation, pump shaft alignment and
10 operation, and submit report to Engineer.
11

12 **END OF SECTION**

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SECTION 22 25 00
MECHANICAL INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of mechanical insulation required by this section is indicated on drawings, and by requirements of this section.
- B. Work shall include all labor, equipment, accessories, materials and services required to furnish and install all insulation, fittings and finishes for piping and related mechanical equipment in the Plumbing/Solar systems
- C. The following types of insulation are specified in this section:
 - 1. Pipe insulation.
 - 2. Mechanical equipment insulation.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 22 09 10 Support and Anchors

1.3 QUALITY ASSURANCE

- A. Acceptable Manufacturers:
 - 1. Owens-Corning
 - 2. Schuller
 - 3. Certainteed
- B. All insulating products delivered to the construction site shall be labeled with the manufacturer's name and description of materials.
- C. All insulation installation methods shall be performed in accordance with the latest edition of MICA (Midwest Insulation Contractors Association) Standard and manufacturer's installation instructions, except as modified in this section of specifications.
- D. Applicator: Company specializing in insulation application with five years minimum experience.
- E. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723 (where required).

1.4 SUBMITTALS

- A. Submit shop drawings for insulation systems, including a schedule for all insulating materials, including adhesives, fastening methods, fitting materials, installed thickness and intended use of each material.

- 1 B. Submittal shall include catalog sheets indicating density, thermal characteristics, jacket, and
2 installation instructions.
3
4

5 **PART 2 - PRODUCTS**
6

7 **2.1 MATERIALS**
8

- 9 A. All products including vapor barriers and adhesives shall conform to NFPA Section 90A. All
10 products except pipe insulation shall possess a flame spread rating of not over 25, without evidence of
11 continued progressive combustion, and a smoke developed rating no higher than 50.
12

13 **2.2 PIPE INSULATION**
14

- 15 A. Glass Fiber: Rigid molded glass fiber pipe insulation with ASJ type factory applied jacketing with a
16 density of 3-4 lbs./cubic feet and a "k" factor of 0.25 @ 75 degrees F. mean. Insulation shall meet
17 Flame Spread 25, smoke development 50 per ASTM E 84-75, -20 degrees to 500 degrees F. usage.
18

- 19 1. Jacket shall be glass fiber reinforced foil kraft laminate with white finish(ASJ All Service
20 Jacket; ASTM C921). Permeance shall not exceed 0.02 perms. Beach puncture resistance
21 shall be 50 units minimum.
22

- 23 B. Closed Cell - Elastomeric: Flexible elastomeric thermal insulation with a "k" factor of 0.26 at 75
24 degrees F mean density of 5.0 lbs./cu. ft. and a maximum water vapor transmission of 0.17 per inch.
25 Seal joints with manufacturers standard sealant. Insulation shall meet Flame Spread 25, smoke
26 development 50 per ASTM E 84-75, -40 degrees to 220 degrees F usage.
27

- 28 1. Solar Piping Insulation: equal to Armccl UT Solarflex. ASTM C 534 rated for 300 deg F.,
29 Thermal conductivity 'k' factor of 0.28.
30

- 31 C. PVC Fitting Covers and Jackets: White PVC film, gloss finish one side, semi-gloss other side, FS
32 LP-535D, Composition A, Type II, Grade GU. Ultraviolet inhibited outdoor grade where exposed to
33 ultraviolet radiation. Jacket thickness to be 0.02 inch (20 mil).
34

- 35 D. Metal Jackets: 0.016 inch thick aluminum or 0.10 inch thick stainless steel with safety edge.
36

- 37 1. Exterior solar piping shall have 0.016" thick aluminum jacket system.
38

39 **2.3 PIPING INSULATION SCHEDULE**
40

- 41 A. Insulation Thickness Pipe Size Schedule:
42

<u>Type of System</u>	<u>Fluid Temp. Range (deg F)</u>	<u>1"and less</u>	<u>1"- 1-1/2"</u>	<u>2"- 4"</u>
Solar Supply & Return	90-200	1.0	1.0	1.5
HWS & R	90-140	1.0	1.0	1.5
Hot Water	90-140	1.0	1.0	1.5
Cold Water	50-60	0.5	0.5	1.0

- 51 B. Insulation thickness shown in schedule are based on products having a maximum "k" factor of 0.26 at
52 a mean temperature of 75 degrees F. These thicknesses can be reduced for products having
53 significantly lower "k" values and shall be increased for products having higher "k" values in order to

produce equivalent or greater thermal resistance. ("R" value of products equals the thickness of the insulation divided by the "k" factor.)

C. Insulation Application Schedule:

Type of System	Fluid Temp. Range (deg. F)	Type of Insulation
Solar Supply - Interior	90-200	Glass Fiber or Closed Cell
Solar Supply - Exterior	90-200	Closed Cell
HWS & R	90-140	Glass Fiber
Hot Water	90-140	Glass Fiber
Cold Water	50-60	Glass Fiber

2.4 EQUIPMENT INSULATION

A. Material: Semi-Rigid Glass Fiber Board: Insulation shall have a minimum density of 3.0 PCF with thermal conductivity of not more than 0.28 at 75 degrees F mean temperature and suitable for 240 degrees F. Insulation shall be rated for 125 PSF compressible strength at 10% deformation with fibers perpendicular to jacket and scored for wrapping cylindrical surfaces.

1. Insulation shall meet Flame Spread 25, smoke development 50 per ASTM E 84-75, -20 degrees to 500 degrees F. usage.

B. Jacket: Jacket shall be white kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with a maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.

2.5 EQUIPMENT INSULATION SCHEDULE

A. Solar Storage Tank:

1. Type Insulation: 2" Semi-Rigid Glass Fiber Board.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Application of insulation materials to piping, equipment, tanks and ductwork shall be done in accordance with manufacturer's written recommendations. Where thickness of insulation is not specified, use applicable thickness recommended by manufacturer and required by applicable codes.

B. All insulation shall be continuous through wall and ceiling openings and sleeves. All covered pipe and ductwork is to be located a sufficient distance from walls, other pipe, ductwork and other obstacles to permit the application of the full thickness of insulation specified. (If necessary, extra fittings and pipe are to be used.).

3.2 INSTALLATION OF PIPING INSULATION

A. All pipe installation shall be installed with joints butted firmly together. All valves and fittings shall be insulated with mitered sections of insulation equal in density and thickness to the adjoining insulation by one of the following methods:

1. Premolded PVC fittings installed in accordance with the manufacturer's instructions.

- 1 2. Jackets on pipe insulation laps are to be vapor sealed using self-sealing lap, lap-seal tape gun
2 or adhesive such as Armstrong 520. All insulation ends are to be tapered and sealed
3 regardless of service.
4
- 5 B. Provide removable insulation sections to permit easy access where inspection, service and/or repairs
6 are required.
7
- 8 1. Insulation for valves, unions (cold only), strainers, flexible connections and expansion joints
9 shall be removable for inspection and repair.
10
- 11 C. On all cold piping insulated with vapor barrier covering, use protection shield to over bottom one-half
12 of insulated pipe. Provide half-round, 12" long, hanger block at the bottom half of the pipe in place
13 of the fiberglass pipe insulation. The hanger blocks shall be molded cork or calcium silicate pipe
14 insulation of the same thickness as the adjoining fiberglass pipe insulation. The vapor barrier jacket
15 shall be continuous through the hanger location.
16
- 17 1. Provide removable elastomeric insulation wraps over cold piping unions.
18
- 19 D. Vapor barrier jackets shall be applied with a continuous, unbroken vapor seal. Pipe hangers on cold
20 lines (dual temperature piping) are to be sized large enough to be installed over the outer surface of
21 the insulation.
22
- 23 E. On hot piping 2" and smaller, the hanger shall be secured directly to the pipe and the pipe insulation
24 shall surround the hanger. Provide pipe covering protection saddles and hanger blocks at hanger
25 locations on hot piping 4" and larger.
26
- 27 F. Insulation shall preferably be applied while surfaces are hot. Chilled water lines shall be at room
28 temperatures when insulation is applied.
29
- 30 G. Omit insulation for the following:
31
- 32 1. Discharges piping from safety and relief valves to outlets.
33 2. Piping unions on hot only (HWS&R) systems.
34 3. Provide removable insulation jackets over unions and valves for hot/chilled water systems.
35 4. Hot water piping inside convector, wall fin radiation and cabinet heater enclosures.
36
- 37 H. Seal all exposed end sections of pipe covering with a coat of vapor barrier mastic. Childers CP-30 or
38 equal.
39
- 40 I. No covering shall be applied until after piping is cleaned and tested, inspected and approved.
41

42 **3.3 PROTECTIVE JACKETS**

43

- 44 A. PVC Protective Jackets: Lap seams and joints a minimum of 2 inches and continuously seal with
45 welding solvent recommended by jacket manufacturer. Lap slip joint ends 4" without fasteners where
46 required to absorb expansion and contraction. For sections where vapor barrier is not required and
47 jacket requires routine removal, tack fasteners may be used.
48
- 49 B. Metal Protective Jackets: Lap seams a minimum of 2 inches. Secure with metal bands for end to
50 end joints, and rivets or sheet metal screws for longitudinal joints. Rivets, screws, and bands to be
51 constructed of the same material as the jacket. Locate seams on bottom for exterior applications.
52 Seal all seams and joints with vapor barrier mastic.
53

54 **3.4 INSTALLATION OF EQUIPMENT INSULATION**

- 1
2 A. General: Install insulation products in accordance with manufacturer's written instructions and in
3 accordance with recognized industry practices to ensure that insulation serves its intended purpose.
4
5 B. Clean and dry surfaces prior to insulating, Butt insulation joints firmly together to ensure complete
6 and tight fit over surfaces to be covered.
7
8 C. Do not insulate over equipment nameplates or ASME stamps. Bevel and seal insulation at these
9 locations.
10
11 D. Do not insulate factory insulated equipment.
12
13 E. Apply insulation to equipment shells using weld pins, bonding adhesive, banded and wired in place.
14 Fill all joints, seams and depressions with insulating cement to a smooth, even surface. Cover with
15 reinforcing fabric and 2 coats of mastic. . Use vapor barrier mastic on systems requiring a vapor
16 barrier.
17
18 F. Install insulation materials with smooth and even surfaces.

19
20 **3.5 PROTECTION AND REPLACEMENT**

- 21
22 A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor
23 barrier damage and moisture saturated units.
24
25 B. Protection: Insulation installer shall advise Contractor of required protection for insulation work
26 during remainder of construction; period, to avoid damage and deterioration.
27
28

29
END OF SECTION

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**SECTION 22 45 10
MECHANICAL EQUIPMENT**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Solar Storage Tank ST-1:
 - 1. One (1) 1200 vertical storage tank .
- B. In-tank Water-Water Heat exchangers HX-1, 2 & 3:
 - 1. Three(3) in-tank water-water heat exchangers.
- C. High-low thermostatic mixing valves MV-1 & 2:
 - 1. Two(2) thermostatic mixing valves.
- D. Water Softener.
- E. Air Separators.
- F. Expansion Tanks.
- G. Glycol Fill Tank/Pump.
- H. High Pressure Washer.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.

1.3 SUBMITTALS

- A. Submit shop drawings in accordance with Division 1 requirements for all products specified.

PART 2 - PRODUCTS

2.1 SOLAR STORAGE TANK ST-1

- A. Manufacturers: Wessels, Badgerland Tanks, A.O. Smith, Bock, Lochinvar.
- B. Horizontal steel storage tank; non-ASME, rated with 125 PSIG working pressure rating; complete with inlets, outlets, sensor and drain fittings as indicated on the drawing details and schematics. Tank shall be 1200 gallon nominal capacity; 54" dia x 10'-9" long.
- C. Provide the following accessories:
 - 1. Base support;
 - 2. Magnesium anodes;
 - 3. Lifting lugs;

- 1 4. Epoxy lining;
- 2 5. Wire brush tank exterior and apply one coat red oxide primer paint;
- 3 6. Three(3) flanged heat exchanger collars for in-tank mounting.
- 4 7. Pre-insulated as Contractor's Option.
- 5
- 6 D. Warranty: Non-prorated 10-year warranty for tank against any failure.
- 7
- 8 1. Provide factory warranty with shop drawing submittals and operation and
- 9 maintenance manuals.
- 10
- 11 **2.2 IN-TANK WATER-WATER HEAT EXCHANGERS HX-1, 2 & 3**
- 12
- 13 A. Manufacturer: B&G, Cemline, Patterson-Kelley.
- 14
- 15 B. Type: Factory fabricated, horizontal tank U-tube in-tank mounted, water-water heat
- 16 exchanger.
- 17
- 18 1. Single-wall in-tank heat exchanger: B&G TCW series or equal.
- 19 2. Double-wall in-tank heat exchanger: B&G DTCW series or equal.
- 20
- 21 C. Construct and stamp in accordance with Section VIII of the ASME Code for a working
- 22 pressure of 150 psig.
- 23
- 24 D. Tank heaters shall be of the shell and tube type. The tube bundle shall be of 'U' bend
- 25 construction with tube ends expanded into a stationary tube sheet. Design shall use
- 26 removable flanged header with removable water connections to allow easy removal of heat
- 27 exchanger. Mating flanged collar shall be provided to tank manufacturer and welded in
- 28 place during tank construction for heat exchanger mounting in field.
- 29
- 30 1. 90/10 cupro-nickel tube construction.
- 31
- 32 E. All materials (including fittings and piping) in contact with domestic water are to be non-
- 33 ferrous. Provide single or double-wall copper/nickel (inner and outer) tube water bundle(s)
- 34 with nonferrous tube sheet and baffles. Provide cast iron header chamber flanged cover.
- 35
- 36 F. Warranty: Non-prorated 10 year warranty for heat exchanger. Provide factory warranty with
- 37 shop drawing submittals and operation and maintenance manuals.
- 38
- 39 **2.3 HIGH-LOW THERMOSTATIC MIXING VALVES MV-1 & 2**
- 40
- 41 A. Combination large capacity and small capacity thermostatic mixing valves rated for
- 42 minimum 1.0 GPM hot water flow. Mixing valves shall be bronze, brass and stainless steel
- 43 construction, factory preassembled and tested. Mixing valves shall use a bi-metallic
- 44 thermostat with locking temperature adjustment lever, and include adjustable stops, integral
- 45 hot and cold supply checkstops.
- 46
- 47 1. 7-year limited warranty on valve.
- 48
- 49 B. Leonard TM series or approved equal.
- 50
- 51 **2.4 WATER SOFTENER**
- 52
- 53 A. Acceptable Manufacturers:
- 54

- 1 1. Hellenbrand, progressive demand-recall arrangement with system controller or
2 approved equal.
3
- 4 B. Softener Tank: Tank shall be of NSF approved, UL listed, non-corrosive reinforced pressure
5 vessel rated for 150 psig working pressure and 120 deg F, and hydrostatically tested at 50%
6 in excess of the working pressure.
7
- 8 C. Internal Distribution:
9
- 10 1. Upper distributor system shall be of the single point baffle type, constructed of
11 Schedule 40 galvanized steel and fittings.
12 2. Lower distribution system shall be the hub and radial arm type, PVC constructed
13 with individual fine slotted non-clogging polyethylene strainers arranged for even
14 flow distribution through the resin bed. Slotted lateral arms are unacceptable. The
15 distribution system shall be embedded in a single layer sub fill of washed 1/8" x
16 1/16" gravel to support the resin bed.
17
- 18 D. Main Operating Valve: The main operating valve shall be an Industrial Automatic Multiport
19 diaphragm type, slow opening and closing, free of water hammer.
20
- 21 1. The diaphragm assembly shall be fully guided on its perimeter when pressure
22 actuated from one position to another to assure a smooth reliable shut-off without
23 sticking.
24 2. There shall be no contact of dissimilar metals within the valve and no special tools
25 shall be required to service the valve.
26 3. The main operating valve shall be manufactured by the manufacturer of the softening
27 equipment.
28 4. Valve shall be equipped with an internal automatic self-adjusting brine injector to
29 draw brine and rinse at a constant rate regardless of water pressure in the range 30 to
30 100 psi.
31 5. Single units shall have an internal automatic by-pass of untreated water during
32 regeneration. Valve shall have a soft water sampling cock.
33
- 34 E. Control: A factory-mounted and wire cycle controller shall incorporate a water meter
35 demand control system with 2" turbine meter and electronic meter controller with multiported
36 pilot valve to control all steps of automatic regeneration. Water demand controller shall
37 backwash resin based on water volume metered as monitored by microprocessor-based
38 controls including the following functions:
39
- 40 1. Volume of gallons.
41 2. Hardness display in grains.
42 3. Totalizing metering.
43 4. System flow rate in GPM.
44 5. Adjustable regeneration times.
45 6. Delayed or immediate regeneration.
46 7. System diagnostic displays.
47 8. Calendar day override.
48
- 49 F. Flow Control: An automatic flow controller shall be provided to maintain proper backwash
50 and flush rates over wide variations in operating pressures and require no field adjustment.
51
- 52 G. Exchange Resin: The ion exchange resin shall be virgin, high capacity sulfonated
53 polystyrene type stable over entire pH range with good resistance to bead fracture from
54 attrition or osmotic shock.

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1. Each cubic foot of resin shall be capable of removing 30,000 grains of hardness as calcium carbonate when regenerated with 15 lbs. of salt.

H. Brine System: Provide a single brine measuring and dry salt storage tank with salt platform. Size tank for at least four (4) regenerations at full salting. Brine dosage shall be easily adjusted in the field without piping revision.

1. Tank shall be constructed of rigid 3/8" thick rotationally molded polyethylene with cover.
2. The brine tank shall be equipped with a float operated plastic, fitted field serviceable brine valve for automatic control of brine withdrawal and fresh water refill. The brine valve shall provide positive shut-off to prevent air from entering system. High purity pellet type or solar salt is required.

2.5 AIR SEPARATORS

A. Approved Manufacturers: Spirovent.

1. Micro bubble eliminator.
2. Dirt separator.

B. 1-1/2" and Smaller: Cast iron construction with steel diffuser tube, bottom and side threaded inlet connections, bottom and top threaded outlet connections, threaded top connection for air elimination, designed for a maximum working pressure of 125 PSIG.

C. 2" and Larger: Cast iron or welded steel construction, flanged and/or threaded connections, perforated stainless steel air collector tube to direct air toward the air elimination connection at the top of the unit, tangential water inlet and outlet connections, bottom blow down connection, constructed in accordance with ASME boiler and pressure vessel code and stamped for 125 PSIG design pressure.

D. Unless indicated otherwise, provide each unit with a removable galvanized steel system strainer with 3/16" diameter perforations and a free area not less than five times the cross sectional area of the connecting pipe.

2.6 EXPANSION TANKS

A. Bladder Type:

1. Steel construction, tested and stamped in accordance with Section 8D of the ANSI/ASME Code and furnished with the National Board Form U-1, rated for not less than 125 psig working pressure, precharged with air to the initial fill pressure indicated on the drawings.
2. Butyl replaceable bladder suitable for fluid temperatures to 220°F, and furnished with a tank drain connection, system connection, mounting base for vertical installation, prime coated, size/capacity as indicated on the drawings.
3. Tank and bladder construction must allow field replacement of the bladder on its failure.

2.7 GLYCOL FILL TANK/PUMP

A. Provide glycol fill tank with electric pressurizing pump assembly. The fill tank shall be constructed of corrosion resistant material with 18 gallon capacity.

- 1 1. Pump shall have a capacity of 3 to 5 gpm at adjustable discharge pressure set at 12
- 2 psig fill pressure.
- 3 2. Electrical cord for standard 120 volt outlet.
- 4 3. Wessels GMP series or approved equal.

6 **2.8 HIGH PRESSURE WASHER**

- 7
- 8 A. Manufacturer/Model: Aaladin 16-423-SLC or approved equal
- 9
- 10 1. Contractor shall match existing high pressure washer installation for 2nd wash bay.
- 11
- 12 B. Wall-mounted on angle-iron frame with gas-fired bonnet and remote control station at wash
- 13 bay.
- 14
- 15 1. Rated Flow Rate: 4.0 GPM.
- 16 2. Pressure Output: 2300 psig.
- 17 3. Maximum Temperature: 210 deg F.
- 18 4. Natural Gas Input: 415 MBH @ 14" WC.
- 19 5. Flue: 10" diameter sealed vent with backdraft damper.
- 20 5. Electrical: 208 volt/3-phase.
- 21 6. Motor HP: 6 HP
- 22
- 23 C. High Pressure Washer vendor shall be responsible to provide a complete installation
- 24 including all parts for a complete and functioning installation.
- 25
- 26

27 **PART 3 - EXECUTION**

28 **3.1 GENERAL INSTALLATION**

- 29
- 30
- 31 A. Install plumbing equipment where indicated in accordance with manufacturer's
- 32 recommendations. Coordinate equipment location with piping, ductwork, conduit and
- 33 equipment of other trades to allow sufficient clearances. Locate equipment and arrange
- 34 plumbing piping to provide access space for servicing all components.
- 35
- 36 B. Set commercial water heaters and floor-mounted equipment on concrete housekeeping
- 37 pads. Adjust and level equipment.
- 38
- 39 C. Connect equipment to water and drain piping using unions or flanges and isolation valves.
- 40
- 41 D. Size temperature and relief valves per CSA ratings. Pipe temperature and pressure relief
- 42 valves to floor drain or floor as indicated.
- 43
- 44 E. Startup and test equipment adjusting operating and safety controls for proper operation.
- 45

46 **3.2 SOLAR STORAGE TANK**

- 47
- 48 A. Install solar storage tank where indicated in accordance with manufacturer's
- 49 recommendations. Coordinate equipment location with piping and equipment of other trades
- 50 to allow sufficient clearances. Locate equipment and arrange piping to provide access
- 51 space for servicing all components.
- 52
- 53 B. Set storage tanks and booster pumps on supports. Adjust and level equipment.
- 54

1 C. Provide piping, unions, valves, thermometers, relief valves, and all necessary accessories.

2

3 **3.3 IN-TANK WATER-WATER HEAT EXCHANGERS**

4

5 A. Install in-tank water-water heat exchangers where indicated in accordance with
6 manufacturer's recommendations. Coordinate equipment location with piping and equipment
7 of other trades to allow sufficient clearances. Locate equipment and arrange piping to
8 provide access space for servicing all components.

9

10 B. Connect equipment to water piping using unions or flanges and isolation valves.

11

12 **3.4 THERMOSTATIC MIXING VALVES**

13

14 A. Install mixing valves where indicated on the Drawings in accordance with manufacturer's
15 recommendations. Locate equipment and arrange plumbing piping to provide access space
16 for servicing all components.

17

18 **3.5 WATER SOFTENER**

19

20 A. Provide field start-up and inspection of softeners by an authorized service representative.
21 Instruct Owner's personnel in the proper operation and maintenance of the softening system.

22

23 1. Document setup testing and submit report to Owner.

24

25 B. Test water hardness to verify proper working performance. Submit report to A/E.

26

27 C. Set softener equipment on 4" high concrete housekeeping pads by General Contractor.

28

29 **3.6 GLYCOL FILL TANK/PUMP**

30

31 A. Install glycol fill tank/pump where indicated on the Drawings in accordance with
32 manufacturer's recommendations. Locate equipment and arrange plumbing piping to
33 provide access space for servicing all components.

34

35 B. Coordinate glycol solution fill solar installation and adjust fill pressure accordingly.

36

37 1. Document setup testing and submit report to Owner.

38

39 2. Provide Owner training of proper operation for glycol fill tank/pumps.

40 **3.7 HIGH PRESSURE WASHER**

41

42 A. Install high pressure washer where indicated on the Drawings in accordance with
43 manufacturer's recommendations. Locate equipment and arrange plumbing piping to
44 provide access space for servicing all components.

45

46 B. Coordinate high pressure washer installation with HVAC and electrical trades for venting
47 and electrical service requirements.

48

49 C. Complete installation and demonstrate operation of high pressure washer.

50

51 1. Document setup testing and submit report to Owner.

52

53 2. Provide Owner training of proper operation for high pressure washer.

END OF SECTION

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SECTION 22 63 00
WATER TREATMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. This section includes requirements for water treatment related to the following:
1. Closed Loop Treatment System.
 2. Pipe Cleaning and Inhibiting Treatment.
 3. Inhibited Propylene Glycol(closed loop solar system).
- B. Specification of an item in this section shall not relieve the Contractor from providing all items, materials, operations, methods, labor, equipment and incidentals necessary for a complete and functional system.
- C. All services will be performed by a qualified, full-time representative of the water treatment company.
1. Coordinate water treatment with Owner's current water treatment program for compatible chemicals and treatment methods.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
1. 22 06 00 Pipe and Pipe Fittings
 2. 22 70 00 Solar Water Heating Equipment

1.3 SUBMITTALS

- A. Submit product data, installation and operating instructions.

1.4 SUPERVISION AND INSPECTION

- A. Water treatment manufacturer or his qualified representative to provide supervision and final inspection upon completion of installation and adjustment, shall submit report in writing, certifying the correctness of the installation in compliance with the specifications and proper operation.

PART 2 - PRODUCTS

2.1 CLOSED LOOP TREATMENT SYSTEM

- A. Water treatment consists of initial chemical type treatment to clean piping and prevent rust and scale in final fill treated water.
1. Sequestering agent to reduce deposits and adjust pH.
 2. Corrosion inhibitors.

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3. Conductivity enhances.

B. Bypass Feeder: Water treatment consists of bypass pot feeder and initial chemical type treatment to prevent rust and scale. Bypass feeder shall be 5 gallon for solar hot water system with filter sock(25 micron) and stainless steel support cage.

2.2 INHIBITED PROPYLENE GLYCOL

A. Inhibited food-grade propylene glycol-based material specifically designed for use in closed heat transfer systems.

1. Solar system water volume estimated at 50 gallons.

B. Dow Chemical Dowfrost HD, Dowcal 20 or approved equal.

Composite:	94% propylene glycol and 6% performance additives
Color:	Yellow
Specific Gravity:	1.053-1.063
PH of solution:	9.5 – 10.5
Reserve Alkalinity(min.):	15.0 ml
Estimated System Volume:	10 gallons.
GSHP Solution Required:	40% Propylene Glycol
Freeze Protection Required:	-21 °F

PART 3 - EXECUTION

3.1 INSTALLATION

A. Contractor will provide initial fill treatment to each closed-loop system. After this initial treatment, the Owner shall be responsible for all future service requirements.

B. Install in a bypass arrangement at pump discharge as indicated.

C. Furnish start-up chemical treatment chemicals, procedures and certification after installation is complete.

D. After start-up treatment, the treatment company shall be responsible for all water treatment service requirements for one year, to include the following treatment services performed by qualified, full time representatives of the treatment company.

1. Initial water analysis and recommendations.
2. Initial equipment clean-up chemicals, procedures and certification after clean-up is complete.
3. Assistance during start-up of the treatment program.
4. Instructions of operating personnel on proper feeding and control techniques.
5. Periodic service and consultation meetings.
6. Any necessary record forms and log sheets.
7. Any required laboratory and technical assistance.

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3.2 WATER TREATMENT SERVICE PROGRAM

- A. After start-up treatment, the treatment company shall be responsible for all water treatment service requirements for one year, to include the following treatment services performed by qualified, full time representatives of the treatment company.
 - 1. Initial water analysis and recommendations.
 - 2. Initial equipment clean-up chemicals, procedures and certification after clean up is complete.
 - 3. Assistance during start-up of the treatment program.
 - 4. Instructions of operating personnel on proper feeding and control techniques.
 - 5. Periodic service and consultation meetings.
 - 6. Any necessary record forms and log sheets.
 - 7. Any required laboratory and technical assistance.

3.3 PIPE CLEANING AND INHIBITING GUIDELINES

- A. Cleaning: Water piping system shall be cleaned by using a solution consisting of a blend of organic alkaline penetrants, emulsifiers, surfactants and corrosion inhibitors and containing propylene glycol, methyl ether, phosphonates, sodium-meta-silicate-hydrate and sodium hydroxide.
 - 1. The material shall not contain tri-sodium phosphate.
 - 2. The piping system shall be filled, vented and circulated employing the chemical cleaner solution for a period of at least 24 hours or more in accordance with the manufacturer's recommendations and job site chemical tests. Water filters shall be removed from the system for this cleaning. The concentration shall be brought to a level which raises the M Alkalinity to a value of 250 above that for the existing water used for the fill.
 - 3. Chemical tests shall be made to verify these levels and submitted to the A/E. The system should be circulated, drained and flushed to achieve the original M Alkalinity level.
- B. Inhibitor:
 - 1. The inhibitor shall be added to the system after it is acceptably cleaned and flushed and refilled. The inhibitor shall consist of a boron nitrite, benzol thiazol, benzotriazole, mercapto-benzo-thiazole, tolyltriazole silicates and color trace all producing a scale and corrosion inhibitor system. The inhibitor shall be chemically installed to a concentration of 700 to 1000 parts per million and the solution shall be tested to indicate that it falls within this range.
 - 2. Test results shall be submitted to the Engineer/Owner.
 - 3. The strainer baskets may be remounted before the system is inhibited.
- C. Supervision:
 - 1. The chemical supplier shall supervise the addition, the testing of the flushing and draining of all chemical scale and inhibitor solutions for all systems. Three copies of the chemical water status shall be submitted to the A/E for final approval.
 - 2. Cleaning, inhibiting and testing of the piping systems shall be carried out in the presence of the owner's representative.

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3.4 GLYCOL WATER SYSTEMS

- A. Inhibited food-grade propylene glycol system is used for the project glycol solution medium.
- B. Completely flush all traces of cleaning chemicals before adding the glycol water mixture to the system. Verify this by chemical test.
- C. Premix the glycol water solution in a 10 or 20-gallon polyethylene drum to a concentration of approximately 40% by volume. Use distilled or deionized water to make the glycol solution. Use a hand or fill pump to fill system from the mixing tank. Circulate fluid for several hours, vent all high points where air may collect, add more solution to the system, if needed, and test the system for proper concentration of glycol.
- D. Test solution freeze protection with a hand held refractometer to measure the refractive index of the solution. Provide a Refractive Index of 1.3555 for the specified solution.
- E. Pressurize the glycol closed loop to 12 psig at approximately 60-70 °F by temporary make-up fill pump. Adjust expansion tank to 12-psig pressure charge. Let system circulate for 24 hours and recheck system pressure. Repressurize system as needed to 12 psig. Record fill pressures and fill quantities.

END OF SECTION

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PART 2 - PRODUCTS

2.1 GENERAL EQUIPMENT REQUIREMENTS

- A. Solar Collectors and Accessories are furnished by the Owner(City of Madison).
 - 1. Solar collectors shall be transported from storage and moved to the site, assembled and installed by the Plumbing Contractor.
- B. Refer to 22 70 00 Appendix for pictorial, description and quantity of available Shuco solar parts available at no cost to the Plumbing Contractor.
- C. Roofing: Refer to Division 7 roofing requirements for maintaining existing roofing warranty with new penetrations. The Plumbing Contractor shall be responsible for retaining a certified Roofing Contractor to modify existing roofing system to retain existing warranty.

2.2 SOLAR COLLECTOR PANELS SC-1

- A. Shuco USA model CTE 220 CH-2.
- B. Solar Collector bypass dump finned-tube elements: three(3) rows @ 24 ft for each of four(4) solar arrays.
 - 1. Elements: 1"dia CU x 4-1/4"x4-1/4"ALUM x 40 FPF
 - 2. Rating: 900 BTU/HR/LF @ 200 deg F AWT & 100 deg F EAT.
 - 3. Total Solar Dump Capacity: 288 LF @ 900 BTU/HR/LF = 259.2 MBH.

2.3 SOLAR CONTROLS AND SENSORS

- A. Solar System will be controlled by Building Automation System(BAS) as specified in Division 23 Controls.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. Install solar equipment where indicated in accordance with manufacturer's recommendations. Coordinate equipment location with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. Locate equipment and arrange plumbing piping to provide access space for servicing all components.
- B. Connect solar equipment to water and drain piping using unions or flanges and isolation valves.
- C. Startup and test equipment adjusting operating and safety controls for proper operation.

3.2 SOLAR COLLECTORS

- A. Connect interconnecting array piping between solar collectors, in a reverse-return configuration with approximately equal pipe length for any possible flow path.

- 1 Indicate flow rate through the collector array.
2
3 B. Provide each collector bank with isolated by valves and with the capability of being
4 drained.
5
6 C. Locate manually operated air vents at system high points, and pitch array piping so that
7 piping can be drained by gravity. Supply calibrated balancing valves at the inlet of each
8 collector bank as indicated.
9

10 **3.3 SUPPORTS FOR SOLAR ARRAY**

- 11
12 A. Refer to P-series(Plumbing) and S-series(Structural) drawings for related structural
13 requirements.
14
15 B. Provide support structure for the collector array of aluminum, stainless steel, hot dipped
16 galvanized or other corrosion-resistant approved material.
17
18 1. Provide a support structure which allows access to all equipment for maintenance,
19 repair, and replacement.
20 2. Provide neoprene or EPDM washers shall separate all dissimilar metals.
21 3. Coordinate support structure with Structural Engineer prior to ordering or
22 fabricating.
23

24 **3.4 SOLAR CONTROLS AND SENSORS**

- 25
26 A. Install solar controls and sensors where indicated on the Drawings in accordance with
27 manufacturer's recommendations. Locate equipment and arrange to provide access space
28 for servicing all components.
29
30 B. Calibrated solar controls for proper operation. Document setup testing and submit
31 report to Owner. Provide Owner training of proper operation of solar controls.
32
33 C. Operational Test
34
35 1. Operationally test the system over a period of 48 consecutive hours with sufficient
36 solar radiation to cause activation of the solar energy system during daylight
37 hours.
38
39 D. Overall System Operations
40
41 1. Demonstrate each solar energy system will operate properly while unattended for
42 a period of at least 72 hours.
43 2. As required by system design, demonstrate the system controller will start the pumps
44 after being warmed by the sun and that it will properly shut down during cloudy
45 weather or in the evening over a minimum of three complete cycles. It is permissible
46 to manipulate the temperature of the storage tank by the introduction of cold water.
47
48 E. Temperature Sensor Diagnostics
49
50 1. As required by system design, demonstrate the controller will correctly identify
51 open and short circuits on both the solar collector temperature sensor circuit and
52 the storage tank sensor circuit.
53
54

1 **3.5 FIELD TRAINING**

2

3 A. Provide a field training course for operating and maintenance staff members after the
4 system are functionally complete. Include in the training a discussion of the system design
5 and layout and demonstrate routine operation, maintenance and troubleshooting procedures.

6

7

END OF SECTION

Schuco Collectors and Mounting Hardware

	<p>300071 U-600088 Kollektor VerSch1.7 Quantity: 28</p>
	<p>U-6000227 ezStand-Off Flashed L-Bracket Quantity: 90</p>
	<p>U-600248 ezStand-Off Flashed – Short bracket on left is U-6000227 bracket on right is U-600248 (for comparison) Quantity: 76</p>
 <p>Schüco ezClamps</p> <p>(forgot picture)</p>	<p>232034 ezPremium Collector Clamp Quantity: 150</p>



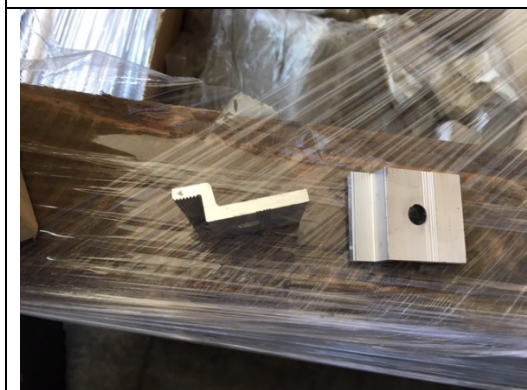
257579
Schuco exClips
Quantity: 100



259748
ezFLAT
Quantity: 50



Flashings
No part number
Quantity: ~75



232034
Collector Clamp
Quantity: unknown

	<p>232131 US Vervinder Set 3/4 Quantity: 20</p>
	<p>257729 T-bolt Set M8x30 A2 Quantity: 125</p>
	<p>231627 Temp Sensor Quantity: 2</p>
	<p>271749 Kollektor Verbinderset 18 Quantity: 60</p>



U-600225
EzFlush Mount Washer
Quantity: 76



231097
Blindst 18 2erVE
Quantity: 6



232068
Manual Air Vent 3/8"
Quantity: 4



221089
Allen Key
Quantity: 7



600158
EZ Rail
Each piece is 20' long
Quantity: 28

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**SECTION 23 05 00
HVAC GENERAL PROVISIONS**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. HVAC work includes:

1. Furnish all labor and materials necessary for the complete installation of heating, ventilating and air conditioning system as shown on the drawings and/or specified herein.
2. Drawings: Refer to H-Series drawings for graphic representations, schedules and notations showing HVAC work.
3. Specifications: Applicable portions of Division 1 govern all work under this Section. Refer to Division 23 Sections for primary technical specifications of HVAC work, as listed below:

23 05 00	HVAC General Provisions
23 05 90	Testing Adjusting and Balancing
23 06 00	Pipe and Pipe Fittings
23 06 30	Piping Specialties
23 09 10	Supports and Anchors
23 10 00	Valves
23 14 00	Pumps
23 20 00	Vibration Isolation
23 25 00	Mechanical Insulation
23 63 00	Water Treatment
23 66 00	Air-Cooled Condensing Units
23 74 00	Terminal Air Distribution Units
23 74 10	Terminal Heating Units
23 75 10	Direct-Fired Makeup Air Heating Units
23 76 30	Air Handling Units
23 82 00	Fans
23 84 00	Ductwork
23 86 00	Ductwork Accessories
23 87 00	Air Outlets and Inlets
23 89 50	Variable Frequency Drives
23 90 00	Controls and Instrumentation
23 91 00	Direct Digital Control Systems
23 95 00	Control Sequence
23 95 10	DDC Point List
23 96 00	Starting of Mechanical Systems

4. HVAC demolition and remodeling.
5. Equipment structural supports, prime painted.
6. Motors for all HVAC equipment.
7. Secure and pay all fee
8. Test, adjust and balance HVAC systems.
9. Cutting and patching existing conditions for HVAC equipment by the HVAC Contractor.
10. Engineer shall provide City of Madison approved HVAC plans for this project and pay plan approval fees. HVAC Contractor shall pay all HVAC permits.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.

1
2 B. General Work by HVAC Contractor :
3

- 4 1. Field painting of all exposed piping, ductwork, hangers, supports and related metal work,
5 unless noted specifically in the Drawings or Specifications herein.
6 2. Building provisions for all recesses and chases intended as equipment space for ductwork and
7 piping in new construction.
8 3. Lintels and openings for ducts and piping through existing walls, floors and ceilings.
9 4. Line voltage (greater than 100 volts) wiring, conduit and connections.
10 5. All equipment starters not furnished as integral part of HVAC equipment.
11 6. All temperature control work as specified, herein.
12

13 D. Coordination of Work:
14

- 15 1. General: Contract Documents are diagrammatic in showing certain physical relationships
16 which must be established within HVAC work, and in its interface with other work including
17 electrical work, and that such establishment is the exclusive responsibility of the Contractor.
18 2. Arrange HVAC work in neat, well organized manner with piping and similar services
19 running parallel with primary lines of building construction, and with minimum of 7 foot
20 overhead clearance where possible.
21 3. Give right-of-way to piping which must slope for drainage.
22 4. Advise other trades of openings required in their work for subsequent move-in of large units
23 of HVAC work.
24 5. Install all sensor wells, dampers and valves provided by the Temperature Control Contractor.
25 6. Flow meters and air transverse stations shall be provided by the Temperature Control
26 Contractor and installed by the HVAC Trade.
27 7. Variable frequency drives(VFD's) shall be provided by the Temperature Control Contractor
28 and installed by the Electrical Trade.
29

30 **1.3 SHOP DRAWINGS AND SAMPLES**
31

- 32 A. The Contractor shall submit to the Architect for approval, shop drawings, giving details, dimensions,
33 capacities, accessories, wiring diagrams, etc., of all materials as indicated in respective specification
34 sections.
35
36 B. All shop drawings shall include proper identification of equipment by name and/or number, as
37 indicated in the specification and/or shown on the plans.
38
39 C. Shop drawings shall be submitted for approval as soon as practicably possible after award of contract.
40 Shop drawings must be approved before installation of materials and equipment. Drawings shall be
41 submitted in accordance with the requirements outlined in Division 1 of the Specifications.
42
43 D. The examination and approval of shop drawings shall not relieve the Contractor from any obligation
44 to perform the work strictly in accordance with the Contract Drawings and Specifications. The
45 responsibility for errors in shop drawings shall remain with the Contractor.
46
47 E. Electronic shop drawing submittals require file labeling to match specification section contained and
48 all equipment identified properly compatible with construction documents. All shop drawings
49 improperly labeled and identified will be returned for corrections.
50

51 **1.4 QUALITY ASSURANCE**
52

- 53 A. Qualifications of Installers: For the actual fabrication, installation and testing of work under this
54 Section, use only thoroughly trained and experienced workmen completely familiar with the items
55 required and the manufacturer's current recommended methods of installation.
56

1 B. In acceptance or rejection of installed work, the Architect will make no allowance for lack of skill on
2 the part of the workmen.

3
4 C. Reference Standards: Specifically, for HVAC work in addition to standards specified in individual
5 work section, the following standards are imposed, as applicable to work in each instance:
6

7	AABC	Associated Air Balance Council
8	ADC	Air Diffusion Council
9	AGA	American Gas Association
10	AMCA	Air Movement and Control Association
11	ANSI	American National Standard Institute
12	ARI	Air Conditioning and Refrigeration Institute
13	ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
14	ASME	American Society of Mechanical Engineers
15	ASTM	American Society of Testing and Materials
16	AWS	American Welding Society
17	IEEE	Institute of Electrical and Electronics Engineers
18	MICA	Midwest Insulation Contractors Association
19	MSS	Manufacturer's Standardization Society
20	NBS	National Bureau of Standards
21	NEBB	National Environmental Balancing Bureau
22	NEC	National Electrical Code
23	NEMA	National Electric Manufacturer's Association
24	NFPA	National Fire Protection Association
25	SMACNA	Sheet Metal and Air Conditioning Contractor's National Association
26	UMC	Uniform Mechanical Code
27	UL	Underwriter's Laboratories
28		All federal, state, local codes, ordinances and utility regulations.

29
30 D. Environmental design conditions for all occupied areas are as follows:

	<u>Winter</u>	<u>Summer</u>
31		
32		
33	Inside: 70 degrees F	74 deg. F 50% RH
34	Outside: -15 degrees F	91 deg. dbF/75 deg. wbF
35		

36 E. Approval of Materials: Refer to General Conditions, Supplementary General Conditions and other
37 requirements of Division 1 for approval of materials and requirements of substituted equipment.
38

39 **1.5 JOB CONDITIONS**

40
41 A. Building Access: Arrange for the necessary openings in the building to allow for admittance of all
42 HVAC equipment.

43
44 B. Temporary Services: No service shall be interrupted or changed without the prior approval of the
45 Owner. Refer to Division 1 requirements.

46
47 C. Compatibility: Provide products which are compatible with other products of HVAC work, and with
48 other work requiring interface with HVAC work. Provide products with proper or correct power
49 characteristics, fuel-burning characteristics and similar adaptation for Project. Coordinate selections
50 from among options for compatibility of products. Design and layout is based on equipment
51 scheduled on drawings or in specifications.

- 52
53 1. Contractor shall coordinate installation of equipment supplied by other approved equal
54 manufacturers and shall make necessary field modifications to allow for installation of this
55 equipment at no additional expense to the Owner.

56
57 D. Record Drawings: Refer to Division 1 requirements.

1
2 **1.6 REMODELING REQUIREMENTS**
3

- 4 A. Prebid Survey: HVAC Contractor shall survey the job site before submitting his bid to determine the
5 extent of areas requiring demolition, relocating and remodeling. The extent of equipment and
6 materials to be removed. Routings for existing and new piping services and systems. Examine
7 accessibility, material storage and working space available.
8
- 9 B. Maintenance of Service: The building will be continuously occupied during the construction period
10 except as noted. Special efforts shall be made to avoid interference with building functions. Consult
11 with the Owner prior to performing work in public areas of building or to turn off services, so that
12 Owner can advise as to most suitable time for the necessary interruptions. All such work and
13 interruptions to services shall be performed at times, which are approved by the Owner.
14
- 15 C. Demolition: Carefully examine the present building site, together with all of the drawings and
16 specifications. Within areas involving remodeling, each Contractor shall be responsible for removal
17 of, relocation of, or revisions to existing equipment, wiring, piping, fixtures and all other existing
18 facilities under appropriate headings of his work, which is necessary to accomplish the final
19 arrangement indicated on the Architect's plans. To assist the Contractor in meeting the above
20 requirement, the drawings note certain of these items, but the absence of such notes shall not limit the
21 responsibility of each Contractor to perform all work as described in this paragraph.
22
- 23 D. Disposition of Demolition Materials and Equipment: Materials demolished or removed shall become
24 the property of the Contractor and shall be removed from the site, except items, which are to be
25 reused or are specifically noted as remaining the property of the Owner.
26
- 27 E. Cutting or Patching Existing Facility:
28
- 29 1. HVAC Contractor will be required to do all remodeling, cutting and/or construction removal
30 and all patching or construction replacement as required for his work except for specific
31 cutting and patching described in the documents as being performed by a specific Contractor.
 - 32 2. HVAC Contractor shall not endanger any work by any demolition, cutting, digging or
33 otherwise. Any cost caused by defective or ill-timed work shall be borne by the contractor
34 responsible.
 - 35 3. HVAC Contractor requiring cutting and patching shall hire men skilled in such cutting and
36 patching to do the work.
 - 37 4. All new work in existing areas shall match existing work in material, quality, texture, finish
38 and color unless specifically noted or scheduled otherwise.
39

40 **1.7 DEMOLITION**
41

- 42 A. The Contractor is responsible for removal and relocation of all existing HVAC equipment and related
43 items affected by the remodeling area.
44
- 45 B. To assist the Contractor in meeting the above design intent, the drawings note certain of these items,
46 but the absence of such notes shall not limit responsibility of the Contractor to perform all demolition
47 work as required to accomplish new design plan.
48
- 49 C. Contractor shall coordinate his remodeling efforts with the building functions and avoid interference
50 wherever possible. All such interruptions of existing services shall be performed at times which are
51 approved by the Postmaster.
52
- 53 D. Interruption of domestic water service during the course of demolition and new work shall be
54 minimized. Interruptions of domestic water service shall be coordinated and approved by the
55 Postmaster, prior to disconnecting or turning off.
56

- 1 E. All existing demolished or removed equipment shall be removed from site and disposed of properly at
2 the cost of the Contractor.
3
4

5 **PART 2 - PRODUCTS**

7 **2.1 ELECTRICAL PROVISIONS OF HVAC WORK**

- 8
9 A. General: The electrical provisions of HVAC work, where indicated to be furnished integrally with
10 HVAC equipment, can be summarized, but not by way of limitation, to include the following: 1)
11 Motors, 2) Motor starters, 3) Control switch, pilot lights, interlocks, and similar devices, and 4) Drip
12 pans to protect electrical work.
13
14 1. Temperature Control Contractor (T.C.C.) shall furnish and install control wiring as part of the
15 Temperature Control Contractor work.
16 2. Power wiring, connections to equipment, motor control wiring and related work by Electrical
17 Contractor.
18 3. Motor starters, disconnects, relays, pushbuttons, pilot lights and related motor control items
19 not furnished integrally with HVAC equipment shall be furnished by Electrical Contractor.
20 4. Provide equipment list, locations and wiring diagrams to Electrical Contractor for all HVAC
21 equipment requiring electrical connections.
22
23 B. Motors:
24
25 1. Standards: Where not otherwise indicated, comply with applicable provisions of the NEC,
26 NEMA Standards, and sections of Division 16 of specifications. All motors 1 HP and larger
27 shall be NEMA Premium Efficiency motors meeting or exceeding values tested in accordance
28 with IEEE Standard 112, Method B procedures as stated in NEMA MG 1-12.53a and shall be
29 EPACT approved.
30 2. Temperature Rating: Class B insulation for 70 degree C temperature rise, except where
31 otherwise indicated or required for service.
32 3. Phases and Current: 1/6 HP and smaller is Contractor's option; up to 1/2 HP, capacitor-start,
33 120 or 277 volt, 60 cycle single-phase; 1/2 HP and larger, squirrel-cage induction NEMA
34 rated 208 or 477 volt, three-phase, 60 cycle.
35 4. Service Factor: 1.15 for motors in drip-proof enclosures, all other enclosures to have
36 minimum 1.0 service factor.
37 5. Construction: Select motors for conditions in which they will be required to perform: i.e.,
38 general purposes, splash proof, explosion proof, standard duty, high torque or other special
39 type as required by manufacturer's recommendations. Enclosures shall be of the type
40 recommended by manufacturer for the specified application.
41 6. Frames: NEMA Standard for horsepower specified.
42 7. Bearings: Permanently lubricated and sealed ball bearings, 1/8 HP and less may be shaded
43 pole type permanently oiled unit bearings.
44 8. Overload Protection: Built-in thermal; with internal sensing device for stopping motor, and
45 for signaling where required.
46 9. Provide split-ring shaft grounding on all motors controlled by VFD drives.
47
48 C. Starters, Switches: All starters shall have thermal overload and low voltage protection, and shall
49 comply with Electrical Division 26 sections of specifications.
50
51 D. Wiring Connections:
52
53 1. Motors: Wired connections in flexible conduit, except where plug-in electrical cords are
54 indicated and permitted by governing regulations.
55 2. General Wiring: Comply with applicable provisions of Electrical Division 16 sections of
56 specifications.
57

- 1 E. Drip Pans: Furnish drain pans below piping which passes directly above electrical work. Locate pan
2 immediately below piping and extend a minimum of 6 inches on each side of piping and lengthwise
3 18 inches beyond equipment. Fabricate of galvanized sheet metal or copper with 2 inch deep
4 watertight pan, copper drain piping and drain valve
5

6 **2.2 FLOOR, WALL, ROOF AND CEILING OPENINGS**

7

- 8 A. Provide sleeves for pipes and ducts passing through masonry, concrete or other similar construction.
9 Openings for pipes shall be 1" larger in diameter than pipe passing through, including insulation,
10 where indicated. Openings for ductwork shall be 1/2" larger on all sides than size of duct passing
11 through, including duct insulation, where indicated. Coordinate additional space requirements for fire
12 or smoke damper installation.
13

- 14 1. Pipe sleeves: Standard weight steel pipe.
- 15 2. Duct sleeves: 24 gauge galvanized sheet metal, unless noted otherwise.
16

- 17 B. Grout openings between sleeves and concrete or masonry walls and floors with sand-cement mortar
18 consisting of one part portland cement and three parts sand, by volume. Add sufficient water to make
19 a stiff placeable mortar.
20

- 21 C. Close joints between sleeves and non-masonry walls and floors with suitable caulking applied over
22 polyethylene foam backer, compatible with caulking used.
23

- 24 D. Pack annular space between sleeves and insulation pipe or ducts with glass fiber blanket insulation
25 and seal with Urethane caulking compound.
26

- 27 E. Where penetrations occur through fire rated walls or floors, fill annular space with fire-resistive
28 materials in compliance with a UL approved fire rated assembly. Seal annular space through fire
29 rated walls or floors with a UL listed fire resistant sealant and materials in conjunction with the fire
30 rated assembly.
31

32 **2.3 CUTTING AND PATCHING**

33

- 34 A. General: Perform all cutting and patching required for complete installation of HVAC systems,
35 unless specifically noted otherwise. Provide all materials required for patching unless otherwise
36 noted. All cutting and patching necessary of structural members to install any HVAC work shall not
37 be done without permission, and then only carefully done under the direction of the Architect.
38

- 39 B. All new work cut or damaged shall be patched and restored to its original condition.
40

41 **2.4 EQUIPMENT ACCESS**

42

- 43 A. General: All valves, volume dampers, equipment and accessories shall be installed to permit access
44 to equipment for maintenance, servicing or repairs. Any relocation of piping ductwork, equipment or
45 accessories required to provide maintenance access shall be accomplished by the HVAC Contractor at
46 no additional cost to the Owner.
47

- 48 B. Provide access doors where equipment is located in chases or generally inaccessible. Access doors
49 used in fire-rated construction must have UL label. Minimum access panel size 12" x 12" or of
50 sufficient size to allow total access for maintenance. Coordinate location with General Contractor.
51

- 52 C. Access panels shall be furnished and installed by the HVAC Contractor in plaster walls, ceilings and
53 related inaccessible surfaces.
54

- 55 D. Access Doors: Milcor or approved equal, steel frames and door, prime coated, except stainless steel
56 in areas subject to excessive moistures, such as toilet rooms.
57

1 **2.5 EQUIPMENT SUPPORTS**

- 2
3 A. General: Provide all supporting steel and related materials not indicated on structural drawings as
4 required for the installation of equipment and materials, including angles, channels, beams and
5 hangers.
6

7 **2.6 EQUIPMENT GUARDS**

- 8
9 A. General: Provide equipment guards over belt-driven assemblies, pump shafts, exposed fans and
10 elsewhere, as indicated in this specification or required by code.
11

12 **2.7 CONCRETE FOR HVAC WORK**

- 13
14 A. General: All concrete work necessary for HVAC equipment by the HVAC Contractor.
15
16 B. General Standards: Except as otherwise indicated, comply with applicable provisions of Division 3
17 for concrete work.
18
19 C. Concrete Equipment Pads: For each piece of HVAC equipment as indicated on the drawings, arrange
20 to install a 4" concrete housekeeping pad a minimum of 2 inches wider than full size of the respective
21 equipment's base. Equipment pads are required for the following equipment.
22
23 1. Floor-mounted Air Handling Units.
24 2. Floor-mounted Fans.
25

26 **2.8 PAINTING HVAC WORK**

- 27
28 A. General: All painting of mechanical equipment will be done by the HVAC Contractor unless
29 equipment is hereinafter specified to be furnished with factory applied finish coats. Coordinate the
30 exterior finish painting and color of exterior HVAC equipment with the General Contractor.
31
32 1. Exposed ductwork in finished areas outside mechanical rooms shall be cleaned for accepting
33 a paint finish or have factory-applied paint grip finish.
34 2. Exposed ductwork scheduled for a paint finish shall be shop painted from a finish color
35 selected by the Owner.
36
37 B. Prime paint all field fabricated metal work under HVAC work, comply with applicable provisions of
38 Division 9.
39
40 C. All equipment shall be provided with factory applied prime finish, unless otherwise specified.
41
42 D. Interior duct surfaces, dampers and other accessories visible through grilles, registers and diffusers
43 shall be painted with flat black paint.
44
45 E. If factory finish on any equipment is damaged in shipment or during construction of the building, the
46 equipment shall be refinished by the Contractor to the satisfaction of the Architect.
47

48 **2.9 HVAC SYSTEM IDENTIFICATION**

- 49
50 A. General: Provide adequate marking of HVAC system and control equipment to allow identification
51 and coordination of maintenance activities and maintenance manuals. Tag and label HVAC
52 equipment located in exposed or in accessible areas to conform to ANSI A13.1-1981. After painting
53 and/or covering is complete, identify all equipment, piping and ductwork by its abbreviated generic
54 name as shown/scheduled/specified.
55
56 B. Equipment: Identify all major HVAC equipment with plastic-laminate signs or 2" minimum high
57 painted stencils and contrasting background. Provide text of sufficient clarity and lettering to convey

adequate information at each location and mount permanently. Identify control equipment by 1-1/2" x 4" plastic nameplates with 1/2" high lettering.

C. Piping and Ductwork: Identify piping and ductwork once every 30 feet at each branch, at termination of lines, and near valve or equipment connections. Place flow directional arrows at each pipe or duct identification. Provide 2" minimum high letters on wrap-around siphonage, adhesive-backed or paint stenciled.

1. Within boiler room provide piping identification every 10 feet and at each branch and termination.

D. Valves: Identify all valves with 1-1/2" minimum polished brass stamp-engraved or plastic laminate tags. Prefix or color-code tags for each generic piping service. Prepare and submit valve tag schedule, listing location, service and tag description, incorporate in Instruction Manual. Mount valve tag schedule behind glass in mechanical room at location determined by Owner.

E. Operational Tags: Where needed for proper or adequate information on operation and maintenance of HVAC systems, provide tags of plasticized or laminated card stock, typewritten to convey the message.

PART 3 - EXECUTION

3.1 HVAC WORK CLOSEOUT

A. Lubrication: Upon completion of the work and before turning over to the Owner clean and lubricate all bearings except sealed and permanently lubricated bearings. Use only lubricant recommended by the manufacturer.

B. Contractor is responsible for maintaining lubrication of all mechanical equipment under his contract until work is accepted by the Owner.

C. Cleaning: After installation has been completed, Contractor shall clean all systems. All piping and ductwork shall be cleaned both internally and externally to remove all dirt, plaster dust or other foreign materials. All temporary throwaway or replaceable media air filters used during the construction period shall be replaced by new filters or new filter media after construction has been completed and before the building is turned over to the Owner. Check all strainers for clean screens.

D. All dirt, plaster dust and other foreign matter shall be blown and/or vacuum cleaned from coils, terminal devices, diffusers, registers and grilles. Equipment shall be thoroughly cleaned of all stains, paint spots, dirt and dust.

E. Housecleaning and Cleanup: Periodically as work progresses and/or as directed by the Architect, the Contractor shall remove waste materials from the building and leave his area of work broom clean. Upon completion of work, remove all tools, scaffolding, broken and waste materials, etc., from the site.

3.2 INSTRUCTION AND MAINTENANCE MANUALS

A. Instruction Manuals: Upon completion of work, but before final acceptance of the system, furnish to the Engineer for approval, three (3) instruction and maintenance manuals in loose leaf binders. One approved copy shall be returned for use during instructional period. Manual shall have an index of contents and tab for each piece of equipment or system, as well as the following:

1. Manufacturer's O&M instructions, parts list and data sheets.
2. Copies of all shop drawings.

3. Wiring diagrams.
4. Start-up and shutdown procedures.
5. Composite electrical diagrams, and flow diagrams.
6. Test records.

C. Equipment Parts Lists: Include a complete list of all equipment furnished for project, with a tabulation of descriptive data of all the equipment replacement parts proposed for each type of equipment or system. Properly identify each part of part number and manufacturer.

D. Instruct Owner's maintenance personnel in the operation and maintenance of all equipment, including composite operating cycle of all equipment. Include not less than 8 hours of instruction, using the O&M manuals during this instruction. Demonstrate startup and shutdown procedures for all equipment.

E. Service Organizations: At time of substantial completion, Contractor shall provide Owner with listing of qualified service organizations, including addresses and telephone numbers for each piece of major equipment.

3.3 RECORD DRAWINGS

A. Refer to Division 1 for further requirements.

B. Maintain a record set of as-built drawings for all HVAC work performed. As-built drawings shall be continuously updated as the project progresses and be available for periodic inspection by the A/E.

3.4 GUARANTEE PERIOD

A. Guarantee all equipment, materials, and workmanship to be free from defects for one year after acceptance by the Owner. Repair, replace or alter systems found defective at no extra cost to the Owner.

B. At the time of substantial completion, turn over the prime responsibility for operation of HVAC equipment and systems to the Owner's operating personnel. During guarantee period, provide one operating engineer, familiar with the work, to consult with and continue training Owner's personnel on an as-need basis.

END OF SECTION

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SECTION 23 05 90
TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. General Requirements: Contractor shall be responsible for providing complete test-adjust-balance (TAB) work of all hydronic and air systems including distribution systems and the equipment and apparatus connected.
- B. Work Included:
 - 1. The extent of TAB work is indicated by the requirements of this section, and also by drawings and schedules, and is defined to include, but is not necessarily limited to, hydronic and air distribution systems, and associated equipment and apparatus of HVAC work.
 - 2. The work consists of setting speed and volume (flow) adjusting facilities provided for the systems, recording data, conducting tests, preparing and submitting reports, and recommending modifications to the work as required by the Contract Documents.
 - 3. The component types of testing, adjusting and balancing specified in this section include but are not limited to the following HVAC equipment:
 - a. Air handling units and variable volume terminals.
 - b. Hydronic distribution.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 06 00 Piping Specialties
 - 2. 23 74 00 Terminal Air Distribution Units
 - 3. 23 75 10 Direct-Fired Makeup Air Heating Units
 - 4. 23 76 30 Air Handling Units
 - 5. 23 89 50 Variable Frequency Drives
 - 6. 23 90 00 Controls and Instrumentation
 - 7. 23 96 00 Starting of Mechanical Systems

1.3 QUALITY ASSURANCE

- A. Tester: Performed by an Independent Trade who is specifically and actively engaged in the balancing business and regularly does such work. Certified by the NEBB (National Environmental Balancing Bureau), AABC (Associated Air Balance Council) or approved equal in those testing and balanced disciplines similar to those required for this project.
- B. Reference Standards: Comply with AABC's Pub. No. 12173, "National Standards for Field Measurements and Instrumentation, Total System Balance", as applicable to HVAC air and hydronic distribution system and associated equipment and apparatus.
- C. Industry Standards: Comply with ASHRAE recommendations pertaining to measurements, instruments and testing, adjusting and balancing, except as otherwise indicated.
- D. Submittals:

- 1
2 1. Submit six (6) certified test report and types of instruments used and their most recent
3 calibration data with submission of final test report.
4 2. Final test report shall bear the name of the person who recorded the data and the seal of the
5 supervisor of the balancing trade.
6
7 E. Guarantee: Guarantee that all TAB work be performed in accordance with NEBB or AABC
8 standards and that all air systems operate within plus or minus 10 percent of the design flow rates as
9 shown on the plans and/or as scheduled.

10
11 **1.4 JOB CONDITIONS**

- 12
13 A. Do not proceed with testing, adjusting and balancing work until the work to be TAB'ed has been
14 completed and is operable. Ensure that there is no latent residual work still to be completed.
15
16 1. Do not proceed until the work scheduled for TAB'ing is clean and free from debris, dirt and
17 discarded building materials.
18
19

20 **PART 2 - PRODUCTS**

21
22 **2.1 MATERIALS**

- 23
24 A. Patching Materials:
25
26 1. Except as otherwise indicated, use same products as used by original Installer for patching
27 holes in insulation, ductwork and housing which have been cut or drilled for test purposes,
28 including access for test instruments, attaching jigs, and similar purposes.
29 2. At Tester's option, plastic plugs with retainers may be used to patch drilled holes in ductwork
30 and housing.
31
32 B. Test Instruments: Utilize test instruments and equipment for the TAB work required, of the type,
33 precision and capacity as recommended for the following TAB standards: AABC's National
34 Standards for Field Measurements and Instrumentation, Total Balance System.
35
36

37 **PART 3 - EXECUTION**

38
39 **3.1 ADJUSTMENT AND TESTING**

- 40
41 A. Tester must examine the installed work and conditions under which testing is to be done to ensure
42 that work has been completed, cleaned and is operable. Notify the Contractor in writing of conditions
43 detrimental to the proper completion of the test-adjust-balance work. Do not proceed with the TAB
44 work until unsatisfactory conditions have been corrected in a manner acceptable to the Tester.
45
46 B. Test, adjust and balance the environmental systems and components, as indicated, in accordance with
47 the procedures outlined in the applicable standards.
48
49 C. Prepare report of the test results including instrumentation calibration reports in format recommended
50 by the applicable standards.
51
52 D. Patch holes in insulation, ductwork and housings, which have been cut or drilled for test purposes, in
53 a manner recommended by the original Installer.

- 1 E. Mark equipment settings, including damper control positions, valve indicators, fan speed control
2 levers, and similar controls and devices, to show final settings at completion of TAB work. Provide
3 markings with paint or other suitable permanent identification materials.
4

5 **3.2 AIR SYSTEMS**

6

- 7 A. Test, adjust and balance systems in accordance with the following procedure:
8

9 1. Preliminary:

- 10 a. Identify and list size, type and manufacturer of all equipment to be tested, including
11 air terminals; check all system components for proper installation and operation.
12 b. Use manufacturer's ratings for all equipment to make required calculations except
13 where field test shows ratings to be impractical.
14 c. Verify that all instruments are accurately calibrated and maintained.
15 d. Install clean filters furnished by the mechanical contractor in all equipment.

16 2. Central System:

- 17 a. Test, adjust and record supply fan RPM design requirements within limits of
18 mechanical equipment provided.
19 b. Test and record motor voltage and running amperes including motor nameplate data
20 and starter heater ratings.
21 c. Make Pitot tube traverse of main supply, return and fresh air return ducts, determine
22 and record CFM at fan and adjust fan to design CFM.
23 d. Test and record total system static pressure and suction and discharge static pressure
24 across coils, filters and related air handling sections.
25 e. Test and adjust systems for design recirculated air; CFM.
26 f. Test and record cooling apparatus entering air temperatures; dry bulb and wet bulb.
27 g. Test and record heating apparatus entering and leaving air temperatures; dry bulb.

28 3. Each Fan:

- 29 a. Each outlet and inlet average velocity, area, CFM.
30 b. Test and record total system static pressure at suction and discharge of fan coils.
31 c. Fan RPM motor RPM.
32 d. Motor name plate current testing.
33 e. Motor current draw.

34 4. Distribution: Adjust zones or branch ducts to proper design CFM, supply; return and
35 exhaust.

36 5. Air Terminals:

- 37 a. Identify each air terminal from reports as to location and determine required flow
38 reading.
39 b. Test, adjust and balance each air terminal to within 10% of design requirement.
40 Record readings.
41 c. Set minimum and maximum flow rates for VAV terminals at specified supply duct
42 pressures and 90% system diversity(10% terminal units at minimum flow rate).

43 6. Verification:

- 44 a. Prepare summation of reading of observed CFM for each system, compare with
45 required CFM and verify that values are within 10% of specified quantities.
46 Determine final coil and filter static pressure drops.
47 b. Verify design CFM at fans as described above.
48

49 **3.3 HYDRONIC SYSTEMS**

50

- 51 A. Test, adjust and balance system in accordance with following procedures:
52

53 1. Preliminary:

- 1 a. List all mechanical specifications of tested equipment verify against contract
- 2 documents. Check all system components for proper installation and operations.
- 3 Clean all screens.
- 4 b. Open all line valves to full open position. Close coil bypass stop valves, then set
- 5 mixing control valve to full coil flow.
- 6 c. For each pump, verify rotation, test and record pump shut-off head and test and
- 7 record pump wide-open head.
- 8 d. Verify proper water level in expansion tanks and in the system.
- 9 e. Verify that air vents in high points of water systems are installed and operating
- 10 freely.
- 11 f. Verify that all instruments are accurately calibrated and maintained.
- 12 2. Central Equipment:
- 13 a. Set and record hot water pumps to proper flow quantity.
- 14 b. Adjust and record flow of hot and chilled water through boilers and chiller equipment
- 15 to design quantities.
- 16 c. Observe and record leaving water temperature and return water temperatures at
- 17 boiler, chiller equipment and zone water distribution loops. Reset to correct design
- 18 temperatures.
- 19 d. Record pump operating suction and discharge pressures. Determine final dynamic
- 20 head.
- 21 3. Distribution:
- 22 a. Balance and record flow to each hot and chilled water hydronic zone and terminal
- 23 unit. For heating mode and cooling mode (chiller).
- 24 b. Adjust and record terminal unit flow rates and pressure drops.
- 25 c. Adjust and record coil flow rates and pressure drops. Verify entering and leaving
- 26 water temperatures at coil terminals.
- 27

28 3.4 AUTOMATIC CONTROL SYSTEM

- 29
- 30 A. Temperature control manufacturer's representative sets and adjusts automatically operated devices to
- 31 achieve required sequence of operations.
- 32
- 33 B. Testing organization verifies all controls for proper calibration and list those controls requiring
- 34 adjustment by temperature control system installer.
- 35

36 **END OF SECTION**

37

**SECTION 23 06 00
PIPE AND PIPE FITTINGS**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of pipe and pipe fitting work is indicated on drawings and by the requirements of this section.
- B. Types of pipe and pipe fittings required for this project include the following:
 - 1. Heating hot water.
 - 2. Refrigerant piping.
 - 3. Make-up water.
 - 4. Condensate and drainage.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 05 00 HVAC General Provisions
 - 2. 23 06 30 Piping Specialties
 - 3. 23 09 10 Supports and Anchors
 - 4. 23 10 00 Valves
 - 5. 23 63 00 Water Treatment

1.3 QUALITY ASSURANCE

- A. American National Standards Institute, ANSI:
 - 1. B31.1: Power Piping.
- B. Welder Qualifications:
 - 1. Prior to starting any metallic welding, Contractor shall submit his Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section IX of the ASME Boiler and Pressure Vessel Code and/or the National Certified Pipe Welding Bureau.
- C. Employ piping materials meeting the latest revision of ASTM specifications as listed in this specification.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Where possible, store pipe and tube inside and protected from weather. When necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.
- B. Prevent dirt and construction debris from accumulating inside the pipe and pipe fittings, cap open ends whenever possible. Store plastic pipe out of direct exposure to sunlight and support to prevent sagging and bending.

1
2 **1.5 SUBMITTALS**

- 3
4 A. Submit schedule of pipe and pipe fittings showing manufacturer and catalog number.
5
6 B. Submittal may be in the form of a typewritten list, with proper references, indicating service and pipe
7 or pipe fitting specifications.
8
9

10 **PART 2 - PRODUCTS**

11
12 **2.1 HOT WATER SYSTEM**

13
14 A. 2" and smaller:

- 15
16 1. ASTM A-53 Type F, standard weight, schedule 40, black steel pipe with class 125, standard
17 weight cast iron threaded fittings.
18 2. ASTM B88 seamless, Type L, hard temper copper tube with wrought copper 95-5 solder-
19 joint fittings.
20 3. Mechanical compression type fittings with integral o-ring seal, Viega ProPress or approved
21 equal.
22 4. Rated PEXa piping may provided from copper manifolds to terminal unit reheat coils.
23

24 B. 3" and larger:

- 25
26 1. ASTM A-53, standard weight, schedule 40, black steel pipe with standard weight,
27 class 150, seamless, carbon steel weld fittings.
28

29 **2.4 WELDED FITTINGS**

- 30
31 A. Weld-o-lets will be permitted in lieu of welding tees where the branch line is at least two sizes smaller
32 than the main line. Field installations of Weld-o-lets are permitted only where inside of pipes are
33 cleaned after welding.
34
35 B. Pipe ends for welding shall be carefully prepared, in accordance with ANSI Standards, to insure
36 proper weld preparation.
37
38 C. Long radius, butt-welding elbows shall be used at all changes in direction.
39

40 **2.2 REFRIGERATION PIPING**

- 41
42 A. ASTM B88 seamless, Type L, ACR hard temper copper tube with flare-type fittings or wrought
43 copper ANSI/ASTM B32 grade 96TS silver-lead solder-joint fittings. Frost proof flare nuts on
44 suction piping.
45
46 1. Refrigerant grade tubing; cleaned, dehydrated and capped.
47 2. Soft temper ACR copper tube line sets may be used on units less than 5 tons.
48

49 **2.3 MAKE-UP WATER**

- 50
51 A. ASTM B88 seamless, Type L, hard temper copper tube with wrought copper 95-5 solder-joint
52 fittings.
53

54 **2.4 CONDENSATE AND DRAINAGE**

1
2 A. 1-1/4" and smaller: Schedule 40 PVC or copper tube, type L piping; protect from foot traffic and
3 physical damage. Solvent or solder weld drainage pattern fittings.

4
5 B. 1-1/2" and greater: Schedule 40 galvanized piping, threaded galvanized fittings.

6
7 **2.5 DIELECTRIC UNIONS**

8
9 A. 1-1/4" and smaller: ASTM A197/ANSI B16.3 WOG malleable insulating unions with vulcanized
10 fiber insulating sleeve and neoprene gasket, equal to Stockam Figure 693-1/2, or EPCO model FX or
11 FB
12 dielectric unions with Epconite No. 2 gasket, 250 PSIG at 210 degrees F.

13
14 B. 1-1/2" and larger: EPCO model GX dielectric flange with Epconite No. 2 gasket, 175 PSIG at 210
15 degrees F.

16
17 C. Clear flow dielectric fittings may be used in lieu of dielectric unions for pipe sizes 2" and smaller.

18
19 **2.5 UNIONS AND FLANGES**

20
21 A. 2" and smaller:

- 22
23 1. ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron
24 on black steel piping and galvanized malleable iron on galvanized steel piping. Copper
25 unions with all copper piping. Stainless steel unions with all stainless steel pipings.
26 2. Use unions of a pressure class equal to or higher than specified for the fittings of the
27 respective piping service.

28
29 B. 2-1/2" and larger:

- 30
31 1. ASTM A181 or A105, grade 1 hot forged steel flanges of threaded welded neck, or slip-on
32 pattern. Use raised face flanges ANSI B16.5 for mating with other raised face flanges or
33 equipment with flat ring or full face gaskets.
34 2. Use ANSIN B16.1 flat face flanges with full face gaskets for mating with other flat face
35 flanges on equipment.
36 3. Use pressure class compatible with that specified for valves, piping specialties and fittings of
37 the respective piping service. Gasket material to be suitable for pressures and temperatures of
38 the piping system.
39 4. ASTM A516 grade 60/ANSI B16.5 cold formed steel flanges will be acceptable.

40
41
42 **PART 3 - EXECUTION**

43
44 **3.1 PREPARATION**

45
46 A. Set pipe on end and hammer sides to remove foreign materials before erection. Ream ends of all
47 piping to remove burrs.

48
49 **3.2 ERECTION**

50
51 A. Install all piping parallel to building walls and ceilings and at such heights not to obstruct any portion
52 of window, doorway, stairway, or passageway. Where interferences develop in the field, offset or
53 reroute piping as required to clear such interferences. In all cases, consult drawings for exact location

1 of pipe spaces, ceiling heights, door and window openings or other architectural details before
2 installing piping.

- 3
- 4 B. Provide anchors, expansion joints, swing joints and expansion loops so that piping may expand and
5 contract without damage to itself, equipment or building.
- 6
- 7 C. Mitered ells, notches tees and "orange peel" reducers are not acceptable. On threaded piping,
8 bushings are not acceptable.
- 9
- 10 D. "Weld-o-lets" and "Thread-o-lets" may be used for branch takeoff up to one half (1/2) the diameter of
11 the main.
- 12
- 13 E. Install drains throughout the systems to permit complete drainage of the entire system.
- 14
- 15 F. Do not install piping through dedicated electrical rooms or spaces unless the piping is serving this
16 room or space.
- 17
- 18 G. Install 2" deep galvanized sheet metal drain pans below piping which passes over electrical switching
19 apparatus. Pipe drain pans to an accessible location with a drain valve and hose bibb adapter such
20 that the system may be drained without damage to other equipment, insulation or finished spaces.
- 21
- 22 H. Install all valves, control valves and piping specialties, including items furnished by others, as
23 specified and/or detailed. Make connections to all equipment installed by others where that
24 equipment requires the piping services indicated in this section.
- 25

26 **3.3 INSTALLATION OF PIPE**

- 27
- 28 A. Run pipe lines straight and true, parallel to building lines with minimum use of offsets and couplings.
- 29
- 30 B. Provide only such offsets as may be required to provide necessary head room or clearance and to
31 provide necessary flexibility in pipe lines.
- 32
- 33 C. Changes:
- 34
- 35 1. Changes in direction of pipe lines made only with fittings or pipe bends.
- 36 2. Changes in size shall be made only with fittings.
- 37 3. Do not use miter fittings, face of flush bushings or street elbows.
- 38 4. All fittings of long radius type, unless otherwise indicated.
- 39
- 40 D. Use full and double lengths wherever possible:
- 41
- 42 1. Cut pipe to exact measurement and install without springing or forcing except in case of
43 expansion loops where cold springing is indicated.
- 44 2. Take particular care to avoid creating, even temporarily, undue loads, forces, or strains on
45 valves, equipment or building elements either piping connections or piping supports.
- 46
- 47 E. Install piping to allow for expansion and contraction without stressing pipe or equipment connected.
- 48
- 49 F. Provide clearance for installation of insulation and for access to valves, air vents, drains, and unions.
- 50
- 51 G. Sizing:
- 52

1. Unless otherwise indicated, install all supply piping, including shut-off valves and strainers, to coils, pumps, and other equipment at line size with reduction in size being made only at inlet to control valve or pump.
2. Install supply piping from outlet of control valve at full size connection in equipment served.
3. Install outlet piping including dirt pockets or mud legs from equipment full size of connection in equipment served.
4. Install piping, check valves, strainers, and shut-off valves in these equipment outlet or return lines beyond dirt pockets size of tapping in trap or if no trap, size of equipment connection.

H. Make reductions in water pipes with eccentric reducing fittings installed to provide drainage and venting.

I. Branch Take-Offs:

1. Liquids: From top, bottom, or side of mains or headers at either 45 degrees or 90 degrees from horizontal plane.
2. Use main sized saddle type branch connections or directly connecting branch lines to mains in steel piping if main is at least 1 pipe size larger than branch for up to 6 inch mains.
3. Do not project branch pipes inside main pipe.
4. Provide flanges or unions at all final connections to equipment, traps and valves to facilitate dismantling.
5. Arrange piping and piping connections so that equipment being served may be serviced or totally removed without disturbing piping beyond final connections and associated shut-off valves.

J. Pipe Drainage Provision:

1. Slope water piping 1 inch in 40 feet and arrange to drain at low points.
2. Closed Systems:
 - a. Equip low points with 3/4 inch valves and hose nipples.
 - b. At high points, provide collecting chambers and high capacity float-operated automatic air vents or manual air vents.

3.4 WELDED PIPE JOINTS

- A. Make all welded joints by fusion welding in accordance with ASME Code, ANSI B31 and the State Codes where applicable.
- B. Electrodes shall be Lincoln, or similar, with coating and diameter as recommended by the manufacturer for the type and thickness of work being done.

3.5 THREADED PIPE JOINTS

- A. Cut threads so that no more than three threads remain exposed after the joint is made. Ream all pipe ends after cutting and clean before erection. Use a thread lubricant when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.6 COPPER PIPE JOINTS

- A. Remove all slivers and burrs remaining from the tube cut by reaming and filing both pipe surfaces. Clean fitting and tube with emery or sand cloth. Remove residue from the cleaning operation, apply flux and assemble joint. Use solder or brazing to secure joint as specified for the specific piping service.

1 **3.7. MECHANICAL GROOVED PIPE CONNECTIONS**

- 2
- 3 A. Use pipe factory grooved in accordance with the coupling manufacturer's specifications or field
- 4 grooved pipe in accordance with the same specifications using specially designed tools specially
- 5 designed for the application.
- 6
- 7 B. Lubricate pipe and coupling gasket, align pipe, and secure joint in accordance with the coupling
- 8 manufacturer's specifications.
- 9

10 **3.8 WATER SYSTEMS**

- 11
- 12 A. Pitch horizontal mains up at 1 inch in 40 feet in the direction of flow. Install manual air vents at all
- 13 high points where air may collect. If vent is not in an accessible location, extend air vent piping to
- 14 the nearest code acceptable drain location with vent valve located at the drain.
- 15
- 16 B. Main branches and runouts to terminal equipment may be made at the top, side or bottom of the main
- 17 provided that there are drain valves suitably located for complete system drainage and manual air
- 18 vents are located as described above.
- 19
- 20 C. Use top connection to main for upfeed risers and bottom connection to main for downfeed risers.
- 21 Connections at a main may be made with a tee and a 45 degree elbow.
- 22
- 23 D. Use a minimum of two elbows in each pipe line to a piece of terminal equipment to provide flexibility
- 24 for expansion and contraction of the piping system. Offset pipe connections at equipment to allow
- 25 for service, such as removal of the terminal device.
- 26
- 27 E. Use eccentric fittings for changes in horizontal pipe sizes with the fittings installed for proper air
- 28 venting. Concentric fittings may be used for changes in vertical pipe sizes.
- 29
- 30 F. When other specification sections or piping details do not require a strainer upstream of each control
- 31 valve, install bottom connections to a main with a capped dirt leg.
- 32
- 33 G. Where copper piping is allowed for heating hot water or solar hot water systems, secure all joints and
- 34 fittings with 95-5 tin-antimony solder or brazing alloys.
- 35
- 36 H. Where mechanically formed tee fittings are allowed, form mechanically extracted collars in a
- 37 continuous operation, consisting of drilling a pilot hole and drawing out the tube surface to form a
- 38 collar having a height of not less than three times the thickness of the tube wall. The collaring device
- 39 shall be adjustable.
- 40
- 41 I. Notch and dimple the branch tube. Braze the joint. Apply heat properly so that pipe and tee does not
- 42 distort. Remove distorted connections.
- 43

44 **3.9 WATER MAKE-UP**

- 45
- 46 A. Install all raw water make-up piping where indicated on the drawings and in the specifications,
- 47 including all valves, piping specialties and dielectric unions required for a functional system.
- 48
- 49 B. Raw water make-up piping for this section is defined as all piping from the air separation device to
- 50 the expansion tank, including the fill line containing the pressure reducing valve for water systems
- 51 and all piping associated with glycol-water system make-up pumps.
- 52
- 53 C. Where copper piping is allowed, secure all joints and fittings with 95-5 tin-antimony solder of brazing
- 54 alloys.

1
2 **3.10 CHEMICAL TREATMENT**
3

- 4 A. Install chemical treatment piping as indicated on the drawings, as detailed, and as recommended by
5 the supplier of the chemical treatment equipment.
6

7 **3.11 VENTS AND RELIEF VENTS**
8

- 9 A. Install vent line and relief valve discharge lines as indicated on the drawings, as detailed, and as
10 specified for each specific valve or piping specialty item.
11

12 **3.12 DIELECTRIC UNIONS**
13

- 14 A. Install insulating or dielectric unions or flanges at each point where a copper to steel pipe connection
15 is required in the following systems.
16

- 17 1. Cold water or non-potable make-up water lines.
18 2. Hot water system.
19 3. Dielectric unions shall not be used at terminal heating/cooling devices.
20

21 **3.13 UNIONS AND FLANGES**
22

- 23 A. Install a union or flange, as required, at each automatic control valve and at each piping specialty or
24 piece of equipment which may require removal for maintenance, repair or replacement. Where a
25 valve is located at a piece of equipment, locate the flange or union connection on the equipment side
26 of the valve.
27

- 28 1. Concealed unions or flanges are not acceptable.
29

30 **3.14 PIPE SYSTEM LEAK TESTS**
31

- 32 A. Conduct pressure test with test medium of air or water unless specifically indicated. If leaks are
33 found, repair the area with new materials and repeat the test; caulking will not be acceptable.
34
35 B. No systems to be insulated until it has been successfully tested. If required for the additional pressure
36 load under test, provide temporary restraints at expansion joints or isolate them during the test.
37 Minimum test time shall be as scheduled below plus such additional time as may be necessary to
38 conduct the examination for leakage.
39
40 C. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air
41 vents or loosening of flanges. Measure and record test pressure at the high point in the system.
42
43 D. For air tests, gradually increase the pressure to not more than one half of the test pressure; then
44 increase the pressure in steps of approximately one-tenth of the test pressure until the required test
45 pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent
46 method. The piping system exclusive of possible localized instances at pump or valve packing shall
47 show no evidence of leaking. Perform the leak tests as follows:
48

<u>System</u>	<u>Test Pressure</u>	<u>Medium</u>	<u>Duration</u>
Heat Water	100 PSIG	Water	8 hours

49
50 **3.15 PIPE CLEANING**
51

- 1 A. Flush all water and condensate systems clear of all dirt and foreign matter with all pumps bypassed
2 and all strainers removed from strainer bodies. Provide circulation by means of Trade Supplied
3 portable pumping apparatus.
4
- 5 B. After initial flushing of a system, use portable pumping apparatus for a continuous 24 hour circulation
6 of a cold water detergent equal to Nalco 2567 cleaner. Flush detergent clear with continuous draining
7 and raw water fill for an additional 12 hours or until all cleaner is removed from the system. Replace
8 strainers and reconnect permanent pumping apparatus.
9

10 **3.16 INITIAL SYSTEM FILL AND VENT**

- 11
- 12 A. Fill and vent all systems with proper working fluids.
- 13
- 14 B. Fluids to be chemically treated as specified in Water Treatment Section 23 63 00.
15

16 **END OF SECTION**

**SECTION 23 06 30
PIPING SPECIALTIES**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Thermometers, sockets and test wells.
- B. Pressure gauges.
- C. Pipeline strainers.
- D. Manual and automatic air vents.
- E. Calibrated Balance Valves.
- F. Air Separators.
- G. Expansion Tanks.
- H. Refrigeration Specialties.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 05 90 Testing, Adjusting and Balancing
 - 2. 23 06 00 Pipe and Pipe Fittings

1.3 QUALITY ASSURANCE

- A. Standards:
 - 1. American National Standards Institute, ANSI: B31.1: Power Piping.
 - 2. ANSI/ASHRAE 15, "Safety Code for Mechanical Refrigeration".

1.4 SUBMITTALS

- A. Submit shop drawings for all items including all data concerning dimensions, capacities, materials of construction, ratings, ranges, pressure drop and appropriate identification.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Construct devices for the highest pressures and temperatures existing in the respective systems in accordance with ANSI specifications.

1 **2.2 THERMOMETERS**

- 2
- 3 A. Manufacturers: Marsh, Taylor, Trerice, U.S. Gauge, Weksler or Weiss.
- 4
- 5 B. Pipeline mounted: Thermometers shall be mercury reading, 9" scale cast aluminum case industrial
- 6 thermometers with clear acrylic plastic window front and adjustable angle stem to permit easy reading
- 7 from the floor or operating platform. Furnish with extended necks suitable for insulated piping as
- 8 required. Thermometers shall be compatible with sockets as specified herein.
- 9
- 10 C. Panel or remote mounted: Thermometers shall be mercury vapor actuated dial type with remote bulb.
- 11 Casing shall be 3-1/2" minimum diameter cast metal with double front. Sensing bulbs shall be of
- 12 length to suit pipe diameter with extended necks as required for insulated piping, suitable for insertion
- 13 in separable brass sockets as specified herein.
- 14
- 15 D. The range of thermometers shall be:
- 16
- 17

<u>Service</u>	<u>Scale Range</u>	<u>Increment</u>
Hot Water	30 deg. F to 240 deg. F	2 deg. F
- 18
- 19
- 20 E. Thermometers by the temperature control manufacturer meeting the above specification will be
- 21 acceptable.
- 22

23 **2.3 THERMOMETER SOCKETS AND TEST WELLS**

- 24
- 25 A. Sockets and test wells shall be brass with threaded connections suitable for thermometer bulbs and
- 26 control sensing devices. Socket and test wells length shall be suitable for pipe diameter with
- 27 extended necks as required to suit pipe insulation.
- 28

29 **2.4 PRESSURE GAUGES**

- 30
- 31 A. Manufacturers: Ashcroft, U.S. Gauge, Marsh, Taylor, Trerice, Weksler or Weiss.
- 32
- 33 B. All gauges shall be suitable for the pressure service intended, with minimum 4-1/2" diameter dial cast
- 34 aluminum case, double strength glass window, phosphor bronze bourdon tube with bronze bushed
- 35 brass movement, and recalibration from the front of the gauge dial, 99% accuracy over the middle
- 36 half of the scale.
- 37
- 38 1. Gauges shall meet ANSI grade A specifications.
- 39 2. Gauges by the temperature control manufacturer meeting these specifications will be
- 40 acceptable.
- 41 3. The range of pressure gauges shall be:
- 42

	<u>Scale Range</u>	<u>Decrement</u>
Hot Water	0 PSIG to 100 PSIG	1 PSIG
- 43
- 44
- 45 C. Pressure snubbers shall be 1/4" size and of all bronze construction, 300 PSIG working pressure. Coil
- 46 siphons shall be 1/4" size and of bronze construction, 150 PSIG working pressure.
- 47
- 48 D. Brass needle type gauge valves, Trerice model 735-2 or other approved product.
- 49

50 **2.5 PIPELINE STRAINERS**

- 51
- 52 A. Manufacturers: Metraflex, Mueller Steam Specialty, Hoffman, Armstrong, Trane, Sarco, Keckley,
- 53 Illinois.
- 54

- 1 B. Strainers 2" and smaller: Full pipeline size, "Y" type, 250 psi W.P. steam, cast iron, with screwed
2 ends. Furnish stainless steel strainer with a removable plug type screen retainer unless otherwise
3 indicated on the drawings.
4
- 5 C. Strainers 2-1/2" and larger: Full pipeline size, "Y" type, 125 psi W.P. steam, cast iron, with flanged
6 ends. Furnish stainless steel strainer with a bolted screen retainer and an off-center blowdown
7 connection piped and valved.
8
- 9 D. Liquid service: Screens to be brass or stainless steel with 1/32" diameter perforation for sizes thru 2"
10 and 1/16" diameter perforation for sizes over 2" for closed piping systems and 1/8" diameter
11 perforation for open piping systems. Maximum pressure drop to be 4 feet W.G. in clean strainer.
12

13 **2.6 AIR VENTS**

- 14
- 15 A. Manual air vents for components and pipe, Bell & Gossett Model 4V or other approved product, 125
16 PSIG at 210 deg. F. Use 1/2" gate valve for main pipes.
17
- 18 B. Automatic air vents shall be pilot operated. Spirovent model spirotop, Thrush-Amtrol model 720,
19 Watson McDaniel model 830, B&G model 107 or other approved product.
20
- 21 1. Cast iron or bronze body with non-ferrous internal parts, designed to vent air automatically
22 with float control.
23
- 24 C. Vents shall be constructed of metal for maximum operating pressure of 150 psi and maximum
25 operating temperature of 250 deg. F and all working parts shall be noncorrosive.
26
- 27 D. Vents shall have minimum air elimination rate of 36 CFM at 80 PSIG and shall be fully open for the
28 removal of air at all pressures in the operating range from 2 to 150 psi. It shall be tightly sealed
29 against loss of system water and prevent entrance of air in negative pressure situations.
30

31 **2.7 CALIBRATED BALANCE VALVES**

- 32
- 33 A. Calibrated Balancing Valves:
34
- 35 1. 2" and smaller: Construct valves of all bronze with threaded connections for sizes 2" and
36 below and for 125 PSIG working pressure at a maximum temperature of 250 deg. F. Provide
37 valve with quick disconnect taps with built-in check valve for pressure differential
38 measurement and integral valve setting index.
39
- 40 2. Select valves for size and pressure drop shown on the drawing and/or schedules. Tag valve
41 plan mark number, flow and pressure drop as specified.
42
- 43 3. Manufacturers: B&G CB plus calibrated balance valves or approved equal.
44

43 **2.8 AIR SEPARATORS**

- 44
- 45 A. Approved Manufacturers: Spirovent.
46
- 47 1. Micro bubble tube screen.
48 2. Dirt separator.
49
- 50 B. 2-1/2" and Smaller: Cast iron construction with steel diffuser tube, bottom and side threaded inlet
51 connections, bottom and top threaded outlet connections, threaded top connection for air elimination,
52 designed for a maximum working pressure of 125 PSIG.
53

- 1 C. 3" and Larger: Cast iron or welded steel construction, flanged and/or threaded connections,
2 perforated stainless steel air collector tube to direct air toward the air elimination connection at the
3 top of the unit, tangential water inlet and outlet connections, bottom blow down connection,
4 constructed in accordance with ASME boiler and pressure vessel code and stamped for 125 PSIG
5 design pressure.
6
- 7 D. Unless indicated otherwise, provide each unit with a removable galvanized steel system strainer with
8 3/16" diameter perforations and a free area not less than five times the cross sectional area of the
9 connecting pipe.

11 **2.6 EXPANSION TANKS**

12 A. Bladder Type:

- 13
- 14
- 15 1. Steel construction, tested and stamped in accordance with Section 8D of the
16 ANSI/ASME Code and furnished with the National Board Form U-1, rated for not
17 less than 125 psig working pressure, precharged with air to the initial fill pressure
18 indicated on the drawings.
- 19 2. Butyl replaceable bladder suitable for fluid temperatures to 220°F, and furnished
20 with a tank drain connection, system connection, mounting base for vertical
21 installation, prime coated, size/capacity as indicated on the drawings.
- 22 3. Tank and bladder construction must allow field replacement of the bladder on its
23 failure.
24

25 **2.10 REFRIGERATION SPECIALTIES**

- 26
- 27 A. Refrigerant Strainer: Brass shell and end connections, brazed joints, Monel screen, 100 mesh, UL
28 listed, 350 psig working pressure.
- 29
- 30 B. Moisture-Liquid Indicators: Forged brass, single port, removable cap, polished optical glass, solder
31 connections, UL listed 299 degrees F temperature rating, 500 psig work pressure.
32
- 33 C. Refrigerant Filter-Driers: Corrosion-resistant steel shell, steel flange ring and spring, wrought copper
34 fittings, ductile iron cover plate with steel cap screws, replaceable filter-drier core, 500 psig working
35 pressure.
36
- 37 D. Expansion Valves:
- 38
- 39 1. Angle type or straight through design suitable for the 250 degree F temperature, 500 psig
40 working pressure.
- 41 2. Brass body, internal or external equalizer, and adjustable superheat setting, complete with
42 capillary tube and remote sensing bulb.
- 43 3. Size expansion valves to avoid of being undersized at full load and excessively oversized at
44 partial load. Select valves for maximum load at design operating pressure and minimum 43
45 degrees F superheat.
- 46 4. Provide electronic controlled expansion valves where scheduled and recommended by the
47 equipment manufacturer for the application.
48
49

50 **PART 3 - EXECUTION**

51 **3.1 PIPELINE STRAINERS**

52
53

- 1 A. Install strainers in steam and water systems on the entering side of all automatic valves and as shown
2 on the drawings and details.
3
4 B. Install strainers in water systems on the suction side of all pumps and elsewhere as indicated on the
5 plans and/or as scheduled.
6
7 C. Install drain valve with hose adapter in each blow off connection and extend drain piping to nearest
8 floor drain.
9

10 **3.2 THERMOMETERS**

- 11
12 A. Install thermometers in thermometer sockets in locations indicated on the drawings and details.
13
14 B. Install sockets at each point where a temperature sensing device is required under Section 15900B -
15 Controls and Instrumentation, and a thermometer location as shown on the piping drawings and
16 details.
17

18 **3.3 PRESSURE GAUGES**

- 19
20 A. Install pressure gauges where indicated on the drawings and details.
21
22 B. Install gauges for water service with pressure snubbers and gauge valves.
23

24 **3.4 PRESSURE GAUGE TAPPING**

- 25
26 A. Install tapings at each point where sensing device is required under Section 15900B - Controls and
27 Instrumentation and at gauge locations as shown on the drawings and details.
28
29 B. Install tapings for water service with pressure snubbers and gauge valves.
30

31 **3.5 AIR VENTS**

- 32
33 A. Install manual air vents where indicated on the drawings, details and at all high points in water
34 systems where air may collect.
35
36 B. Install automatic air vent at the top of the air separator and where shown on drawings with a shut-off
37 valve between air separator and air vent.
38

39 **3.6 FLOW SENSORS**

- 40
41 A. Install flow sensors as indicated on the drawings and/or schedules and in accordance with the
42 manufacturer's recommendations.
43

44 **3.7 AIR SEPARATORS**

- 45
46 A. Install air separators in the locations as shown on the plans, details and/or schedules.
47
48 B. Provide valved blow down connections and extend drain piping to nearest floor drain.
49

50 **3.8 EXPANSION TANKS**

- 51
52 A. Install expansion tanks in the locations as shown on the plans, details and/or schedules on concrete
53 pad.
54

1 B. Inflate bladder pressure to pressure as scheduled.

2

3 **3.9 REFRIGERATION SPECIALTIES**

4

5 A. Refrigerant Strainers: Install in refrigerant lines as indicated, and in accessible location for servicing.

6

7 B. Moisture-Liquid Indicators: Install as indicated on refrigerant liquid lines, and in accessible
8 locations.

9

10 C. Refrigerant Filter-Dryers: Install in refrigerant lines as indicated, in accessible locations for service.
11 Install with bypass assembly to permit isolation for servicing.

12

13 D. Expansion Valves: Locate expansion valve sensing bulb immediately after evaporator outlet mounted
14 on the suction line properly insulated.

15

16 E. Install the expansion valve, indicator, solenoid valve and filter-drier as close to the evaporator as
17 possible.

18

19

20

END OF SECTION

**SECTION 23 09 10
SUPPORTS AND ANCHORS**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Pipe hangers and supports for mechanical system piping.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 govern work under this section.

- B. Specified Elsewhere:

- | | | |
|----|----------|-----------------------|
| 1. | 23 06 30 | Piping Specialties |
| 2. | 23 20 00 | Vibration Isolation |
| 3. | 23 25 00 | Mechanical Insulation |

1.3 QUALITY ASSURANCE

- A. Standards:

- | | |
|----|----------------------------------|
| 1. | <u>ANSI B31.1</u> : Power Piping |
| 2. | MSS SP58 & SP69 |

1.4 SUBMITTALS

- A. Submit shop drawings for the following:

1. Schedule of all manufactured hanger and support devices, indicating type of device for each pipe size range and type of service, including shielding devices as specified.

1.5 MANUFACTURERS

- A. Grinnell, Fee and Mason, Michigan Hanger, B-Line or Elcen, or approved equal.

- B. Grinnell figures listed as reference only.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58 and SP-69 unless otherwise specified.

- B. Design supports of strength and rigidity to suit loading, service, and in manner, which will not unduly stress the building construction. Where support is from concrete construction, take care not to weaken concrete or penetrate waterproofing. Fasten supports and hangers to building steel framing whenever practical. Do not use perforated iron, chain or wire as hangers.

- 1 C. Where piping can be conveniently grouped to allow the use of trapeze type supports, the supporting
2 steel shall be by means of standard structural shapes or continuous insert channels. Where continuous
3 insert channels are used, pipe-supporting devices made specifically for use with the channels may be
4 substituted for the specified supporting devices provided that similar types are used and all data is
5 submitted for approval.

6 7 **2.2 EQUIPMENT SUPPORTS**

- 8
9 A. Provide all supporting steel, not indicated on the structural drawings, that is required for the
10 installation of mechanical equipment and materials, including angles, channels, beams, etc. to
11 suspend or floor support tanks and equipment.
12
13 B. Refer to HVAC Drawing details for further requirements.
14

15 **2.3 PIPE HANGERS AND SUPPORTS**

- 16
17 A. Manufacturers: Grinnell, Fee and Mason, Michigan Hanger, B-Line or Elcen similar to the Grinnell
18 figures listed.
19
20 B. Pipe Hangers Application:
21
22 1. 2" and smaller: Adjustable, swivel split ring type Grinnell Fig. 104 or lightweight,
23 adjustable clevis type Grinnell Fig. 65.
24 2. 2-1/2" and larger: Adjustable clevis type Grinnell Fig 260.
25
26 C. Hangers for copper pipe without insulation shall be either copper plated or PVC coated.
27
28 D. Hot piping 2" and smaller: Hanger may be secured directly to the pipe with insulation system around
29 hanger.
30

31 **2.4 INSULATION PROTECTION SHIELDS**

- 32
33 A. Application: Insulation protection shields are required on the following piping systems:
34
35 1. Cold piping (under 60 deg. F): All sizes.
36 2. Hot piping (over 120 deg. F): 2-1/2" and larger piping.
37
38 B. Insulation Protection Shields: Grinnell Fig. 167, Fee & Mason or Elcen or other approved product,
39 constructed of galvanized carbon steel. Select shield to accommodate outer diameter of insulation.
40 Shield lengths and gauge shall be as follows:
41

<u>Pipe Size</u>	<u>Length</u>	<u>Gauge</u>
1/2" thru 2-1/2"	12"	18
3" thru 6"	18"	16
8" thru 12"	24"	14

47 **2.5 HANGER SUPPORT INSULATION**

- 48
49 A. Application: Piping 2-1/2" diameter and larger in conjunction with insulation protection shields to
50 resist compression of insulation system.
51
52 B. Hanger insulation system shall cover bottom half of pipe at the same thickness as pipe insulation
53 system.
54

1 **2.6 PIPE HANGER RODS**

- 2
- 3 A. Support rods shall conform to the latest MSS standards except as modified herein.
- 4
- 5 B. Size rods for individual hangers and trapeze support as indicated in the following schedule:

<u>Pipe size</u>	<u>Maximum Rod Diameter</u>	<u>Load (lbs.)</u>
Up to 2"	3/8"	610
2-1/2" and 3"	1/2"	1130
4" and 5"	5/8"	1810
6"	3/4"	2710
8" thru 12"	7/8"	3770

- 13 C. Furnish rods complete with adjusting and lock nuts.
- 14
- 15 D. In piping 4 inches and larger, each valve shall be supported.

16 **2.7 HANGERS AND SUPPORT SPACING**

- 17
- 18
- 19 A. Space pipe hangers and supports in accordance with the following schedule, with exceptions as indicated herein:

<u>Pipe size</u>	<u>Steel</u>	<u>Copper</u>
Up thru 1-1/4"	8'-0"	6'-0"
1-1/2" and 2"	10'-0"	8'-0"
2-1/2" and 3"	12'-0"	10'-0"
4" and 5"	14'-0"	10'-0"
6" to 12"	14'-0"	10'-0"

- 20
- 21
- 22
- 23
- 24
- 25
- 26
- 27
- 28
- 29 B. Place hangers to meet the requirements of the piping section of this specification, with regard to pitch for drainage and venting, and clearance between services.
- 30
- 31
- 32 C. Place hangers within one foot of each elbow and at each valve and strainer for piping 4" and above.

33 **2.8 BEAM CLAMPS**

- 34
- 35
- 36 A. Grinnell Fig. 87 Series beam clamps with retaining clip for hanger rods to 5/8". Maximum load 440 lbs.
- 37
- 38
- 39 B. Grinnell Fig. 228 beam clamps with links for hanger rods 3/4" and above.

40 **2.9 RISER CLAMPS**

- 41
- 42
- 43 A. Grinnell Fig. 261 for steel pipe, CT-121 for copper tubing.

44 **2.10 CONCRETE INSERTS**

- 45
- 46
- 47 A. Grinnell Fig. 285, 281 or 282, poured concrete ceiling insert, suitable for rod diameter and weight supported.
- 48
- 49
- 50 B. Inserts drilled and placed after concrete pour shall have steel shell with expander plug, not depending on soft lead for holding power.
- 51
- 52
- 53

54 **PART 3 - EXECUTION**

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3.1 INSTALLATION

- A. Install supports to provide for free expansion of the pipe. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.
- B. Coordinate hanger and support installation to properly group piping of all trades.

3.2 INSULATION PROTECTION SHIELDS

- A. Install insulation protection shields at support points for insulated piping as scheduled herein.
- B. Spacing shall be 10'-0" maximum based on insulation with a compressive strength of 15 psi. For insulation with compressive strengths greater than 15 psi, span may be increased proportionally up to a maximum allowable as listed under hanger and support spacing in this section.

END OF SECTION

**SECTION 23 10 00
VALVES**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Valves for mechanical system piping.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 govern work under this section.

B. Specified Elsewhere:

- | | | |
|----|----------|----------------------------------|
| 1. | 23 05 90 | Testing, Adjusting and Balancing |
| 2. | 23 06 00 | Pipe and Pipe Fittings |
| 3. | 23 06 30 | Piping Specialties |

1.3 SUBMITTALS

- A. Submit shop drawings for all valves including all data concerning dimensions, materials of construction and pressure/temperature ratings.
- B. Mark shop drawings clearly for each system and note with the correct cross reference number.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturers: Powell, Crane, Nibco, Hammond, Stockham, Lunkenheimer, Milwaukee.
1. Valves shall be of same manufacturer, unless otherwise approved by A/E.
- B. Acceptable manufacturer and Fig. No. are listed under each valve type as the standard for equal quality from approved manufacturers.
- C. Manufacturer's name and pressure ratings clearly mounted on outside of valve body.
- D. All valve packing to be non-asbestos and flexitallic type.

2.2 WATER SYSTEMS VALVES

A. Globe Valves:

1. Valves 2-1/2" and smaller: Bronze body, screwed pattern, renewable composition disc, union or screw-over bonnet, malleable iron hand wheel, 300 psi W.O.G., Mueller Fig. 203-AP or Metraflex No. 700.
2. Valves 3" and larger: Iron body, bronze mounted O.S. & Y., flanged, renewable bronze seat and disc, 200 psi W.O.G., Nibco Fig. F-718.

1
2 B. Check Valves:
3

- 4 1. 2-1/2" and smaller: Bronze body, screwed, regrinding type, horizontal swing, renewable seat
5 and disc, 150 SWP - 200 WOG rated. Nibco Fig. T-413-Y.
6 2. 3" and larger: Iron body, flanged, bronze-mounted, horizontal swing, bronze disc and seat,
7 150 SWP - 200 WOG rated. Nibco Fig. F-918-B or Milwaukee F2974.
8

9 C. Spring Loaded Check Valves:
10

- 11 1. Valves 2-1/2" and smaller: Bronze or iron body, bronze trim, stainless steel spring, screwed,
12 250 psi WOG, Nibco Fig. T-480Y, Mueller Fig. 203-AP or Metraflex No. 700.
13 2. Valves 3" and larger: Iron body, wafer type, bronze trim, stainless steel spring, Buna-N seat,
14 200 psi W.O.G., Nibco Fig. W-960, Metraflex No. 700, Mueller Sure Check Model No. 71,
15 or Milwaukee 1800 series.
16

17 D. Balancing Valves(non-calibrated):
18

- 19 1. Valves 2-1/2" and smaller: Use eccentric plug valves or ball valves with memory stops.
20 2. Valves 3" and larger: Use eccentric plug valves or butterfly valves with locking memory
21 stops.
22

23 E. Balancing Valves(calibrated):
24

- 25 1. Valves 2-1/2" and smaller: Refer to Section 23 06 30, Piping Specialties, under Flow Sensors
26 and Meters.
27 2. Valves 3" and larger: Use butterfly valves with locking memory stops together with flow
28 meters as specified in Section 23 06 30, Piping Specialties, under Flow Sensors and Meters.
29

30 F. Eccentric Plug Valves:
31

- 32 1. Valves 2-1/2" and smaller: Semi-steel body, screwed, bronze bearings, bronze or electroless
33 nickel plated semi-steel plugs, adjustable memory stop, isobutene-isoprene resilient seat,
34 175 psi WOG, DeZurik Fig. 499.
35 2. Valves 3" and larger: Iron body, flanged, stainless steel bearings, resilient faced plugs,
36 adjustable memory stop, isobutene-isoprene resilient seat, 175 psi WOG, DeZurik Fig. 118.
37 3. Provide at least three (3) handles for each valve size thru 2". Provide all valves over 2" with
38 permanent handles. Provide all valves 6" and larger with gear operator.
39

40 G. Butterfly Valves:
41

- 42 1. Valves 3" and larger: Iron body, stainless steel shaft, bronze, aluminum-bronze, ductile iron
43 nickel plated or cast iron with welded nickel edge disc, bronze bearings, bubble tight resilient
44 EPDM seat, adjustable memory stop, minimum 175 psi WOG pressure differential in the
45 closed position and suitable for continuous operation at temperature up to 250 degrees F.
46 2. Valve necks to be sufficient length to allow for insulation where insulation is specified.
47 3. Valves shall be lug type, permitting removal of down stream piping without removing valve.
48 4. Provide valves 5" and smaller with infinite position lever actuators and 6" and larger with
49 worm gear wheel operators.
50 5. Manufacturers: DeZurik Fig. 632, Keystone Fig. 228, Nibco LD 2000 or Centerline LT
51 series, Milwaukee M or C series..
52

53 H. Ball Valves:

- 1
2 1. Valves 2-1/2" and smaller: Bronze body, screwed, brass or stainless steel ball, full or
3 conventional port, Teflon seat rings, blowout-proof stem, two-piece construction, 600 psi
4 WOG, Apollo No. 70 Series, Milwaukee BA 100/150, Nibco T/S 585-70.
5 2. Provide valve neck extensions with sufficient length to allow for insulation where insulation
6 is specified.
7

8 I. Drain Valves:
9

- 10 1. Bronze, screwed, Buna-N seat discs, hose thread adapter, 125 psi WOG, Nibco Fig 74, or ball
11 valve as specified above with hose thread adaptor.
12 2. Minimum drain valve size - 3/4" except where strainer blowdown valves are indicated, drain
13 valve same as blowdown connection size.
14

15 J. Combination Shut-off, Check and Balancing Valves:
16

- 17 1. 2" and smaller: Provide check valve and balance valve in series at pump discharge.
18 2. 2-1/2" and larger: Cast iron or semi-steel body, flanged, spring loaded disc, calibrated
19 balancing adjustment with memory bank, valve steam, maximum working pressure of 175
20 PSIG, maximum operating temperature of 300 deg. F.
21 3. Design valves to permit repacking under full line pressure.
22

23 K. Shut-off and Check Valves: Provide spring-loaded check valve and shut-off (ball or butterfly) valve
24 in series at pump discharge.
25

26 **2.3 WATER PRESSURE REDUCING VALVES**
27

28 A. Manufacturers: Thrush, Watts, Cash-Acme, Taco, or B&G valves.
29

30 B. Valves shall be diaphragm operated and pressure adjustable with anti-siphon check valve and inlet
31 strainer designed for a maximum working pressure of 125 PSIG at 240 deg F.
32

33 C. Set the valves for pressures required, or as scheduled.
34

35 **2.4 WATER RELIEF VALVES**
36

37 A. Manufacturers: Kunkle, Consolidated, Thrush, Watts, Cash-Acme, or B&G. Valves shall be iron or
38 bronze body, diaphragm operated, with non-ferrous seat and designed for a maximum working
39 pressure of 125 PSIG.
40

41 B. Relief valves shall conform to State requirements and each valve shall have an ASME stamp.
42

43 **2.5 GAUGE VALVES**
44

45 A. Tetric Fig. 735, 1/4" brass needle valve, threaded ends, 300 WOG rated.
46
47

48 **PART 3 - EXECUTION**
49

50 **3.1 GENERAL**
51

52 A. Install valves as shown on plans, details and according to the valve manufacturer's installation

1 recommendations. Install valves with stems upright or horizontal.

- 2
3 B. Install all temperature control valves furnished under Section 15900B - Controls and Instrumentation.

4
5 **3.2 SHUT-OFF VALVES**

- 6
7 A. Install shut-off valves at all equipment, at each branch take-off from mains, and at each automatic
8 valve for servicing.

9
10 **3.3 THROTTLING VALVES**

- 11
12 A. Install globe or angle valves for throttling service and control device or PRV station bypass.

- 13
14 B. Install gate valves for throttling in steam systems sizes 8 inches and larger.

15
16 **3.4 BALL AND BUTTERFLY VALVES**

- 17
18 A. Ball and butterfly valves shall be used for water system shut-off valves.

19
20 **3.5 BALANCING VALVES**

- 21
22 A. Provide balancing valves for complete balancing of water systems. Furnish calibrated balance valves
23 and flow meters as specified in Section 23 06 30, Piping Specialties, under Flow Meters.

24
25 **3.6 DRAIN VALVES**

- 26
27 A. Provide drain valves where specified, detailed and at all low points of piping systems for complete
28 drainage of the systems.

29
30 **3.7 WATER RELIEF VALVES**

- 31
32 A. Install relief valves as shown on drawings.

- 33
34 B. Unless otherwise indicated, provide one relief valve in each closed water system in the pump inlet
35 piping.

36
37 **3.8 SPRING LOADED CHECK VALVES**

- 38
39 A. Provide a spring loaded check valve in each pump discharge line.

40
41 **3.9 COMBINATION SHUT-OFF, CHECK AND BALANCING VALVES**

- 42
43 A. Install combination or triple-duty (shut-off, check and balancing) valve in lieu of providing separate
44 shut-off valve, check valve and balancing valve at water circulation pump discharge line.

45
46 **3.10 WATER RELIEF VALVES**

- 47
48 A. Install water relief valves on closed system hydronic heating systems to relief rated system input
49 capacity. Extend relief outlet to safe location near floor drain.

50
51 **END OF SECTION**

**SECTION 23 14 00
PUMPS**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Types of pumps specified in this section include the following:

1. Inline Pumps

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 govern work under this section.

B. Specified Elsewhere:

1. 23 05 90 Testing, Adjusting and Balancing
2. 23 06 30 Piping Specialties
3. 23 10 00 Valves
4. 23 20 00 Vibration Isolation

1.3 QUALITY ASSURANCE

A. UL and NEMA Compliance: Provide electric motors and products which have been listed and labeled by Underwriters Laboratories and comply with NEMA Standards.

1.4 SUBMITTALS

A. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve, when applicable.

B. Submit all data concerning dimensions, materials of construction, ratings, and other relevant product data.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide factory tested pumps, thoroughly cleaned, and painted with one coat of machinery enamel prior to shipment. Type, size, and capacity of each pump are listed on pump schedule. Provide pumps of same type by same manufacturer.

B. Pump shall meet or exceed the operating efficiencies scheduled.

C. Select motor with sufficient horsepower rating for non-overloading operation over the entire pump curve.

D. All pumps shall operate without objectionable noise or vibration.

2.2 INLINE CENTRIFUGAL PUMPS

- 1 A. General: Provide in-line pipe-mounted, single suction, centrifugal type pumps where
2 indicated, and of capacities as scheduled.
3
- 4 B. Acceptable Manufacturers:
5
6 1. Bell and Gossett
7 2. Grundfos
8
- 9 C. Casing: Cast iron bronze - fitted with a working pressure of 175 PSIG and operating
10 temperature of 225 degrees F continuous, 250 degrees F intermittent. Provide tapped and
11 plugged openings for vent, drain, suction and discharge gauge connections.
12
- 13 D. Shaft: Alloy steel with integral thrust collar.
14
- 15 E. Bearings: Oil lubricated bronze sleeve bearings or regreasable ball bearings.
16
- 17 F. Seal: Mechanical single unbalanced type with Buna-N/Carbon rotating element and ceramic,
18 Ni-resist stationary seat or other approved product.
19
- 20 G. Impeller: Single-suction enclosed type, hydraulically and dynamically balanced, and keyed
21 to shaft. Bronze Construction.
22
- 23 H. Motor: Non-overloading at any point on pump curve, open, drip-proof, oil-lubricated journal
24 bearings, resilient mounted construction, built-in thermal overload protection on single phase
25 motors.
26
- 27 1. Motor shall be non-overloading over the entire pump curve.
28 2. Premium efficiency motor per IEEE Standard 112, Method B and EPACT
29 requirements.
30
- 31 I. Nameplate: Each pump and motor shall be provided with a nameplate displaying the
32 manufacturer's name, serial number of pump, capacity in GPM, and head in feet at design,
33 horsepower, voltage, frequency, speed and full load current.
34
- 35 1. Permanently identify exact impeller size of pump on nameplate.
36
- 37 J. ECM Motor and Controller: Where scheduled, inline pump shall be equipped with an ECM
38 motor with integral controller for constant pressure control of pump output as setup integrally
39 on motor-mounted controller.
40
- 41 1. Provide terminal strip for remote speed control from 0-10VDC signal by BAS.
42
43

44 **PART 3 - EXECUTION**

45 **3.1 INSTALLATION OF PUMPS**

- 46 A. Install pumps where indicated, in accordance with manufacturer's published installation
47 instructions, with recommended clearance provided for service and maintenance.
48
- 49 B. Install in-line pumps supported from piping system, located for access to oil cups, service and
50 maintenance. Pipe to be free of all movement.
51
52
53

- 1 C. Provide piping, accessories, hangers, supports, and anchors, valves, meters and gauges,
2 vibration isolation, and equipment supports, as indicated for completion installation. All
3 valves and piping specialties are to be full line sizes as indicated on drawings.
4
- 5 1. Install a full line size silent spring loaded check valve and balancing valve in the
6 pump discharge piping.
7 2. Provide line size ball or butterfly valve and strainer on suction piping.
8 3. Provide supports under elbows on pump suction sizes 4 inches and over.
9
- 10 D. Lubricate pump before start-up. Start-up in accordance with manufacturer's instructions.
11
- 12 E. Ensure that pump units are wired properly, with rotation in correct direction, and that pump
13 and motor grounding have been provided.
14
- 15 F. Start-Up Services and Inspection Report: Manufacturer's representative shall inspect pump
16 installation and start-up pump to verify proper installation, pump shaft alignment and
17 operation, and submit report to Engineer.
18

19 **END OF SECTION**

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SECTION 23 20 00
VIBRATION ISOLATION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of vibration isolation work required by this section is indicated on drawings and schedules, and/or specified in other Division 15 sections.
- B. Types of vibration isolation products specified in this section include the following:
 - 1. Vibration Isolation Supports.
 - 2. Flexible Duct Connectors.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 86 00 Ductwork Accessories

1.3 DESIGN CRITERIA

- A. Isolate all motor driven mechanical, unless otherwise noted, from the building structure, and from the systems which they serve, to prevent equipment vibrations from being transmitted to the structure.
- B. Consider equipment weight distribution to provide uniform deflections.
- C. For equipment with variable speed capability, select vibration isolation devices based on the lowest speed.

1.4 SUBMITTALS

- A. Submit shop drawings of isolation devices indicating isolation materials, isolator heights both free & operating, isolator dimensions, deflections, and isolation efficiency based on lowest operating speed.

1.5 SUPERVISION AND INSPECTION

- A. Vibration isolation manufacturer or his qualified representative to provide supervision to assure correct installation and adjustment of the isolators.
 - 1. Upon completion of the installation and after the system is put into operation, the manufacturer, or his representative, shall make a final inspection and submit his report to the A/E in writing, certifying the correctness of installation and compliance with the specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

- 1 A. All isolation devices shall be designed for the equipment with which they will be used. Materials
 2 used shall retain their isolation characteristics for the life of the equipment served. All elastomeric
 3 materials shall be industrial grade neoprene.
 4
 5 B. Isolation devices subject to weather shall have hot-dipped galvanized finish and be furnished with
 6 limit stops to resist wind.
 7
 8 C. Coordinate the selection of devices with the isolator and equipment manufacturer.
 9

10 **2.2 MANUFACTURERS**

- 11
 12 A. Products and methods of fabrication shall be as manufactured by Mason Industries, Korfund Co.,
 13 Amber/Booth Co., Vibration Mounting & Controls, or Kinetics, similar to the manufacturers model
 14 listed.
 15

16 **2.3 TYPE FD FLEXIBLE DUCT CONNECTORS**

- 17
 18 A. Laminated flexible sheet of cotton duct and sheet elastomer (butyl, neoprene or vinyl), reinforced
 19 with steel wire mesh where required for strength to withstand duct pressure indicated. Form
 20 connectors with full-faced flanges and accordion bellows to perform as flexible isolation units. Equip
 21 each unit with galvanized steel retaining rings for airtight connection with ductwork.
 22

23 **2.4 TYPE C MOUNTS**

- 24
 25 A. Mason type SLR, combination spring and neoprene with rib-molded base. Isolator housing shall have
 26 vertical limit stops with 1/2" minimum clearance. Housing shall be free hot-dipped galvanized with
 27 1/2" neoprene acoustical friction pads between the baseplate and the support.
 28
 29 B. All mounting shall have leveling bolts that must be rigidly bolted to the equipment. Springs shall
 30 have a minimum additional travel to solid equal to 50% of the rated deflection. Spring diameters
 31 shall be no less than 0.8 of the compressed height of the spring at rated load.
 32

33 **2.5 TYPE D HANGERS**

- 34
 35 A. Mason type 30N, vibration hangers with steel spring and 0.3" deflection neoprene element in series.
 36 Neoprene element shall be molded with a rod isolation bushing that passes through the hanger box.
 37 Spring diameters and hanger box shall permit hanger rod to swing 30 deg. arc before contacting the
 38 hole and short circuiting the spring.
 39
 40 B. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection.
 41

42 **2.6 PERFORMANCE**

- 43
 44 A. Select all vibration isolation devices to provide minimum 95% isolation efficiency or based on the
 45 minimum static deflection and mounting criteria listed below, whichever greater.
 46

47

	Floor Span					
	On Grade		20 feet		30 feet	
	Min. Static		Min. Static		Min. Static	
	Type	Defl.	Type	Defl.	Type	Defl.
48 B.						
49	1. <u>Suspended Fans:</u>	FD-D	1.5"	FD-D	1.5"	FD-D 1.5"
50	2. <u>Floor-mounted Fans:</u>	FD-C	0.75"	FD-C	0.75"	FD-C 0.75"

51
 52
 53
 54

1 Note: Air Handling Units are internally isolated and do not require external vibration isolation.
2
3

4 **PART 3 - EXECUTION**

5 6 **3.1 GENERAL**

7
8 A. Except as otherwise indicated, apply the following types of vibration isolators at indicated locations
9 or for the following indicated items of equipment. Selection is Installer's option where more than one
10 type is indicated.

11 12 B. Spring Isolators:

- 13 1. Suspended Fans.
- 14 2. Floor-mounted Fans.

15 16 C. Flexible Duct Connectors:

- 17 1. Duct connections with air handling equipment mounted on vibration isolators.

18 19 20 21 **3.2 INSTALLATION**

22
23 A. General: Except as otherwise indicated, comply with manufacturer's instructions for installation and
24 load application to vibration isolation materials and units. Adjust to ensure that units do not exceed
25 rated operating deflections or bottom out under loading, and are not short-circuited by other contact
26 or bearing points.

27
28 B. Anchor and attach units to substrate and equipment as required for secure operation and to prevent
29 displacement by normal forces, and as indicated.

30
31 C. Install vibration isolation devices as specified, as shown on the drawings and according to the
32 manufacturer's installation instructions.

33
34 D. In no case shall the installation short circuit the isolation device. Flexible piping connections are to
35 be installed on the equipment side of shut-off valves.

36
37
38 **END OF SECTION**
39

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**SECTION 23 25 00
MECHANICAL INSULATION**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of mechanical insulation required by this section is indicated on drawings, and by requirements of this section.
- B. Work shall include all labor, equipment, accessories, materials and services required to furnish and install all insulation, fittings and finishes for piping, ducts and related mechanical equipment in the Heating, Ventilating and Air Conditioning Systems.
- C. The following types of insulation are specified in this section:
 - 1. Pipe insulation.
 - 2. Duct insulation.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 09 10 Support and Anchors
 - 2. 23 84 00 Ductwork

1.3 QUALITY ASSURANCE

- A. Acceptable Manufacturers:
 - 1. Owens-Corning
 - 2. Schuller
 - 3. Certainteed
- B. All insulating products delivered to the construction site shall be labeled with the manufacturer's name and description of materials.
- C. All insulation installation methods shall be performed in accordance with the latest edition of MICA (Midwest Insulation Contractors Association) Standard and manufacturer's installation instructions, except as modified in this section of specifications.

1.4 DEFINITIONS

- A. Concealed Ductwork: Concealed areas, where indicated in this section, shall apply to shafts, furred spaces, space above finished ceilings, low tunnels and crawl spaces.
- B. Exposed Ductwork: Exposed ductwork, include mechanical rooms, walk-through tunnels, and similar installations subjecting ductwork insulation to physical damage and tearing.

1.5 SUBMITTALS

- 1 A. Submit shop drawings for insulation systems, including a schedule for all insulating materials,
 2 including adhesives, fastening methods, fitting materials, installed thickness and intended use of each
 3 material.
 4
 5 B. Submittal shall include catalog sheets indicating density, thermal characteristics, jacket, and
 6 installation instructions.
 7

8 **PART 2 - PRODUCTS**

9
 10 **2.1 MATERIALS**

- 11
 12 A. All products including vapor barriers and adhesives shall conform to NFPA Section 90A. All
 13 products except pipe insulation shall possess a flame spread rating of not over 25, without evidence of
 14 continued progressive combustion, and a smoke developed rating no higher than 50.
 15

16 **2.2 PIPING INSULATION SCHEDULE**

- 17
 18 A. Insulation Thickness Pipe Size Schedule:

Type of System	Fluid Temp. Range Deg F	*Run-outs Up to 2"	1" and Less	1-1/4"	2-1/2"	5&6 inch	8"& Up
<u>Hot Water:</u>							
Low Temp.	141-200	0.5	1.0	1.0	1.5	1.5	1.5
<u>Cooling Systems:</u>							
Refrigerant Suction	40-55	0.5	0.5	0.75	1.0	1.0	1.0
Cond. Drains	40-55	0.375	0.375	0.5	0.5	0.5	0.5

19
 20
 21
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 30
 31 *Runouts are extensions to individual terminal units not exceeding 12 ft. in
 32 length.
 33

- 34 B. Insulation thickness shown in schedule are based on products having a maximum "k" factor of 0.26 at
 35 a mean temperature of 75 degrees F. These thicknesses can be reduced for products having
 36 significantly lower "k" values and shall be increased for products having higher "k" values in order to
 37 produce equivalent or greater thermal resistance. ("R" value of products equals the thickness of the
 38 insulation divided by the "k" factor.)
 39

- 40 C. Insulation Application Schedule:

Type of System	Fluid Temp. Range (deg. F)	Type of Insulation
<u>Hot Water:</u>		
Low Temp/HWS&R	141-200	Glass Fiber
<u>Cooling Systems:</u>		
Refrigerant Suction	40-55	Elastomeric
Cond. Drains	40-55	Elastomeric

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 51
 52 **2.3 PIPE INSULATION**
 53

1 A. Rigid molded glass fiber pipe insulation with ASJ type factory applied jacketing with a density of 3-4
2 lbs./cubic feet and a "k" factor of 0.25 @ 75 degrees F. mean. (Flame Spread 25, smoke development
3 50 per ASTM E 84-75, -20 degrees to 500 degrees F. usage.)
4

- 5 1. Jacket shall be glass fiber reinforced foil kraft laminate, factory applied, with white finish.
6 Permeance shall not exceed 0.02 perms. Beach puncture resistance shall be 50 units minimum.
- 7 2. Provide Aluminum or UV-resistant PVC jacket for all exposed exterior piping insulation.
8

9 B. Flexible elastomeric thermal insulation with a "k" factor of 0.26 at 75 degrees F mean density of 5.0
10 lbs./cu. ft. and a maximum water vapor transmission of 0.17 per inch. Seal joints with manufacturers
11 standard sealant. (Armaflex AP-Flame Spread 25, smoke development 50 per ASTM E 84-75, -40
12 degrees to 220 degrees F usage).
13

- 14 1. Provide Aluminum or UV-resistant PVC jacket for all exposed exterior piping insulation.
15

16 2.4 DUCTWORK INSULATION 17

18 A. Material: Flexible Glass Fiber Wrap: Flexible glass fiber insulation shall have a minimum density of
19 0.75 PCF with thermal conductivity of not more than 0.31 at 75 degrees F mean temperature and
20 suitable for 240 degrees F with FSK aluminum foil reinforced vapor barrier jacket. Material shall
21 meet NFPA 90A and 90B.
22

- 23 1. Jacket shall be glass fiber reinforced foil kraft laminate factory applied with paintable white
24 finish. Permeance shall not exceed 0.04 perms. Beach puncture resistance shall be 15 units
25 minimum.
26

27 2.5 DUCTWORK INSULATION SCHEDULE 28

29 A. Concealed - Supply Air Ducts:
30

- 31 1. Type Insulation: 2" Flexible Wrap (R5 min).
32

33 B. Exposed - Supply Air Ducts:
34

- 35 1. Type Insulation: 1" Rigid Board (Unconditioned spaces - Mech. Rms.).
36 *Note:* Insulation not required if supply duct is lined. Refer to Section 15840B.
- 37 2. Exposed ducts in conditioned spaces do not require external insulation.
38

39 C. Exhaust and Tempered Exhaust Air Ducts - General Exhaust:
40

- 41 1. Automatic Control Damper (ACD) to Ambient Outlet (Louver):
42 1-1/2" Flexible Wrap (Concealed).
- 43 2. Exhaust Registers to Fan Inlet: None.
44

45 D. Fresh and Tempered Fresh Air Ducts:
46

- 47 1. Fresh Air: 1" Rigid Board (exposed) or 1-1/2" Flexible Wrap (concealed).
48

49 E. Transfer Air Ducts:
50

- 51 1. Type Insulation: 1" Acoustic Duct Liner. Refer to Section 15840B.
52
53
54

1 **PART 3 - EXECUTION**

2
3 **3.1 GENERAL INSTALLATION**

- 4
5 A. Application of insulation materials to piping, equipment, tanks and ductwork shall be done in
6 accordance with manufacturer's written recommendations. Where thickness of insulation is not
7 specified, use applicable thickness recommended by manufacturer and required by applicable codes.
8
9 B. All insulation shall be continuous through wall and ceiling openings and sleeves. All covered pipe
10 and ductwork is to be located a sufficient distance from walls, other pipe, ductwork and other
11 obstacles to permit the application of the full thickness of insulation specified. (If necessary, extra
12 fittings and pipe are to be used.).
13

14 **3.2 PIPING INSTALLATION**

- 15
16 A. All pipe installation shall be installed with joints butted firmly together. All valves and fittings shall
17 be insulated with mitered sections of insulation equal in density and thickness to the adjoining
18 insulation by one of the following methods:
19
20 1. Premolded PVC fittings installed in accordance with the manufacturer's instructions.
21 2. Jackets on pipe insulation laps are to be vapor sealed using self-sealing lap, lap-seal tape gun
22 or adhesive such as Armstrong 520. All insulation ends are to be tapered and sealed
23 regardless of service.
24
25 B. Provide removable insulation sections to permit easy access where inspection, service and/or repairs
26 are required.
27
28 1. Insulation for valves, unions (cold only), strainers, flexible connections and expansion joints
29 shall be removable for inspection and repair.
30
31 C. On all cold piping insulated with vapor barrier covering, use protection shield to over bottom one-half
32 of insulated pipe. Provide half-round, 12" long, hanger block at the bottom half of the pipe in place
33 of the fiberglass pipe insulation. The hanger blocks shall be molded cork or calcium silicate pipe
34 insulation of the same thickness as the adjoining fiberglass pipe insulation. The vapor barrier jacket
35 shall be continuous through the hanger location.
36
37 1. Provide removable elastomeric insulation wraps over cold piping unions.
38
39 D. Vapor barrier jackets shall be applied with a continuous, unbroken vapor seal. Pipe hangers on cold
40 lines (dual temperature piping) are to be sized large enough to be installed over the outer surface of
41 the insulation.
42
43 E. On hot piping 2" and smaller, the hanger shall be secured directly to the pipe and the pipe insulation
44 shall surround the hanger. Provide pipe covering protection saddles and hanger blocks at hanger
45 locations on hot piping 4" and larger.
46
47 F. Insulation shall preferably be applied while surfaces are hot. Chilled water lines shall be at room
48 temperatures when insulation is applied.
49
50 G. Omit insulation for the following:
51
52 1. Discharges piping from safety and relief valves to outlets.
53 2. Piping unions on hot only (HWS&R) systems.
54 3. Provide removable insulation jackets over unions and valves for hot/chilled water systems.

1 4. Hot water piping inside convector, wall fin radiation and cabinet heater enclosures.

2
3 H. Seal all exposed end sections of pipe covering with a coat of vapor barrier mastic. Childers CP-30 or
4 equal.

5
6 I. No covering shall be applied until after piping is cleaned and tested, inspected and approved.
7

8 **3.3 DUCTWORK INSULATION INSTALLATION**
9

10 A. Insulation shall be installed per manufacturer recommendations with mechanical fasteners. Seal all
11 joints and fasteners with UL labeled vapor proof tape.

12
13 B. Provide finished edges at all access doors and ends.
14

15 **3.4 INSTALLATION OF EQUIPMENT INSULATION**
16

17 A. General: Install insulation products in accordance with manufacturer's written instructions and in
18 accordance with recognized industry practices to ensure that insulation serves its intended purpose.
19

20 B. Install insulation materials with smooth and even surfaces.
21

22 C. Clean and dry ductwork surfaces prior to insulating, Butt insulation joints firmly together to ensure
23 complete and tight fit over surfaces to be covered.
24

25 D. Do not insulate over equipment nameplates or ASME stamps. Bevel and seal insulation at these
26 locations.
27

28 E. Do not insulate factory insulated equipment.
29

30 **3.5 PROTECTION AND REPLACEMENT**
31

32 A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor
33 barrier damage and moisture saturated units.
34

35 B. Protection: Insulation installer shall advise Contractor of required protection for insulation work
36 during remainder of construction; period, to avoid damage and deterioration.
37
38

39 **END OF SECTION**

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5 **SECTION 23 63 00**
6 **WATER TREATMENT**

7 **PART 1 - GENERAL**

8 **1.1 DESCRIPTION OF WORK**

- 9 A. This section includes requirements for water treatment related to the following:
- 10
11 1. Closed Loop Treatment System
12 2. Pipe Cleaning and Inhibiting Treatment
13
- 14 B. Specification of an item in this section shall not relieve the HVAC Contractor from providing
15 all items, materials, operations, methods, labor, equipment and incidentals necessary for a
16 complete and functional system.
17
- 18 C. All services will be performed by a qualified, full-time representative of the water treatment
19 company.
20
- 21 1. Coordinate water treatment with Owner's current water treatment program for
22 compatible chemicals and treatment methods.
23

24 **1.2 RELATED DOCUMENTS**

- 25
26 A. Applicable provisions of Division 1 shall govern work under this section.
27
- 28 B. Specified Elsewhere:
29
- 30 1. 23 06 00 Pipe and Pipe Fittings
31

32 **1.3 SUBMITTALS**

- 33
34 A. Submit product data, installation and operating instructions.
35

36 **1.4 SUPERVISION AND INSPECTION**

- 37
38 A. Water treatment manufacturer or his qualified representative to provide supervision and final
39 inspection upon completion of installation and adjustment, shall submit report in writing,
40 certifying the correctness of the installation in compliance with the specifications and proper
41 operation.
42
43

44 **PART 2 - PRODUCTS**

45
46 **2.1 CLOSED LOOP TREATMENT SYSTEM**

- 47
48 A. Water treatment consists of initial chemical type treatment to clean piping and prevent rust
49 and scale in final fill treated water.
50
- 51 1. Sequestering agent to reduce deposits and adjust pH.
52 2. Corrosion inhibitors.
53 3. Conductivity enhances.
54

- 1 B. Bypass Feeder: Water treatment consists of bypass pot feeder and initial chemical type
2 treatment to prevent rust and scale. Bypass feeder shall be 5 gallon for each hot and chilled
3 water system with filter sock(5 micron) and support cage.
4
5

6 **PART 3 - EXECUTION**
7

8 **3.1 INSTALLATION**
9

- 10 A. Heating Contractor will provide initial fill treatment to each closed-loop system. After this
11 initial treatment, the Owner shall be responsible for all future service requirements.
12
13 B. Install in a bypass arrangement at pump discharge as indicated.
14
15 C. Furnish start-up chemical treatment chemicals, procedures and certification after installation
16 is complete.
17
18 D. After start-up treatment, the treatment company shall be responsible for all water treatment
19 service requirements for one year, to include the following treatment services performed by
20 qualified, full time representatives of the treatment company.
21
22 1. Initial water analysis and recommendations.
23 2. Initial equipment clean-up chemicals, procedures and certification after clean-up is
24 complete.
25 3. Assistance during start-up of the treatment program.
26 4. Instructions of operating personnel on proper feeding and control techniques.
27 5. Periodic service and consultation meetings.
28 6. Any necessary record forms and log sheets.
29 7. Any required laboratory and technical assistance.
30

31 **3.2 WATER TREATMENT SERVICE PROGRAM**
32

- 33 A. After start-up treatment, the treatment company shall be responsible for all water treatment
34 service requirements for one year, to include the following treatment services performed by
35 qualified, full time representatives of the treatment company.
36
37 1. Initial water analysis and recommendations.
38 2. Initial equipment clean-up chemicals, procedures and certification after clean up is
39 complete.
40 3. Assistance during start-up of the treatment program.
41 4. Instructions of operating personnel on proper feeding and control techniques.
42 5. Periodic service and consultation meetings.
43 6. Any necessary record forms and log sheets.
44 7. Any required laboratory and technical assistance.
45
46

47 **3.3 PIPE CLEANING AND INHIBITING GUIDELINES**
48

- 49 A. Cleaning: Hydronic water piping system shall be cleaned by using a solution consisting of a
50 blend of organic alkaline penetrants, emulsifiers, surfactants and corrosion inhibitors and
51 containing propylene glycol, methyl ether, phosphonates, sodium-meta-silicate-hydrate and
52 sodium hydroxide.
53
54 1. The material shall not contain tri-sodium phosphate.

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2. The piping system shall be filled, vented and circulated employing the chemical cleaner solution for a period of at least 24 hours or more in accordance with the manufacturer's recommendations and job site chemical tests. Water filters shall be removed from the system for this cleaning. The concentration shall be brought to a level which raises the M Alkalinity to a value of 250 above that for the existing water used for the fill.
3. Chemical tests shall be made to verify these levels and submitted to the A/E. The system should be circulated, drained and flushed to achieve the original M Alkalinity level.

B. Inhibitor:

1. The inhibitor shall be added to the system after it is acceptably cleaned and flushed and refilled. The inhibitor shall consist of a boron nitrite, benzol thiazol, benzotriazole, mercapto-benzo-thiazole, tolyltriazole silicates and color trace all producing a scale and corrosion inhibitor system. The inhibitor shall be chemically installed to a concentration of 700 to 1000 parts per million and the solution shall be tested to indicate that it falls within this range.
2. Test results shall be submitted to the A/E.
3. The strainer baskets may be remounted before the system is inhibited.

C. Supervision:

1. The chemical supplier shall supervise the addition, the testing of the flushing and draining of all chemical scale and inhibitor solutions for all systems. Three copies of the chemical water status shall be submitted to the A/E for final approval.
2. Cleaning, inhibiting and testing of the piping systems shall be carried out in the presence of the owner's representative.

END OF SECTION

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SECTION 23 66 00
AIR-COOLED CONDENSING UNITS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Pad-mounted condensing units.
- B. Refrigerant piping and controls.
- C. Refrigerant charge.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 05 00 HVAC General Provisions
 - 2. 23 06 00 Pipe and Pipe Fittings
 - 3. 23 06 30 Piping Specialties
 - 4. 23 90 00 Controls and Instrumentation

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Air Conditioning and Refrigeration Institute, ARI:
 - a. ARI 210: Unitary Air Conditioning Equipment.
 - b. ARI 270: Sound Rating.
 - 2. Underwriter's Laboratories, UL: Conform to requirements of UL.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Submit with shop drawings, schematic layouts showing condensing units, cooling coils, refrigerant piping, and accessories required for complete system.
 - 2. Submit complete pipe sizing data and piping schematic for refrigerant piping with valves and refrigerant specialties indicated.
 - 3. Submit manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Air Cooled Condensing Units:
 - 1. AAON
 - 2. Carrier Corp.
 - 3. McQuay Co.

1 4. Johnson Controls

2
3 **2.2 TYPE AND PERFORMANCE**

4
5 A. Self-contained, packaged, factory-assembled and prewired units suitable for outdoor use
6 consisting of cabinet, compressors, condensing coils and fans, integral sub-cooling coil,
7 controls, liquid receiver, wind deflector, and screens.

- 8
9 1. Refrigerants: R-410A as scheduled.
10 2. Two circuits, where scheduled.

11
12 B. Minimum Operating Condition EER: 11.8

13
14 C. Electrical Service: 480 volt, 3-phase, 60 Hertz.

15
16 **2.3 MATERIALS**

17
18 A. Use corrosion-resistant materials for parts in contact with refrigerant.

19
20 B. Timer circuits to prevent rapid loading and unloading of compressor.

21
22 **2.4 CABINET**

23
24 A. Galvanized steel (14 gauge) with anti-corrosion, baked enamel finish, and removable access
25 doors or panels with quick fasteners.

- 26
27 1. 2500 hrs salt spray tested exterior paint finish.

28
29 B. PVC coated steel wire condenser coil guard.

30
31 **2.5 COMPRESSORS**

32
33 A. Hermetically sealed, 1750 or 3500 RPM, resiliently mounted compressor with positive
34 lubrication, crankcase heater, motor overload protection, service valves, and filter-drier.

- 35
36 1. Modular scroll compressors.
37 2. Digital modulating capacity scroll compressors, where scheduled as lead compressor.

38
39 B. Extended compressor warranty: 5 years.

40
41 **2.6 CONDENSER**

42
43 A. Coil: Seamless copper tubing with aluminum fins.

44
45 B. Fans: Vertical discharge, direct-drive axial fans, resiliently mounted with guard and motor.

46
47 C. Motors: Permanently lubricated ball bearing motors with built-in current and overload
48 protection.

49
50 **2.8 CONTROLS**

51
52 A. High and low pressure cut-outs for compressor, oil pressure control, anti-cycle timer 5 min.
53 (adj.) and reset relay.

- 1 B. Accessory Controls: As scheduled on Drawings.
- 2
- 3 1. One circuit: digital scroll compressor with modulating capacity(0-5 VDC control
- 4 signal).
- 5 2. Low-ambient(35 deg F) modulating condenser fan speed(ECM motor) controlled by
- 6 refrigerant condensing pressure.
- 7 3. Anti-corrosion paint finish.
- 8
- 9 C. Unit Controls:
- 10
- 11 1. 115 volt 1-phase fusing and control power transformer.
- 12 2. Magnetic contactors for compressor and condenser.
- 13 3. High/low pressure cutouts.
- 14 4. Reset relay.
- 15 5. Anti-recycle compressor timer.
- 16 6. Terminal strip for Temperature Control Contractor interface and control of cooling
- 17 enable/disable and steps or modulation.
- 18
- 19

20 **PART 3 - EXECUTION**

21

22 **3.1 INSTALLATION**

- 23
- 24 A. Complete structural, mechanical, and electrical connections in accordance with
- 25 manufacturer's installation instructions.
- 26
- 27 B. Furnish charge of refrigerant and oil.
- 28

29 **3.2 FIELD QUALITY CONTROL**

- 30
- 31 A. Start-up: Supply initial charge of refrigerant and oil for each refrigeration system.
- 32
- 33 B. Testing:
- 34
- 35 1. Charge system with refrigerant and test entire system for leaks after completion of
- 36 installation.
- 37 2. Repair leaks, put system into operation, and test equipment performance.
- 38 3. Shut-down system if initial start-up and testing takes place in winter and machines
- 39 are to remain inoperative.
- 40 4. Repeat start-up and testing operation at beginning of first cooling season.
- 41
- 42 C. Manufacturer's Start-up Test Report and Acceptance:
- 43
- 44 1. Submit start-up test report and acceptance letter from Manufacturer's representative
- 45 indicating the air-cooled condensers are properly installed and piped for refrigerant
- 46 flow.
- 47 2. Test report shall indicate operating pressures and temperatures for the suction and
- 48 liquid lines under normal cooling operation.
- 49
- 50

51 **END OF SECTION**

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SECTION 23 74 00
TERMINAL AIR DISTRIBUTION UNITS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of terminal air distribution unit equipment work is indicated by drawings and schedules, and by requirements of this section.
- B. Types of terminal air distribution unit equipment required for project include the following:
 - 1. VAV Boxes with hot water reheat.
 - 2. Fan-powered VAV Boxes with hot water reheat
- C. Refer to other Division 15 temperature control system sections for control work required in conjunction with air distribution equipment.

1.2 RELATED DOCUMENTS

- A. Applicable provision of Division 1 governs work under this section.
- B. Specified Elsewhere:
 - 1. 23 05 90 Testing, Adjusting and Balancing
 - 2. 23 06 30 Piping Specialties
 - 3. 23 25 00 Mechanical Insulation
 - 4. 23 90 00 Controls and Instrumentation

1.3 QUALITY ASSURANCE

- A. IBR Compliance: Provide terminal heating units bearing the IBR Hydronics Institute Certified Rating Seal.
- B. AMCA Compliance: Provide air distribution equipment bearing the Air Movement and Control Association, Inc. (AMCA) Certified Rating Seal.
- C. UL Compliance: Provide air distribution equipment electrical components which have been listed and labeled by Underwriter Laboratories (UL).

1.4 SUBMITTALS

- A. Submit shop drawings for all equipment including all data concerning dimensions, air flow capacities, sound ratings, unit pressure drop, finish and appropriate identification.
- B. Submit certified sound data for both casing discharge and radiated sound levels from 125 thru 8000 Hz as tested in accordance with Air Diffusion Council (ADC) Test Standard 1062R4.

PART 2 - PRODUCTS

2.1 VARIABLE AIR VOLUME BOXES

- 1 A. General: Provide single-duct VAV boxes of size and arrangement as indicated on Drawings, and of
2 capacities and having accessories as scheduled.
3
- 4 B. Housing: Factory assembled unit with welded 26-gauge galvanized steel casing, acoustically and
5 thermally lined with 1" thick 3 PSF fiberglass with high-density facing. Leakage rate 2% maximum
6 at 0.5 inch W.G. Insulation to be UL listed and meet NFPA 90A requirements.
7
- 8 1. Provide bottom or side access panel for air valve.
9 2. Provide bottom or side access panel upstream and downstream of reheat coil. Access panel
10 shall be large enough to allow proper cleaning of reheat coil without dismantling ductwork.
11
- 12 C. Air Valves: Air flow control device with integral actuator. Electronic volume regulator supplied by
13 Temperature Control Contractor, factory or field installed. Integral flow ring sensor with taps and
14 calibration chart to measure air flow with 10% regardless of inlet connections.
15
- 16 D. V.A.V. Box Control: DDC/Electronic actuators, sensor wiring and application-specific controller
17 supplied by Temperature Control Contractor, field-installed.
18
- 19 F. Hot Water Coil: Performance and rated capacities as indicated on schedules on Drawings.
20
- 21 1. Hot water coil with aluminum fins mechanically bonded to 5/8" OD seamless copper tube.
22 Same end connections.
23 2. Coil leak tested at 300 PSIG air pressure, under water.
24 3. Provide duct extensions for access panel installation upstream of reheat coil to clean coil
25 surface.
26
- 27 G. Fan-Powered Unit(Series): Forward-curved fan wheel, 22 gauge steel housing, 18 gauge steel fan
28 board. ECM Motors permanently lubricated, direct-drive. Acoustically lined 1" insulation per
29 NFPA- 90A. Intergral disconnect switch. Air filter holder and MERV 8 filters for secondary air
30 flow.
31
- 32 1. Provide intergral speed controller at unit for balancing as scheduled.
33 2. Provide low-voltage terminal strip for remote fan speed control.
34
- 35 F. Acceptable Manufacturers:
36
- 37 1. VAV Boxes: Accutrol LLC
38 2. Fan-powered VAV Boxes: Enviro-Tec, Carnes, Titus or approved equal.
39
40

41 **PART 3 - EXECUTION**

42 **3.1 INSPECTION**

- 43 A. Examine areas and conditions under which terminal air distribution units are to be installed. Do not
44 proceed with work until unsatisfactory conditions have been corrected.
45

46 **3.2 INSTALLATION OF TERMINAL AIR DISTRIBUTION EQUIPMENT**

- 47 A. Install terminal air distribution equipment where indicated, in accordance with equipment
48 manufacturers installation instructions, and with recognized industry practices to ensure that
49 equipment complies with requirements and serves intended purposes.
50

- 51 1. Provided proper service clearance space for controls and damper actuators.
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SECTION 23 74 10
TERMINAL HEATING UNITS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of terminal heating unit equipment work is indicated by drawings and schedules, and by requirements of this section.
- B. Types of terminal heating unit equipment required for project include the following:
 - 1. Panel Radiation.
- C. Refer to other Division 23 temperature control system sections for control work required in conjunction with terminal heating equipment equipment.

1.2 RELATED DOCUMENTS

- A. Applicable provision of Division 1 governs work under this section.
- B. Specified Elsewhere:
 - 1. 23 05 90 Testing, Adjusting and Balancing
 - 2. 23 06 30 Piping Specialties
 - 3. 23 90 00 Controls and Instrumentation

1.3 QUALITY ASSURANCE

- A. IBR Compliance: Provide terminal heating units bearing the IBR Hydronics Institute Certified Rating Seal.
- B. UL Compliance: Provide air distribution equipment electrical components, which have been listed and labeled by Underwriter Laboratories (UL).

1.4 SUBMITTALS

- A. Submit shop drawings for all equipment including all data concerning dimensions, heating capacities, sound ratings, unit pressure drop, cabinet construction, finish and appropriate identification.

PART 2 - PRODUCTS

2.1 PANEL RADIATION

- A. General: Furnish panel radiation units and accessories as indicated, and scheduled on plans.
- B. Panel Radiators: Provide steel double panel radiators of the lengths and in locations as indicated, and of capacities, style and having accessories as scheduled. The double heating panel radiation shall be of one-piece all-welded steel construction, consisting of a pair of flattened water tube panels welded to headers at each end. Working pressure rating of 75 psig.

- 1 1. Welded to the inside of each panel shall be steel corrugated fins to increase the
2 convective output of the radiator.
- 3 2. The fins shall start at no less than 3" from the end of the radiator, and shall have no
4 less than 32 fins per foot. A third set of fins shall be added to the backside of the
5 radiator for maximum convective output.
- 6 3. The radiators shall include an integral heavy gauge (0.09" minimum) all-welded
7 perforated top grille, which will cover the top of all of the finned areas
- 8 4. The headers shall include all necessary inlet, outlet and vent connections as required.
- 9 5. Standard connection sizes are 1/2" NPT tapered thread for supply and return piping,
10 and 1/8" for the vent connection. Internal baffling is provided where required for
11 proper water flow.
- 12 6. Finish: Baked-on enamel finish over phosphatized prime coat color selection by
13 Architect from manufacturer's standard colors.
- 14
- 15 C. Accessories: End panels, inside and outside corners, enclosure extensions and related as
16 indicated on drawings.
- 17
- 18 1. All accessories shall have non-visible fasteners.
- 19
- 20 D. Acceptable Manufacturers:
- 21
- 22 1. Runtal;
- 23 2. Rittling;
- 24 3. Approved equaa.
- 25

26

27 **PART 3 - EXECUTION**

28

29 **3.1 INSPECTION**

- 30
- 31 A. Examine areas and conditions under which terminal units are to be installed. Do not proceed
32 with work until unsatisfactory conditions have been corrected.

33

34 **3.2 INSTALLATION OF TERMINAL HEATING UNITS**

- 35
- 36 A. Install terminal heating units where indicated, in accordance with equipment manufacturers
37 installation instructions, and with recognized industry practices to ensure that equipment
38 complies with requirements and serves intended purposes.
- 39
- 40 B. Coordinate with other work, including recessed wall installations, floor-mounted
41 construction, and control work as necessary to interface installation of terminal heating units
42 with work of other Trades.
- 43
- 44 C. Coordinate installation of radiation supports and enclosure for continuous panel radiation
45 installation, straight and true to outside wall.

46

47 **3.3 FIELD QUALITY CONTROL**

- 48
- 49 A. Upon completion of installation of terminal heating unit equipment, test equipment to
50 demonstrate compliance with requirements. Where possible, field correct malfunctioning
51 equipment, then retest to demonstrate compliance. Replace equipment, which cannot be
52 satisfactorily corrected.

53

54 **END OF SECTION**

1
2
3
4
5 **SECTION 23 76 20**
6 **GAS-FIRED MAKEUP AIR UNITS**

7
8
9 **PART 1 - GENERAL**

10
11 **1.1 DESCRIPTION OF WORK**

- 12
13 A. Direct-fired, Indoor Make-up Air Units.

14
15 **1.2 RELATED DOCUMENTS**

- 16
17 A. Applicable provisions of Division 1 shall govern work under this section.

- 18
19 B. Specified elsewhere:

- 20
21
22 1. 23 05 90 Testing, Adjusting and Balancing
23 2. 23 20 00 Vibration Isolation
24 3. 23 90 00 Controls and Instrumentation
25 4. 23 96 00 Starting of Mechanical Systems

26
27 **1.4 QUALITY ASSURANCE**

- 28
29 A. Regulatory Requirements:

- 30
31 1. Reference Standards:

32
33

AGA	American Gas Association
ANSI Z83.4	Direct Gas Fired Makeup Air Heaters
ANSI Z83.6	Gas Fired Infrared Heaters
ANSI Z21.64	Direct Vent Central Furnaces
GAMA	Gas Appliance Manufacturers Association
NEC	National Electrical Code

- 34
35 B. WARRANTY:

- 36
37 1. Gas-fired primary and secondary heat exchangers warranted for 20 years under normal use
38 and maintenance. Remainder of heating components warranted for 1 year from date of
39 startup

40
41 **1.5 SUBMITTALS**

- 42
43 A. Refer to division 1, General Conditions, Submittals.

- 44
45 B. Submit complete product data, manufacturer's installation instructions and accessories required for
46 complete system.

47
48 **PART 2 - PRODUCTS**

49
50 **2.1 DIRECT-FIRED MAKE-UP AIR UNITS**

- 51
52 A. Furnish fully assembled and wired gas-fired direct-fired make-up air units in the size and capacity as
53 shown on the Drawings.

- 54
55 B. Furnish fully assembled and wired direct-fired outdoor make-up unit with blower/filter section, and
56 duct furnace section in the size and capacity as shown on the Drawings and specified herein.

1 Designed for 100% make-up air applications with ETL certified compliance with ANSI Standard
2 Z83.18 and Z83.4.

3
4 C. Casing: Shall be complete with insulated double-wall galvalume steel construction in weatherized
5 cabinet, removable side panels, filters (2" 30% - MERV 8) and external angled filter rack. Unit shall
6 be configured for indoor horizontal discharge with rail mounting. Access panels shall employ
7 locking cams with tool-less door access handles to access equipment.

8
9 D. Bonnet Section: AGA certified and constructed of AGA defined corrosion resistant material with a
10 built-in draft diverter. Burners shall be cast iron construction with stainless steel mixing plates.
11 Burner shall employ an electronic modulating gas design for 25:1 turndown ratio.

12
13 E. Blower Section: Shall be factory installed with NEMA standard motor, IEC contactor or starter,
14 dynamically-balanced class I or II centrifugal blower fan and adjustable belt drive.

15
16 F. Gas Train:

- 17 1. Units shall be provided with gas valves suitable for Class 2, maximum inlet pressure of 0.5
18 psi (14 inch W.C.) on natural gas.
- 19 2. The 24-volt combination automatic gas valves must include a main operating valve, pilot
20 safety shutoff, pressure regulator, manual main and pilot shutoff valve, and adjustable pilot
21 valve.
- 22 3. Gas valves shall be electronic modulating gas valve. Ignition shall be at full fire (100% input)
23 and modulate the gas input from 100 to 10% rated input. Gas valve shall be energized
24 through duct thermostat control with reset from the space selector thermostat. Maxitrol
25 Series 14 amplifier or approved equal.

26
27
28 G. Controls:

- 29 1. A factory installed control box or junction box shall be provided for all power connections. A
30 24-volt control transformer, high limit, and fan time delay relay must be provided. Fan time
31 delay relay will delay the fan start until the heat exchanger reaches a predetermined
32 temperature and allow the fan to operate after burner shutdown to remove residual heat from
33 the heat exchanger.
- 34 2. A solid-state ignition control system shall ignite the pilot by spark during each cycle of
35 operation. When pilot flame is proven, main burner valve shall be open to allow gas flow to
36 burner. Pilot and burners must be extinguished during the off cycle.

37
38
39 H. Accessories: (Refer to Schedules for further requirements)

- 40 1. Low voltage duct thermostat, modulating control and remote control station as scheduled for
41 discharge air temperature control.
- 42 2. 460 volt/3-phase electric service with control transformers.
- 43 3. Indoor filter section with locking access door.
- 44 4. Double-wall construction.
- 45 5. Painted enamel finish.

46 47 48 49 **PART 3 - EXECUTION**

50 51 **3.1 INSTALLATION**

52
53 A. General: Comply with all applicable codes, standards and local utility requirements. Install units per
54 manufacturer's recommended instructions.

1
2
3
4
5
6
7
8

- B. Connect natural gas line to gas-fired equipment and adjust pilot flame, gas input and pressure per manufacturer's recommendations.
- C. Install and adjust integral and remote temperature controls for proper operation.

END OF SECTION

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SECTION 23 76 30
AIR HANDLING UNITS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. This section includes material specifications and installation requirements for air handling units, coils mounted in the units and other accessories normally furnished by the equipment supplier.
- B. Types of air handling units with coils specified in this Section.
 - 1. Horizontal Draw-Thru Units(AHU).
 - 2. Horizontal Draw-Thru Units with Energy Recovery Wheel(DOAS)
- C. Mechanical Room Access: Air handling units shall be split in sections to allow access through 72" standard double door opening.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 05 90 Testing, Adjusting and Balancing
 - 2. 23 20 00 Vibration Isolation
 - 3. 23 89 50 Variable Frequency Drives
 - 4. 23 90 00 Controls and Instrumentation
 - 5. 23 96 00 Starting of Mechanical Systems

1.3 SUBMITTALS

- A. Submittals are required for all material in this section.
- B. Submittals shall include all data concerning dimensions, capacities, materials of construction, weights, appropriate identification and fan curves.
 - 1. Fan curves shall include a series of curves indicating the relationship of CFM and static pressure for various RPM, brake horsepower curves, and selection range (surge curves, maximum RPM, etc.).
 - 2. Indicate operating point on the fan curves at design air quantity and at 110 percent of design air quantity.
 - 3. For variable air volume application, indicate all operation points on the fan curves.

1.4 MANUFACTURERS

- A. McQuay;
- B. Trane;
- C. Carrier;
- D. Johnson Controls;

1 **PART 2 - PRODUCTS**

2
3 **2.1 DESIGN CRITERIA**

- 4
5 A. Furnish units complete with fans, motors, coils, drain pans, filter sections, face and bypass, air
6 blending and mixing sections as shown on the plans and/or as scheduled. All materials shall meet
7 requirements of NFPA 90A.
8 B. Units shall have the configuration as indicated on the plans and/or as scheduled.
9
10 C. Each fan and motor combination shall be capable of delivering plus 10% of the air quantity scheduled
11 at the scheduled static pressure.
12
13 D. Air handling unit static pressure shall take into consideration the actual static pressure loss of the
14 components furnished within the unit.
15
16 E. Where inlet and outlet ductwork at any fan is changed from that shown on the drawings, submit a
17 scaled layout of the change and system effect factor calculations, indicating increased static pressure
18 requirement as described in AMCA Publication 201. This Trade shall be responsible for any motor,
19 drive and/or wiring changes required as a result of duct configuration changes at the fan.
20
21 F. Variable frequency drives supplied with the air handler unit shall meet Section 23 89 50
22 requirements.
23

24 **2.2 CASING**

- 25
26 A. Unit casing shall be constructed of factory-painted finish 18-gauge G90 galvanized steel throughout,
27 with steel framework. Casings shall be furnished with removable panels to provide access to all
28 internal parts. Units shall be constructed air tight and water tight, shall be rust inhibited and furnished
29 prime coated or galvanized. Closed cell foam gasketing shall be employed where modules are joined.
30
31 B. Unit casings shall be double-wall solid-liner construction of 2-inch thermally broken double-wall
32 construction with injected foam insulation for an R-value of not less than R-13. All connecting
33 channels shall be insulated to prevent sweating.
34
35 C. Drain pan to be insulated, double-wall stainless steel construction under cooling coil sections.
36 Provide drain connection on both sides.
37
38 D. Air handling unit and accessories shall be furnished with a nameplate which includes model number,
39 serial number and unit tag number.
40
41 E. Casing sections with internal fan and motor isolation packages do not require piping vibration
42 isolators, piping flexible connectors or external vibration isolation.
43

44 **2.3 FANS**

- 45
46 A. Fans shall be double width, double inlet centrifugal or single width single-inlet air foil plenum fan
47 type, statically and dynamically balanced in unit fan section. Fans shall be securely fastened to solid
48 or hollow steel shafts and shall be designed for continuous operation at the maximum rate static
49 pressure.
50
51 1. Housed fan performance shall be certified as complying with ARI standard 430-89.
52 2. Centrifugal fans shall be dynamically balanced at factory as a complete fan assembly.
53 3. Fan shafts shall not exceed 75% of their first critical speed at any cataloged RPM.

- 1 B. Bearings shall be internally mounted and provided with an extended grease line and fitting to allow
2 servicing without entering or dismantling of the unit. Bearings shall be self aligning, anti-friction
3 pillow block bearings with a minimum life of L-50 200,000 hours.
4
- 5 C. Fans shall be provided with a belt guard to insure than no rotating parts are exposed. Provision shall
6 be made so that a tachometer may be used to verify fan speed without removing the belt guard
7 assembly.
8
- 9 D. Provide variable pitch V-belt drives for purposes of system balancing within 5% of specified RPM.
10
- 11 E. Fan and motor assembly shall be internally isolated from unit casing with spring isolators furnished
12 and installed by unit manufacturer. Fan scroll shall be attached to the unit casing by a flexible canvas
13 duct.
14

15 **2.4 MOTORS**

- 17 A. Motors shall have characteristics consistent with the torque and speed of the fans being driven. All
18 motors shall be NEMA frames and be rated in accordance with NEMA performance standards for
19 continuous full load performance at 40 degrees C temperature rise above ambient, with a 1.15 service
20 factor. Motor horsepower and voltages shall be as scheduled.
21
- 22 B. The motor furnished with the fan shall not operate into the motor service factor. Drive efficiency
23 shall be considered in motor selection according to manufacturers published recommendations, or
24 according to AMCA publication 203.
25
- 26 C. Furnish premium-efficiency motors per Section 23 05 00. Provide VFD compatible motors where
27 fans are controlled by VFD drives.
28
- 29 1. Fan motors controlled by VFD's shall be fitted with split-ring shaft grounding assemblies.
30

31 **2.5 WATER COILS**

- 33 A. Construct coils of 1/2" or 5/8" O.D. min. copper tubes with aluminum fins suitable for working
34 pressures to 200 PSIG.
35
- 36 B. Coil fins shall be the continuous or plate fin type. Maximum fin spacing 10 fins per inch.
37
- 38 C. Construct coil headers of cast iron with tubes expanded into the headers, steel pipe with brazed tube
39 connections, or of heavy seamless copper with all tubes brazed to the header.
40
- 41 D. Casing shall have galvanized steel end supports and top and bottom channels of rigid construction
42 with allowance for expansion and contraction of the finned tube section.
43

44 **2.6 REFRIGERANT COILS**

- 46 A. Construct coils of 1/2" or 5/8" O.D. min. copper tubes with aluminum fins suitable for working
47 pressures to 200 PSIG.
48
- 49 1. Provide distributor quantities as scheduled for multiple DX stages.
50
- 51 B. Coil fins shall be the continuous or plate fin type. Maximum fin spacing 12 fins per inch.
52
- 53 C. Construct coil headers of cast iron with tubes expanded into the headers, steel pipe with brazed tube
54 connections, or of heavy seamless copper with all tubes brazed to the header.

1
2 D. Casing shall have galvanized steel end supports and top and bottom channels of rigid construction
3 with allowance for expansion and contraction of the finned tube section.
4

5 **2.7 DESICCANT ENERGY RECOVERY WHEEL**
6

7 A. Wheel Media: The enthalpy wheel shall be constructed of corrugated synthetic fibrous
8 media, with a desiccant intimately bound and uniformly and permanently dispersed
9 throughout the matrix structure of the media.
10

- 11 1. Rotors with desiccants coated, bonded, or synthesized onto the media are not
12 acceptable due to delamination or erosion of the desiccant material.
- 13 2. Media shall be synthetic to provide corrosion resistance and resistance against attack
14 from laboratory chemicals present in pharmaceutical, hospital, etc. environments as
15 well as attack from external outdoor air conditions.
- 16 3. Coated aluminum is not acceptable. Face flatness of the wheel shall be maximized in
17 order to minimize wear on inner seal surfaces and to minimize cross leakage.
- 18 3. Rotor shall be constructed of alternating layers of flat and corrugated media.
- 19 4. Wheel layers should be uniform in construction forming uniform aperture sizes for
20 air flow.
- 21 5. Wheel construction shall be fluted or formed honeycomb geometry so as to eliminate
22 internal wheel bypass.
- 23 6. Wheel layers that can be separated or spread apart by air flow are unacceptable due to
24 the possibility of channeling and performance degradation.
- 25 7. The minimum acceptable performance shall be as specified in the drawing schedules.
26

27 B. Desiccant Material: The desiccant material shall be a molecular sieve, and specifically a 4A
28 or smaller molecular sieve to minimize cross contamination.
29

30 C. Wheel Media Support System: The wheel frames shall consist of evenly spaced steel spokes,
31 galvanized steel outer band and rigid center hub. The wheel construction should allow for
32 post fabrication wheel alignment.
33

34 D. Wheel Seals: The wheel seals shall be full contact nylon brush seals or equivalent. Seals
35 should be easily adjustable.
36

37 E. Wheel cassette: Cassettes shall be fabricated of heavy duty reinforced galvanized steel or
38 welded structural box tubing. Cassettes shall have a built in adjustable purge section
39 minimizing cross contamination of supply air. Bearings shall be inboard, zero maintenance,
40 permanently sealed roller bearings, or alternatively, external flanged or pillow block
41 bearings.
42

- 43 1. Drive systems shall consist of fractional horsepower A.C. drive motors with multilink
44 drive belts.
45

46 F. Certification: The wheel shall be ARI certified and must bear the ARI certification stamp.
47 Private independent testing performed "in accordance with" various standards is not a
48 substitute for ARI certification and shall not be accepted. The wheel shall be listed or
49 recognized by UL or equivalent.
50

1 **2.8 FILTERS**

- 2
- 3 A. MERV 13 Filter Media: Air filters shall consist of disposable 4" thick, pleated, lofted, non-woven,
4 cotton and synthetic media, reinforced fabric, supported and bonded to a welded wire grid, and
5 enclosed in cardboard frame. UL Class 2.
- 6
- 7 1. Media nominal rating shall be 500 FPM face velocity, 0.30 inch W.G. initial resistance.
8 2. Filter shall provide a minimum of 4.6 S.F. of media per square foot of filter face area and
9 shall contain not less than 15 pleats per linear foot.
- 10
- 11 B. Provide extra set of prefilter media to be used during the construction period.
- 12

13 **2.9 MIXING BOX SECTION**

- 14
- 15 A. Furnish mixing box sections where indicated on Drawings. Outdoor damper shall be low-leakage
16 type with fully gasketed continuous vinyl seals and stainless steel jamb seals rated at less than 0.2%
17 leakage at 2" pressure differential per AMCA Standard 500.
- 18
- 19 B. Casing shall be insulated equal to air handler with access door in section.
- 20
- 21 1. Provide access door at mixing box section for mounting actuators.
- 22

23 **2.10 BLENDER SECTION**

- 24
- 25 A. Furnish blender sections where indicated on Drawings. Blender sections shall provide for air mixing
26 and distribution of the outside and return air streams. Proper spacing provided in the direction of air
27 flow as recommended by the blender manufacturer, approved as follows:
- 28
- 29 1. Kees.
30 2. Blender Products.
- 31
- 32 B. Casing shall be insulated equal to air handler unit section.
- 33
- 34 1. Provide access door at blender section for access upstream of cooling coil.
- 35

36 **2.11 VIBRATION ISOLATION**

- 37
- 38 A. All units shall be provided with internal, factory-installed internal vibration isolation for the fan
39 section.
- 40

41 **2.12 ACCESSORIES**

- 42
- 43 A. Provide factory installed filter section air pressure drop magnahelic gauge (0-1.00 W.G.) at each filter
44 section.
- 45

46

47 **PART 3 - EXECUTION**

48

49 **3.1 AIR HANDLING UNIT INSTALLATION**

- 50
- 51 A. Install units according to manufacturer's instructions in locations as indicated on the drawings and as
52 detailed.
- 53

- 1 B. All units shall be installed on concrete pad, factory-mounted rail or welded steel stand, as indicated or
2 specified.
- 3
- 4 C. Sufficient room shall be allowed for maintenance of the equipment and for removal of coils and the
5 fan shafts.
- 6
- 7 D. Install all belts, sheaves and motors to form a complete drive package for each fan according to the
8 manufacturer's recommendations.
- 9
- 10 E. Belt tension and alignment shall be inspected and corrected, if necessary, every week after start-up
11 until corrections are no longer necessary.
- 12
- 13 F. Install belt gauge so that belts are completely enclosed. Provisions shall be made for measuring fan
14 speed with a tachometer without removing entire guard.
- 15
- 16 G. Provide drains connections from coils with shutoff valve. Trap height 1/2" and total static pressure.
17 Mount units at proper height above floor so that proper trap depth is provided.
- 18

19 **3.2 COILS IN GENERAL**

- 20
- 21 A. Install coils in factory packaged air handling units or on a structural steel frame for field erected air
22 handling units as indicated on the drawings and/or as detailed. Pitch coils for proper drainage
23 according to the manufacturer's installation.
- 24
- 25 B. Comb out fins when bent or crushed before enclosing coils in housing. Clean dust and debris from
26 each coil to ensure its cleanliness.
- 27
- 28 C. Provide offsets in piping to facilitate coil removal. Unless otherwise specified, pipe coils for
29 counterflow arrangement.
- 30
- 31 D. Provide air vent and drain valve at each coil.
- 32

33 **END OF SECTION**

SECTION 23 82 00
FANS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of fan work is shown on drawings and schedules, and by requirements of this section.
- B. Types of fans required for project include the following:
 - 1. Inline Vane Axial Fans.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 05 90 Testing, Adjusting and Balancing
 - 2. 23 20 00 Vibration Isolation
 - 3. 23 90 00 Controls and Instrumentation

1.3 QUALITY ASSURANCE

- A. Manufacturers:
 - 1. Greenheck
 - 2. Carnes
 - 3. Cook
- B. AMCA Compliance: Provide fans bearing the Air Movement and Control Association, Inc. (AMCA) Certified Rating Seal.
- C. UL Compliance: Provide power roof ventilator electrical components which have been listed and labeled by Underwriters Laboratories (UL).

1.4 SUBMITTALS

- A. Submittals shall include all product data, performance, materials of construction, and installation instructions.

PART 2 - PRODUCTS

2.1 VANE AXIAL INLINE

- A. General: Vane axial fans shall be the direct drive, inline type, as indicated on the drawings and schedules. Fan shall include housing, fan wheel, shaft, bearings, diffuser section, motor mounting support, beltguard and mounting frame as a factory assembled unit. AMCA Standard 210 certified.
 - 1. Unit shall be equal to Greenheck VAD series.

- 1
2 B. Fan Wheel: The fan wheel shall be axial type constructed of aluminum casting with eight radially
3 projected blades of air foil design. Diffuser shall be cast aluminum with twenty-nine radially
4 projected straightening vanes of air foil design. The fan wheel shall be dynamically balanced. The
5 fan shall be quiet operating and vibration free. Fan performance shall be certified by an AMCA
6 ratings seal.
7
8 C. Shaft: The fan shaft shall be hot rolled steel, turned and polished and mounted in lubricated ball
9 bearing pillow blocks. Bearings shall be provided with grease fittings and caps. Bearings shall be
10 rated for 200,000 hours.
11
12 D. Housing: The fan housing shall be steel construction 14 gauge steel hydraulically expanded to form
13 integral inlet bell and diffuser sections. Stiffening rings shall be welded inplace at area of wheel
14 raceways.
15
16 E. Motors shall have characteristics consistent with the torque and speed of the fans being driven. All
17 motors shall be NEMA frames and be rated in accordance with NEMA performance standards for
18 continuous full load performance at 40 degrees C temperature rise above ambient, with a 1.15 service
19 factor. Motor horsepower and voltages shall be as scheduled.
20
21 1. The motor furnished with the fan shall not operate into the motor service factor. Drive
22 efficiency shall be considered in motor selection according to manufacturers published
23 recommendations, or according to AMCA publication 203.
24 2. Furnish premium-efficiency motors per Section 23 05 00. Provide VFD compatible
25 motors where fans are controlled by VFD drives. Fan motors controlled by VFD's
26 shall be fitted with split-ring shaft grounding assemblies.
27
28 F. Accessories: As specified herein and indicated on drawings schedules:
29
30 1. Support legs.
31 2. Spring vibration isolation supports.
32 3. VFD compatible motor with motor shaft grounding rings.
33 4. Flanged connections.
34
35

36 PART 3 - EXECUTION

37 3.1 INSPECTION

- 38
39
40 A. General: Examine areas and conditions under which fans are to be installed. Do not proceed with
41 work until unsatisfactory conditions have been corrected.
42

43 3.2 INSTALLATION OF FANS

- 44
45 A. General: Except as otherwise indicated or specified, install ventilators in accordance with
46 manufacturer's installation instructions and recognized industry practices to insure that ventilators
47 serve their intended function.
48
49 B. Coordinate ventilator work with work of roofing, walls and ceilings, as necessary for proper
50 interfacing.
51
52 C. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-
53 mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical installer.
54

1 1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and
2 installation requirements of Division 26 sections. Verify proper rotation direction of fan
3 wheels. Do not proceed with equipment start-up until wiring installation is acceptable to
4 equipment installer.

5
6 D. Install vibration isolation as scheduled and specified in Section 23 20 00.

7
8 **3.3 FIELD QUALITY CONTROL**

9
10 A. Testing: After installation of ventilators has been completed, test each ventilator to demonstrate
11 proper operation of units at performance requirements specified. When possible, field correct
12 malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be
13 satisfactorily corrected.

14
15 **3.4 SPARE PARTS**

16
17 A. General: Furnish to Owner, with receipt, one spare set of belts for each belt drive power ventilator.
18
19

20 **END OF SECTION**

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**SECTION 23 84 00
DUCTWORK**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of ductwork requirements is indicated on the Drawings and by requirements of this section.
- B. The ductwork requirements for this project include the following:
 - 1. Low-Pressure Ductwork
 - 2. High-Pressure Ductwork
 - 3. Plenums
 - 4. Flexible Ductwork.
 - 5. Acoustic Duct Lining.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 25 00 Mechanical Insulation
 - 2. 23 86 00 Ductwork Accessories

1.3 QUALITY ASSURANCE

- A. SMACNA Standards: Comply with SMACNA "HVAC Duct Construction Standards" 3rd edition 2005 for fabrication and installation of metal and flexible ductwork.
 - 1. Duct Leakage Standards: HVAC Air Duct Leakage Test Manual, 2nd Edition, 2012.
 - 2. HVAC Systems - Duct Design: 4th Edition, 2006
- B. ASHRAE Standards: Comply with ASHRAE Handbook and Product Directory, 1979 Equipment Volume, Chapter 1 "Duct Construction", for fabrication and installation of ductwork.
- C. NFPA Compliance: Comply with ANSI/NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and ANSI/NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems."
- D. ACIGH Industrial Ventilation 24th Edition 2001.

1.4 SUBMITTALS

- A. Submit product data and specifications for ductwork materials.
- B. Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for low and high-pressure and exhaust ductwork systems.

1.5 DELIVERY, STORAGE AND HANDLING

- 1 A. Protect Ductwork by storing inside or by durable, waterproof, above ground packaging. Do not store
2 material on grade. Protect Ductwork from dirt, dust, construction debris and foreign material. Where
3 end caps/packaging are provided, take precautions so caps/packaging remain in place and free from
4 damage.
5
6 B. Offsite storage agreements do not relieve the contractor from using proper storage techniques.
7
8

9 **PART 2 - PRODUCTS**

10 **2.1 DUCTWORK MATERIALS**

- 11 A. Above ground, general ductwork: Galvanized steel, lock-forming quality, ASTM A527; 1.25 oz. zinc
12 coating each side, mill phosphatized, ASTM A525.
13
14 1. Round – Spiral wound ductwork.
15
16 B. Steel Ducts: Galvanized steel, lock-forming quality, ASTM A527; 1.25 oz. zinc coating each
17 side(G90), mill phosphatized, ASTM A525.
18
19 C. Stainless Steel Ducts: ASTM A167, Type 304.
20
21 D. Flexible Duct:
22
23 1. Spiral wire Reinforced Fabric: Spiral wire reinforced fabric type flexible duct shall be made
24 of a corrosion-resistant reinforcing wire helix bonded to a continuous layer of fabric. Class I
25 Air Duct Material, UL Standard 181.
26
27 E. Insulated Flexible Duct: Insulation shall be cellular glass, 1-1/2" nominal thickness of 1-1/2 pound
28 density per cubic foot. The insulation shall encase the flexible duct and shall be sheathed with vapor
29 barrier having a permeability of not over 2.0 perm. Insulation and vapor barrier shall be factory
30 installed.
31
32 F. Flexible Fiberglass Duct Liner: Flexible coated glass fiber duct liner; ANSI/ASTM C553; 'K' value
33 of 0.26 at 75 degrees F; 1-1/2 lbs./cu. ft. minimum density; coated air side for maximum 4,000
34 ft./min. air velocity.
35
36 1. Lagging Adhesives: Fire resistive to ASTM E84, NFPA 255.
37
38 2. Impale Anchors: Galvanized steel, 12 gage self-adhesive pad or mechanical fastener type as
39 recommended, insulation manufacturer.
40
41 G. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant gaskets and tapes as
42 compounded and recommended by the manufacturer specifically for sealing joints and seams in
43 ductwork.
44
45 H. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel
46 fasteners, anchors, rods, straps, trim and angles for support of ductwork.
47
48 I. Drive Screws and Clamps: As recommended by SMACNA.
49
50 J. Factory Made Joints: Ductmate system as manufactured by Ductmate Industries, Inc., Nexus system
51 as manufactured by Exanno, or other approved product may be used.
52
53

54 **2.2 DUCTWORK PRESSURE-VELOCITY CLASSIFICATION**

- 1
2 A. General: Construct ductwork in conformance to SMACNA "HVAC Duct Construction Standards"
3 1st edition 1985.
4
5 B. Low Pressure Ductwork:
6
7 1. Static Pressure Class: +2" W.G.
8 2. Maximum Velocity Level: 2500 FPM.
9
10 C. High Pressure Ductwork:
11
12 1. Static Pressure Class: +4" W.G.
13 2. Maximum Velocity Level: 4000 FPM.
14

15 **2.3 DUCTWORK SEALING CLASSIFICATION**

- 16
17 A. General: Construct ductwork in conformance to SMACNA "HVAC Duct Construction Standards"
18 most current edition.
19
20 B. Low Pressure Ductwork:
21
22 1. Seal Class: B seal transverse joists and longitudinal seams.
23
24 C. High Pressure Ductwork:
25
26 1. Seal Class: A seal transverse joints and longitudinal seams and ductwall penetrations.
27

28 **2.4 FABRICATION**

- 29
30 A. Shop fabricate ductwork in 4, 8, 10, or 12 foot lengths, unless otherwise indicated or required to
31 complete runs. Pre-assemble work in shop to greatest extent possible, so as to minimize field
32 assembly of systems. Disassemble systems only to extent necessary for shipping and handling.
33 Match-mark sections for reassembling and coordinated installation.
34
35 B. All dimensions indicated on drawings are free area ductwork requirements. Increase ductwork
36 dimensions to accommodate ductwork lining requirements.
37
38 C. Accessories:
39
40 1. Fabricate ductwork with accessories such as air turns, extractors, and volume dampers,
41 installed during fabrication to greatest extent possible.
42 2. Fabricate ductwork with duct liner in each section of duct where required.
43
44 D. Variation: No variation of duct configuration or sizes permitted except by written permission.
45
46 E. Directional Change:
47
48 1. Construct tees, bends, and elbows with radius minimum 1-1/2 times width of duct on center
49 lines.
50 2. Where not possible and where rectangular elbows used, provide airfoil type turning vanes.
51 3. Where acoustical lining is required, provide turning vanes of perforated metal type with
52 fiberglass inside.
53
54 F. Size Change:

- 1
2 1. Increase duct sizes gradually, not exceeding 15 deg. divergence wherever possible.
3 2. Maximum divergence upstream of equipment to be 30 deg. and 45 deg. convergence
4 downstream.

5
6 G. Seams and Joints:

- 7
8 1. Seams and joints fabricated in accordance with SMACNA standards.
9 2. Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and
10 stiffened so not to breathe, rattle, vibrate, or sag.

11
12 **2.5 LOW PRESSURE DUCTWORK**

- 13
14 A. Fabricate and support in accordance with SMACNA Low Pressure Duct Construction Standards and
15 ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing for
16 operating pressures indicated.
17
18 B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of
19 equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except
20 by written permission.
21
22 C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on center line.
23 Where not possible and where rectangular elbows are used, provide airfoil turning vanes. Where
24 acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.
25
26 1. Where acoustic lining is indicated, provide turning vanes of perforated metal with glass fiber
27 insulation.
28
29 D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence
30 upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45
31 degrees.
32
33 E. Provide easements where low pressure ductwork conflicts with piping and structure. Where
34 easements exceed 10 percent duct area, split into two ducts maintaining original duct area.
35
36 F. Connect flexible ducts to metal ducts with adhesive and draw bands.
37
38 G. Round Duct Take-Offs: Provide conical or bellmouth low-pressure fittings.
39
40 H. Square Duct Take-Offs: Provide 45 degree leading edge at square take-off with 4: minimum depth.

41
42 **2.6 HIGH PRESSURE DUCTWORK**

- 43
44 A. Fabricate and support in accordance with SMACNA High Pressure Duct Construction Standards and
45 ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing for
46 operating pressures indicated.
47
48 B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline.
49 Where not possible and where rectangular elbows are used, provide airfoil-turning vanes. Where
50 acoustical lining is required, provide turning vanes of perforated metal with glass fiber insulation.
51 Weld in place.
52
53 C. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.
54

- 1 D. Fabricate continuously welded medium and high pressure round and oval duct fittings as indicated in
2 SMACNA Standard. Joints shall be minimum 4-inch cemented slip joint, brazed or electric welded.
3 Prime coat welded joints.
4
- 5 E. Round or flat oval type ducts shall be constructed with lock tight spiral seams, gored elbows with
6 centerline radius of 1-1/2 times the duct diameter and male/female fittings.
7
- 8 F. Take-Offs: Conical tees, conical 45 degree laterals, conical bellmouth taps and fittings shall be used.
9 Seal all joints airtight with gaskets and mastic sealants.
10
- 11 G. Fabricated rectangular ducts shall be constructed with companion angle flanged joints secured to duct
12 walls. Use continuous closed cell gasket at joints with snap-on cleats and corner bolts. Provide 45-
13 degree close openings at takeoffs and corners. Seal all joints air tight with gaskets and mastic
14 sealants.
15

16 **2.7 DUCTWORK APPLICATION SCHEDULE**

	<u>Air System</u>	<u>Classification</u>	<u>Material</u>
19 A.	Supply air - AHU's to VAV boxes:	High Press	Steel
20 B.	Return air - to AHU's:	Low Press	Steel
21 C.	Supply air - VAV boxes to outlets:	Low Press	Steel
22 D.	Exhaust air:	Low Press	Steel
23 E.	Fresh air:	Low Press	Steel

25 **2.8 ACOUSTIC DUCT LINING APPLICATION SCHEDULE**

	<u>Air System</u>	<u>Thickness</u>
28 A.	Transfer Ducts - Square or rectangular:	1"
29 B.	Downstream of VAV box - 10 feet	1"
30 B.	Exhaust Fan RH-1 Inlet ductwork:	1"

33 **PART 3 - EXECUTION**

35 **3.1 INSTALLATION**

- 37 A. Assemble and install ductwork in accordance with SMACNA standards, and which will achieve
38 airtight and noiseless systems, capable of performing each indicated service.
39
- 40 1. Align ductwork accurately at connections.
- 41 2. Support ducts rigidly with suitable ties, braces, hangers and anchors of type, which will hold
42 ducts straight, plumb and free of sags and vibration.
43
- 44 B. Electrical Equipment Spaces: Do not run ductwork through transformer vaults and other electrical
45 equipment spaces and enclosures.
46
- 47 C. Metal Duct Support:
48
- 49 1. Support ductwork from building structure as required and, where not otherwise indicated,
50 anchor with bolts, concrete inserts, steel expansion anchors, welded studs, C-clamps or
51 special beam clamps.
- 52 2. Support vertical ducts, at 12 foot spacing, by attachment to adjacent vertical structural
53 surfaces or by direct bearing at floor penetrations and similar locations.

- 1 3. Support horizontal ducts located against structural walls and other similar adjacent vertical
2 surfaces, at 8 foot spacing for ducts up to 40 inches horizontal dimension and 4 foot spacing
3 for larger ducts.
- 4 4. Hang horizontal rectangular ducts from overhead structure, at 10 feet spacing for duct widths
5 up to 60 inches and 8 foot spacing for larger ducts.
- 6 5. Arrange hangers, supports and duct rests to permit free, unrestrained and noiseless expansion
7 and contraction of duct.
- 8 6. Where duct lining not used, vertical members may be fastened to duct sides with sheet metal
9 screws.
- 10 7. Where duct lining is used, do not puncture sheet metal.
- 11
- 12 D. Provide openings in ductwork where required to accommodate thermometers and controllers.
13 Provide pilot tube openings where required for testing of systems, complete with metal can with
14 spring device or screw to ensure against air leakage. Where openings are provided in insulated
15 ductwork, install insulation material inside a metal ring.
- 16
- 17 E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance
18 activities.
- 19
- 20 F. Slope underground ducts to plenums or low pumpout points at 1:100 feet. Provide access doors for
21 inspection.
- 22
- 23 G. Connect terminal units to high-pressure ducts directly with three-foot maximum length of flexible
24 duct. Do not use flexible duct to change direction.
- 25
- 26 H. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for
27 cleanout.
- 28
- 29 I. During construction provide temporary closures of metal or taped polyethylene on open ductwork to
30 prevent construction dust from entering ductwork system.
- 31
- 32 J. Provide sleeved opening where ducts pass through smoke, fire and sound walls.
33
- 34 1. Seal space between duct and sleeve airtight with mineral wool or approved fire stopping
35 material.
- 36 2. Provide duct flange to cover and retain fire-stopping material.
- 37
- 38
- 39 K. Connections:
40
- 41 1. Connect duct to equipment with flexible fabric, sheet metal clips, screws and washers.
- 42 2. Connect branch take-offs to include prefabricated air scoops formed of same material as
43 associated duct system.
- 44 3. Connect diffusers or plenum boots to low-pressure ducts with 10-foot maximum length of
45 flexible duct, held in place with strap or clamp.
- 46
- 47 L. Flexible Ductwork:
48
- 49 1. Do not exceed 6 feet in length in accordance with NFPA 90.
- 50 2. Install flexible ductwork with minimum offsets and trim.
- 51 3. Connect with factory-installed compression coupling each end or provide separate adjustable
52 bond and clamp to secure duct to trunk fitting and to distribution unit fitting.
- 53 4. Where recommended by manufacturer, make connections with mastic duct tape and
54 adjustable clamp.

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3.2 DUCT LEAKAGE

- A. Inspect all ductwork for leak sources and repair.
- B. Do not insulate ductwork until it has been accepted for duct leakage.
- C. Refer to Section 23 05 90 for Testing, Adjusting, and Balancing requirements of ductwork system.
- D. Low pressure ductwork leakage rate shall not exceed 5%.
- E. High pressure ductwork leakage rate shall not exceed 2%.

END OF SECTION

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**SECTION 23 86 00
DUCTWORK ACCESSORIES**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of duct accessories work is indicated on drawings and in schedules, and by requirements of this section.
- B. Types of duct accessories required for this project include the following:
 - 1. Dampers:
 - a. Manual dampers
 - b. Control dampers
 - 2. Fire dampers
 - 3. Turning vanes
 - 4. Duct hardware
 - 5. Duct access panels
 - 6. Flexible connections
 - 7. Duct Silencers
 - 8. Air Flow Meters

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 25 00 Mechanical Insulation
 - 2. 23 84 00 Ductwork
 - 3. 23 90 00 Controls and Instrumentation

1.3 QUALITY ASSURANCE

- A. SMACNA Compliance: Comply with applicable portions of Sheet Metal and Air Conditioning Contractor's National Association SMACNA "HVAC Duct Construction Standards" 1st edition, 1985.
- B. Industry Standards: Comply with American Society of Heating, Refrigerating and Air Conditioning Engineers Inc. (ASHRAE) recommendations pertaining to construction of duct accessories, except as otherwise indicated.
- C. UL Compliance: Construct, test, and label fire dampers in accordance with Underwriters Laboratories (UL) Standard 555 "Fire Dampers and Ceiling Dampers".
- D. NFPA Compliance: Comply with applicable provisions of ANSI/NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of duct accessories.

PART 2 - PRODUCTS

2.1 DAMPERS

- 1
2 A. Manual Dampers: Provide dampers of single blade type (up to 6" height) or multiblade type (over 6"
3 height), constructed in accordance with SMACNA Standards. Provide damper operator with locking
4 devices and damper position indicator.
5
6 B. Automatic Control Dampers (ACD): Refer to Division 23 90 00 section "Controls and
7 Instrumentation" for automatic control damper requirements. Furnished by Temperature Controls
8 Contractor.
9
10 C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering dampers
11 which may be incorporated in the work include, but are not limited to the following:
12
13 1. Honeywell.
14 2. Vent Products
15 3. Ruskin Mfg. Co.
16

17 2.2 FIRE DAMPERS

- 18
19 A. Fire Dampers: Provide 1-1/2 hour, Type 'B' UL listed fire dampers, of sizes indicated, unless
20 indicated otherwise. Construct casing of 16 ga. galvanized steel with bonded red acrylic enamel
21 finish. Provide fusible link as required. Provide damper with positive lock in closed position, and
22 with the following additional features:
23
24 1. U.L. Listed Fire Rating: 1-1/2 hour
25 2. Damper Blade Assembly: Curtain type.
26 3. Blade Material: Steel, match casing.
27
28 B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fire and
29 smoke dampers which may be incorporated in the work include, but are not limited to the following:
30
31 1. Air Balance Inc.
32 2. Safe Air Inc.
33 3. Ruskin Mfg. Co.
34

35 2.3 TURNING VANES

- 36
37 A. Manufactured Turning Vanes: Provide turning vanes constructed of 1.5" wide curved blades set at
38 1.5" spacing O.C., supported with bars perpendicular to blade set at 2" O.C., and set into side strips
39 suitable for mounting in ductwork. Double wall type turning vanes shall be 2" radius, 2-1/8" spacing
40 O.C.
41
42 1. Ducts over 24-inch dimension shall use double-wall airfoil type turning vane.
43 2. Ducts with air velocity over 2500 FPM shall use double-wall airfoil type turning vane.
44
45 B. Acoustic Turning Vanes: Provide acoustic turning vanes constructed of airfoil shaped aluminum
46 extrusions with perforated faces and fiberglass fill.
47
48 1. Provide where acoustic duct liner is required.
49

50 2.4 DUCT HARDWARE

- 51
52 A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the
53 following:
54

1. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering duct hardware which may be incorporated in the work include, but are not limited to the following:

1. Ventfabrics, Inc.
2. Young Regulator Co.

2.5 DUCT ACCESS PANELS

A. General: Provide where indicated, duct access panels of size indicated. Minimum size 12" x 12". Access panels are required at the following equipment, but are not limited to these locations:

1. Upstream and downstream of reheat or duct-mounted coils.
2. Fire Dampers.
3. Backdraft and motorized dampers.
4. Automatic Control Dampers - internally mounted.
5. Louvers.

B. Construction: Construct of same or greater gauge as ductwork served, provide insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one size hinged, other side with one (1) handle-type latch for doors 1/2" high and smaller, 2 handle-type latched for larger doors.

C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering duct access door which may be incorporated in the work include, but are not limited to the following:

1. Air Balance Inc.
2. Duro Dyne Corp.
3. Ruskin Mfg. Co.
4. Ventfabrics Inc.

2.6 FLEXIBLE CONNECTIONS

A. General: Provide flexible duct connections, wherever ductwork connects to vibration-isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment.

2.7 DUCT SILENCERS

A. General Requirements: Silencers shall be of the size, configuration, capacity and acoustic performance as scheduled on the drawings. All silencers shall be factory fabricated and supplied by the same manufacturer.

1. Silencer inlet and outlet connection dimensions must be equal to the duct sizes shown on the drawings. Duct transitions at silencers are not permitted unless shown on the contract drawings.
2. Silencers shall be constructed in accordance with ASHRAE and SMACNA standards for the pressure and velocity classification specified for the air distribution system in which it is installed. Material gauges shall be increased as required for the system

- 1 pressure and velocity classification. The silencers shall not fail structurally when
 2 subjected to a differential air pressure of 8 inches water gauge.
- 3 3. All casing seams and joints shall be lock-formed and sealed or stitch welded and
 4 sealed except as noted in Section G below, to provide leakage-resistant construction.
 5 Airtight construction shall be achieved by use of a duct-sealing compound supplied
 6 and installed by the contractor at the jobsite.
- 7 4. All perforated steel shall be adequately stiffened to insure flatness and form. All spot
 8 welds shall be painted.
- 9 5. Fire-Performance Characteristics: Silencer assemblies, including acoustic media fill,
 10 film liner, sealants, and acoustical spacer, shall have flame-spread index not
 11 exceeding 25 and smoke-developed index not exceeding 50 when tested according to
 12 ASTM E 84, NFPA 255 or UL 723.
- 13 6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with
 14 requirements in ASHRAE 62.1-2007.
- 15 B. Silencers Outer casing shall be ASTM A 653/A 653M, G90 galvanized sheet steel, minimum 22
 16 gauge.
- 17 C. Inner perforated metal liner: ASTM A 653/A 653M, G90 galvanized sheet steel.
- 18 1. Silencers: 26 gauge.
 19 2. Elbow Silencers: 22 gauge.
- 20 D. Principal Sound-Absorbing Mechanism:
- 21 1. Dissipative silencers: provide with acoustic media of acoustic quality, shot-free glass
 22 fiber insulation with long, resilient fibers bonded with a thermosetting resin.
 23 2. Glass fiber density and compression shall be as required to insure conformance with
 24 laboratory test data.
 25 3. Glass fiber shall be packed with a minimum of 15% compression during silencer
 26 assembly.
 27 4. Media shall be resilient such that it will not crumble or break, and conform to
 28 irregular surfaces. Media shall not cause or accelerate corrosion of aluminum or
 29 steel. Mineral wool will not be permitted as a substitute for glass fiber.
 30
- 31 E. Media Protection:
- 32 1. Dissipative silencers: Where indicated on the silencer schedule, media shall be
 33 encapsulated in glass fiber cloth to help prevent shedding, erosion and impregnation
 34 of the glass fiber.

35
 36
 37
 38
 39 **2.8 AIR FLOW METERS**

- 40
 41 A. Air Flow Meters(AFM) stations: Refer to Division 23 90 00 section "Controls and Instrumentation"
 42 for air flow meter station requirements. Furnished by Temperature Controls Contractor.
 43
 44

45 **PART 3 - EXECUTION**

46
 47 **3.1 INSPECTION**

- 48
 49 A. Examine areas and conditions under which duct accessories will be installed. Do not proceed with
 50 work until unsatisfactory conditions have been corrected.
 51

52 **3.2 INSTALLATION**

- 1
2 A. Install duct accessories in accordance with manufacturer's installation instructions, with applicable
3 portions of details of construction as shown in SMACNA Standards, and in accordance with
4 recognized industry practices to ensure that products serve intended function.
5
6 B. Install turning vanes in square or rectangular 90 deg. elbows in supply and exhaust air systems, and
7 elsewhere as indicated.
8
9 C. Install access doors to open against systems air pressure, with latches operable from either side,
10 except outside only where duct is too small for person to enter.
11
12 D. Coordinate with other work, including ductwork as necessary to interface installation of duct
13 accessories properly with other work.
14
15 1. Install control dampers provided by Temperature Control Contractor.
16
17 E. Field Quality Control: Operate installed duct accessories to demonstrate compliance with
18 requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as
19 required to obtain proper operation and leak proof performance.
20
21

END OF SECTION

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SECTION 23 87 00
AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.
- B. Types of outlets and inlets required for project include the following:
 - 1. Ceiling Diffusers.
 - 2. Return & Exhaust Registers and Grilles.
 - 3. Linear Diffusers.
 - 4. Louvers.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 84 00 Ductwork
 - 2. 23 86 00 Ductwork Accessories

1.3 QUALITY CONTROL

- A. Manufacturers: Firms regularly engaged in manufacturer of outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years. Acceptable manufacturers are listed as follows:
 - 1. Carnes
 - 2. Titus
 - 3. Metal-Aire
 - 4. Krueger
 - 5. Price.
- B. ARI Standards: Comply with Air Conditioning and Refrigeration Institute (ARI) Standard 650 "Air Outlets and Inlets".
- C. ADC Standards: Comply with Air Diffusion Council standards.
- D. MCA Standards: Comply with Air Moving and Conditioning Association standards.

1.4 SUBMITTALS

- A. Submit shop drawings covering each item together with schedule of outlets and inlets.
- B. Submit manufacturer's air diffusion performance data and installation instructions.

1 **PART 2 - PRODUCTS**

2
3 **2.1 GENERAL**

- 4
5 A. Except as otherwise indicated, provide manufacturers standard outlet and inlet products where shown,
6 of size, shape, capacity and type indicated on schedules, constructed of materials and components as
7 indicated, and as required for complete installation.
8
9 B. Performance: Provide outlet and inlet products that have, as minimum, temperature and velocity
10 traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturers
11 current data and schedule for application.
12
13 C. Ceiling Compatibility: Provide outlet and inlet products with border styles that are compatible with
14 adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with
15 accurate fit and adequate support. Refer to general construction drawings and specifications for types
16 of ceiling systems, which will contain each type of ceiling air diffuser.
17

18 **2.2 CEILING DIFFUSERS**

- 19
20 A. Ceiling Diffusers: Face panel and blades shall be constructed of galvanized steel with exposed
21 surfaces finished in off-white or as scheduled. Diffuser shall have horizontal directional blades for
22 airflow, round or square neck with opposed blade damper. Adjustable vertical or horizontal hinged
23 blades, where scheduled.
24
25 1. Extruded aluminum construction.
26
27 B. Diffuser is designed to mount over T-bar suspended or surface mounted in plaster ceiling systems.
28

29 **2.3 PERFORATED CEILING GRILLES**

- 30
31 A. Perforated Square: Steel construction, perforated hinged face, T-Bar mounted, white finish with
32 black interior. Square or round neck, as scheduled.
33

34 **2.4 RETURN AND EXHAUST GRILLES AND REGISTERS**

- 35
36 A. Square and Rectangular: Steel or extruded aluminum construction, 40 degrees fixed deflection,
37 surface-mounted.
38
39 1. Opposed blade damper, as scheduled.
40 2. Finish: White.
41 3. Reversible bar aluminum bar grilles, as scheduled.
42
43 B. Heavy Duty Aluminum Wall Grille and Register: Heavy duty extruded aluminum construction, 1/8"
44 face bars, 1/3" O.C., 30 degree fixed deflection down, extruded aluminum frame.
45
46 1. Opposed blade damper, as scheduled.
47

48 **2.5 SUPPLY REGISTERS**

- 49
50 A. Square and Rectangular: Aluminum construction, double-deflection, streamlined bars spaced 1/2"
51 O.C., 1 1/4" margin, and gasket seals.
52
53 1. Opposed blade damper, as scheduled.
54

- 1 B. Heavy Duty Industrial Registers: Steel construction, blades 2" on center, single-deflection, air-foil
2 blades on heavy duty frame.
3

4 **2.6 LINEAR SLOT DIFFUSERS**

- 5
6 A. Insulated Plenum Slot Diffusers: Steel construction, insulated plenum with linear slot diffusers for 1
7 or 2-way throw at ceiling. T-bar mounted or surface mounted with flanged frame.
8

- 9 1. Opposed blade damper, as scheduled.
10 2. Finish: White.
11 3. Notched center for 48 inch diffusers, as scheduled.
12 4. Provide center T-bar, as scheduled.
13

14 **2.7 LOUVER**

- 15
16 A. Stationary extruded: Extruded aluminum 6063-T5 alloy construction, minimum section
17 0.080", stainless steel screw assembly with integral caulking recess. "S" blades 4" or 6" deep
18 spaced on 4" centers set at 45 degrees with rainhook and 5/8" flanges at edges. Aluminum
19 birdscreen 1/2" mesh on inside face.
20

- 21 1. Extended sills, where indicated.
22 2. Finish: Factory paint finish as scheduled, finish color selection by Architect.
23
24

25 **PART 3 - EXECUTION**

26 27 **3.1 INSTALLATION**

- 28
29 A. Coordinate with other work, including ceiling layout, ductwork and ductwork accessories, as
30 necessary to interface installation of air diffusers properly with other work.
31

- 32 B. Install items in accordance with manufacturer's printed instructions.
33

- 34 C. Paint ductwork visible behind air outlets matt black.
35

- 36 D. Diffusers:

- 37
38 1. At each duct drop or take-off to individual diffusers, locate extractor or scoop.
39 2. Support diffusers adequately for type of ceiling receiving diffusers.
40 3. Adjust diffuser air pattern as required to provide draft less uniform air distribution.
41

- 42 E. Grilles and Registers:

- 43
44 1. Secure overlapping frame of register or grille to screen, flange, or angle of ductwork with
45 countersunk screws.
46 2. Locate wall registers and grilles minimum 6 inches below ceiling, unless otherwise indicated.
47 3. Locate separate accessible balancing volume damper at each register or grille in addition to
48 control damper integral with register or grille.
49 4. Adjust registers and grilles to provide draft less uniform air distribution.
50

- 51 F. Louvers:

- 52
53 1. Coordinate required wall openings with other trades.

- 1 2. Turn over louver to General Contractor for installation.
- 2 3. Verify proper opening requirement with General Contractor.
- 3 4. Caulking and waterproofing by General Contractor.
- 4

5 **3.2 FIELD QUALITY CONTROL**

- 6
- 7 A. Test and operate installed outlets and inlets to demonstrate compliance with requirements.

8
9

END OF SECTION

SECTION 23 89 50
VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of variable frequency drive (VFD) equipment work is indicated by the Drawings and schedules, and by requirements of this section.

B. Types of variable frequency drives required for this project include the following:

1. AHU-1 10 HP 208-volt 3-phase.
2. DOAS-1 SF 3 HP 208-volt 3-phase.
3. DOAS-1 EF 3 HP 208-volt 3-phase.
4. DOAS-1 WHEEL 1/2 HP 208-volt 1-phase.
5. MAU-1 50 HP 480-volt 3-phase
6. EF-1 1 HP 480-volt 3-phase
7. EF-2 3 HP 480-volt 3-phase
8. EF-3 3 HP 480-volt 3-phase
9. EF-4 3 HP 480-volt 3-phase

C. Variable Frequency Drives(VFD) shall be provided by the Temperature Control Contractor(T.C.C.).

1. The Variable Frequency Drives shall be mounted and wired by the Electrical Contractor, unless factory mounted.
2. The HVAC Contractor shall be responsible for providing VFD's and providing VFD-compatible HVAC motors, where applicable.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified Elsewhere:

1. 23 05 00 HVAC General Provisions
2. 23 90 00 Controls and Instrumentation

1.3 QUALITY ASSURANCE

A. UL and NEMA Compliance: Provide products which have been listed and labeled by Underwriters Laboratories and comply with NEMA Standards.

1. ANSI/UL Standard 508.

B. IEEE and ANSI Compliance: VFD shall comply with applicable standards of IEEE, ANSI and NEC.

C. Power Line Noise: Power line noise shall be limited to a voltage distortion factor and line notch depth as defined in IEEE Standard 519-1981, Guide for Harmonic Control and Reactive Compensation of Static Power Converters. Distortion shall not exceed 5%.

- 1 D. Radiated Noise: VFD shall not emit either conducted or radiated RFI in excess of limitations
2 set forth in the FCC Rules and Regulations, Part 15, Subpart J.
3
- 4 E. Installation and Start-Up Services: VFD manufacturer shall provide a factory trained
5 engineer to approve the installation; start-up operations, test and adjust for proper operations
6 and instruct Owner's representative in the proper operation and maintenance of the units.
7
- 8 F. Warranty: Manufacturer shall provide standard 18-month warranty for VFD system parts and
9 labor against defects in workmanship and material.
10
- 11 G. Acceptable Manufacturers:
12
13 1. Danfoss.
14
15

16 **1.4 SUBMITTALS**

- 17
- 18 A. Submit shop drawings for all VFD and associated system components as herein specified
19 including all data concerning dimensions, capacities and performance, wiring diagrams and
20 appropriate identification.
21
- 22 B. Submit certified efficiency versus load and speed curves for VFD.
23
- 24 C. Submit certified electrical noise generation data in accordance with IEEE 519 standard.
25 Submit electrical noise attenuation equipment required to meet criteria specified.
26
- 27 D. Operation and Maintenance Manual.
28
29

30 **PART 2 - PRODUCTS**

31 **2.1 GENERAL REQUIREMENTS**

- 32
- 33
- 34 A. Furnish complete variable frequency drives as specified herein for the fans and pumps,
35 designated on the drawing schedules to be variable speed. All standard and optional features
36 shall be included within the VFD enclosure, unless otherwise specified. VFD enclosure shall
37 be NEMA 1, freestanding or wall mounted.
38
- 39 B. The VFD shall convert three-phase, 60-Hz utility power to adjustable-voltage and frequency,
40 three-phase power for stepless motor speed control from 5% to 100% of the motor's 60-Hz
41 speed. Input voltage shall be as specified on the Drawing schedules.
42
- 43 C. The VFD shall include a converter and an inverter section. the converter section shall
44 convert fixed frequency and voltage AC utility power to DC voltage. All VFDs shall include
45 input line reactors.
46
- 47 D. The inverter section of the VFD shall invert the DC voltage into a quality output waveform,
48 with adjustable voltage and frequency for stepless motor speed control.
49
- 50 E. The VFD and options shall be tested to ANSI/UL Standard 508. The Complete system,
51 including all specified options, shall be listed by a nationally recognized testing agency such
52 as UL or BTL.
53

- 1 F. Power line noise shall be limited to a voltage distortion factor and line notch depth as defined
 2 in IEEE Standard 519-1981, Guide for Harmonic Control and Reactive Compensation of
 3 Static Power Converters. The total voltage distortion shall not exceed 5%.
 4
- 5 G. The VFD shall not emit radiated RFI in excess of the limitations set forth in the FCC Rules
 6 and Regulations, Part 15 for Class A computing devices. The VFD shall carry a FCC
 7 compliance label. PWM type drives shall include RFI filters.
 8
- 9 H. The VFD shall not cause objectionable acoustical motor noise. Motor noise as a result of the
 10 VFD shall be limited to three dB-over across-the-line operation, measured at three feet from
 11 the motors centerline.
 12
- 13 I. The VFD's full load AMP rating shall meet or exceed NEC Table 430-150.
 14
- 15 J. Motors and variable frequency drives shall be provided by the drive manufacturer and
 16 selected to accommodate additional motor heating when driven by a VFD, while maintaining
 17 full nameplate horsepower at specified service factor.
 18
- 19 K. VFD system shall modulate the speed of its respective motor in response to a 0-10 VDC or 4-
 20 20 mA control signal provided by the Temperature Control Sub-contractor.
 21
- 22 L. VFD system shall consist of the following components:
 23
- 24 1. Variable frequency drive.
 - 25 2. Bypass motor contactor and bypass switch for VFD.
 - 26 3. Input disconnect switch.
 - 27 4. Electrical noise filters.

28

29 **2.2 VFD UNIT**

30

- 31 A. General: VFD shall be variable torque, solid state transistorized control with diode bridge
 32 rectifier and manual transfer switch. The unit shall be U.L. listed, solid state, micro
 33 processor-based with a pulse width modulated (PWM) output wave form (none others are
 34 acceptable).
 35
- 36 1. The VFD shall employ a full wave bridge rectifier, to prevent line notching, with DC
 37 output bus choke, capacitors to minimize the ripple of the rectified voltage to
 38 maintain near constant DC voltage. Insulated gate bipolar transistors (IGBT's) shall
 39 be employed as the output switching device.
 - 40 2. VFD shall be factory tested at maximum HP and 40 deg. C for 100 hours.
 41
- 42 B. Performance:
 43
- 44 1. Input Voltage: 208/480 volts, 3-phase, 60 Hertz.
 - 45 2. Output Voltage: 208/480 volts, 3-phase, 3 to 60 Hertz.
 - 46 3. Speed Range: 20:1 maximum.
 - 47 4. Enclosure: NEMA 1 with lock, wall mount.
 - 48 5. Minimum Efficiency: 92% @ 50%; 99% @ 100% speed.
 - 49 6. Power Factor: 0.95 thru speed range.
 - 50 7. Adjustments: Minimum and maximum speed acceleration-deceleration 30 to 50
 51 seconds.
 - 52 8. Power Line Noise: Voltage distortion factor of 5% or less and a line notch depth of
 53 25% or less.
 54

- 1 C. Standard Features:
2
3 1. Run/stop selector switch, auto/manual selector switch, fault light, manual speed
4 potentiometer, power on light, ready light.
5 2. Speed/power/load digital display and selector switch.
6 3. Automatic under voltage reset with adjustable time delay.
7 4. 0-10 VDC or 4-20 mA common input signal follower.
8 5. Motor overload protection.
9 6. Over temperature protection.
10 7. Under voltage/over voltage protection.
11 8. Adjustable current limit.
12 9. Door interlock disconnect.
13
- 14 D. Special Features:
15
16 1. Drive/Off/Line manual bypass switch with bypass contactor and motor overload
17 protection.
18 2. VFD input disconnect switch.
19 3. Two N.C. and N.O. auxiliary contacts.
20
- 21 E. Provide partitioning within drive enclosures to separate and isolate bypass section from VFD
22 section of drive, to house bypass wiring, contactors, relays, automatic or manual transfer
23 switch. Devices within the convertor/inverter compartment must be able to be maintained
24 with power completely off in the convertor/inverter section.
25
- 26 F. Provide an automatic transfer switch/bypass starter to allow operation in bypass mode in the
27 event of convertor/inverter failure or shutdown. Drive shall also be provided with capability
28 to manually switch from drive to bypass operation.
29
30 1. Provide a manual switch and bypass contactors to transfer from VFD operation to
31 bypass operation.
32 2. Provide a fixed or adjustable current limiting control device.
33
- 34 G. Provided devices to permit field adjustment of minimum and maximum output frequency.
35
- 36 H. Drives shall be equipped with devices allowing field adjustment of acceleration rate.
37 Capability shall exist to allow motor speed to increase from start to full speed in a field
38 adjustable period of time.
39
- 40 I. Provide one normally open and one normally closed auxiliary contact in each drive. These
41 contacts shall be activated upon drive failure of any kind, including safety shutdowns.
42 Contacts are intended to be used for remote monitoring of drive operation by the central
43 energy management system.
44
- 45 J. Field performance testing of adjustable speed drive assemblies to determine compliance with
46 specified performance requirements will be performed at the Owner's discretion.
47 Performance testing may include any specified feature, including operation of protective
48 devices (through simulated fault). The cost of initial testing will be borne by the owner.
49 Should drive be found to be deficient in any performance category, drive manufacturer will
50 be required to make any and all changes necessary to bring units into compliance with
51 performance guidelines as specified. The cost of changes, and the cost of retest, will be borne
52 by mechanical contractor.
53

54 **PART 3 - EXECUTION**

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3.1 INSTALLATION OF VFD SYSTEM

- A. Install VFD system in accordance with details, shop drawings and manufacturer's instructions.
- B. VFD system components shall be turned over to the Electrical Trade for mounting and wiring under the supervision of the HVAC Trade.
 - 1. Field electrical wiring of line voltage components between transformer, VFD and motors shall be by the Electrical Trade.
 - 2. Control wiring (100 volts or less) shall be by the Temperature Control Contractor.
- C. Start-up, Operation and Maintenance:
 - 1. Manufacturer shall provide the services of a factory-trained engineer to approve the installation, start-up, test and adjust VFD units for proper operation, and instruct and train the owner's maintenance personnel in the operation and maintenance of the units.
 - 2. Manufacturer's representative shall demonstrate operational capability of units during instruction and training period.
 - 3. Upon completion of this service, submit to the Engineer a complete diagnostic report, including start-up and test log, signed by the manufacturer's representative.

END OF SECTION

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SECTION 23 90 00
CONTROLS AND INSTRUMENTATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Includes:

1. Complete system of XL5000 Direct Digital Automatic Controls System.
2. Complete Integration into City of Madison Honeywell SymmetrE Network.
3. Electrical Control system.
4. Control devices, components, wiring and material.
5. Instructions for users.

B. Existing Honeywell DDC controls at the existing facility shall be reused to fullest extent.

1.2 DESCRIPTION OF WORK

A. Extent of controls and instrumentation work is indicated on drawings and schedules and by requirements of this section.

B. Control system for air handler units, garage ventilation and hot water solar system operation shall be electronic (DDC) to control HVAC systems as specified herein. Electronic controlled devices such as valve and damper actuators shall be employed. Control loop logic and sequencing of HVAC operations shall be accomplished by DDC controls with electronic input devices as temperature and pressure sensors.

C. Control systems shall be electronic DDC to control valve and damper actuators for terminal units, as specified herein.

D. Control Contractor shall provide hydronic flow meters and air flow meters for installation by the HVAC Contractor.

E. Control Contractor shall provide VFD's as specified for installation by the Electrical Trade.

F. Instruction of Owner's personnel.

1.3 RELATED WORK

A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified Elsewhere:

- | | | |
|----|-----------------|--------------------------------|
| 1. | Div 22 Plumbing | |
| 2. | 23 89 50 | Variable Frequency Drives |
| 3. | 23 91 00 | Direct Digital Control Systems |
| 4. | 23 95 00 | Control Sequence |
| 5. | 23 90 10 | DDC Point List |

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. National Electrical Code, NEC
2. National Electrical Manufacturers Association, NEMA
3. Underwriter's Laboratories, UL

- 1
2 B. All equipment provided, including control panels, dampers, valves, controllers, transmitters, sensors
3 and other control devices shall bear the manufacturer's nameplate.
4
5 C. Entire control system including piping and wiring shall be installed by mechanics specifically
6 authorized by the Temperature Control equipment manufacturer for the installation and having
7 acceptable experience installing and servicing similar control equipment.
8
9 D. Acceptable Manufacturers/Contractor:
10
11 1. Honeywell XL5000/SymmetrE Network/Niagra AX
12
13 E. Authorized Controls Integrator: The control contractor shall be a Honeywell ACI – Authorized
14 Integrator.
15
16 F. Guarantee: Guarantee the controls and instrumentation to maintain the temperature within one degree
17 of the setpoint and further guarantee all work, materials, equipment, and controls against defects in
18 workmanship and material, and provide service for a period of one (1) year from date of final
19 acceptance.
20

21 **1.5 SUBMITTALS**

- 22
23 A. Shop Drawings:
24
25 1. Schematic control diagrams giving specific data on all settings, ranges, action, adjustments,
26 and normal positions.
27 2. Wiring diagrams detailed adequately for field construction and include all related wiring.
28 3. Control valve and damper schedules with complete sizing data giving required design flow
29 and temperature or pressure, and any other pertinent data.
30 4. Sequence of operation for each system corresponding to control schematics.
31 5. Panel drawings including complete internal wiring and piping schematics and complete data
32 on all mounted components.
33 6. Damper operator schedule, listing quantity, size of operators and mounting arrangement.
34 7. Space thermostat sensor schedule indicating types of covers and adjustment means for each
35 space.
36
37 B. Control Diagrams:
38
39 1. Furnish and mount in each equipment room or space prints of schematic control diagrams and
40 corresponding sequences of operation for all systems located therein.
41 2. Diagrams and sequences mounted in frames under clear plastic and located in easily visible
42 location or as directed by A/E.
43
44 C. Product Data:
45
46 1. Submit published descriptive data on each item of equipment and accessories.
47 2. Submit manufacturer's installation instructions.
48
49 D. Report:
50
51 1. At completion of work, submit report of check-out of automatic control system.
52 2. Report actual setpoints with record drawings.
53

54 **1.6 CALIBRATION AND ADJUSTMENTS**

- 55
56 A. After completion of the installation, perform final calibrations and adjustments of the control
57 equipment provided under this contract and supply services incidental to the proper performance of
58 the automatic control system under warranty.

- 1
2 B. Submit letter to Engineer indicating all controls are calibrated and operating per sequence of control.
3

4 **1.7 SYSTEM START-UP AND ACCEPTANCE PROCEDURE**
5

- 6 A. Upon completion of the calibration, the Control Contractor shall start up the system and perform all
7 necessary testing and run diagnostic tests to ensure proper operation. Control Contractor shall be
8 responsible for generating all software and entering all database necessary to perform the sequence of
9 control and specified software routines. An acceptance test in the presence of the Owner's
10 representative or engineer shall be performed.
11

12 **1.8 OWNER TRAINING**
13

- 14 A. Provide sufficient but not less than 8 hours of training to the Owner's representatives, concerning the
15 proper operation and maintenance of all control systems, sensing, monitoring and control equipment.
16 Training sessions shall be conducted during normal business hours after system start-up and
17 acceptance by the Owner.
18
19 B. Submit operating and maintenance manuals to Owner a minimum of five (5) working days prior to
20 training session. Use these manuals as the basis for instruction at all training sessions.
21
22 C. Provide two follow-up visits for troubleshooting and instruction, one six months after substantial
23 completion and the other at the end of the warranty period. Length of each visit to be not less than
24 four (4) hours or the time necessary to provide required information and complete troubleshooting
25 and inspection activity.
26

27 **1.9 DELIVERY, STORAGE AND HANDLING**
28

- 29 A. Factory shipping cartons for each piece of equipment.
30
31 B. Factory-applied plastic end caps on each length of pipe and tube.
32
33 C. Maintain cartons and end caps through shipping, storage and handling as required to prevent
34 equipment and pipe-end damage, and to eliminate dirt and moisture from equipment and inside of
35 pipe and tube.
36
37 D. Where possible, store equipment and materials inside and protected from weather.
38
39 E. When necessary to store outside, elevate well above grade and enclose with durable waterproof
40 wrapping.
41
42

43 **PART 2 - PRODUCTS**
44

45 **2.1 SYSTEM REQUIREMENTS**
46

- 47 A. Provide complete control systems consisting of thermostats, sensors, control valves, dampers,
48 operators, indicating devices, interface equipment, and other apparatus required to operate mechanical
49 system and to perform functions specified and in compliance with the sequence of operations
50 described herein.
51
52 B. Provide necessary materials, labor and field work necessary to connect control components factory
53 supplied as part of equipment controlled.
54

55 **2.2 COORDINATION OF TEMPERATURE CONTROL WORK**
56

- 1 A. Electric Wiring: All electric wiring in connection with the automatic temperature control system shall
2 be furnished and installed by the Controls Trade, except for equipment starter interlocks, which are
3 the responsibility of the Electrical Trade.
4
- 5 1. All 120 (line) volt or larger electrical service wiring and connections to equipment and motor
6 starters is the responsibility of the Electrical Trade.
7 2. All additional line voltage power requirements beyond which is indicated on the Drawings
8 and Specifications for the temperature control system shall be the responsibility of the
9 Controls Trade.
10
- 11 B. Valves and Piping Wells: Furnish by Controls Trade, installed by HVAC Trade under supervision.
12
- 13 C. Dampers, Valves, Actuators and related Controlled Devices: Furnished by Controls Trade, installed
14 by HVAC Trade under supervision.
15

16 2.3 CONTROL PANELS 17

- 18 A. Provide local panels of unitized cabinet type for each system under automatic control. Mount relays,
19 switches, and controllers with control point adjustment in cabinet and temperature indicators, pressure
20 gages, pilot lights, push buttons, and clocks and switches flush on cabinet panel face. All components
21 within the control panels shall be prewired to numbered terminal strips, ready for field connection to
22 field-mounted control components.
23
- 24 B. Control panels shall be constructed of steel or extruded aluminum with hinged door and keyed lock,
25 with baked enamel finish of manufacturer's standard color.
26
- 27 C. Panel mounted indicators or thermometers shall indicate the temperature sensed by each remote built
28 sensor as shown or as required. Indicators or thermometers shall be 3-1/2" in diameter and have an
29 accuracy of 1% of scale range.
30
- 31 D. Mount panels adjacent to associated equipment on vibration free walls or free standing steel angle
32 supports. One cabinet may accommodate more than system in same equipment room. Provide
33 engraved plastic name plates for instruments and controls inside cabinet and on cabinet face.
34

35 2.4 ELECTRICAL EQUIPMENT REQUIREMENTS 36

- 37 A. Provide electrical devices and relays that are UL listed and of a type meeting current and voltage
38 characteristics of the project.
39

40 2.5 THERMOSTATS 41

- 42 A. Room Thermostats(Sensors):
43
- 44 1. Electronic Sensors: Provide space sensors with dual setpoint settings, LCD readout, local
45 face temperature adjustment with actual space temperature readout and local override switch.
46 Removable cover shall be smooth hard plastic ivory or off-white color.
47 2. Provide tamperproof locking covers in all public areas.
48 3. Confirm final sensor requirements with Owner prior to ordering.
49 4. Honeywell TR71 or approved equal.
50
- 51 B. Immersion Thermostats: For remote bulb elements use either averaging type or suitable length for air
52 or rigid bulb type for liquids.
53
- 54 1. In liquids, use separable wells.
55 2. Duct thermostat sensing element shall be remote bulb or minimum 8 foot averaging element.
56 3. Thermostats shall be one or two-pipe, proportioning type, direct or reverse acting as required.
57 Thermostat shall have adjustable setpoint and throttling ranges adequate for the application.
58

1 C. Outdoor Bulbs for Thermostats and Thermometers:

- 2
3 1. Locate on north side, with sun shield at least 10 feet above grade and at least 5 feet from
4 openings.
5 2. Non-ferrous type securely fastened to construction.
6

7 **2.6 FREEZESTATS (LOW-LIMIT CUT-OFF)**

- 8
9 A. Freezestats shall be of the electric 2 position type with temperature sensing element and manual reset.
10 Stats shall be capable of opening the stat circuit if any one foot length of the sensing element is
11 subject to a temperature below the stat setting.
12
13 B. Sensing element shall not be less than one lineal foot per square foot of coil surface area, minimum
14 length 12 feet. Unless otherwise indicated, set freezestats at 38 deg. F.
15

16 **2.7 SENSORS/TRANSMITTERS**

- 17
18 A. Temperature Sensors (Room): Use a surface mount zone temperature sensor housed in a durable,
19 ventilated plastic wall-mount enclosure, with broad aluminum faceplate. The sensing element to be a
20 1,000 ohm RTD (nickel or silicon) 0-10 VDC, or 4-20 MA accuracy +/- 1/2% span.
21
22 1. Tamperproof locking covers and concealed adjustment in public areas.
23
24 B. Temperature Sensors (Discharge and Return Duct): Use a surface mount duct temperature sensor
25 housed onto a standard metal handibox. The sensing element to be a 10,000 ohm RTD (nickel or
26 silicon) 0-10 VDC, or 4-20 MA. House sensor in a 8-1/2" stainless steel probe. Accuracy +/- 1/2%
27 span.
28
29 C. Temperature Sensor (Mixed Air - Averaging): Select an averaging capillary type sensor housed on a
30 standard metal handibox. The capillary type sensor to house no less than five sensing elements which
31 will return an average of the five or more sensor elements. The sensing elements are to be a 1,000
32 ohm RTD (nickel or silicon) 0-10 VDC, or 4-20 MA. Accuracy +/- 1/2% span.
33
34 D. Immersion type temperature sensors: Rod and tube type with linear output. Provide separable
35 thermowells with heat conductive fluid for installation in pipeline. Units shall be factory calibrated.
36
37 E. Ambient Static Pressure Sensor(reference): Equal to BAPI model ZPS-ACC-10 outside air pickup
38 port or approved equal.
39

40 **2.8 CONTROL VALVES**

- 41
42 A. Water Valves:
43
44 1. Furnish all modulating straight-through water valves with equal-percentage contoured
45 throttling plugs. Furnish all three-way valves with linear throttling plugs such that the total
46 flow through the valve shall remain constant regardless of the valve's position.
47 2. Size 3-way control valves for a pressure drop equal to the unit they serve but not to exceed 5
48 psi.
49
50 B. Valves 2" and smaller shall be screwed type, forged or cast brass, 125 PSIG rated, stainless steel
51 stems, synthetic elastomeric or teflon packing.
52
53 C. 2-1/2" and larger valves shall be iron body, bronze mounted, stainless steel stems, PTFE teflon
54 packing.
55

56 **2.9 ELECTRIC CONTROL ACTUATORS**

- 1 A. Electronic Actuators shall be sized to operate their appropriate dampers or valves with sufficient
2 reserve power to provide smooth proportional action or two-position action as specified.
3
- 4 1. Modulating Valves: Valve actuators shall accept proportional 0-10 VDC or 0-20 mA signals
5 for modulating action. Provide at air handling unit water coils and reheat coils at VAV
6 boxes.
7 2. Two-Position Valves: May be provided at radiation valves or convectors.
8 3. Three-way Valves: Air handling unit water coils.
9

10 B. Provide positive position sequencing relays for accuracy and non-overlapping operation of two or
11 more actuators where required system design function.
12

13 C. Actuators shall be designed to allow replacement of seal glands without draining the piping system.
14

15 D. Acceptable Manufacturers: Belimo or approved equal.
16

17 **2.10 NORMAL POSITIONS**

18
19 A. Regardless of type of system, each device shall assume specified normal positions on power failure.
20

21 B. Normal positions shall be safe positions and as follows:
22

- 23 1. Outside and Relief/Exhaust Air Dampers: Normally closed.
24 2. Return Air Damper: Normally open.
25 3. Automatic Control Valves: Normally open - full flow thru heat transfer device.
26 4. Terminal Heating Valves: Normally open valve position; spring-return to full flow thru heat
27 transfer device.
28

29 **2.11 CONTROL DAMPERS**

30
31 A. The control trade shall furnish all control dampers as shown on the plans and/or as required to
32 perform the control sequence specified except those furnished with fan equipment.
33

34 B. All modulating dampers shall be sized by the control trade to meet flow requirements of the
35 application in accordance with his recommendation. All two position dampers to be sized as close as
36 possible to duct size, but in no case is damper size to be less than 90% of duct area.
37

38 C. Unless otherwise indicated, all control dampers shall be opposed blade type. Two position dampers
39 may be parallel blade type.
40

41 D. All dampers shall be factory fabricated and shall be standard products of the control manufacturer.
42

43 E. Damper frames shall not be less than 13 gauge galvanized steel or extruded aluminum of 12 gauge.
44 Blades shall not be less than 16 gauge galvanized steel or 14 gauge aluminum, not over 8 inch width
45 with steel trunnions mounted in a bronze sleeve or ball bearings.
46

47 F. All blade linkage hardware shall have corrosion-resistant finish and be readily accessible for
48 maintenance.
49

50 G. Fresh and Relief Air Dampers: Furnish low-leakage type dampers with replaceable neoprene edging
51 seals installed at all four sides of the fame and each blade.
52

- 53 1. Dampers and seals shall be suitable for maximum temperature and air velocities to be
54 encountered in the system with the minimum temperature ranges of -40 degrees F to 200
55 degrees F.
56 2. Submit leakage and flow characteristic data for all control dampers along with shop
57 drawings.

- 1 3. Dampers when closed, shall be guaranteed by the control manufacturer not to leak air in
2 excess of 1/2% at 4 inches static pressure water gauge.
3

4 **2.12 HYDRONIC FLOW METERS**
5

- 6 A. General: Provide insertion-type, pipe-mounted turbine fluid flow stations.
7

- 8 1. Provide hydronic flow stations equal to Onicon F-1110 with electronic flow meter with
9 integral 24VDC electronic monitor and 0-10 VDC calibrated output signal.
10

- 11 B. Single turbine: +/- 2% at 0.4 to 20 fps fluid velocity.
12

13 **2.13 AIR FLOW METERS**
14

- 15 A. Airflow Measuring System: Thermal Dissipation Airflow Measuring Probe:
16

- 17 1. Each probe array shall be assembled using heavy wall anodized aluminum tubing,
18 stainless steel adjustable support struts, stainless steel mounting brackets, and an
19 aerodynamically optimized molded sensing apertures to ensure accurate measurement in
20 angular airflow conditions.
21 2. Probe arrays shall be connected to the transmitter using cable of up to 100' in length,
22 included with the transmitter.
23 3. Each stand-alone sensing point shall use an ambient temperature thermistor and an
24 externally heated thermistor to determine the point velocity and temperature. Automatic
25 equal area averaging of the individual point measurements shall be performed in the
26 transmitter.
27 4. Each airflow sensor shall have an operating range of 0-10,000 FPM, with a NIST traceable
28 accuracy of ±2% of reading for velocity measurement and 0.1°F for temperature
29 measurement. Individual sensors shall be fully field serviceable without need for field
30 calibration, not requiring that the probe be returned to the Factory for repair and/or
31 calibration.
32 5. Each transmitter shall be capable of averaging as many as thirty-two (32) sensors.
33 6. The transmitter will have a high visibility backlit LCD for display of either the averaged or
34 individual sensor airflow and temperature measurements, in user selectable units of
35 measure. The transmitter shall be factory configured to output duct air volume for plug and
36 play operation.
37 7. All transmitter configuration, scaling, and diagnostic functions shall be performed by means
38 of a password protected, cover mounted membrane keypad.
39 8. The transmitter outputs shall be dual analog (4-20mA, 0-5VDC or 0-10VDC) for airflow
40 and temperature or optional LonWorks® communication interface.
41 9. The operating temperature range of the transmitter shall be from -20° to 140°F.
42 The transmitter shall be located where it will be sheltered from water or weather.
43 10. Input power to each transmitter shall be 24VAC/24VDC.
44 11. The transmitter shall be provided with interconnect cable for remote mounting up to 100'
45 away.
46 12. When installed per the manufacturer's minimum installation requirements, the transmitter
47 with probe array shall measure with an accuracy of ±3-10% of actual airflow as installed
48 or within ±2-3% of actual flow with field calibration.
49

- 50 B. Manufacturer: Air Monitor Electria-flo or approved equal.
51
52

53 **PART 3 - EXECUTION**
54

55 **3.1 GENERAL**
56

- 57 A. Install all control equipment, wiring and air piping in a neat and workmanlike manner.
58

- 1 B. All immersion wells, pressure tappings and any associated shut-off valves, flow switches, level
2 switches and other such items furnished by the control manufacturer shall be installed by the
3 mechanical contractor under the coordinating control and supervision of the control contractor.
4
- 5 C. Install all control devices in an accessible location.
6
- 7 D. Electrical Wiring: All electrical wiring for the automatic control system, excluding line voltage power
8 to control panels, as indicated on the Drawings, shall be furnished and installed by the Temperature
9 Control Contractor in accordance with this specification section. All the electrical sections of this
10 specification and all applicable electric codes shall apply to the required work.
11
- 12 1. Sensor and/or control wiring shall be provided with conduit independent of those used for
13 high voltage, switches AC or other signals which may create interference or cause induced
14 voltages which promote signal drift or reduced accuracy. Sensor and high voltage wiring may
15 not be run in the same conduit.
16

17 3.2 INSTALLATION

- 18
- 19 A. Check and verify location of thermostats, room sensors and other exposed control sensors with plans
20 and piping details before installation. Locate thermostats and sensors 60 inches above floor.
21
- 22 1. Isolated from exterior walls as recommended by manufacturer.
23 2. Located where not exposed to direct rays of sun, and where not influenced by concealed or
24 adjacent heating, domestic hot water piping or warm air currents.
25
- 26 B. Valve tops, inserts or bonnets, sensors, thermostats, thermometers, gauges, and damper motors of all
27 types:
28
- 29 1. Provide with access doors and/or access panels, in building construction so that they may be
30 readily removed, replaced and serviced.
31 2. Access doors and access panels by HVAC Contractor.
32
- 33 C. Control Wiring of all Kinds:
34
- 35 1. All control wiring to be labeled at both ends identifying termination and origination point.
36 2. In conduit and included with temperature control system.
37 3. Concealed low voltage control wiring may be routed as cabling.
38 4. Exposed control wiring shall be in EMT conduit.
39 5. Conforming to all requirements of Electrical Specifications, Division 16.
40
- 41 D. Locate controls, relays, instruments, switches, valves, devices and accessories so they are readily
42 accessible for adjustment, service, and replacement or as indicated on the drawings.
43
- 44 E. Install control valves horizontal with power unit up unless otherwise indicated. Maximum variation
45 from vertical is 45 degrees.
46
- 47 F. Locate, size and support temperature sensing elements in water streams to properly sense the
48 representative temperature.
49
- 50 1. For controlling, transmitting and indicating elements, sensing device located, sized and of the
51 type to sense the average condition.
52 2. Wells shall not obstruct the flow of the fluid being measure.
53 3. Pipes 1" and smaller shall be increased at least one pipe size at point of insertion.
54
- 55 G. Where insulation on piping, ductwork or equipment is punctured or penetrated due to the installation
56 of sensing elements or tubing, reseal the openings air and vapor tight.
57

- 1 H. Where control devices are to be located on insulated surfaces, provide brackets to clear the finished
2 surface of the insulation avoiding punctures of the vapor seal.
3
- 4 I. Locate support, enclose and install control devices and equipment so that they will not be subject to:
5
6 1. Vibration
7 2. Excessive temperatures
8 3. Dirt, moisture or other harmful effects.
9 4. Conditions beyond their rated limitations.
10
- 11 J. Conceal all piping except piping in mechanical rooms and other areas where mechanical system
12 piping may be exposed.
13
- 14 K. Install all exposed piping and conduit parallel to or at right angles to the building structure and
15 support adequately at uniform intervals. Use only tool made bends.
16
- 17 L. Make tests on piping from time to time during the progress of installation to insure against leaks.
18

19 **3.3 TESTING, ADJUSTING AND PERFORMANCE DEMONSTRATIONS**

- 21 A. All controlling devices which are a part of the automatic temperature control system, shall be tested
22 and adjusted by the Contractor before system is offered for final acceptance.
23
24 1. All associated devices, valves, operators and dampers adjusted.
25 2. All operating and positioning of all dampers verified.
26
- 27 B. After all calibrations, adjustment and checking have been completed and all systems are operational:
28
29 1. Demonstrate to User's representative, the complete and correct functioning of all control
30 systems and equipment.
31 2. Demonstrations shall consist of operating the controls through their normal full ranges and
32 sequences.
33 3. Simulate abnormal conditions to demonstrate proper functioning of safety devices.
34 4. Readjust all settings to their correct design values and after sufficient time, observe ability of
35 controls to establish the desired conditions, noting any abnormal deviations.
36 5. Make any necessary repairs, replacements or adjustments on all items which fail to perform
37 satisfactorily, all to the satisfaction of the Owner's representative.
38
- 39 C. Upon completion of the work and testing, but prior to final acceptance:
40
41 1. A representative of the control system manufacturer shall spend such length of time as
42 necessary to instruct the Owner's personnel in proper operation, adjustment and maintenance
43 of the control equipment and systems.
44 2. Instruction shall be performed by competent, trained, full-time employees of the control
45 system manufacturer who have a complete working knowledge of the systems and equipment
46 installed in this job.
47

48 **END OF SECTION**
49

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SECTION 23 90 00
DIRECT DIGITAL CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

- A. The Building Automation System (BAS) shall be capable of integrating multiple building functions, including equipment supervision and control, alarm management, energy management, and trend data collection.
- B. The BAS shall consist of the following:
 - 1. Direct Digital Control Panels.
 - 2. Standalone Application Specific Controllers (ACSs).
 - 3. Network wiring.
- D. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, ASCs, and operator devices.
- E. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

1.2 RELATED WORK

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified elsewhere:
 - 1. 23 90 00 Controls and Instrumentation
 - 2. 23 95 00 Control Sequences
 - 3. 23 90 10 DDC Point List
 - 4. Division 23 HVAC Specifications
 - 5. Division 26 Electrical Specifications

1.3 QUALITY ASSURANCE

- A. Acceptable Manufacturer/Installer: A firm regularly engaged in manufacture of DDC control equipment similar to the specified equipment and has been in satisfactory similar service for not less than five (5) years. Subject to compliance with requirements, provide DDC control system from the following manufacturers:
 - 1. Manufacturer: Honeywell
 - 2. Installer Qualifications: A firm specializing and experienced in DDC control system installation with a local service office within 60 miles of Madison metropolitan area and experience with a minimum of five(5) similar installatons for no less than five(5) years experience with Honeywell Control installations. All work to be done by qualified mechanics in the direct employ of this manufacturer.
- B. Electrical Standards: Provide electrical products which have been tested, listed and labeled by Underwriters' Laboratories (UL) and comply with NEMA standards.
- C. DDC Standards: DDC manufacturer shall provide written proof with shop drawings that the equipment being provided is in compliance with F.C.C. rules governing the control of interference caused by Digital Electronic Equipment to Radio Communications (1979 Amendment to Part 15, Subpart J).

1 **1.4 SUBMITTALS**

2
3 A. Product Data:

- 4
5 1. Submit manufacturer's specifications for each control device furnished, including installation
6 instructions and startup instructions. General catalog sheets showing a series of the same
7 device is not acceptable unless the specific model is clearly marked.
8 2. Annotated software program documentation shall be submitted for system sequenced, along
9 with descriptive narratives of the sequence of operation of the entire system involved.
10 3. Submit wiring diagram for each electrical control device with other details required to
11 demonstrate that the system has been coordinated and will function as a systems.

12
13 B. Maintenance Data: Submit maintenance data and spare parts lists for each control device. Include
14 this data in maintenance manual.

15
16 C. Record Drawings: Prior to request for final payment, provide complete composite record drawings to
17 incorporate the DDC and Pneumatic/Electric field work

18
19 **1.5 MATERIAL DELIVERY AND STORAGE**

20
21 A. Provide factory shipping cartons for each piece of equipment and control device. This contractor is
22 responsible for storage of equipment and materials inside and protected from the weather.

23
24
25 **PART 2 - PRODUCTS**

26
27 **2.1 NETWORKING/COMMUNICATIONS**

28
29 A. The design of the BAS shall be networked as shown on the attached system configuration drawing.
30 Inherent in the system's design shall be the ability to expand or modify the network either via a local
31 network, auto-dial telephone line modem connections, or a combination of the two networking
32 schemes.

33
34 B. Building Operator's Station: Existing to be reused in Mechanical Room.

35
36 C. Local Network:

- 37
38 1. Building Digital Panel Support: The Building Operator's Digital Panel shall directly oversee
39 a local network such that communications may be executed directly to and between ASCs.
40 The Operator's Digital Panel version shall be referred to as the "Digital Panel(s)" throughout
41 this document.
42 2. Data Access: All operator devices either network resident or connected via dial-up modems,
43 shall have the ability to access all point status and application data on the network.
44 Access to system data shall not be restricted by the hardware configuration of the facility
45 management system.
46 3. Global Data Sharing: global Data Sharing or Global point broadcasting shall allow point
47 data to be shared between ASCs, when it would be inefficient or impractical to locate
48 multiple sensors.
49 4. General Network Design: Network design shall include the following provisions:
50 a. Data transfer rates for alarm reporting and quick point status from multiple ASCs.
51 The minimum baud rate shall be 9600 baud.
52 b. Support of any combination of ASCs. A minimum of 100 ASCs shall be supported
53 on a single local network. The bus shall be addressable for up to 255 ASCs.
54 c. Detection of single or multiple failures of the ASCs or the network media.
55 d. Error detection, correction, and retransmission to guarantee data integrity.
56 e. Commonly available, multiple sourced, networking components shall be used.
57 f. Use of an industry standard protocol, such as Optomux, and IEEE RS-485
58 communications interface.

1
2 **2.2 DIGITAL PANELS**
3

- 4 A. General: Digital Panels shall be microprocessor-based, multi-tasking, multi-user, digital control
5 processors.
6
- 7 B. Memory: Each Digital Panel shall have sufficient memory to support its own operating system and
8 databases including:
9
- 10 1. Control Processes
 - 11 2. Energy Management Applications
 - 12 3. Alarm Management
 - 13 4. Trend Data
 - 14 5. Maintenance Support Applications
 - 15 6. Operator I/O
 - 16 7. Dial-Up Communications
 - 17 8. Manual Override Monitoring
- 18
- 19 C. Expandability: The system shall be modular in nature, and shall permit easy expansion through the
20 addition of field controllers, sensors, and actuators.
21
- 22 D. Serial Communication Ports: Digital Panels shall provide at least two RS-232C serial data
23 communication ports for simultaneous operation of multiple operator I/O devices such as laptop
24 computers, Personal Computers, and Video Display terminals.
25
- 26 E. Hardware Override Monitoring: Digital Panels shall monitor the status of all overrides, and include
27 this information in logs and summaries to inform the operator that automatic control has been
28 inhibited.
29
- 30 F. Integrated On-Line Diagnostics: Each Digital Panel shall continuously perform self-diagnostics,
31 communication diagnosis and diagnosis of all subsidiary equipment. The Digital Panels shall provide
32 both local and remote annunciation of any detected component failures, or repeated failure to
33 establish communication. Indication of the diagnostic results shall be provided at each Digital Panel.
34
- 35 G. Surge and Transient Protection: Isolation shall be provided at all network terminations, as well as all
36 field point terminations to suppress induced voltage transients consistent with IEEE Standard 587-
37 1980. Isolation levels shall be sufficiently high as to allow all signal wiring to be run in the same
38 conduit as high voltage wiring where acceptable by electrical code.
39
- 40 H. Powerfail Restart: In the event of the loss of normal power, there shall be an orderly shutdown of the
41 Digital Panels to prevent the loss of database or operating system software. Non-volatile memory
42 shall be incorporated for all critical controller configuration data, and battery back-up shall be
43 provided to support the real-time clock and all volatile memory for a minimum of 72 hours.
44
- 45 Upon restoration of normal power, the Digital Panels shall automatically resume full operation
46 without manual intervention.
47

48 **2.3 SYSTEM SOFTWARE FEATURES**
49

- 50 A. General
51
- 52 1. All necessary software to form a complete operating system as described in this specification
53 shall be provided.
 - 54 2. The software programs specified in this section shall be provided as an integral part of the
55 Digital Panel and shall not be dependent upon any higher level computer for execution.
56
- 57 B. Graphic Requirements: Provide color graphic backgrounds with operational information interface for the
58 following systems:

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- 58
1. Air handling system with AH-2 and ERV-2
2. Each VAV terminal.
3. Building Floor Plan graphic for temperature sensor informational and terminal unit service designations.

C. Control Software Description:

1. Equipment Cycling Protection: Control software shall include a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period.
2. Heavy Equipment Delays: The system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
3. Powerfail Motor Restart: Upon the resumption of normal power, the DDC panel shall analyze the status of all controlled equipment, compare it with normal occupancy scheduling, and turn equipment on or off as necessary to resume normal operation.

D. Energy Management Applications: Digital Panels shall have the ability to perform any or all of the following energy management routines:

1. Time of Day Scheduling
2. Calendar Based Scheduling
3. Holiday Scheduling
4. Temporary Schedule Overrides
5. Optimal Start
6. Optimal Stop
7. Demand Limiting
8. Load Rolling
9. Heating/Cooling Interlock
10. Average/High/Low Signal Select and Reset

All programs shall be executed automatically without the need for operator intervention, and shall be flexible enough to allow user customization. Programs shall be applied to building equipment as described in the "Execution" portion of this specification.

E. Programming Capability: Digital Panels shall be able to execute configured processes defined by the user, to automatically perform calculations and control routines.

1. Process Inputs and Variables: It shall be possible to use any of the following in a custom process:
 - a. Any system-measured point data or status
 - b. Any calculated data
 - c. Any results from other processes
 - d. Boolean logic operators (and, or,)
2. Process Triggers: Configured processes may be triggered based on any combination of the following:
 - a. Time of Day
 - b. Calendar Date
 - c. Other Processes
 - d. Events (e.g., point alarms)
3. Data Access: A single process shall be able to incorporate measured or calculated data from any and all other ASCs.

In addition, a single process shall be able to issue commands to points in any and all other NCUs on ASCs local network.

F. Alarm Management: Alarm management shall be provided to monitor, buffer, and direct alarm reports to operator devices and memory files. Each Digital Panel shall perform distributed,

1 independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms,
2 minimize network traffic, and prevent alarms from being lost. At no time shall the Digital Panel's
3 ability to report alarms be affected by either operator activity at the local I/O device, or
4 communications with other ASCs on the network.
5

- 6 1. Alarm Messages: In addition to the point's descriptor and the time and date, the user shall be
7 able to print, display or store a 60-character alarm message to more fully describe the alarm
8 condition or direct operator response.
- 9 2. Each Digital Panel shall be capable of storing a library of at least 100 Alarm Messages. Each
10 message may be assignable to any number of points in the panel.
- 11 3. Auto-Dial Alarm Management: In dial-up applications, only critical alarms shall initiate a
12 call to a remote operator device. In all other cases, call activity shall be minimized by time-
13 stamping and saving reports until an operator scheduled time, a manual request, or until the
14 buffer space is full. The alarm buffer must store a minimum of 50 alarms.
15

16 G. Trend Analysis: A data collection utility shall be provided to automatically sample, store and display
17 system data.
18

19 Measured and calculated analog and binary data shall be assignable to user-definable trends for the
20 purpose of collecting operator-specified performance data over extended periods of time. Sample
21 intervals of 5 seconds to 24 hours, in one-minute or one-hour intervals, shall be provided. Each
22 Digital Panel shall have a dedicated buffer for trend data, and shall be capable of storing 32 trend
23 logs. Each trend log shall have up to 4 points trended at 168 data samples each. data shall be stored
24 at the Digital Panel.
25

26 Trending: The BAS will be capable of trending all data points for 5 years with logging intervals of
27 15 minutes, and be available to trend all data points with an interval of 5 seconds or less for up to at
28 least two hours. The format of the trending data will be in a format acceptable by MS Excel-2003 or
29 newer.
30

31 The trend data shall be in a table with date and time in the first column(s) and the trending data in
32 consecutive columns. All columns shall have the heading on the first row(s) and the data for that
33 heading in the same column in the following rows. All headings will be explained in detail such that
34 there is no uncertainty as to what was measured and the location of that sensor. All columns headings
35 shall include the units for the trended data.
36

37 The trending data files shall not contain more than 200 columns and 65,000 rows each.
38

39 H. Runtime Totalization: Digital Panels shall automatically accumulate and store runtime hours for
40 binary input and output points as specified in the "Execution" portion of this specification.
41

- 42 1. The Totalization routine shall have a sampling resolution of one minute.
- 43 2. The user shall have the ability to define a warning limit for Runtime Totalization. Unique,
44 user-specified messages shall be generated when the limit is reached.
45

46 I. Event Totalization: Digital Panels shall have the ability to count events such as the number of times a
47 pump or fan system is cycled on and off. Event totalization shall be performed on a daily, weekly, or
48 monthly basis.
49

- 50 1. The Event Totalization feature shall be able to store the records associated with a minimum
51 of 9,999,999 events before reset.
- 52 2. The user shall have the ability to define a warning limit. Unique, user-specified messages
53 shall be generated when the limit is reached.
54

55 2.4 APPLICATION SPECIFIC CONTROLLERS - HVAC APPLICATIONS

56

57 A. Each Digital Panel shall be able to extend its performance and capacity through the use of standalone
58 Application Specific Controllers (ASCs).

- 1
2 B. Each ASC shall operate as a standalone controller capable of performing its specific control
3 responsibilities independently of other controllers in the network. Each ASC shall be of
4 microprocessor-based, multi-tasking, real-time digital control processor.
5
- 6 C. Each ASC shall have sufficient memory to support its own operating system and data bases including:
7
8 1. Control Processes
9 2. Energy Management Applications
10 3. Operator I/O (Portable Service Terminal)
11
- 12 D. The operator interface to any ASC point data or programs shall be through the Digital Panel or
13 portable operator's terminal connected to any ASC on the network.
14
- 15 E. ASCs shall directly support the temporary use of a portable service terminal that can be connected to
16 the ASC via zone temperature or directly at the controller. The capabilities of the portable service
17 terminal shall include, but not be limited to, the following:
18
19 1. Display temperatures
20 2. Display status
21 3. Display setpoints
22 4. Display control parameters
23 5. Override binary output control
24 6. Override analog setpoints
25 7. Modification of gain and offset constants
26
- 27 F. Powerfail Protection: All system setpoints, proportional bands, control algorithms, and any other
28 programmable parameters shall be stored such that a power failure of any duration does not
29 necessitate reprogramming the ASC.
30
- 31 G. Application Descriptions:
32
- 33 1. VAV Terminal Unit Controllers:
34 a. VAV Terminal Unit Controller shall support, but not be limited to, the control of the
35 following configurations of VAV boxes to address current requirements described in
36 the "Execution" portion of this specification, for future expansion.
37 1.) Single Duct Only (Cooling Only, or Cooling with Reheat)
38 2.) Fan Powered (Parallel/Side Pocket, Series On/Off Logic Series/Proportional
39 Fan)
40 3.) Dual Duct (Constant Volume, Variable Volume)
41 4.) Supply/Exhaust.
42 b. VAV Terminal Unit Controller shall support the following types of point inputs and
43 outputs:
44 1.) Proportional Cooling Outputs
45 2.) Box and Baseboard Heating Outputs: (Proportional or 1 to 3 Stages)
46 3.) Fan Control Output: (On/Off Logic, or Proportional Series Fan Logic)
47 c. VAV Terminal Unit Controllers shall support the following library of control
48 strategies to address the requirements of the sequences described in the "Execution"
49 portion of this specification, and for future expansion:
50 1.) Daily Schedules
51 2.) Comfort/Occupancy Mode
52 3.) Economy Mode
53 Standby Mode
54 Unoccupied
55 Shutdown
56 4.) Lighting Logic Interlock to Economy Mode
57 5.) Temporary Override Mode
58

- 1 c. Alarm Management: Each VAV Terminal Unit Controller shall perform its own
2 limit and status monitoring and analysis to maximize network performance by
3 reducing unnecessary communications.
4

5 2. Unitary Controllers:
6

- 7 a. Unitary Controllers shall support, but not be limited to, the following types of
8 systems to address specific applications described in the “Execution” portion of this
9 specification, and for future expansion:
10 1.) Unit Vents (ASHRAE Cycle I, II, III, or W)
11 2.) Heat Pumps (Air-to-Air, Water-to-Air)
12 3.) Packaged Rooftops
13 4.) Fan Coils (Two-Pipe, Four-Pipe)
14 5.) Generic Point Multiplexing
15

- 16 b. Unitary Controllers shall support the following types of point inputs and outputs:

- 17 1.) Economizer Switchover Inputs
18 a.) Drybulb
19 b.) Outdoor Air Enthalpy
20 c.) Differential Temperature
21 d.) Binary Input from a separate controller
22 2.) Economizer Outputs
23 a.) Integrated Analog with minimum position
24 b.) Binary Output to enable self-contained
25 c.) Economizer Actuator
26 3.) Heating and Cooling Outputs
27 a.) 1 to 3 Stages
28 b.) Analog Output with two-pipe logic
29 c.) Reversing valve logic for Heat Pumps
30 4.) Fan Output
31 a.) On/Off Logic Control
32

- 33 c. Unitary controllers shall support the following library of control strategies to address
34 the requirements of the sequences described in the “Execution” portion of this
35 specification, and for future expansion:
36

- 37 1.) Daily Schedules
38 2.) Comfort/Occupancy Mode
39 3.) Economy Mode:
40 Standby Mode/Economizer Available
41 Unoccupied/Economizer Not Available
42 Shutdown
43 4.) Lighting Logic Interlock to Economy Mode
44 5.) Temporary Override Mode:
45 Temporary Comfort Mode (Occupancy-Based Control)
46 Boost (Occupant Warmer/Cooler Control)
47

- 48 d. Alarm Management: Each VAV Terminal Unit Controller shall perform its own
49 limit and status monitoring and analysis to maximize network performance by
50 reducing unnecessary communications.
51

52 3. AHU Controllers

- 53 a. AHU Controllers shall support, but not be limited to the following configurations of
54 systems to address current requirements as described in the “Execution” portion of
55 this specification, and for future expansion:
56 1.) Air Handling Units
57 Mixed Air-Single Path
58 Mixed Air-Dual Path

100% Single Path

100% Dual Path

Generic Point Multiplexing

- b. AHU Controllers shall support all the necessary point inputs and outputs to perform the specified control sequences in a totally standalone fashion.
 - c. AHU controllers shall have a library of control routines and program logic to perform the sequence of operation as specified in the "Execution" portion of this specification.
 - d. Continuous Zone Temperature Histories: Each AHU Controller shall automatically and continuously, maintain a history of the associated zone temperature to allow users to quickly analyze space comfort and equipment performance for the past 24 hours. A minimum of two samples per hour shall be stored.
 - e. Alarm Management: Each AHU Controller shall perform its own limit and status monitoring and analysis to maximize network performance by reducing unnecessary communications.
 - f. Each AHU Controller shall come with a hand-held Zone Terminal permanently mounted at the controller to allow interface with the controller. This device will allow the user to monitor or adjust set points and time scheduling within a specific zone.
4. Lab and Central Plan (LCP) Controllers:
- a. LCP controllers shall support, but not be limited to, the following configurations of systems to address current requirements described in the "Execution" portion of this specification, and for future expansion.
 - 1.) Single boiler or chiller plants with pump logic
 - 2.) Cooling towers
 - 3.) Zone pressurization of labs
 - 4.) Air Handling Units and Roof-top units with complex controls sequences
 - 5.) Plant Heating and Cooling circuits
 - 6.) Heat exchangers
 - b. LCP controllers shall support all the necessary point inputs and outputs to perform the specified control sequences in a totally standalone fashion. A minimum of 30 I/O points expandable to 94 shall be supported by the LCP.

2.5 OPERATOR INTERFACE

A. Basic Interface Description:

1. Command Entry/Menu Selection Process: Operator interface software shall minimize operator training through the use of English language prompting, English language point identification.

The operator interface shall have the option of using a mouse or similar pointing device for a "point and click" approach to facilities management. Users shall be able to start and stop equipment or change setpoints from graphical displays through the use of a mouse or similar pointing device.
2. Password Protection: Multiple-level password access protection shall be provided to allow the user/manager to limit control, display and database manipulation capabilities as he deems appropriate for each user, based upon an assigned password.
 - a. Passwords shall be exactly the same for all operator devices.
 - b. A minimum of four (4) levels of access shall be supported:
 - 1.) Level 1 = Data Access and Display
 - 2.) Level 2 = Level 1 + Operator Overrides and Commands
 - 3.) Level 3 = Level 2 + Operator Management
 - 4.) Level 4 = Level 3 + Database Generation and Modification
 - c. A minimum of eight (8) passwords shall be supported at each Digital Panel.

- 1 d. Operators will be able to perform only those commands available for their respective
2 passwords. Menu selections displayed at any operator device, shall be limited to
3 only those items defined for the access level of the password used to log-on.
4 e. User-definable, automatic log-off timers of from 1 to 60 minutes shall be provided to
5 prevent operators from inadvertently leaving devices logged on.
6
- 7 4. Operator Commands: The operator interface shall allow the operator to perform commands
8 including, but not limited to, the following:
9
- 10 a. Start-up or shutdown selected equipment
11 b. Adjust setpoints
12 c. Add/Modify/Delete time programming
13 d. Enable/Disable process execution
14 e. Lock/Unlock alarm reporting for each point
15 f. Enable/Disable Totalization for each point
16 g. Enable/Disable Trending
17 h. Enter temporary override schedules
18 i. Define Holiday Schedules
19 j. Change time/date
20 k. Enter/Modify analog alarm limits
21 l. Enable/Disable demand limiting
22 m. Enable/Disable duty cycle
23 n. Enable/Disable average/high/low signal select and reset
24
- 25 5. Logs and Summaries: Reports shall be generated manually, and directed to the displays. As
26 a minimum, the system shall allow the user to easily obtain the following types of reports:
27
- 28 a. A general listing of all points in the network shall include, but not be limited to, the
29 following:
30 1.) Points currently in alarm
31 2.) Off-line points
32 3.) Points currently in override status
33 4.) Points in Weekly Schedules
34 5.) Holiday Programming
35 b. Summaries shall be provide for specific points, for a logical point group, for a user-
36 selected group of groups, or for the entire facility without restriction due to the
37 hardware configuration of the facility management system. Under no conditions
38 shall the operator need to specify the address of hardware controller to obtain
39 system information.
40
- 41 B. System Configuration and Definition: All temperature and equipment control strategies and energy
42 management routines shall be definable by the operator. System definition and modification
43 procedures shall not interfere with normal system operation and control.
44
- 45 1. The system shall be provided complete with all equipment and documentation necessary to
46 allow an operator to independently perform the following functions:
47
- 48 a. Add/Delete/Modify Application Specific Controllers
49 b. Add/Delete/Modify points of any type, and all associated point parameters, and
50 tuning constants
51 c. Add/Delete/Modify alarm reporting definition for each point
52 d. Add/Delete/Modify energy management applications
53 e. Add/Delete/Modify time- and calendar-based programming
54 f. Add/Delete/Modify Totalization for every point
55 g. Add/Delete/Modify Historical Data Trending for every point
56 h. Add/Delete/Modify configured control processes
57 i. Add/Delete/Modify dial-up telecommunication definition
58 j. Add/Delete/Modify all operator passwords

1 k. Add/Delete/Modify Alarm Messages
2

- 3 2. Programming Description: Definition of operator device characteristics, ASCs, individual
4 points, applications and control sequences shall be performed through fill-in-the-blank
5 templates.
6 3. System Definition/Control Sequence Documentation: All portions of system definition shall
7 be self-documenting to provide hardcopy printouts of all configuration and application data.
8 4. Database Save/Restore/Back-Up: Back-up copies of all ASC and Digital Panel databases
9 shall be stored in at least one personal computer or laptop. Users shall also have the ability to
10 manually execute downloads of an ASC or Digital Panel data base.
11

12
13 **PART 3 - EXECUTION**

14
15 **3.1 INSTALLATION**

- 16
17 A. Install the control system in accordance with manufacturer's instructions.
18

19 **3.2 DEMONSTRATION**

- 20
21 A. The system manufacturer or his representative shall provide start-up and adjustment service for the
22 control system.
23
24 B. The system manufacturer or his representative shall provide a minimum four (4) hours of training for
25 the Owner's personnel on the operation and maintenance of the packaged control system.
26

27
28 **END OF SECTION**

**SECTION 23 95 00
CONTROL SEQUENCES**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Section 23 90 00 - Controls and Instrumentation, applies to the work of this section.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Refer to schematic layout of control and HVAC equipment on HVAC drawings.
- C. Specified Elsewhere:
- | | | |
|----|----------|--------------------------------|
| 1. | 23 90 00 | Controls and Instrumentation |
| 2. | 23 91 00 | Direct Digital Control Systems |
| 3. | 23 95 10 | DDC Point List |

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Refer to Section 23 90 00 - Controls and Instrumentation.

PART 3 - EXECUTION

3.1 CONTROL SEQUENCE

- A. Systems shall perform in accordance with the following descriptions of the control strategy intent.
- B. BAS = Building Automation System (DDC Controls).

3.2 OCCUPIED/UNOCCUPIED CONTROL

- A. Building Automation System (BAS) controls shall schedule occupied/unoccupied schedules for HVAC equipment.
- B. Provide occupied/unoccupied schedules for the following HVAC Equipment.

1. Air Handling Unit AH-1/DOAS-1.

3.3 HOT WATER CIRCULATION PUMPS P-1 & 2

- A. Lead pump shall be started by the BAS (Building Automation System) and shall operate continuously during the heating season. Pumps shall be switched for lead/lag operation automatically by the BAS, or by pumps failure, as sensed by differential pressure or current switches across the piping of the respective pump.
- B. Pump lead operation shall be manually rotated for equal run time by the BAS.

- 1 C. Pump Capacity Control: Integral pump static pressure controller shall modulate pump capacity
2 through signal to ECM motor speed controls to maintain set point pressure differential between HWS
3 and HWR piping. Provide BACnet connection to DDC control network.
4

5 **3.4 AIR HANDLER UNIT AH-1**
6

- 7 A. System consists of a draw-through single path air handling unit with variable volume supply fan,
8 mixing box control dampers, 2-way control valve on hot water heating coil, two-stage DX cooling
9 coil with modulating compressor capacity on one stage, fresh, mixed air, minimum fresh air and
10 exhaust air control dampers. Air handler is coupled with dedicated outside air system DOAS-1 to
11 temper minimum fresh air requirements.
12
- 13 B. Furnish normally open two-way modulating automatic valve for the heating coil. Provide water-
14 based freezestat control.
15
- 16 C. Provide damper operators only for mixing box return/maximum fresh air and minimum fresh dampers
17 mounted in factory air handling unit.
18
- 19 D. Provide dampers and operators for maximum fresh air and economizer exhaust relief mounted in
20 ductwork.
21
- 22 E. Furnish filter section pressure drop monitoring and alarm signal .
23
- 24 F. Occupied Mode: Supply fan SF-1 and DOAS-1 shall run continuously. Open minimum fresh
25 dampers 100% serving AH-1. Mixed air dampers shall be indexed to minimum fresh air position 0%
26 open. Maximum fresh air and relief exhaust air dampers shall be closed. Discharge air controller
27 shall sequence economizer low-limit mixed air control, modulate 2-way hot water valve on the
28 heating coil and sequence on two(2) stages of mechanical cooling with modulating(0-5 VDV)
29 compressor capacity to maintain discharge air temperature set point. Discharge air temperature set
30 point shall be reset by the BAS based on the most demanding VAV damper position.
31
- 32 1. Reset range: 53 to 60 degrees F.
33 2. Interlock DOAS-1 supply and exhaust fans to run continuous with AH-1 occupied mode.
34
- 35 G. Unoccupied Mode: Supply fan SF-1 and DOAS-1 will be deactivated with dampers and valves in
36 normal positions.
37
- 38 1. Perimeter radiation will be the primary heating source during unoccupied mode.
39 2. If space temperatures drop below unoccupied set point with perimeter radiation; cycle air
40 handler AH-1 with 100% return to supplement heating requirements of spaces.
41
- 42 H. Morning Warm-Up Mode: On morning warm-up cycle, supply fan SF-1 shall operate continuously
43 with 100% return air. DOAS-1 will remain deactivated. Hot water coil and reheat coil valves shall
44 open 100% to supply heat to discharge air until return air temperatures reach a preset warm-up set
45 point temperature.
46
- 47 1. Initial Warm-Up Set Point: 70 degrees F.
48
- 49 I. VAV Supply Air Fan SF-1 Capacity Control: Static pressure controller with duct-mounted pressure
50 sensor in main supply trunk shall modulate supply air fan volume through VFD motor speed controls
51 to maintain minimum duct static set point in supply duct at sensor location.
52
- 53 1. Initial Set point: 0.75" W.G.(adjustable). Provide digital electronic manometer at duct
54 sensing location.
55 2. High limit supply duct static pressure control set at 3.0" W.G. shall shut down supply fan and
56 signal alarm with manual reset.
57

1 J. Economizer Control: A low-limit mixed dry bulb controller will sense tempered fresh air temperature
2 and outside air temperature conditions and modulate mixing box dampers in sequence to maintain
3 optimum mixture for discharge air set point conditions.

4
5 1. Maximum fresh damper shall open 100% upon a call for economizer air.

6
7 K. Building Space Pressurization Control: Static air pressure controller with one reference sensor
8 located outside the building on the roof and one(1) space sensors in the occupied space modulate
9 relief damper open, start and sequenced relief air fan RF-1 through VFD motor speed controls(0-10
10 VDV) to limit maximum space static pressure set point differential.

11
12 1. Initial Set point: positive(+) 0.08" W.G.(adjustable).

13
14 L. Building Humidity Monitoring: Humidity sensor in the return air duct shall be used for monitoring
15 and alarm purposes only.

16
17 M. Demand Controlled Ventilation Control: A carbon dioxide sensor in the return air duct shall be used
18 to reset minimum fresh air quantities higher upon carbon dioxide levels exceeding set point of 800
19 PPM(adjustable).

20
21 N. Freeze Control: Low-limit immersion water sensor in the heating coil leaving water stream(HWR)
22 shall upon sensing temperature below 35 degrees: Close fresh air damper, open heating coil valve
23 100%, shut down supply fan and energy recovery ventilator ERV-1 and move mixed air dampers to
24 100% return air. Signal local and BAS alarm with manual local reset and remote BAS reset.

25
26 O. Smoke Detector: Smoke detector in the return air ductwork shall shut down supply fan and energy
27 recovery ventilator ERV-1 supply fan, close fresh air damper and return mixing box dampers to 100%
28 tempered fresh air position upon detection of products of combustion. Duct-mounted smoke detector
29 shall be provided by the Electrical Trade; associated wiring to the temperature control panel and
30 interlocks shall be provided by this Contractor. Signal local and BAS alarm with manual local reset.

31
32 **3.4 DEDICATED OUTSIDE AIR SYSTEM DOAS-1**

33
34 A. System consists of a draw-through dual path air handling unit with constant volume supply and
35 exhaust fans, tempered exhaust air and fresh air control dampers, 2-way control valve on hot water
36 heating coil with coil pump P-3, two-stage DX cooling coil with modulating compressor capacity on
37 one stage in the tempered fresh air steam and energy recovery wheel. Air handler is coupled with air
38 handler unit AH-1 to temper minimum fresh air requirements.

39
40 1. Provide VFD's on supply and exhaust fans for balancing and future fan capacity
41 programming by the Owner.

42 2. VFD provided on energy recovery wheel for capacity control.

43
44 B. Furnish normally open two-way modulating automatic valve for the heating coil with coil pump P-3.
45 Provide water-based freestat control.

46
47 C. Provide dampers and operators for fresh air and tempered exhaust relief mounted in ductwork.

48
49 D. Furnish filter section pressure drop monitoring and alarm signal .

50
51 E. Occupied Mode: Supply fan SF and exhaust fan EF shall run continuously with energy recovery
52 wheel at full speed. Open fresh and tempered fresh dampers 100% serving DOAS-1. Discharge air
53 controller shall sequence and modulate 2-way hot water valve on the heating coil and sequence on
54 two(2) stages of mechanical cooling with modulating(0-5 VDV) compressor capacity to maintain
55 discharge air temperature set point. Discharge air temperature set point shall be reset by the BAS
56 based on the AH-1 loads.

57
58 3. Reset range: 53 to 60 degrees F.

1 4. Interlock DOAS-1 supply and exhaust fans to run continuous with AH-1 occupied mode.

2
3 F. Heating Coil Pump P-3: BAS shall automatically start coil pump operation upon any call for heating
4 at the air handler discharge controller and also anytime the leaving air or water temperature from the
5 coil drop below 40 deg F.

6
7 G. Unoccupied Mode: DOAS-1 will be deactivated with dampers and valves in normal positions.

8
9 H. Morning Warm-Up Mode: DOAS-1 will be deactivated with dampers and valves in normal positions.

10
11 J. Economizer Control: On a call for economizer mode at AH-1, DOAS-1 energy recovery wheel
12 speed will be modulate to provide optimum tempered fresh air leaving air temperature.

13
14 **3.8 VAV TERMINAL UNITS WITH REHEAT**

15
16 A. The VAV terminal units shall be individually controlled by a DDC VAV controller per VAV terminal
17 unit. VAV box manufacturer shall provide flow ring with VAV box. The DDC controller, damper
18 motor, and differential pressure transducer shall be supplied by the BAS Contractor and furnished to
19 the terminal unit supplier for factory installation.

20
21 B. The room sensor working through the pressure independent DDC controller shall modulate the box
22 damper from minimum damper position and reheat coil valve to maintain discharge air set point at 70
23 deg F heating and 75 deg F cooling. Discharge air shall be reset by the space stat to satisfy the space
24 conditions.

25
26 1. Reset range 55 deg F - 100 deg F.

27 2. Sequence perimeter radiation valves at VAV zones as first priority in heating mode with
28 reheat coil valves secondary.

29 3. Provide maximum air damper positions for cooling and heating as scheduled on VAV
30 Terminal Unit schedules.

31
32 C. Fan-powered VAV Terminals: Series-powered VAV terminals shall activate fans continuously
33 during occupied mode

34
35 1. During unoccupied mode, fans shall cycle to maintain unoccupied set point temperature.

36
37 D. Unoccupied: The reheat coil valve shall move to its 100% open position.

38
39 E. Morning Warm-Up: The box damper and reheat coil valve shall remain in 100% open position.

40
41
42 **3.10 PANEL RADIATION**

43
44 A. Upon a call for heating from space sensor, 2-way valve on HWS shall open to satisfy space
45 temperature set point.

46
47 **3.11 GAS-FIRED MAKE-UP AIR UNIT MAU-1**

48
49 A. System consists of a draw-through single path air handling unit with constant volume supply fan,
50 filter bank, inlet motorized fresh air dampers, air flow meter and modulating gas-fired bonnet.

51
52 1. Furnish filter pressure drop monitoring and alarm signal.

53 2. Supply fan is equipped with VFD for balancing and capacity programming by the Owner.

54
55
56 B. DDC controller by TCC shall provide electronic signal to MAU gas train controls to control
57 discharge air temperature at MAU.

1. Control Contractor to enable MAU and monitor fan status only.
 2. Monitor discharge air temperature status.
 3. Furnish filter pressure drop monitoring and alarm signal.
- C. Ventilation Mode: MAU supply fan shall run continuously. Motorized fresh damper opens 100%. Discharge air controller shall modulate direct gas-fired bonnet capacity to maintain discharge air temperature setpoint(heating only). Discharge air temperature setpoint shall be set by remotely at control panel.
- D. Flow Capacity: MAU unit flow shall provide 90% of exhaust fan capacity as measured by air flow meters at exhaust fans.
- E. Building Space Pressurization Control: Static air pressure controller with one reference sensor located outside the building on the roof and one(1) space sensors in the occupied space modulate MAU supply fan through VFD motor speed controls(0-10VDC) to maintain negative space static pressure set point differential.
1. Initial Set point: negative(-) 0.03" W.G.(adjustable).
- F. Deactivated Mode: MAU supply fan will be deactivated with motorized fresh damper shall close.
- G. Smoke Detector: Smoke detector in the filtered fresh air ductwork shall shut down MAU supply fan and close motorized fresh air damper upon detection of products of combustion. Duct-mounted smoke detector shall be provided by the MAU supplier and mounted by the HVAC Contractor. Electrical Contractor shall wire interlocks to fan starter/controller for shutdown. Temperature Control Contractor shall monitor smoke alarm signal and issue BAS alarm.

3.12 EXHAUST FANS

- A. Exhaust Fan EF-1 is a indoor axial exhaust fan with air flow meter and automatic control damper on discharge ductwork to roof vent.
1. Exhaust fan EF-1 shall run continuous for garage minimum ventilation requirements.
 2. Exhaust damper will open with EF activation.
- B. Exhaust Fans EF-2,3 &4 are indoor axial exhaust fans with air flow meters and automatic control dampers on discharge ductwork to roof vent.
1. Exhaust fan EF-2, 3 & 4 shall run continuous in the ventilation mode.
 2. Exhaust damper will open with EF activation.

3.13 SOLAR HOT WATER CIRCULATION PUMP SP-1

- A. Solar Pump SP-1 shall be started by the control system and shall operate continuously during available supply of hot water from solar collector panels as measured by differential temperatures between solar collector panel header and solar tank temperature.
- B. Pump Status: Monitor each solar pump status operation status through BAS.
- C. High Limit: Upon temperatures at the solar collector panel header exceeding a high limit setpoint(210 deg F adj.), a 2-way valve will bypass the solar return water through a bypass finned-tube dump on the roof to relief supply temperatures.
- D. Low Limit: Upon temperatures at the solar collector panel header falling below a low limit setpoint(40deg F adj.), the Solar Pump shall stop.

3.14 SOLAR HOT WATER HEATING SYSTEM

- 1
2 A. BAS shall monitor the following temperatures:
3
4 1. Solar supply from collector panels.
5 2. Solar return from collector panels.
6 3. Solar water temperature in solar storage tank.
7 5. Non-potable tempered water from solar storage tank to the wash bay.
8 6. Potable cold water to and from the solar storage tank.
9
10 B. BAS shall measure the following flows:
11
12 1. Solar water flow to the collector panels from the solar storage tank.
13 2. Non-potable(plant) tempered water flow from solar storage tank to the wash bay.
14 3. Potable tempered water flow from the solar storage tank to the water heater.
15
16 C. Calculated and summarize the following BTU's of energy flow per hour, day, month and year:
17
18 1. Solar collector system energy flow.
19 2. Non-potable tempered water energy flow to the wash bay.
20 3. Potable tempered water energy flow.
21
22

END OF SECTION

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SECTION 23 95 10
DDC POINT LIST

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Direct Digital Control (DDC) Point List.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Refer to schematic layout of control and HVAC equipment on HVAC drawings.
- C. Specified Elsewhere:
- | | | |
|----|----------|--------------------------------|
| 1. | 23 90 00 | Controls and Instrumentation |
| 2. | 23 91 00 | Direct Digital Control Systems |
| 3. | 23 95 10 | Control Sequences |

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Refer to Section 23 90 00 - Controls and Instrumentation.
- B. Refer to Section 23 91 00 - Direct Digital Control Systems.

PART 3 - EXECUTION

3.1 DDC POINT LIST

- A. Controls systems shall provide the DDC input/output control points and related as scheduled on the attached sheets 23 95 10 - 2 and 4.

END OF SECTION

DDC POINT LIST

<u>POINT DESCRIPTION</u>	<u>TYPE</u>	<u>OPERATION SCHEDULE</u>	<u>ALARM</u>	<u>HISTORY</u>	<u>FIELD DEVICE</u>
<u>AIR HANDLING UNIT AH-1 & RELIEF EXHAUST FAN RF-1</u>					
SF-1 FAN(AH-1)	DIGITAL OUTPUT	START/STOP	--	RUNTIME	RELAY @ VFD
SF-1 FAN(AH-1)	DIGITAL INPUT	STATUS	FLOW FAIL	--	CURRENT SENSOR
SF-1 VFD	ANALOG OUTPUT	FAN SPEED	--	15 MIN.	0-10 VDC SIGNAL
AH-1 MA	ANALOG INPUT	TEMP.	H/L TEMP.	15 MIN.	SENSOR-AHU
AH-1 FA	ANALOG INPUT	TEMP.	H/L TEMP.	15 MIN.	SENSOR-DUCT
AH-1 RA	ANALOG INPUT	TEMP.	H/L TEMP.	15 MIN.	SENSOR-DUCT
AH-1 RA RH	ANALOG INPUT	REL HUM	H/L RH	15 MIN.	SENSOR-DUCT
AH-1 CC TEMP	ANALOG INPUT	TEMP.	H/L TEMP.	15 MIN.	SENSOR-AHU CLG COIL
AH-1 DA	ANALOG INPUT	TEMP.	H/L TEMP.	15 MIN.	SENSOR-DUCT
AH-1 RA CO2 SENSOR	ANALOG INPUT	CO2 PPM	H/L	15 MIN	CO2 SENSOR IN RA DUCT
AH-1 SD	DIGITAL INPUT	STATUS	SMOKE	15 MIN.	AUX. CONTACT @ SD
CU-1	ANALOG OUTPUT	CAPACITY	--	15 MIN.	0-5 VDC SIGNAL MOD COMP
CU-1	DIGITAL OUTPUT	ENABLE/DISABLE	--	15 MIN.	CU CONDENSER RELAY
AH-1 FILTER APD	ANALOG INPUT	PRESS	H PRESS.	15 MIN.	DIFF. PRESS. SENSOR
AH-1 MA DPRS	ANALOG OUTPUT	MODULATE	--	15 MIN.	DAMPER ACTUATOR
AH-1 FA DPRS	DIGITAL OUTPUT	OPEN/CLOSE	--	15 MIN.	DAMPER ACTUATOR
AH-1 LL	DIGITAL INPUT	FREEZESTAT	LOW TEMP.	30 MIN.	DPST SWITCH
AH HTG VALVE	ANALOG OUTPUT	MODULATE	--	30 MIN.	2-WAY VALVE ACTUATOR
SA DUCT PRESS.	ANALOG INPUT	PRESS.	H/L PRESS.	15 MIN.	DUCT PRESS. SENSOR
SA HL DUCT PRESS.	DIGITAL INPUT	PRESS.	HIGH PRESS.	15 MIN.	HIGH LIMIT DUCT PRESS.
SPACE SP PRESS. DIFF	ANALOG INPUT	PRESS	H/L PRESS	15 MIN.	SPACE STATIC DIFF PRESS.
RF-1 EF	DIGITAL INPUT	STATUS	FLOW FAIL	--	CURRENT SENSOR
RF-1 VFD	ANALOG OUTPUT	FAN SPEED	--	15 MIN.	0-10 VDC SIGNAL
RF-1 EA DPR	ANALOG OUTPUT	MODULATE	--	15 MIN.	DAMPER ACTUATOR
<u>VAV TERMINAL UNITS-TYPICAL</u>					
VAV BOX (TYPICAL EA.)	ANALOG INPUT	TEMP.	H/L TEMP	15 MIN.	SPACE SENSOR
VAV BOX (TYPICAL EA.)	ANALOG OUTPUT	MODULATE	--	15 MIN.	AIR VALVE ACTUATOR
VAV BOX (TYPICAL EA.)	ANALOG OUTPUT	MODULATE	--	15 MIN	REHEAT HW VALVE
VAV BOX (TYPICAL EA.)	ANALOG INPUT	AIR FLOW	H/L TEMP	15 MIN.	CFM OF VAV BOX
VAV BOX (TYPICAL EA.)	ANALOG INPUT	TEMP.	H/L TEMP	15 MIN.	ENTERING SA
VAV BOX (TYPICAL EA.)	ANALOG INPUT	TEMP.	H/L TEMP	15 MIN.	LEAVING SA
FP VAV FAN	DIGITAL OUTPUT	START/STOP	--	RUNTIME	RELAY @ VFD
FP VAV FAN	DIGITAL INPUT	STATUS	FLOW FAIL	--	CURRENT SENSOR
FP VAV FAN - ECM	ANALOG OUTPUT	FAN SPEED	--	15 MIN.	0-10 VDC SIGNAL
<u>HEATING UNITS-TYPICAL</u>					
SPACE SENSOR	ANALOG INPUT	TEMP.	H/L TEMP	15 MIN.	SPACE SENSOR
WALL FIN RADIATION	DIGITAL OUTPUT	OPEN/CLOSE	--	15 MIN	2-WAY CONTROL VALV

DDC POINT LIST

<u>POINT DESCRIPTION</u>	<u>TYPE</u>	<u>OPERATION SCHEDULE</u>	<u>ALARM</u>	<u>HISTORY</u>	<u>FIELD DEVICE</u>
<u>DOAS-1</u>					
DOAS-1 SF	DIGITAL OUTPUT	START/STOP	--	30 MIN	AUX. CONTACT @ ERV
DOAS-1 SF	DIGITAL INPUT	STATUS	FLOW FAIL	--	CURRENT SENSOR
DOAS-1 SF VFD	ANALOG OUTPUT	FAN SPEED	--	15 MIN.	0-10 VDC SIGNAL
DOAS-1 EF	DIGITAL OUTPUT	START/STOP	--	30 MIN	AUX. CONTACT @ ERV
DOAS-1 EF	DIGITAL INPUT	STATUS	FLOW FAIL	--	CURRENT SENSOR
DOAS-1 EF VFD	ANALOG OUTPUT	FAN SPEED	--	15 MIN.	0-10 VDC SIGNAL
DOAS-1 FA	ANALOG INPUT	TEMP.	H/L TEMP.	30 MIN.	SENSOR-DUCT
DOAS-1 EA	ANALOG INPUT	TEMP.	H/L TEMP.	30 MIN.	SENSOR-DUCT
DOAS-1 TFA	ANALOG INPUT	TEMP.	H/L TEMP.	30 MIN.	SENSOR-DUCT
DOAS-1 TFA RH	ANALOG INPUT	REL HUM	H/L RH	15 MIN.	SENSOR-DUCT
DOAS-1 TEA	ANALOG INPUT	TEMP.	H/L TEMP.	30 MIN.	SENSOR-DUCT
DOAS-1 TEA DPR	DIGITAL OUTPUT	OPEN/CLOSE	--	30 MIN.	DAMPER ACTUATOR
DOAS-1 FA DPR	DIGITAL OUTPUT	OPEN/CLOSE	--	30 MIN.	DAMPER ACTUATOR
DOAS-1 CC TEMP	ANALOG INPUT	TEMP.	H/L TEMP.	15 MIN.	SENSOR-AHU CLG COIL
CU-2	ANALOG OUTPUT	CAPACITY	--	15 MIN.	0-5 VDC SIGNAL MOD COMP
CU-2	DIGITAL OUTPUT	ENABLE/DISABLE	--	15 MIN.	CU CONDENSER RELAY
DOAS-1 LL	DIGITAL INPUT	FREEZE/STAT	LOW TEMP.	30 MIN.	DPST SWITCH
DOAS-1 HTG VALVE	ANALOG OUTPUT	MODULATE	--	30 MIN.	2-WAY VALVE ACTUATOR
DOAS-1 HC PUMP	DIGITAL OUTPUT	START/STOP	--	30 MIN.	COIL PUMP RELAY P-3
DOAS-1 FA FILTER APD	ANALOG INPUT	PRESS	H PRESS.	30 MIN.	DIFF. PRESS. SENSOR
DOAS-1 EA FILTER APD	ANALOG INPUT	PRESS	H PRESS.	30 MIN.	DIFF. PRESS. SENSOR
<u>MAKE-UP AIR UNIT MAU-1</u>					
MAU-1	DIGITAL OUTPUT	ENABLE/DISABLE	--	RUNTIME	CONTACTS @ CNTRL PNL
MAU-1 SF	DIGITAL INPUT	STATUS	FLOW FAIL	--	CURRENT SENSOR
MAU-1 SF VFD	ANALOG OUTPUT	FAN SPEED	--	15 MIN.	0-10 VDC SIGNAL
MAU-1 FA	ANALOG INPUT	TEMP.	H/L TEMP.	15 MIN.	SENSOR-DUCT
MAU-1 FA DPRS	DIGITAL OUTPUT	OPEN/CLOSE	--	15 MIN.	DAMPER ACTUATOR
MAU-1 GAS VALVE	ANALOG OUTPUT	TEMP	H/L	30 MIN.	GAS CONTROLLER INPUT
MAU-1 DA	ANALOG INPUT	TEMP	H/L	30 MIN	DISCHARGE AIR SENSOR
MAU-1 SD	DIGITAL INPUT	STATUS	SMOKE	30 MIN.	AUX. CONTACT @ SD
MAU-1 FILTER APD	ANALOG INPUT	PRESS	H PRESS.	30 MIN.	DIFF. PRESS. SENSOR
MAU-1 AFM	ANALOG INPUT	AIR FLOW	H/L TEMP	15 MIN.	CFM AIR FLOW
<u>EXHAUST FANS-TYPICAL EF-1-4</u>					
EF FAN	DIGITAL OUTPUT	START/STOP	--	RUNTIME	RELAY @ VFD
EF FAN	DIGITAL INPUT	STATUS	FLOW FAIL	--	CURRENT SENSOR
EF VFD	ANALOG OUTPUT	FAN SPEED	--	15 MIN.	0-10 VDC SIGNAL
EF AFM	ANALOG INPUT	AIR FLOW	H/L TEMP	15 MIN.	CFM AIR FLOW

DDC POINT LIST

<u>POINT DESCRIPTION</u>	<u>TYPE</u>	<u>OPERATION SCHEDULE</u>	<u>ALARM</u>	<u>HISTORY</u>	<u>FIELD DEVICE</u>
<i>SOLAR HOT WATER SYSTEM</i>					
SOLAR PUMP SP-1	DIGITAL OUTPUT	START/STOP	--	15 MIN	RELAY
SOLAR PUMP SP-1	DITAL INPUT	STATUS	FLOW FAIL	--	CURRENT SWITCH
SOLAR PANEL HDR TEMP	ANALOG INPUT	TEMP.	H/L TEMP.	15 MIN.	STRAP-ON SENSOR - PIPE
SOLAR SUPPLY TEMP	ANALOG INPUT	TEMP.	H/L TEMP.	15 MIN.	IMMERSION SENSOR - PIPE
SOLAR RETURN TEMP	ANALOG INPUT	TEMP.	H/L TEMP.	15 MIN.	IMMERSION SENSOR - PIPE
SOLAR STOR TANK TEMP	ANALOG INPUT	TEMP.	H/L TEMP.	15 MIN.	IMMERSION SENSOR - PIPE
NP TCW TEMP	ANALOG INPUT	TEMP.	H/L TEMP.	15 MIN.	IMMERSION SENSOR - PIPE
POTABLE CW TEMP	ANALOG INPUT	TEMP.	H/L TEMP.	15 MIN.	IMMERSION SENSOR - PIPE
POTABLE TCW TEMP	ANALOG INPUT	TEMP.	H/L TEMP.	15 MIN.	IMMERSION SENSOR - PIPE
SOLAR WATER FLOW	ANALOG INPUT	GPM	NO FLOW	15 MIN.	FLOW METER SENSOR
NP WATER FLOW	ANALOG INPUT	GPM	--	15 MIN.	FLOW METER SENSOR
POTABLE WATER FLOW	ANALOG INPUT	GPM	--	15 MIN.	FLOW METER SENSOR

END OF SECTION

SECTION 23 96 00
STARTING OF MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Contractor:

1. Provide material and labor required for start up of all equipment and systems installed under general contract.
2. Coordinate start-up work with pipe cleaning, pipe system leak tests, and initial system fill and venting.
3. Provide all information and assistance required for cooperation with testing, adjusting and balancing services.
4. Contractor shall coordinate start-up of mechanical equipment with manufacturer's representative to be present for supervision and certification of correct operating procedures.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified Elsewhere:

- | | | |
|----|----------|----------------------------------|
| 1. | 23 05 90 | Testing, Adjusting and Balancing |
| 2. | 23 06 30 | Piping Specialties |
| 3. | 23 63 00 | Water Treatment |
| 4. | 23 90 00 | Controls and Instrumentation |

1.3 START-UP PROCEDURES

A. Bearings:

1. Inspect for cleanliness, clean and remove foreign materials.
2. Verify alignment.
3. Replace defective bearing and those which run rough or noisy.
4. Lubricate as necessary in accordance with manufacturer's recommendations.

B. Motors:

1. Check each motor for amperage comparison to nameplate value.
2. Correct conditions, which produce excessive current flow, which exist due to equipment malfunction.

C. Drives:

1. Adjust tension in V-belt drives, and adjust vari-pitch sheaves and drives for proper equipment speed.
2. Adjust drives for alignment of sheaves and V-belts.
3. Clean and remove foreign materials before starting operation.

D. Pumps:

1. Check mechanical seals for cleanliness and adjustment before running pump.
2. Inspect shaft sleeves for scoring.
3. Inspect mechanical faces, chambers and seal rings; replace if defective.
4. Verify that piping system is free of dirt and scale before circulating liquid through pump.
5. Clean suction strainers.

E. Control Valves:

1. Inspect hand and automatic control valves, clean bonnets and stems.
2. Tighten packing glands to assure no leakage, but permit valve stems to operate without galling.
3. Replace packing on any valve, which continues to leak.
4. Remove and repair bonnets, which leak.
5. Coat packing gland threads and valve stems with surface preparation after cleaning.
6. Verify that control valve seats are free from foreign materials and are properly positioned for intended service.

F. Water Systems:

1. Tighten flanges after system has been placed in operation. Replace flange gaskets, which show signs of leakage after tightening.
2. Inspect screwed joints for leakage. Promptly remake each joint, which appears to be faulty; do not wait for rust to form.
3. After water system has been placed in operation, clean strainers, dirt pockets, orifices, valve seats and headers in fluid systems to assure being free of foreign materials.
4. Remove rust, scale and foreign materials from equipment and renew defaced surfaces.
5. Inspect each electrical control circuit to assure that operation complies with specifications and requirements to provide desired performance.
6. Inspect each pressure gauge and thermometer for calibration. Replace items defaced, broken or read incorrectly.
7. Repair damaged insulation.

G. Air Systems:

1. Set and calibrate draft gages of air filters and other equipment.
2. Replace filter media with new clean units.
3. Inspect fan wheels for clearance and balance. Provide factory-authorized personnel for adjustment when needed.
4. Check each electrical control circuit to assure that operation complies with specifications and requirements to provide desired performance.

H. Adjustments:

1. Provide such periodic continuing adjustment services as necessary to insure proper functioning of mechanical systems after occupancy of the Project, and for a period of one year after Date of Substantial Completion.
2. Note: Adjustment services are not maintenance services.

PART 2 - PRODUCTS

--- NOT USED ---

1 **PART 3 - EXECUTIONS**

2

3 --- NOT USED ---

4

5

END OF SECTION

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SECTION 26 05 00 - ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Applicable provisions of Division 1 shall govern Work under this Section.
- B. Furnish all labor, materials, equipment and accessories required to complete all electrical work as shown on the Drawings and specified herein, and shall include, but is not necessarily limited to:

- 26 05 00 Electrical General Provisions
- 26 10 00 Electrical Demolition and Alterations
- 26 11 00 Raceways and Boxes
- 26 12 00 Low Voltage Conductors and Cables
- 26 14 00 Wiring Devices
- 26 16 20 Panelboards
- 26 18 50 Equipment Connections
- 26 19 00 Supporting Devices
- 26 45 00 Grounding and Bonding
- 26 51 00 Interior Building Lighting
- 26 51 10 Lighting Control Systems
- Division 27 Communications
- Division 28 Electronic Safety and Security

- C. Work Included in Division 26:

1. General: The mention hereinafter of article, operation, material, equipment or method requires that the E.C. shall provide such article of quality noted, in the quantity required, shall perform each operation, and use such method, material or equipment prescribed, all in complete accordance with the conditions stated. The E.C. shall provide all materials, labor, tools, equipment and transportation as necessary to complete the project in conformity with the drawings, the specifications, and other Contract Documents. In general, this work includes everything essential for a complete electrical system in operating order as shown or implied on the drawings or hereinafter specified.
2. All work shall be in accordance with all Local & State Inspection Authorities having jurisdiction together with the recommendations of the manufacturer whose equipment is to be supplied and connected by the E.C. All materials shall bear a UL label where a UL Standard and/or test exists.
3. Before submitting his bid, each bidder shall examine the drawings relating to this work and shall become fully informed as to the extent and character of the work required and its relation to other work in the building. No consideration will be granted for any alleged misunderstanding of materials to be furnished or work to be done, it being understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein or indicated on the accompanying drawings.
4. The E.C., in conjunction with the Engineer's representative, shall establish exact location of all materials and equipment to be installed in consideration of construction features, equipment of other trades and requirements and purpose of equipment installed by the E.C.

- D. Summary of Electrical Work:

1. Drawings and Specifications: The Electrical drawings are schematic in intent. Minor relocations of these items may be made by the Engineer prior to rough in at no expense to the Owner.
2. Any conflict between the drawings and specifications shall be brought to the attention of the Engineer.
3. Note that the electrical drawings are only a portion of the complete set of plans. The complete set of plans shall be used to define the electrical work.
4. The complete specifications will be utilized to define the electrical work.
5. General Outline: The facilities and systems of the electrical work can be described (but not by way of limitation) as follows:
 - a. Demolish and remove electrical equipment, light fixtures, raceways and conductors, and related.
 - b. Provide new panelboard served from existing distribution equipment.
 - c. Provide new lighting, electrical devices and distribution.
 - d. Provide and support communications cabling and raceways per Div 27 requirements.
 - e. Provide and support fire alarm system cabling and raceways per Div 28 requirements.
 - f. Support door access/security system installation with raceways required by installation by others.

E. Coordination of Electrical Work:

1. General: The Contractor shall confer with the other trades and the Engineer so that all concerned will be thoroughly familiar with the specific items and areas of the coordination.
2. Conflicts of any type shall be immediately reported to the Engineer.
3. The Contractor shall furnish and be responsible for the proper installation of all reinforcement required for wall or ceiling attached equipment.
4. Arrange electrical work in a neat, well organized manner with conduit and similar services running parallel with primary lines of the building construction.
5. Locate operating and control equipment properly to provide easy access, and arrange entire electrical work with adequate access for operation and maintenance.
6. All conduit shall be concealed except in mechanical and electrical rooms.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.

1.3 DEFINITIONS

- A. Provide: Furnish and install, complete and ready for service.
- B. Exposed: Exposed to view in any room, corridor or stairway.
- C. E.C.: Electrical Contractor.
- D. The Engineer: HEIN Engineering Group.
- E. The Owner: City of Madison
- F. A/E: Architect/Engineer.

- G. ANSI: American National Standards Institute
- H. NEC: National Electric Code
- I. NEMA: National Electric Manufacturers Association
- J. NFPA: National Fire Protection Association
- K. UL: Underwriters Laboratories, Inc.

1.4 PERMITS AND LICENSES

- A. Prepare and submit to all authorities having jurisdiction, for their approval, all applications and working drawings required by them. Secure and pay for all licenses and permits required.

1.5 QUALITY ASSURANCE, STANDARDS AND SYMBOLS

- A. General: Specifically, for the electrical work (in addition to standards specified in individual work section), the following standards are imposed, as applicable to the work in each instance:
 1. Standards for Materials and Workmanship: All materials shall conform to the standard of the UL in every case where the UL has established a standard of such materials. In addition, these materials shall bear the UL label to show their conformance. Materials not covered by UL standards shall be processed, supplied or manufactured to NEMA, IEEE, or other accepted industry standards for these materials and shall also be labeled or properly identified as being in conformance with the appropriate standards. Substitute standards for those listed are not acceptable. Materials and equipment shall be protected during delivery and handling to prevent damage; and shall be stored in a clean dry area to prevent contamination. Damaged materials shall not be used.
 2. All materials and work shall conform to the applicable portions of the latest issues of the following standards:
 - a. UL
 - b. NEMA
 - c. NEC
 - d. NECA
 - e. ANSI
 - f. IEEE
 - g. ASTM
 - h. NFPA
 - i. IPCEA
 - j. FM
 - k. ETL
 3. All work shall be installed in accordance with National and State laws, ordinances and regulations. Comply with all applicable OSHA regulations.
 - a. IBC
 - b. IECC
 4. All materials shall have a UL label where a UL Standard and/or test exists.
 5. All work shall be executed in a neat and workmanlike manner by workers thoroughly qualified in the trade of duties they are to perform. A rough or unworkmanlike installation will be cause for removal and replacement of said installation.

B. Substitution of Materials:

1. All requests for substitution shall be in writing and shall include sufficient product information to permit the Architect/Engineer to evaluate the request.
2. The Architect/Engineer specifically reserves the right to reject or approve any and all substitute materials or equipment in order to insure compliance with the minimum standards of quality established for the project herein specified, and also to insure that any substitute materials or equipment maintains the trends of style and appearances established for this project.
3. When an item is approved as an equal, either by specification or by approved substitution, this item shall give the same end results, to the Architect/Engineer's satisfaction, as the item it has replaced from the specification. Any modification, additional fittings or change to the approved item or to concomitant items to accomplish these results shall be at the expense of the Contractor.
4. The Contractor shall choose from the listed manufacturers for specific items or a substitute manufacturer if approved, but once a manufacturer has been chosen all similar items shall be by the same manufacturer.

1.6 JOB CONDITIONS

A. Job Site:

1. The Contractor shall be familiar with conditions which will affect his work, and locations where the work will be performed and other pertinent factors.
2. The Contractor shall furnish all labor and materials to complete each installation ready for use.
3. No additional allowances will be granted because the Contractor's knowledge of job site conditions was incomplete.

B. Products, Electrical Work:

1. Product Listing: Prepare the product listing for electrical work. Include listing of each significant item of equipment and material used in the work; and indicate the generic name, product name, manufacturer, model number, related specification number(s).
 - a. Submit list to the Architect/Engineer for approval.
2. Compatibility: Provide products which are compatible with other products of the electrical work, and with other work requiring interface with the electrical work, including electrical connections and control devices. For exposed electrical work, coordinate colors and finishes with the other work.

1.7 WORK SEQUENCE

- A. The Contractor shall review the work sequence and determine if any dates of completion can not be met for his work. Any conflicts with completion dates shall be brought to the Engineer's attention prior to submitting a bid. No time extensions will be granted after contracts are awarded unless permitted in other parts of these specifications.

1.8 DIMENSIONS AND DEFINITE LOCATIONS

- A. The drawings depicting electrical work are diagrammatic and depict, in their approximate location, symbols representing electrical equipment. The exact location shall be established in the field in accordance with instructions from the Architect.

- B. Unless specifically stated to the contrary, no measurement of an electric drawing by scale shall be used as a dimension to work by. Dimensions noted on the electric drawings are subject, in each case, to measurements of adjacent or previously completed work and all such measurements necessary shall be taken before undertaking any work dependent upon time.

1.9 DRAWINGS

- A. The E.C. shall prepare, at his expense, complete field installation drawings necessary for the proper installation of his work. These drawings shall be submitted to the Engineer when requested for review and such copies of same as are necessary shall be provided for others as directed.
- B. The E.C. shall keep a detailed record, up-to-date, of the manner and location in which all installations are actually made, properly indexing each feeder, pull box and protective device.
- C. As Built Drawings: See General Requirements - Division 1.
- D. In the event of a conflict between the drawings and specifications the E.C. shall base his bid on the greater quantity, cost or quality of the item in question, unless such conflict is resolved by addenda.

1.10 MATERIALS AND EQUIPMENT

- A. Provide all new materials and equipment to form a complete installation, unless otherwise specified.
- B. All equipment supplied shall be based on materials and equipment of manufacturers specified. No substitutions will be allowed except as provided in Instructions to Bidders.
- C. All items specified shall be the latest type or model produced by the manufacturer specified. If descriptive specification or model number is obsolete, substitute current product.

1.11 FLOOR, WALL AND CEILING OPENINGS

- A. Pipe sleeves must be set for all pipes passing through new masonry construction. Coordinate with G.C. as to size and location of openings.
- B. Coordinate the location of sleeves, openings, chases, furred spaces, etc., with the other Contractors. Provide all sleeves, hangers and inserts that are to be built into the structure during the progress of construction.
- C. Pipe sleeves shall be Schedule 40 galvanized steel pipe and shall extend completely through the construction.
- D. Sleeves for pipe 4" and smaller shall be at least two pipe sizes larger than the pipe passing through.
- E. Sleeves shall extend 3/8" above the finished floor. In mechanical rooms and other areas where water may accumulate, sleeves shall extend 2" above the finished floor.
- F. Pack annular space between sleeves and insulation or pipe with fiberglass. Where penetrations occur through mechanical rooms or fire rated walls, floors, fill with Dow-Corning 3-6548 Silicone RTV Foam.

1.12 SHOP DRAWINGS

- A. Submit to Engineer for review, in accordance with Division 1, shop drawings and/or equipment brochures for the following:
 - 1. Raceways and Boxes.
 - 2. Low Voltage Conductors and Cables.
 - 3. Panelboards.
 - 4. Disconnects and Starters.
 - 5. Wiring Devices.
 - 6. Light Fixtures.
 - 7. Lighting Controls.
- B. Submit in advance of construction requirements and as to cause no delay in the E.C.'s work and to allow the Engineer reasonable time to review them to make necessary corrections.
- C. All data submitted for Engineer's review shall be numbered consecutively, shall be noted to correlate with the electrical drawings and shall bear the name and location of the project, the name of the E.C., the date of submittal, the date of the drawings and the date of each correction and revision. If more than one type of lighting fixture (or other materials) are on submitted sheet, the one specified shall be conspicuously checked with red pencil by the E.C.

1.13 DELIVERY STORAGE AND HANDLING

- A. All materials shall be suitably stored and protected prior to installation and all work shall be protected after installation, during construction and all work prior to acceptance.
- B. The E.C. shall furnish and remove upon completion of the project, all scaffolding, rigging, hoisting and services necessary for delivery, erection and installation of all equipment and apparatus required to be installed by the E.C.

1.14 MAINTENANCE MANUALS

- A. The E.C. shall assemble and submit to the Architect for subsequent submission to the Architect/Engineer, in accordance with Division 1, complete sets of a Manual of Operation and Maintenance for each of the separate systems furnished as a part of the electrical subcontractor.
- B. Each manual shall consist of an approved loose-leaf type bound volume instructing the Architect/Engineer's personnel in the use, operation and maintenance of the system in question. The manual shall cover all phases of operation of the equipment and it shall be illustrated with photographs, drawings, wiring diagrams, etc., as required to accurately and adequately describe the operation, construction and adjustable features of the complete system and each component part. The manual shall be complete with an equipment parts listing to facilitate the ordering of spare and replacement parts.
- C. Each manual shall contain two sets of final shop drawings depicting equipment as installed.
 - 1. Equipment Parts Lists: Include a complete list of all equipment furnished for project, with a tabulation of descriptive data of all the equipment replacement parts proposed for each type of equipment or system. Properly identify each part of part number and manufacturer.

1.15 CLEANING AND PAINTING

- A. All rubbish resulting from this work shall be removed and disposed of on a daily basis and in such manner as to be acceptable to the Architect.
- B. The E.C. shall clean all exposed ironwork, interior and exterior of panels and pull boxes, etc., and remove all rubbish and debris resulting from the work.
- C. Where painted surfaces of equipment have been abused, removed, or rusted during construction, the E.C. shall paint same to match original factory or surrounding finish.

1.16 TESTS AND ACCEPTANCE

- A. The operation of the equipment and electrical installations done does not constitute an acceptance of the work by the Architect/Engineer. The final acceptance is to be made after the E.C. has adjusted his equipment and demonstrated that it fulfills the requirements of the drawings and the specifications.
- B. After the work is completed and prior to acceptance, the E.C. shall conduct the following tests, tabulate data, date, sign and submit to the Engineer: clamp ammeter test on each feeder conductor with all utilization equipment energized. The load current in each phase conductor of the feeder of the portion thereof supplying the panel shall not differ from the average connected load currents in the several conductors by more than 10%. If the load current does differ by more than 10%, the E.C. shall change phase loading to same or receive written approval from the Engineer that this is not required due to the nature of the load.
- C. At the time of connection, or energizing, check all motors for proper rotation, conferring with contractor furnishing equipment, if necessary, to determine proper direction.
- D. Upon completion of the installation, the E.C. shall furnish certificates of approval from all authorities having jurisdiction. He shall demonstrate that all work is complete and in perfect operating condition, with raceway and conduit system properly grounded, all wiring free from grounds, shorts, and that the entire installation is free from any physical defects. In the presence of the Engineer and the Architect/Engineer, the E.C. shall demonstrate the proper operation of all miscellaneous systems.
- E. All materials and workmanship is subject to inspection, examination and tests by the Architect/Engineer at any time.

1.17 EXTRA STOCK/SPARE PARTS

- A. None anticipated for electrical work.

1.18 DEFECTS

- A. Should it be found by the Engineer that the fixtures, equipment or any portion thereof furnished and installed under this subcontract fail to comply with the specifications and drawings, with respect or regard to the quality, amount or value of material, appliances or labor used in the work, it shall be rejected and replaced by the E.C. and all work disturbed by changed necessitated in consequence of said defects or imperfections shall be made good at the E.C.'s expenses.

1.19 WARRANTY

- A. The Contractor shall warranty: All materials furnished to be perfect in every respect; and, if not, replace same immediately. Replace any material or part showing defects within a

minimum of one year of acceptance, or within warranty period of the item if greater than one year. This one-year warranty period shall be binding even though it may exceed the product warranty period normally furnished by some manufacturers. Repair or replacement shall bear an additional 12 months warranty as called for, dated from final acceptance of the repairs or replacement. The apparatus to be installed in strict accordance with these specifications and the various codes covering this work. Neither the final acceptance nor any provisions in the Contract Documents shall relieve this Contractor of the responsibility for negligence, faulty materials or workmanship within the extent and period provided by this contract.

1.20 IDENTIFICATION

A. General:

1. Materials and equipment shall be clearly identified as listed below.
2. Locate identification conspicuously.
3. Terminology to be approved by Architect.
4. See plans for any additional items to be identified.
5. Loads such as motors shall be described by function rather than by the system of arbitrary number as shown on electrical plans.
6. Use abbreviations sparingly.

B. All panels and cabinets shall be stenciled with 2" letters indicating usage, plan designation and voltage. In Equipment and Mechanical Rooms this identification may be on the exterior of unit; in other areas identification shall be inside door or cover.

C. Junction and pull boxes shall be stenciled utilizing a coded identification system. The following junction and pull boxes shall be identified using a coded system. Coding shall be submitted to Engineer for approval.

1. Light and Power - 120/208V.
2. Light and Power - 277/480V.
3. Fire Alarm Systems.
4. Voice and Data Cabling.
5. CATV Cabling.
6. Access Control Systems.

D. On all 3-phase systems, each phase shall be identified at all terminals using code markers.

E. Laminated Bakelite Plates: Engraved plastic nameplate shall be securely fastened to the following equipment. Size 1" x 4" with 3/8" high letters unless space available dictates differently.

1. Each section of main distribution switchboards and panelboards. Mount one next to each protection device to identify load served by each circuit breaker.
2. Each contractor, time switch, metering cabinet, starter, motor disconnect switch. In Equipment and Mechanical Rooms this identification may be on the exterior of unit, in other areas identification shall be inside door or cover.
3. Each feeder at all accessible locations, i.e., panels, junction boxes, pull boxes, etc. (strap plate to feeder conductors in junction boxes or pull boxes).
4. Each end of empty conduit runs to indicate the intended use of the conduit and the location of opposite end. Use room numbers that are permanently assigned.

F. Typewritten Directory: Each panelboard shall be provided with a typewritten directory in a steel frame with plastic cover contained on the inside of panel door. These directories shall indicate load served and rooms served by each protective device in the respective panel.

G. Conductor Identification:

1. Identify each conductor at each conductor or splice point with permanently attached wrap around adhesive markers as manufactured by Brady Company.
2. This identification shall include branch circuit number, control circuit number, or any other appropriate number or lettering that will expedite future tracing and "trouble shooting".
3. All wire shall be color-coded per the NEC. In addition, color-coding shall be used to identify phases, neutral, ground and voltages. Coding shall be:

120/208V - Phase A - Black
 - Phase B - Red
 - Phase C - Blue
 - Neutral - White
 - Ground - Green

277/480V - Phase A - Yellow
 - Phase B - Brown
 - Phase C - Orange
 - Neutral - Gray
 - Ground - Green with two yellow stripes

1.21 ACCESS PANEL

A. Access panels required by code or otherwise to electrical equipment shall be provided by Electrical Contractor. Access panels shall be in accordance with Division 1 complete with master cylinder lock.

PART 2 - PRODUCTS

--- Not Used ---

PART 3 - EXECUTION

--- Not Used ---

END OF SECTION

SECTION 26 10 00 - ELECTRICAL DEMOLITION AND ALTERATIONS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Applicable requirements of Division 1 shall govern work in this section.

1.2 JOB CONDITIONS

- A. The Electrical Contractor shall work with WPS(Electrical Utility) to coordinate the disconnection of the all electrical services to the building. It is the responsibility of the demolition contractor for demolition of any interior electrical equipment. The Electrical Contractor shall verify for demolition contractor that all electrical equipment is de-energized prior to demolition.
- B. Prior to demolition or alteration of structures, the following shall be accomplished:
1. Owner release of such structure.
 2. Disconnection of electrical power to equipment and circuits removed or affected by demolition work.
 3. Electrical services rerouted or shut off outside area of demolition.
 4. Coordinate sequencing with Owner and other Contractors.
 5. Survey and record condition of existing facilities to remain in place that may be affected by demolition operations. After demolition operations are completed, survey conditions again and restore existing facilities to their predemolition condition.
- C. Remove all and any unused materials not complying or reused with new electrical plan.
- D. Contractor shall dispose of all obsolete material.
- E. Contractor shall notify the Engineer of any existing code violations observed during the course of performing his work. The Engineer will decide if corrective action needs to be taken. Corrective actions that change the scope of the work will be considered a change order and will be processed accordingly.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 ELECTRIC SERVICE

- A. De-energize existing electric service serving remodeled as required to install new equipment with proper notice to General Contractor and Owner prior to starting shutdown.
1. Refer to Division 1 for further requirements regarding continuation of existing services.

3.2 REMOVAL

- A. Remove or relocate conduit, wire, boxes, and fixtures.
- B. Remove electrical equipment released from service as a result of construction or as indicated on drawings.
- C. Do not reuse removed electrical equipment, unless specifically called out in the drawing documents.
- D. Where existing equipment is being removed, removal shall include all equipment associated with the device. Associated equipment shall include but not be limited to coverplates, backboxes, conduit, fittings, de-energized conductors, etc. When boxes are removed from existing walls which will remain, it shall be the Electrical Contractor's responsibility to fill in openings and sand as required flush with adjacent surfaces. The General Contractor shall be responsible for final finish work unless specifically indicated otherwise on the plans.

3.3 DISPOSAL

- A. Dispose of equipment that is removed unless specifically indicated on the drawings.
- B. Raceway, conductors, boxes, cabinets and supporting devices shall become the property of the Contractor and shall be removed from the site and disposed of by the Contractor.
- C. The Contractor shall tour demolition areas with the Owner to determine the status of all other equipment to be removed during demolition. All equipment that is to be salvaged for reuse by the Owner shall be removed by the Contractor and transported to an owner designated storage area on the site. The Owner shall be responsible for removal of salvaged equipment from the storage area.

3.4 LIGHTING FIXTURE BALLAST DISPOSAL

- A. The contractor shall inspect all ballasts in all light fixtures removed as part of this project and take the actions described below.
- B. All ballasts labeled as "NON PCB'S" or "NO PCB'S" shall be handled as described in other sections of these specifications which describe demolition or salvage materials handling. If the PCB content is not stated on the ballast label, the ballast shall be handled as a PCB ballast.
- C. All PCB ballasts shall have the wires clipped off and the ballasts placed in US DOT approved type 17C or type 17H barrels and placed in storage in a location within the building as designated by the Owner. The Contractor shall provide to the Owner, in typewritten form, a total count of these ballasts and where they are stored.
- D. These ballasts are not to be removed from the work site by the Contractor.
- E. The Contractor shall label and mark the PCB storage barrels with EPA approved PCB labels and shall mark the storage area with signs, marks, and lines to meet the regulations of Wisconsin Code NR 157.
- F. The Contractor shall provide approved PCB absorbent materials to be stored immediately adjacent to the barrel storage area. Do not place loose absorbent material in the barrels.

- G. When the ballast demolition is completed and all PCB ballasts are placed in barrels ready to be picked up for disposal, the Contractor shall notify the Owner in writing so the Owner can make arrangements for pick up and disposal of the PCB ballasts.

3.5 LIGHTING FIXTURE LAMP DISPOSAL

- A. The Contractor shall be responsible for the proper removal and recycling of all existing fixture lamps being removed from service in accordance with EPA and State of Wisconsin DNR requirements. Lamps shall not be disposed of in any way except as described herein.
- B. The Contractor shall be responsible for arranging for recycling of lamps by a licensed waste lamp and bulb recycler. The cost for recycling of removed lamps shall be included in the Contractor's bid.
- C. The Contractor shall carefully package removed lamps to prevent breakage. The Contractor shall store waste lamps in a secure area, either in the container that the lamps are shipped in or in other ways so as to eliminate breakage. Both the lamp storage area and individual containers should be labeled as hazardous waste. Store lamps in covered containers to prevent lamps from being broken as a result of other debris being placed on top of them.

3.4 ASBESTOS REMOVAL

- A. Any work involved with asbestos removal, disposal or abatement shall not be considered as part of this project. All work in this regard shall be the responsibility of the Owner. If this Contractor shall discover the presence of any asbestos material he shall cease work immediately and notify Owner and Engineer of condition.

END OF SECTION

SECTION 26 11 00 - RACEWAY AND BOXES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide complete raceway system as specified for power, standby and emergency power systems.
 - 1. Conduit, box and raceway systems.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 26 05 00 Electrical General Requirements
 - 2. 26 12 00 Low Voltage Conductors and Cables
 - 3. 26 19 00 Supporting Devices
 - 4. 26 45 00 Grounding and Bonding

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. National Electrical Code, NEC: Comply with NEC/NFPA No. 71 as applicable to construction and installation of electrical conduit.
 - 2. National Electrical Manufacturer's Association, NEMA: Comply with applicable portions of NEMA standards pertaining to non-metallic duct and fittings for underground installation.
 - 3. Underwriters Laboratories: Provide electrical conduit listed and labeled by UL.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Provide color-coded end-cap thread protectors on exposed threads of threaded metal conduit.
- B. Storage:
 - 1. Store pipe and tubing inside and protect from weather.
 - 2. When necessary to store outdoors, elevate well above grade and enclose with durable, watertight wrapping.
- C. Handle conduit and tubing carefully to prevent bending and end damage and to avoid scarring the finish.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Conduit:
 - 1. Allied Tube and Conduit Corporation.

2. Wheatland Tube Company.
3. Steelduct Conduit Products.

B. Couplings:

1. Appleton Electric Company.
2. Crouse-Hinds Company.
3. Killark Electric Manufacturing Company.

C. Flexible Conduit:

1. Anaconda Metal Hose.
2. I.B.C. Corporation.
3. Electri-Flex Company.

D. Boxes:

1. Appleton Electric Company.
2. Crouse-Hinds Company.
3. General Electric Company.
4. Killark Electric Manufacturing Company.
6. Lew Electric Fitting Company.
7. O.Z./Gedney Company.
8. Raco, Inc.
9. Square D Company.
10. Steel City Division.
11. Thomas and Betts Company, Inc.
12. Wiremold/Walker.

2.2 CONDUIT MATERIAL

A. RIGID METAL CONDUIT AND FITTINGS

1. Conduit: Heavy wall, galvanized steel, schedule 40, threaded.
2. Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

B. INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

1. Conduit: Galvanized steel, threaded.
2. Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

C. ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

1. Conduit: Steel, galvanized tubing.
2. Fittings: All steel, set screw, concrete tight. No push-on or indenter types permitted.
Conduit Bodies: All steel threaded conduit bodies.

D. FLEXIBLE METAL CONDUIT AND FITTINGS

1. Conduit: steel, galvanized, spiral strip.
2. Fittings and Conduit Bodies: All steel, galvanized, or malleable iron.

E. LIQUIDTIGHT FLEXIBLE METAL CONDUIT AND FITTINGS

1. Conduit: flexible, steel, galvanized, spiral strip with an outer Liquidtight, nonmetallic, sunlight-resistant jacket.
2. Fittings and Conduit Bodies: ANSI/NEMA FB 1, compression type. There shall be a metallic cover/insert on the end of the conduit inside the connector housing to seal the cut conduit end.

F. CONDUIT

1. Rigid Threaded: Steel, ANSI C80.1
2. Electrical Metallic Tubing: ANSI C80.3
3. Rigid Nonmetallic Tubing: Schedule 40 PVC; NEMA TC-2 & WC-1094

2.3 BOXES MATERIAL

A. OUTLET BOXES

1. Sheet Metal Outlet Boxes: galvanized steel, with stamped knockouts.
2. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 3/8 inch male fixture studs where required.
3. Concrete Ceiling Boxes: Concrete type.
4. Cast Boxes: Cast ferroalloy, or aluminum type deep type, gasketed cover, threaded hubs.
5. Boxes:
 - a. Metallic hot-dipped galvanized, 1.25 oz. per square foot or cadmium plated.
 - b. Non-metallic, PVC thermoplastic or thermoset polyester.
6. Interior Boxes:
 - a. Pressed sheet steel, blanked for conduit.
 - b. Provide attached lugs for locating.
7. Exterior Boxes: Cast aluminum, deep type, corrosion proof fasteners, water tight, gasketed with threaded hubs.
8. For Ceiling: 4-inch octagon boxes for 1 fixture, including fixture studs and maximum 2 connecting conduits.
9. For Flush Mounting in Walls:
 - a. Boxes with matching plaster cover for single or two gang outlets.
 - b. Two-gang box or larger or deep masonry box for conductors, conductor joints, conduit terminations and wiring devices.
10. Surface Mounted: 4 inches square.

B. PULL AND JUNCTION BOXES

Pull boxes and junction boxes shall be minimum 4 inch square by 2-1/8th inches deep for use with 1 inch conduit and smaller. On conduit systems using 1-1/4 inch conduit or larger, pull and junction boxes shall be sized per NEC but not less than 4-11/16 inch square.

1. Sheet Metal Boxes: code gauge galvanized steel, screw covers, flanged and spot welded joints and corners.
2. Sheet Metal Boxes Larger Than 12 Inches (300 mm) in any dimension shall have a hinged cover or a chain installed between box and cover.
3. Cast Metal Boxes for Outdoor and Wet Location Installations: Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron or aluminum box and cover with ground flange, neoprene gasket, and stainless steel cover screws.
4. Box extensions and adjacent boxes within 48" of each other are not allowed for the purpose of creating more wire capacity.

5. Junction boxes 6" x 6" or larger size shall be without stamped knock-outs.
6. Wireways shall not be used in lieu of junction boxes.
7. Pull Boxes and Junction Boxes: NEC metal construction with screw or hinged cover.

C. CONDUIT BODIES:

1. Galvanized or aluminum cast-metal of type, shape and size to fit each respective location.
2. Constructed with threaded conduit ends, removable cover and corrosion-resistant screws.

D. BUSHINGS, KNOCKOUT CLOSURES AND LOCKNUTS: Provide corrosion-resistance punched-steel box knockout closures, conduit locknuts and malleable iron conduit bushing, type and size to suit respective use.

E. POWER POLES: Steel dual channel raceways with knockouts for voice/data devices on the communication channel and receptacles devices on the power channel. A full compliment of fittings for the Power Pole shall be available including, but not limited to, entrance end fitting for top of the electrical channel, ceiling trim plate, pole-mounting bracket.

1. Power poles shall be equal to Legrand Wiremold 25DTP series.
2. Field measure required heights prior to ordering.

PART 3 - EXECUTION

3.1 CONDUIT INSTALLATION

A. Wiring: All wiring shall be installed in raceways as herein specified. All raceway runs shown on the drawings are diagrammatic; exact locations shall be determined in the field.

1. Conceal all conduit in finished areas.
2. Concealed raceways shall be installed in the walls, above ceilings, below floors or in furred out spaces so as to be completely concealed from view by occupants during their normal activities in use of the space.
3. Exposed raceways shall be run in straight lines at right angles or parallel with walls, beams and columns.
4. Provide raceways as required by the access control equipment controls for door operating and monitoring.

B. Raceway Installation: All raceways, which are not buried or embedded in concrete shall be supported by straps, suitable clamps or hangers to provide a rigid installation. Perforated strap or wire hangers will not be acceptable. In no case shall raceways be supported or fastened to other pipe. No raceway smaller than 1/2" shall be used, except that light fixture switch legs may be 3/8".

1. Bends: Not more than three 90 degree bends will be allowed in one raceway run. Where more bends are necessary, a conduit or pull box shall be installed. All bends in 1" and smaller conduit or electrical metallic tubing shall be made with proper bender. All other bends shall be machine made.
2. Joints: Joints in rigid metal shall be threaded type made up watertight with white lead or compound applied to male threads only and all field joints shall be cut square, reamed smooth and properly threaded to receive couplings. Electrical metallic tubing

- systems shall utilize watertight compression type fittings throughout. No indenter type fittings or running threads will be permitted.
3. Locknuts: Double locknuts shall be provided on all conduit terminations with the exception of conduits terminating in threaded hubs and couplings. Locknuts shall be of a type that have sharp beveled teeth that dig into the metal when tightened and will not loosen through vibration.
 4. Bushing: Bushing shall be provided on all conduits with the exception of conduits terminating in hubs and couplings. Insulating bushings consisting of insulating inserts in metal housing shall be provided on all installations. Insulating bushings shall be grounding type where required by the National Electrical Code.
 5. Heating Ducts and Pipes: Care shall be used to avoid proximity to heating duct and hot water lines. Where such crossings are unavoidable, raceway shall clear covering or line by at least 6".
- C. Utilize rigid steel conduit or rigid nonmetallic conduit where exposed to moisture, buried in earth or in concrete.
- D. Utilize electrical metallic tubing(EMT) or intermediate metal conduit in other above-grade locations.
- E. For underground conduit: use PVC-coated rigid conduit or rigid non-metallic conduit.
- F. Connections:
1. Motors and equipment: Minimum 1/2" size; PVC jacketed flexible conduit and liquid-tight connectors.
 2. Flexible conduit sufficient length to avoid vibration transmission.
 3. Use 3/8" flexible conduit only for light fixture whips(72" max.)and control wiring.
 4. Coordinate service conduit connections with location of service transformers.
- G. Install conduit and tubing products as indicated, in accordance with manufacturers written instructions and applicable requirements of NEC and NEMA Standard and Installation.
- H. Install conduit concealed in all areas excluding mechanical, electrical and other unfinished rooms, connections to motors and connections to surface cabinets.
- I. Coordinate installation of conduit in masonry work.
- J. Do not install conduit larger than 1" in concrete slabs.
- K. Install conduit free from dents and bruises.
- L. Plug conduit end to prevent entry of dirt or moisture.
- M. Clean out conduit before installation of conductor.
- N. Alter conduit routing to avoid structural obstructions, minimizing cross-overs.
- O. Seal conduit with oakum or fiberglass where conduits leave heated area and enter unheated area.
- P. Roof Penetrations: Provide flashing and pitchpockets making watertight joints where conduits pass through roof or waterproofing membrane.

- Q. Building Expansion Joints:
1. Install UL listed expansion fittings complete with grounding jumpers where conduits cross building expansion joints.
 2. Provide bends or offsets in conduits adjacent to building expansion joints where conduit is installed above suspended ceiling.
- R. Route all exposed conduits parallel or perpendicular to building lines.
- S. Allow minimum 6" clearance at flues, steam pipes and heat source.
- T Underground Conduit: Direct burial minimum.
1. Support multiple runs vertically and horizontally with plastic spacers 8' on center.
 2. Slope conduit to drainage point.
 3. Adjust final layout to coordinate with existing utilities.
 4. Trench and backfill as detailed on drawings.
 5. Encase conduit with 3" concrete cover under driveways.
- U. Cap all spare conduits.
- V. Provide all empty raceways with a heavy duty nylon cord, full length of raceway. Tag cord for identification.
- W. Maintain safe clearances from hazardous adjacent equipment, hot water piping, flues, high temperature piping, ductwork, etc.

3.2 CONDUIT INSTALLATION SCHEDULE

- A. Concealed in Concrete and Block Walls: Rigid steel conduit. Electrical metallic tubing. Schedule 40 PVC conduit. Electrical Nonmetallic Tubing (ENT).
- B. Within Concrete Slab: Rigid steel conduit. Schedule 40 PVC conduit. Electrical Nonmetallic Tubing (ENT).
- C. Wet Interior Locations: Rigid steel conduit. Schedule 40 PVC conduit.
- D. Concealed Dry Interior Locations: Rigid steel conduit. Intermediate metal conduit. Electrical metallic tubing.
- E. Exposed Dry Interior Locations: Rigid steel conduit. Intermediate metal conduit. Electrical metallic tubing.
- F. Motor and equipment connections: Flexible PVC coated metal conduit (all locations). Minimum length shall be one foot (300 mm), maximum length shall be three feet (900 mm). Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.
- G. Light fixtures: Direct box or conduit connection for surface mounted and recessed fixtures. Flexible metal conduit from a J-box for recessed lay-in light fixtures. Conduit size shall be 3/8" minimum diameter and six foot (1.8 M) maximum length. Conduit length shall allow movement of fixture for maintenance purposes.

- F. In areas where the walls cannot be fished, the station cable serving these outlets shall be covered with raceways. No exposed wire shall be permitted within offices, laboratories, and conference rooms or like facilities.
- G. The non-metallic raceway shall have a screw applied base. Both the base and cover shall be manufactured of rigid PVC materials.
- H. The raceway shall originate from a surface mounted box mounted adjacent to and at the same height as existing electrical boxes in the room, be attached to the wall and terminate above the ceiling.
- I. All fittings including, but not limited to, extension boxes, elbows, tees, fixture bodies shall match the color of the raceway.
- J. The raceway and all systems devices shall be UL listed and exhibit nonflammable self extinguishing characteristics, tested to specifications of UL94V-0.
- K. The raceway and all systems devices shall adhere to the EIA/TIA Category 5e bend radius standard.

3.3 BOX INSTALLATION

- A. Pull Boxes and Junction Boxes: Locate pull boxes and junction boxes above removable ceilings or in electrical rooms, utility rooms or storage areas.
- B. Outlet Boxes:
 - 1. Mount outlet boxes flush in area other than mechanical rooms, electrical rooms and above removable ceilings.
 - 2. Adjust position of outlets in finished masonry walls to suit masonry course lines.
 - 3. Do not install boxes back-to-back in same wall.
 - 4. Masonry Walls:
 - a. Coordinate cutting of masonry walls to achieve neat openings for boxes.
 - b. Locate boxes in masonry walls so that only corner need be cut from masonry walls.
 - 5. Do not use sectional or handy boxes unless specifically requested.
 - 6. For boxes mounted in exterior walls, make sure that there is insulation behind outlet boxes.
 - 7. For outlets mounted above counters, benches or splashbacks, coordinate locations and mounting heights with built-in units.
 - 8. Adjust outlet mounting height to agree with required location for equipment served.
- C. Boxes supplied by others: Verify exact mounting location and type of mounting.
- D. Provide knockout closures to cap unused knockout holes where blanks have been removed.
- E. Support all boxes independently of conduit.

3.4 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.

1. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.
 2. No outlet, junction, or pull boxes shall be located where it will be obstructed by other equipment, piping, lockers, benches, counters, etc.
 3. Boxes shall not be fastened to the metal roof deck.
- B. It shall be the Contractor's responsibility to study drawings pertaining to other trades, to discuss location of outlets with workmen installing other piping and equipment and to fit all electrical outlets to job conditions.
1. If any question arise over the location of an outlet, the Contractor shall refer the matter to the Architect/Engineer and install outlet as instructed by the Architect/Engineer.
 2. The proper location of each outlet is considered a part of this contract and no additional compensation will be paid to the Contractor for moving outlets which were improperly located.
- C. Locate and install boxes to allow access to them. Where installation is inaccessible, coordinate locations and provide 12 inch by 12 inch access doors.
- D. Locate and install to maintain headroom and to present a neat appearance.
- E. Install boxes to preserve fire resistance rating of partitions and other elements, using approved materials and methods.

3.5 PULL AND JUNCTION BOX INSTALLATION

- A. Locate pull boxes and junction boxes above accessible ceilings, in unfinished areas or furnish and install approved access panels in non-accessible ceilings where boxes are installed. All boxes are to be readily-accessible.
- B. Support pull and junction boxes independent of conduit.

END OF SECTION

SECTION 26 12 00 - LOW VOLTAGE CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 WORK INCLUDES

- A. Provide all wires and cables required for a complete electrical system.

1.2 RELATED WORK

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 26 11 00 Raceways and Boxes

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. National Electrical Code, NEC: Comply with NEC/NFPA No. 70, as applicable to construction and installation of electrical cable, wire and connectors.
 - 2. Underwriter Laboratories, UL: Electrical cable, wire and connectors listed and labeled by UL.
- B. References: National Electrical Manufacturers Association/Insulated Power Cable Engineer's Association, NEMA/IPCEA.

1.4 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Conductor sizes are based on copper.
- C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet project conditions.
- D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Provide factory-wrapped waterproof flexible barrier material for covering wire and cable on wood reels, where applicable; and weather-resistant fiberboard containers for factory-packaging of cable, wire and connections to protect against physical damage in transit.
- B. Store cable, wire and connectors in factory-installed coverings in clean, dry indoor space which provides protection against weather.
- C. Do not install damaged cable, wire and connectors; remove from project site.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Wire and Cable:

1. Anaconda Wire and Cable Company.
2. Collyer Insulated Wire Company, Division.
3. Electrical Cable Division.
4. General Cable Corporation.
5. General Electric Company.
6. Phelps Dodge Cable and Wire Company.

B. Connectors:

1. AMP, Inc.
2. Burndy Corporation.
3. General Electric Company.
4. Ideal Industries, Inc.
5. 3M Company.
6. O.Z./Gedney Company.
7. Thomas and Betts Company.
8. Buchanon.

2.2 MATERIALS

A. Wire and Cable:

1. 98% conductivity copper.
2. 600 volt insulation.
3. Branch circuit wiring #10 and smaller shall be solid or stranded THWN or THHN. Sizes #8 and larger stranded type THWN or THHN. Stranded wire shall be used for all motor connections regardless of size. Lighting fixture wiring shall be 90 deg C THHN.
4. Stranded conductors may only be terminated with UL OR ETL Listed type terminations or methods.
5. Conductors smaller than No. 12 AWG gauge not permitted except for alarm and signal circuits which may be #14 AWG minimum.
6. Color code and identify all wiring as specified in Section 16050.

B. Insulation: Type THHN/THWN, XHHW-2 insulation for feeders and branch circuits. Type XHHW-2 insulation for feeders with aluminum conductors.

C. Exterior Wiring: Comply with NEC for wet location wiring.

D. Wiring for systems other than power:

1. Conform to system manufacturer standards as to size, type and coding, subject to specified minimums.
2. Size conduit as required by system manufacturer, but no smaller than shown.
3. Provide copper XHHW for exterior services.

E. Armored Cable (AC) or Metal-Clad Cable (MC):

1. Limit AC and MC usage to concealed only locations, branch-circuit wiring after the first junction box from the panelboards; where approved by NEC, state and local electrical inspecting authorities.
2. Not allowed for Panelboard feeders or service conduit.
3. Provide and install per NEC Articles 333 and 334 with grounding conductor.

2.3 WIRING CONNECTORS

- A. Solderless Pressure Connectors: High copper alloy terminal. May be used only for cable termination to equipment pads or terminals. Not approved for splicing.
- B. Spring Wire Connectors: Solderless spring type pressure connector with insulating covers or copper wire splices and taps. Use for conductor sizes 10 AWG and smaller.
- C. All wire connectors used in underground or exterior pull boxes shall be gel filled twist connectors or a connector designed for damp and wet locations.
- D. Mechanical Connectors: Bolted type tin-plated; high conductivity copper alloy; spacer between conductors; beveled cable entrances.
- E. Split Bolt Connectors: Not acceptable.
- F. Compression (crimp) Connectors: Long barrel; seamless, tin-plated electrolytic copper tubing; internally beveled barrel ends. Connector shall be clearly marked with the wire size and type and proper number and location of crimps.
- G. Splices: Splices and taps for No. 10 or smaller shall be with twist-on insulated connectors. Splices in wire No. 8 and larger shall be made with split-bolt or compression connectors equal to Burndy Hydent requiring a tool and die application. Tape all non-insulated compression connectors to achieve full 600V insulation.

PART 3 - EXECUTION

3.1 GENERAL WIRING METHODS

- A. All wire and cable shall be installed in conduit, unless specified
- B. Do not use wire smaller than 12 AWG for power and lighting circuits.
- C. Conductors size indicated on drawings indicates ampacity requirements using copper conductors and type THHN insulation unless otherwise noted.
 1. Provide XHHW for exterior services.
- D. All conductors shall be sized to prevent excessive voltage drop at rated circuit ampacity. As a minimum use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 100 feet (30 m), and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet (61 m).

3.2 INSTALLATION

- A. Make conductor length for parallel feeders identical.

- B. Lace or clip groups of feeder conductors at new panel board.
- C. Install wire and cable in NEC Code conforming raceway.
- D. Pulling:
 - 1. Use wire pulling lubricant for pulling No. 4 AWG and larger wire. Use special care to avoid overstraining of conductors.
 - 2. Pull conductors together where more than one is being installed in raceway.
 - 3. Do not use pulling means, including fish tape, cable or rope which can damage raceway.
 - 4. All raceways shall be thoroughly swabbed out with a dry swab to remove moisture and debris before conductors are drawn into place. All ends of raceways shall be tightly plugged with tapered plugs or capped bushings until the conduits are pulled to prevent water and debris from entering conduits. All conduits stubbed up through floors shall be capped and aligned during construction by the use of spacers and caps.
- E. Install wire in conduit runs after concrete and masonry work is complete, conduit shall be clean and dry.
- F. Splicing:
 - 1. Splice only in accessible junction boxes.
 - 2. Install splices and taps which have equivalent or better mechanical strength and insulation as conductor.
 - 3. Use splice and tap connectors which are compatible with conductor material.
 - 4. No. 10 and smaller joints: Utilize connectors as hereinbefore specified with PVC or nylon covers.
 - 5. No. 8 and larger joints: Clean and join with tool and die compression type fitting.

3.3 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use Listed wire pulling lubricant for pulling 4 AWG and larger wires and for other conditions when necessary.
- B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- C. Completely and thoroughly swab raceway system before installing conductors.
- D. Place all conductors of a given circuit (this includes phase wires, neutral (if any), and ground conductor) in the same raceway. If parallel phase and/or neutral wires are used, then place an equal number of phase and neutral conductors in same raceway or cable.

3.4 WIRING CONNECTIONS AND TERMINATIONS

- A. Splice only in accessible junction boxes.
- B. Wire splices and taps shall be made firm, and adequate to carry the full current rating of the respective wire without soldering and without perceptible temperature rise.
- C. Use solderless spring type pressure connectors with insulating covers for wire splices and taps, 10 AWG and smaller.

- D. Use mechanical or compression connectors for wire splices and taps, 8 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor.
- E. Thoroughly clean wires before installing lugs and connectors.
- F. At all splices and terminations, leave tails long enough to cut splice out and completely re-splice.

END OF SECTION

SECTION 26 14 00 - WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Furnish and install all devices such as switches, receptacles, plates, etc., as shown on the drawings.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 26 11 00 Raceways and Boxes
 - 2. 26 18 50 Equipment Connections
 - 3. 26 45 00 Grounding and Bonding

1.3 SUBMITTALS

- A. Submit products and technical data per Division 1 and Section 26 0500.
- B. Wiring Device and plate color to be selected by Architect.

PART 2 - PRODUCTS

2.1 WALL SWITCHES

- A. Wall Switches for Lighting Circuits and Motor Loads Under 1/2 HP: Heavy duty use toggle switch, rated 20 amperes and 120/277 volts AC. Switches shall be UL20 Listed and meet Federal Specification WS-896. All switches shall be heavy duty Specification Grade with separate green ground screw.
- B. All switches shall be back and side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG. Switches shall be Leviton model 1221-S, Hubbell model CS1221, Pass & Seymour model CSB20, Cooper model CSB120, or approved equal.
- C. Handle: made of nylon or high impact resistant material.
- D. Dimming Switches: Combination slider with toggle switch at bottom and LED indicator light. Dimmer switch shall be compatible with the type of LED lighting system under control as recommended by light fixture/driver manufacturer.
 - 1. 0-10 VDC Dimmer: Synergy ISD BC 120/277 IV(ivory) or approved equal.

2.2 RECEPTACLES

- A. Convenience and Straight-blade Receptacles: NEMA Type 5-15R or 5-20R, nylon impact resistant face. Receptacles shall be UL498 Listed and meet Federal Specification WC-596.

- B. All duplex receptacles shall be heavy duty Specification Grade, 15 or 20-amp rated, as scheduled or shown on drawings. All receptacles shall be back and side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG, with a separate green ground screw. Receptacles shall be Leviton model 5362-S, Hubbell model CR5362, Pass & Seymour model CRB5362, Pass & Seymour model PT5362 with 90° connector, Cooper model 5362C, or approved equal.
 - 1. Provide tamperproof receptacles where required by local code.
- C. Generally, all receptacles shall be duplex convenience type unless otherwise noted.
- D. Receptacles installed in damp or wet locations shall be UL listed weather resistant.
- E. All receptacles installed in outdoor locations, in garages, within 6 feet of the outside edge of sinks, and in other damp or wet locations shall be GFCI type.
- F. GFCI Receptacles: Duplex convenience receptacle, Specification Grade, with integral ground fault current interrupter meeting the requirements of UL standard 943 Class A and UL standard 498. GFCI receptacles shall be Leviton model 8899, Hubbell model GRF5352, Pass & Seymour model 2095 or approved equal.
- G. All receptacles on emergency circuits shall have a red face.
- H. All receptacles designated as isolated ground shall have an isolated ground triangle imprint on the face of the receptacle.
- I. Locking-Blade Receptacles: As indicated on drawings.

2.3 DEVICE PLATES AND BOX COVERS

- A. Receptacle Cover Plate: Specification Grade 302/304 smooth stainless steel or nylon construction.
 - 1. Plate color to be selected by Architect.
- B. Weatherproof Cover Plate: Gasketed metal with hinged device covers.
- C. Surface Cover Plate: Raised galvanized steel.
- D. Receptacles installed in damp or wet locations shall be UL listed weather resistant.
 - 1. Provide as required for each outlet, single or multiple gang.
 - 2. Provide blank covers on all empty boxes or outlets.
 - 3. Galvanized steel box covers shall be used in unfinished areas. Cover shall be 1/2" raised with no sharp edges.
 - 4. Provide single gang, die-cast, weather-resistant covers equal to Leviton #6196-V on receptacles in damp areas and exterior for in-use per NEC.
- E. Any device switches or receptacles necessary for completion of the work, but not called for in the Contract Documents shall be furnished and installed by the Contractor as needed at no additional cost to the Owner. Such devices shall meet the intended standards described in this Section.

PART 3 - EXECUTION

3.1 GENERAL

- A. Receptacles above counters shall be mounted vertically 6" above counter or high enough to miss backsplash if provided.
- B. Receptacles required for equipment shall be located within 2 feet of that equipment if possible.
 - 1. Receptacles for refrigerators, freezers and vending machines shall be mounted at 36" AFF.
 - 2. Verify final mounting height required for electric water cooler with Plumbing Contractor.
- C. Verify all device locations with General Contractor before rough in.

3.2 WIRING DEVICE INSTALLATION

- A. Install wall switches 48 inches above floor, OFF position down.
- B. Install convenience receptacles 18 inches above floor, grounding pole on bottom.
- C. Install box for information outlet 18 inches above finished floor. Install box for telephone jack for wall telephone 54 inches above finished floor.
- D. Install specific-use receptacles at heights shown on Contract Drawings.
- E. Drill opening for poke-through fitting installation in accordance with manufacturer's instructions.
- F. Install device plates on switch, receptacle, and blank outlets in finished areas.
- G. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.
- H. Install devices and wall plates flush and level.
- I. Receptacles shall have a bonding conductor from grounding terminal to the metal conduit system. Self-grounding receptacles using mounting screws as bonding means are not approved.

END OF SECTION

SECTION 16 15 10 - MOTORS AND MOTOR WIRING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Provide motor branch circuit wiring, motor starters, and disconnect switches to make a complete code complying motor branch circuit for each motor on project.
- B. Mounting of all equipment under this contract.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 26 11 00 Raceways and Boxes
 - 2. 26 15 50 Motor Starters
 - 3. 26 17 00 Motor and Circuit Disconnects
 - 4. 26 18 50 Equipment Connections
 - 5. Division 22 Plumbing Equipment
 - 6. Division 23 HVAC Equipment
- C. Each motor shall have an individual means of disconnect within equipment cabinet in finished area. Adjacent to motor in sight of and within 25'-0" of motor in all other areas.
- D. Disconnect shall be heavy-duty, horsepower-rated fused switch for three phase motors and fused toggle switch or manual fractional motor starter switch for single phase motors, unless noted otherwise in Motor Schedules or otherwise.
- E. Enclosures for outdoor locations and those marked "WP" shall be NEMA Type 3R elsewhere, unless otherwise noted, enclosures shall be NEMA Type 1.
- F. All controls shall be 120 volt or less. Control wiring shall have all controls wired in hot line (fused for three or more control devices and all fuel burners) with other side grounded. Control panel protected per NEC 430 and 440. Control wiring by contractor furnishing motor except as noted.
- G. Contractor who furnished and installed motor or other current using equipment shall furnish to Electrical Contractor all line voltage(greater than 100 volts) control devices for installation.
 - 1. Specified manual, automatic, local and remote motor and other control devices and switches, including thermostats, pressurestats, aquastats and other devices when specified as supplied by others.
 - 2. Detailed wiring diagrams, installation and operating instructions in form of reviewed shop drawings for complete wiring installations of above equipment.
 - 3. Motors will be set and aligned by contractor furnishing motor.

1.3 QUALITY ASSURANCE

- A. Motor and related equipment shall conform to NEMA standards for the type and application.

PART 2 - PRODUCTS

2.1 MOTORS

- A. Motors smaller than 1/2 HP: 120 V, single phase, 60-cycle current.
- B. Motors 1/2 HP and larger:
 - 1. In accordance with NEMA Standards, unless otherwise indicated.
 - 2. 460V or 208V, 3-phases, 60-cycle current.
- C. Characteristics: Quiet, non-overloading under operating conditions, 1.15 series factor, suitable for intended services, accessible for servicing and with oiling devices arranged for easy access.
- D. Motor Protection:
 - 1. Motor protection integral with motor starter, thermal overload type, including manual reset.
 - 2. Automatic reset type overloads or built-in overload not acceptable.
 - 3. Provide motor protection for each speed of multiple speed motors.
- E. Factory Wired Panels:
 - 1. Factory wired panels supplied as integral part of equipment provided by Division 22 & 23 Contractor.
 - 2. Factory wired panel includes responsibility for totally wired control system as indicated on control drawings by Division 15 Contractor.
 - a. Furnished with completely integrated control panel, including switches, starters, certain disconnects, protective devices and control transformers mounted on associated mechanical equipment.
 - b. "Factory wired panel" does not mean wired at factory, but does mean provided by the Heating, Ventilating or Plumbing Contractor specified in Division 22 & 23.
 - c. In certain cases, as indicated, Electrical Contractor provides disconnect switch ahead of factory wired panel.
- G. Temperature Control Panels: Electrical Contractor shall provide line voltage power to control panels as indicated on the Drawings and Schedules. Additional line voltage wiring requirements shall be the responsibility of the Temperature Control Contractor to retain an electrical trade to complete temperature control power requirements.

2.2 STARTERS - See Section 26 15 50 Motor Starters.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide wiring, disconnect devices, final connection to all equipment noted.

- B. Furnish, install and wire all such electrical devices, controls, interlocks, including main, control and interlocking wiring, final connections and testing in full compliance with all requirements of contract.
- C. Perform all such work under direct supervision of Contractor who provided motor or equipment. Latter Contractor shall have full responsibility for complete motor, current using device, controls and wiring installations, including all work done by Electrical Contractor and shall guarantee all such work as if he had installed it.
- D. All conductors shall be stranded for motor feeders.
- E. Provide liquid tight flexible conduits at motors and other vibrating equipment.
- F. Grounding wire shall be provided in all flexible conduits. All motors shall be grounded per NEC 250.
- G. When a motor box serves more than one motor and motor branch wire size is smaller than wire size in motor outlet box, motor branch shall be protected as required by NEC.
- H. Examine the drawings and specifications covering all contracts to ascertain what equipment is furnished by others. Furnish the necessary labor and materials to wire said equipment unless material and wiring is called for under the specifications.
- I. Locate and install control devices, as indicated. Coordinate requirements with all other trades.
- J. In finished areas, mount motor protection switches flush and install suitable coverplates.
- K. Install overload heater or related with full load current of motors provided. Provide actual field measurements of equipment operating under normal loads to verify proper heater selection.
- L. Set all protective devices to suit motors provided.
- M. Mount and wire all controlling equipment furnished in Division 22 & 23.
- N. Verify motor sizes for starters, including verification of required number of auxiliary contacts.
- O. Install all power and control wiring including conduit to and from starters to motors and to all remote devices required for complete system operation as indicated on drawings.
- P. Install all motor starter, pilot lights, pushbuttons, selector switches, thermal overloads and local disconnect switches at motors, except those devices specified as part of integral factory wired panels or as provided under Division 22 & 23.
- Q. E.C. is responsible for connections, proper phase relationships and motor rotation.

END OF SECTION

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SECTION 26 15 50 - MOTOR STARTERS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Provide and install motor starters where indicated on plans and elsewhere in these specifications.
- B. Submittals: Provide submittal as required in 22 05 00.

PART 2 - EQUIPMENT

2.1 MOTOR STARTERS

- A. All motor starters shall be furnished by the Electrical Contractor unless otherwise noted. Starters shall be Allen Bradley, Square D, or Cutler Hammer.
- B. Magnetic starters shall be non-reversing, full voltage across-the-line type in a NEMA-1 enclosure; where located exterior provide NEMA 3R enclosure.
 - 1. Starters shall have external manual reset thermal overload relays, undervoltage protection, 120V holding coil voltage, "Hand-Off Automatic" selector and pilot light.
 - 2. Each starter shall have 3 melting alloy overload protectors. See Drawings for size and voltage.
 - 3. Auxiliary contacts required for interconnection of controlled equipment shall be furnished by the Electrical Contractor after consultation with the temperature control and other mechanical contractors.
 - 4. When interlocking or automatic control of single-phase motors is required, motors shall have magnetic across-the-line starters.
 - 5. Each starter shall be complete with magnetic circuit breaker and front operated position - indicating handle. Each circuit breaker shall have means of padlocking external operating handle in the off position.
 - 6. The starter door shall be interlocked so that the circuit breaker must be "off" before the door can be opened. Each starter shall be equipped with a control transformer 208 or 480 volt, 2-wire primary and 120 volt, wire secondary.
 - 7. Each control transformer shall be equipped with a Bussman type KTK fuse on the secondary side.
- C. Manual starter shall have melting allow type trip-free thermal overload relays furnished in NEMA- enclosure with toggle switch disconnect and pilot light. Refer to Motor Schedule for sizes and voltage requirements.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install motor starters where shown on plans and as indicated on Motor Equipment Schedule.
- B. Verify all overload heaters are correctly sized.
- C. Coordinate all motor line voltage control wiring for starters with other Trades

- D. Torque all conductor and busbar connections to manufacturer's recommendations.

END OF SECTION

SECTION 26 16 20 - PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Branch Circuit Panelboards.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern under work of this section.

- B. Specified Elsewhere:

- 1. 26 05 00 Electrical General Provisions
 - 2. 26 45 00 Grounding and Bonding

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:

- 1. National Electrical Code, NEC: Comply with NEC/NFPA No. 70/ANSI C1, as applicable to installation of cabinets, cutout boxes and panelboards.
 - 2. Underwriters Laboratories, UL:
 - a. Comply with specified UL publications pertaining to panelboards, enclosures and panelboard accessories.
 - b. Units listed and labeled by UL.

1.4 REFERENCES

- A. National Electrical Manufacturers Association, NEMA:

- 1. PB.1: Panelboards.
 - 2. PB.1.1: Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

1.5 SUBMITTALS

- A. Submit in accordance with Division 1 and Section 16 05 00.

- B. Shop Drawings: Submit dimensioned drawings of installed panelboards and enclosures.

- 1. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, and circuit breaker arrangement and sizes.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Store panelboards and enclosure indoors. Protect from weather.

- B. When necessary to store outdoors, elevate well above grade and enclose with durable waterproof wrapping.

- C. Handle panelboards and enclosures carefully to prevent breakage, denting and scarring of finish.

1.7 SPARE PARTS

- A. Keys: Furnish 2 keys for each panelboard to Owner.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Panelboards shall be constructed in accordance with latest NEMA, UL and NEC requirements and shall bear UL label.
- B. Panelboard cabinets including boxes and fronts, shall be code gauge galvanized steel. Panel cover shall be finished in manufacturer's standard color. Main lugs shall be top or bottom mounted to coordinate with incoming feeder entrance location.
- C. Provide isolated ground bus, where indicated, in addition to normal ground bus. Label isolated ground bus appropriately.
- D. All panelboards shall be from one manufacturer.

2.2 ACCEPTABLE MANUFACTURERS

- A. Panelboards:

- 1. Square D Company.

2.3 PANELBOARD RATINGS

- A. UL listed short circuit rating (integral equipment rating):
 - 1. 208Y/120V Branch Circuit Panels: 10,000 RMS symmetrical amperes minimum or as indicated on panel schedule equivalent to Square D Type NQ series.
 - 2. 277Y/480V Branch Circuit Panels: 14,000 RMS symmetrical amperes minimum or as indicated on panel schedule equivalent to Square D Type NF series.

2.4 BRANCH CIRCUIT PANELBOARDS

- A. Lighting and Appliance Branch Circuit Panelboards: Circuit breaker type.
- B. Enclosure: Type 1. Minimum cabinet size: 5-3/4 inches deep; 20 inches wide with 5" minimum gutter space top and bottom. Constructed of galvanized code gauge steel. Panel enclosure (back box) shall be of non-stamped type (without KO's) to avoid concentric break out problem.
- C. Cabinet front cover and cabinet shall be Type 4X, 304 stainless steel in wet and damp locations including kitchen, food service and therapeutic/pool applications.
- D. Provide flush and surface cabinet fronts as scheduled with concealed trim clamps, concealed hinge and flush cylinder lock all keyed alike. Front cover shall be hinged to allow access to wiring gutters without removal of panel trim. Hinged trim shall be held in place with screw fasteners. Finish in manufacturer's standard gray enamel.
- E. Provide metal directory holders with clear plastic covers.
- F. Provide panelboards with copper bus (phase buses, bus fingers, etc.), ratings as scheduled on Drawings.
 - 1. Provide ground bars in all panelboards. Phase, neutral and ground bar terminations can be dual rated ALCU9.

2. Incoming conductors shall terminate at lug landing pads rated for the panelboard.
 3. Provide compression type lugs to accommodate the conductor shown on drawings.
- G. Minimum System (i.e. individual component) Short Circuit Rating: As shown on the Drawings and as required by short circuit/ coordination study provided by the Electrical Contractor.
- H. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers. Provide UL Class A ground fault interrupter circuit breakers where shown on Drawings. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
1. Do not use tandem circuit breakers.
 2. Circuit breakers shall be bolt-on type with common trip handle for all poles. No handle ties of any sort will be approved.
- I. All of the panelboards provided under this section shall be by the same manufacturer.
- J. All sub-feed panelboards installed side by side shall utilize same enclosure height.

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to NEMA PB.1.
- B. Coordinate installation of panelboards and enclosures with cable and raceway installation work.
- C. Provide mounting brackets, busbar drillings and filler pieces for unused spaces.
- D. Anchor enclosures firmly to walls and structural surfaces, insuring that they are permanently and mechanically secure.
- E. Provide electrical connections within enclosures.
- F. Prepare and affix typewritten directory to inside cover of panelboard indicating loads controlled by each circuit.
- G. Install panelboards so that no cracks or gaps exist between breakers, breaker cover, panelboard cover and wall (where flush).
- H. All wires shall be neatly installed inside the panelboard box.
- I. Unused spaces shall be filled with metal filler designed for the purpose by the manufacturer.
- J. Stub four(4) empty 3/4" conduits into accessible ceiling space for future wiring requirements.

3.2 INSPECTION

- A. Examine area to receive panelboard to assure adequate clearance for panelboard installation.
- B. Start work only after unsatisfactory conditions are corrected.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices.
- B. Flush mount, surface mount, as specified on drawings and schedules.
- C. Support panel cabinets independently to structure with no weight bearing on conduits.
- D. Install recessed panelboards to allow cover to be drawn tight against wall to provide neat appearance.
- E. Install panelboards so top breaker is not higher than 6 ft.-7 in. above floor.
- F. Adjacent panel cabinets shall be of same size and mounted in horizontal alignment.
- G. Install in each panelboard a typewritten directory accurately indicating rooms and/or equipment being served.
- H. Attach nameplates. Nameplates for panels in public areas shall be attached to the inside face of the cover. Nameplates for panels in equipment rooms and other non- public areas shall be attached to the outside face of the cover.
- I. EC shall coordinate depth of recess-mounted panels with G.C. and wall construction to ensure panel is fully contained within wall cavity.
- J. Recess-mounted panels shall be provided with three 3/4" conduits stubbed into adjacent ceiling space for future circuits.

3.4 FIELD QUALITY CONTROL

- A. Balance load among feeder conductors.
- B. Unbalance shall not exceed + 7-1/2% of computed average load per phase.
- C. Energize each circuit and check for complete and correct function.

3.5 ADJUSTMENT AND CLEANING

- A. Adjust doors and operating mechanisms for free mechanical movement.
- B. Tighten lugs and bus connections.
- C. Clean interior of panelboard.
- D. Sand, prime and paint scratched or marred surfaces to match original finish. If other than factory standard color is indicated on Architectural plans, G.C. shall be responsible for painting panel enclosure and/or cover.
- E. EC shall install temporary panel covers as necessary during construction to reduce the construction debris within panels.

END OF SECTION

SECTION 16 17 00 - MOTOR AND CIRCUIT DISCONNECTS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Provide fused and unfused disconnect switches for motor and branch circuit disconnects as shown on plans and as required by code.
- B. Provide all fuses, circuit breakers, and motor overload elements as described in the specifications and drawings or required by code to protect all equipment.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 26 05 00 Electrical General Provisions
 - a. Identification.
 - b. Spare fuses.
 - 2. 26 15 00 Motors and Motor Wiring
 - 3. 26 18 50 Equipment Connections

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. National Electrical Code, NEC: Comply with NEC/NFPA No. 70, as applicable to construction and installation of electrical motor and circuit disconnect switches.
 - 2. National Electrical Manufacturers Association, NEMA: Classification of Standard Type of Non-Ventilating Enclosures for Electrical Controllers.
 - 3. Underwriters Laboratories, UL: Motor and circuit disconnect switches listed and labeled by UL.

1.4 SUBMITTALS

- A. Submit in accordance with Division 1 and Section 16050.
- B. Submit manufacturers product data for disconnect switches.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver switches individually wrapped in factory-fabricated fiberboard type containers.
- B. Store switches in clean, dry space. Protect switches from dirt, fumes, water and physical damage. Handle switches carefully to avoid damage to material components, enclosure and finish.

PART 2 - PRODUCTS

2.1 SAFETY SWITCHES

- A. Heavy-duty type; as scheduled:
1. Sheet steel enclosed safety switches, size and electrical characteristics indicated, rated at 250 or 600 volts.
 2. Quick-make, quick-break constructed so switch blades are visible in "OFF" position with door open.
 3. Operating handle as integral part of enclosure base, easily recognizable position, padlockable in "OFF" position.
 4. Current carrying parts constructed of high-conductivity copper and silver-tungsten type switch contact.
 5. Positive pressure type reinforced fuse clips.
 6. Neutral bars shall be provided in all disconnects serving distribution circuits carrying a neutral.
 7. Fuses shall be dual element type. Size per NEC code and equipment manufacturer's requirements.
 8. Enclosures:
 - a. NEMA Type 1.
 - b. NEMA Type 3R.
- B. Motor and Circuit Disconnects:
1. General Electric.
 2. Square D Company.
 3. Cutler-Hammer.

2.2 FUSES

- A. All fuses shall be of one manufacturer and shall, where possible, be coordinated per manufacturer's instructions for short circuit currents so that the fuse or circuit breaker closest to the short circuit will trip and clean the fault first.
- B. Low voltage fuses shall be Buss KRP-C, JJN, FRN or equal as required. FRN fuses shall only be used for motor loads. No single element fuses will be permitted.

PART 3 - EXECUTION

3.1 DISCONNECT SWITCHES

- A. Install disconnect switches as shown on plans and Motor Equipment schedule.
- B. Install fuses in all fused disconnects.
- C. The Electrical Contractor shall be responsible for maintaining working clearance around all electrical equipment as required by 1999 NEC.

3.2 FUSES

- A. Furnish and install all fuses for project.
- B. Turn over to Owner 3 spare fuses of each rating 100 amperes and over, 1 box of fuses for each rating less than 100 amperes.

END OF SECTION

MOTOR AND CIRCUIT DISCONNECTS

16170 - 2

SECTION 26 18 50 - EQUIPMENT CONNECTIONS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Power and selected control wiring for all equipment including, but not limited to:
 - 1. Plumbing motors and control panels.
- B. Coordinate all equipment requirements with the various contractors and the Owner. Review the complete set of drawings and specifications to determine the extent of wiring, starters, devices, etc., required.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. Div. 22 Plumbing
 - 2. Div. 23 HVAC
 - 2. 26 05 00 Basic Materials and Methods
 - 3. 26 11 00 Raceways and Boxes
 - 4. 26 12 00 Low Voltage Conductors and Cables
 - 5. 26 15 10 Motors and Motor Wiring
 - 6. 26 17 00 Motor and Circuit Disconnects

PART 2 - PRODUCTS

- 2.1 SEE 1.2 ABOVE AND DRAWINGS.**

PART 3 - EXECUTION

3.1 HVAC AND PLUMBING CONNECTIONS

- A. Provide all power wiring including all circuitry carrying electrical energy from panelboard or other source through starters and disconnects to motors or to packaged control panels.
 - 1. Packaged control panels may include disconnects and starters and overcurrent protection. Provide all wiring between packaged control panels and motors.
 - 2. Include starters disconnects and overload protection if not included in packaged control panels.
- B. Provide 120 volts circuits to each temperature control panel as indicated on the Drawings.
 - 1. Line voltage wiring requirements for temperature control beyond the requirements shown on the drawings and schedules shall be the responsibility of the Temperature Control Contractor to retain the electrical trade and pay for such work.
- C. Unless otherwise specified, all electrical motors and control devices such as aquastats, float and pressure fan powered VAV boxes, switches, electropneumatic switches, solenoid valves

and damper motors requiring mechanical connections shall be furnished and installed and wired for low-voltage connections (less than 100volts) by the Contractor supplying the devices or the Temperature Control Contractor, as specified elsewhere.

- D. Each motor terminal box shall be connected with a maximum 36" piece of flexible conduit to a fixed junction box. A green wire run through the flexible conduit shall interconnect the motor frame and the rigid conduit system. Use Liquid tight flexible metal conduit for all motor connections.
- E. Check for proper rotation of each motor.

END OF SECTION

SECTION 26 19 00 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Conduit and equipment supports.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified Elsewhere:

1. 26 11 00 Raceways and Boxes

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:

1. National Electrical Code, NEC: Comply with NEC/NFPA No. 70, as applicable to supports.
2. Underwriters Laboratories, UL: Supports listed and labeled by UL.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Support Channel: Steel, Galvanized, Enameled or other corrosion resistant.
- B. Hardware: Corrosion resistant.
- C. Minimum sized threaded rod for supports shall be 3/8" for trapezes and single conduits 1-1/4" and larger, and 1/4" for single conduits 1" and smaller.
- D. Conduit clamps, straps, supports, etc., shall be steel or malleable iron. One-hole straps shall be heavy duty type. All straps shall have steel or malleable backing plates when rigid steel conduit is installed on the interior or exterior surface of any exterior building wall.

2.2 CONDUIT SUPPORTS

A. Material:

1. Single Runs:
- a. Galvanized two-hole conduit straps or ring-bolt type hangers with specialty spring clips.
- b. *Do not use plumber's perforated straps.*
2. Multiple Runs: Conduit rack with 25% spare capacity.
3. Vertical Runs: Channel support with conduit fittings.
- a. 25-ft intervals.

B. Anchor Methods:

1. Hollow Masonry: Toggle bolts or spike type expansion anchors.
 2. Solid Masonry: Lead expansion anchors or preset inserts.
 3. Metal Surfaces: Machine screws, bolts or welded studs.
 4. Wood Surfaces: Wood screws.
 5. Concrete Surfaces: Self-drilling anchors or power driven studs.
- C. Light Fixtures:
1. Provide grid troffer clips in accordance with NEC 410-16.
- D. Mounting Racks and Supports:
1. Provide rack and supports of galvanized or painted steel channel sections with bolted or welded fittings.
 2. Provide exterior treated 3/4" plywood mounting surface with gray paint finish on both sides and edges.

PART 3 - EXECUTION

3.1 GENERAL

- A. Maintain headroom, neat mechanical appearance and to support equipment loads.
- B. Suspend, support from and attach only to the structural elements at intervals required by code, with threaded rod, channels, "stand-off" and other clips and NECA approved devices.
- C. To the fullest extent possible, group several conduits together and run parallel, supporting with rod and channel.

3.2 INSTALLATION

- A. Fasten hanger rods, conduit clamps, outlet, junction and pull boxes to building structure using pre-cast insert system, preset inserts, beam clamps, expansion anchors, or spring steel clips (interior metal stud walls only).
 1. Do not use "stand-off" clips for attachment to walls and partitions.
 2. Install raceways tight to walls.
- B. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet metal screws in sheet metal studs and wood screws in wood construction. If nail-in anchors are used, they must be removable type anchors.
- C. Do not fasten supports to piping, ductwork, mechanical equipment, cable tray or conduit. Do not fasten to suspended ceiling grid system.
- D. Fabricate supports from galvanized structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- E. In wet locations, mechanical rooms and electrical rooms install free-standing electrical equipment on 3.5 inch (89 mm) concrete pads.

- F. Install surface-mounted cabinets and panelboards with minimum of four anchors. Provide steel channel supports to stand cabinet one inch (25 mm) off wall (7/8" Uni-strut or 3/4" painted, fire-retardant plywood is acceptable).
- G. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.
- H. Furnish and install all supports as required to fasten all electrical components required for the project, including free standing supports required for those items remotely mounted from the building structure, catwalks, walkways etc.

END OF SECTION

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SECTION 26 45 00 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Provide and install materials for a complete grounding system integral with the power distribution in accordance with the National Electrical Code.
- B. Distribution grounding system.
- C. Equipment grounding system.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 26 11 00 Raceways and Boxes
 - 2. 26 12 00 Low Voltage Conductors and Cables

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. ANSI/IEEE 142 (Latest edition) - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 2. National Electrical Code, NEC: Comply with NEC/NFPA No. 70, as applicable to materials and installation of electrical grounding systems and associated equipment and wiring.
 - 3. Underwriters Laboratories:
 - a. Comply with UL Standards pertaining to electrical grounding and bonding.
 - b. UL 467: Grounding and Bonding Equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials used for grounding conductors shall be as called for in National Electrical Code Article #250-81.
- B. Ground Fittings:
 - 1. OZ Company:
 - a. Type BF
 - b. Type OG
 - c. Type LG
 - d. Type MG

2.2 MECHANICAL CONNECTORS

- A. The mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper alloy material. Bolts, nuts, washers and lockwashers shall be made of Silicon Bronze and supplied as a part of the connector body and shall be of the two bolt type.
- B. Split bolt connector types are NOT allowed. Exception: the use of split bolts is acceptable for grounding of wire-basket type cable tray, and for cable shields/straps of medium voltage cable.
- C. The connectors shall meet or exceed UL 467 and be clearly marked with the catalog number, conductor size and manufacturer.

2.3 COMPRESSION CONNECTORS

- A. The compression connectors shall be manufactured from pure wrought copper. The conductivity of this material shall be no less than 99% by IACS standards.
- B. The connectors shall meet or exceed the performance requirements of IEEE 837, latest revision.
- C. The installation of the connectors shall be made with a compression, tool and die system, as recommended by the manufacturer of the connectors.
- D. The connectors shall be clearly marked with the manufacturer, catalog number, conductor size and the required compression tool settings.
- E. Each connector shall be factory filled with an oxide-inhibiting compound.

2.4 WIRE

- A. Material: Stranded copper (aluminum not permitted).
- B. Feeder and Branch Circuit Equipment Ground: Size as shown on drawings, specifications or as required by NFPA 70, whichever is larger. Differentiate between the normal ground and the isolated ground when both are used on the same facility.

PART 3 - EXECUTION

2.1 GENERAL

- A. Install Products in accordance with manufacturer's instructions.
- B. Mechanical connections shall be accessible for inspection and checking. No insulation shall be installed over mechanical ground connections.
- C. Ground connection surfaces shall be cleaned and all connections shall be made so that it is impossible to move them.
- D. Attach grounds permanently before permanent building service is energized.

2.2 LESS THAN 600 VOLT SYSTEM GROUNDING

- A. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.
- B. **Equipment Grounding Conductor:** Provide separate, insulated equipment grounding conductor within each raceway. Terminate each end on suitable lug, bus, enclosure or bushing. Provide a ground wire from each device to the respective enclosure.

3.3 INSTALLATION

- A. Electrical service, electrical equipment enclosures and associated metallic raceway system shall be permanently grounded and bonded together by a grounding electrode conductor as per NEC requirements with a ground clamp to a 1-1/4 inch or larger cold water metallic pipe on street side of water meter and ground rod electrodes.
 - 1. Provide water meter shunt; cable to pipe connections copper cable shunt.
- B. Bond main switches, ground rods, foundation reinforcement rebar and water service entrance together with ground electrodes sized per code.
 - 1. Ground connection surfaces shall be clean.
 - 2. Bond structural steel frame to grounding electrode conductor.
- C. Damp Locations: All convenience outlets, switches, fixtures, boxes and plates in damp locations or outdoors shall be fully grounded by a separate green grounding conductor.
- D. Panelboard Grounding: Install grounding conductor from main service to each panelboard and ground bar as indicated on Drawings:
 - 1. Provide separate circuit grounding conductors to dedicated ground circuits, surge suppression receptacles (computers), and GFI receptacles.
- E. Bonding Jumpers:
 - 1. Maintain ground continuity by separate insulated green ground wire in fixture cords, flexible connections or similar location where raceway system is interrupted.
 - 2. Light Fixtures: Provide separate green wire grounded from fixture housing to nearest conduit system box, where flexible conduit is used.
 - 3. Receptacles: Provide green wire bonding jumper from all new receptacles to metal back box.
- F. Motors: Provide insulated grounding conductor from motor connection to distribution panel grounding bus for all motors.
 - 1. Where motors are connected to conduit systems with flexible conduit section, install greenfield grounding conductor in flexible conduit section.
- G. Equipment Grounding Conductors: Provide separate, insulated grounding conductor within each feeder raceway.
 - 1. Ground cable tray at intervals not exceeding 100 feet.
- H. Device Boxes: Provide new green wire ground from panel ground bar to all new devices located in the raceway systems.

1. Provide dedicated ground wire to GFI and surge suppression receptacles.

END OF SECTION

SECTION 26 51 00 - INTERIOR BUILDING LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Provide and install lighting fixtures, supports and accessories for mounting condition encountered.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified Elsewhere:

- | | | |
|----|----------|-----------------------------------|
| 1. | 26 11 00 | Raceways and Boxes |
| 2. | 26 12 00 | Low Voltage Conductors and Cables |
| 3. | 26 51 10 | Lighting Control Systems |

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Certified Ballasts Manufacturers Association, CBM: Ballast labeled by CBM.
2. National Electrical Code, NEC: Comply with NEC/NFPA No. 70, as applicable to installation and construction of interior lighting fixtures.
3. Life Safety Code: Comply with NFPA 101 as applicable to exit signs.
4. Underwriter's Laboratories, UL:
 - a. Interior lighting fixtures listed and labeled by UL.
 - b. UL 57: Electric lighting fixtures.

B. Lamps General:

1. All lamps shall be new.
2. Approved Manufacturers:
 - a. Fluorescent: Philips, Osram/Sylvania, General Electric
 - b. Ballast and lamp combinations shall meet Focus On Energy Guidelines.
3. Lamps shall be U.S. Green Building Council (USGBC) Leed certified.

1.4 REFERENCES

A. Standards:

1. American National Standards Institute, ANSI: Comply with applicable ANSI standards pertaining to lamp materials and lighting ballasts.

B. Manufacturers:

1. National Electrical Manufacturer's Association, NEMA: Comply with applicable portions of NEMA standards pertaining to lighting equipment.

1.5 SUBMITTALS

- A. Submit in accordance with Division 1 and Section 16050.

1. Shop Drawings: Submit shop drawings for luminaires indicating pertinent physical characteristics and photometric data.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Acceptance: Deliver interior lighting fixtures individually wrapped in factory fabricated fiberboard type containers.
- B. Storage:
 1. Store interior lighting fixtures in clean, dry space.
 2. Store in original cartons and protect from dirt, physical damage, weather and construction traffic.
- C. Handling:
 1. Handle interior lighting fixtures carefully to prevent breakage, denting and scoring fixture finish.
 2. Do not install damaged lighting fixtures.
 3. Replace and return damaged units to equipment manufacturer.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Refer to fixture schedule. Engineer has final decision on whether submitted fixture is equal.
- B. Other fixture manufacturers who consider their products equal to those specified are required to request approval for bidding as base bid in accord with Instructions to Bidders section.
- C. Approval of products will be considered subject to the following:
 1. Equal manufacturers are required to nominally meet specifications of specified fixtures and lenses in regard to ceiling opening size and shape, housing, and trim/door appearance and construction, general overall appearance, efficiency, thickness, brightness control and lamp hiding characteristics.
 2. Provide equivalent performance to specified fixtures considering application in the environment and intended usage by the Owner.
 3. Manufacturers shall submit complete fixture and lens data for evaluation and shall be prepared to submit sample fixtures and/or lenses. Samples shall be submitted only at the request of the Engineer.

2.2 GENERAL

- A. Subject to compliance with requirements, fixtures that may be incorporated into the work include the products specified in the Lighting Fixture Schedule on the drawings, and the equals listed in the accompanying notes.
- B. The basic catalog number only is indicated in the Lighting Fixture Schedule. The EC shall furnish complete lighting fixtures in quantities, and/or row lengths as shown on the plans, including plaster frames, ends, or caps, couplings, connectors, suspension assemblies, mounting brackets and all auxiliary accessories as required.

- C. Refer to Schedule for description of fixture nomenclature and associated ceiling type and suspension system.

2.3 LUMINAIRES

A. Housings:

1. Shall be free from burrs, sharp corners and edges.
2. Shall be steel, unless noted otherwise, formed and supported to prevent warping and sagging.
3. Provide spring loaded latches for all troffers.
4. Provide UL approved earthquake clips for all troffers.
5. Provide locking sockets for fluorescent lamps.

B. Mounting Accessories:

1. Recessed fixtures:
 - a. Provide trim type and accessories required for installation in ceiling types specified and/or shown on the reflected ceiling plan.
 - b. Fixtures mounted in sloped ceilings shall be provided with sloped ceiling adapters and appropriate trim rings and other accessories as required.
2. Surface-mounted fixtures:
 - a. Provide ceiling spacers as required for fixtures not labeled as suitable for direct mounting to a low density ceiling.
3. Suspended fixtures:
 - a. Provide swivel canopy to accommodate any sloped ceilings shown on the plans.
 - b. Provide pendant or cable length required to suspend luminaires at indicated height.
 - c. Swivel hangers in mechanical equipment areas shall be shock- absorbing type.

C. Finishes:

1. Painted finishes:
 - a. Shall be polyester powder painted enamel finish.
2. Polished, brushed, other metal finishes:
 - a. Shall be finished with clear coat to inhibit finish deterioration and corrosion.
3. All finish types and colors shall be verified with the architect prior to ordering.

D. Louvers, Reflectors, Lenses:

1. All louvers and reflectors shall be semi-specular, low iridescent, clear alzak, unless noted otherwise.
2. Provide reflector channels to separate all lamp sections.
3. All acrylic lenses shall be pattern 12 prismatic, overall 0.125" minimum thickness.

2.4 LED LIGHTING

- A. The manufacturer of the LED lighting fixture shall utilize high-brightness LEDs and high-efficiency electronic LED drivers, dimmed or no dimmed as required.

- B. The LED fixture shall be thermally designed as to not exceed the maximum junction temperature of the LED for the ambient temperature of the location the fixture is to be installed.
- C. Light output of the LED system shall be the absolute photometry following IESNA LM-79 and IESNA LM-80 requirements and guidelines.
- D. Minimum power factor of 0.90.
- E. LED lighting fixture shall be mercury-free, lead-free and RoHS compliant.
- F. The LED lighting fixture shall maintain 70% lumen output for a minimum of 50,000 hours.
- G. All components of the LED lighting fixture shall be replaceable.
- H. The LED lighting fixture shall carry a limited 3-year warranty minimum.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. It shall be the Contractor's responsibility to determine mounting requirements and verify ceiling types and to coordinate locations of lighting with other contractors to assure that installation will not interfere with other equipment.
2. Anchor surface mounted fixtures on walls or ceilings in a manner to prevent rotation and light leakage. Do not use plastic, composition or wood type anchors.
3. Provide pendant mounted fixtures with self aligning stem hangers and rigid steel conduit stems, cut and threaded to fit required length. One stem must serve as wireway.
4. Mount suspended fixtures at heights indicated on the drawings. If height is not indicated, mount as high as possible, but not above lowest point of mechanical equipment.
5. Support all suspended fixtures from structural building components. Unless directed otherwise, do not suspend from other suspended equipment.
6. Support system capable of supporting 300% fixture and lamp weight.

B. Recessed Luminaires:

1. Install recessed luminaire to permit removal from below for access to outlet or prewired fixture box.
2. Connect recessed luminaire to boxes with flexible conduit and fixture wire.
3. Suspended ceiling with exposed tee bar grid system. Support from ceiling tee bar grid structure and with bolts, screws, rivets or approved ceiling framing member clips.

C. Lay-In Fixtures:

1. Install with plastic protection over louver.
2. Remove plastic protection after final clean up.
3. Fixtures used for temporary lighting shall have louver removed and safely stored.

4. Any contact with louver shall be made utilizing clean gloves to prevent fingerprints on specular finish.

3.2 FIELD QUALITY CONTROL

- A. At time of substantial completion, replace lamps in fixtures, which are observed to be noticeably dimmed after Contractor's use and testing as judged by Architect-Engineer.
- B. Prior to final acceptance replace all cracked or broken lenses, dented, scratched or otherwise damaged fixtures at no cost to the Owner.

3.3 ADJUST AND CLEAN

- A. Align luminaires and clean diffusers prior to final acceptance.
- B. Provide lamps, as scheduled, for each luminaire.

3.4 SCHEDULES

- A. Lighting Fixture Schedule on Drawings.

END OF SECTION

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SECTION 26 51 10 - LIGHTING CONTROL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Furnish all labor, equipment, materials, and performing all operations in connection with the installation of the Lighting Control System as shown on the drawings, as hereinafter specified, and as directed by the Engineer. The intent of this specification is to provide for furnishing, installing, testing and placing in operation, the necessary equipment for switching and control of lighting systems.
- B. Extent of lighting control system work is indicated by drawings and by the requirements of this section. Types of lighting control equipment and wiring specified in this section includes the following:
 - 1. Occupancy sensor controls.
- C. Requirements are indicated elsewhere in these specifications for work including, but not limited to, raceways, electrical boxes and fittings, and routers or other network components required for installation of control equipment, which are not work of this section.

1.2 LIGHTING CONTROL SYSTEM OPERATION

- A. It shall be the contractor's responsibility to make all proper adjustments to assure owner's satisfaction with the lighting control system.
- B. Factory Startup: It shall be the manufacturer's responsibility to verify all proper adjustments and train owner's personnel to ensure owner's satisfaction with the occupancy system. This service is provided at an additional cost.

1.3 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 26 05 00 Basic Materials and Methods
 - 2. 26 11 00 Raceways and Boxes
 - 3. 26 19 00 Supporting Devices
 - 4. 26 51 00 Interior Building Lighting

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Local and state building codes.
 - 2. All requirements of the local authority having jurisdiction.
 - 3. Underwriter's Laboratories: The system and all components shall be listed by Underwriters Laboratories, Inc. for use in fire protective signaling systems under the following standards as applicable.
- B. Codes and Standards:

1. Network - ANSI 875.1, ARCNET®
 2. Protocol - ASHRAE 135 – 1995, BACnet®
 3. IEEE Std 2000.1-1998
 4. UL 916 Energy Management Equipment
 5. California Energy Commission
- C. Independent Testing Laboratory - The control panels shall be tested and listed under the UL 916 Energy Management Equipment standards.
- D. System Checkout and training - A factory trained technician or other factory-authorized personnel shall functionally test the system and verify performance after contractor installation. Factory authorized personnel shall conduct a training session to train the building operations personnel on the set-up, programming, operation and maintenance of the lighting control systems.

1.5 SUBMITTALS

- A. Submit in accordance with Section 23 05 00.
- B. Submit complete documentation showing the type, size, rating, style, catalog number, manufacturer's names, photos and or catalog data sheets for all items to ensure compliance with these specifications.
- C. Prior to fabrication manufacture shall submit the following materials for approval:
1. Manufacturer's published catalog data sheets for all equipment and components of the lighting control system.
 2. Shop Drawings - Submit drawings of lighting control system and accessories including, but not necessarily limited to, the central programming system, intelligent relay/dimmer panels, network wiring, switch inputs, analog inputs and modem location. As a minimum, the shop drawings shall include the following:
 - One-line schematic diagram with wire type details
 - Network wiring details
 - Lighting control panel load schedules
 - Input and output wiring details
 - Programming worksheets for system configurations
- D. Submit point list for owner to complete custom label requirements.
- E. All references to manufacturer's or supplier's model numbers and other pertinent information herein is intended to establish minimum standards for performance, function and quality. Equivalent equipment (compatible UL listed) from other manufacturers may be substituted for that specified providing the submittal is performed as specified above.

1.6 DELIVER, STORAGE AND HANDLING

- A. Deliver equipment individually wrapped in factory fabricated fiberboard type containers.
- B. Store equipment in clean, dry space.
- C. Protect from dirt, fumes, water and physical damage.
- D. Do not install damaged equipment, remove from site.

1.7 FIELD PROGRAMMING

- A. The system shall be programmable, configurable and expandable in the field without the need for special tools or PROM programmers and shall not require replacement of memory ICs. All standard control panel keyboard or through the use of the optional CRT-1 keyboard. All programs shall be stored in non-volatile memory.
- B. The programming function shall be entered with a special password that may be selected when the system is installed. The password may be changed in the field to a new value at any time by entering the old password and requesting a password change. In the event that the programmer may enter a password and then lose or forget it, the system shall be designed such that the password may be determined by special procedures available through the system manufacturer.

PART 2 - PRODUCTS

2.1 OCCUPANCY SENSOR CONTROLS

- A. Occupancy Sensors shall be equal to Sensor Switch Watt Stopper, Hubbell/Unenco, Novitas, or approved equal.
 - 1. Line voltage occupancy sensors may be used in lieu of low-voltage sensors where approved by the Engineer for areas with inaccessible power pack locations.
- B. Wall switch sensors shall be capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.
- C. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180° coverage capability.
- D. Wall switch products shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor's longevity.
- E. Wall switch sensors shall have no leakage current to load, in manual or in Auto/Off mode for safety purposes and shall have voltage drop protection.
- F. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from automatic-ON to manual-ON.
- G. Where specified, vandal resistant wall switch sensors shall utilize a hard lens with a minimum 1.0mm thickness. Products utilizing a soft lens will not be considered.
- H. Passive infrared sensors shall utilize Pulse Count Processing and Digital Signature Analysis to respond only to those signals caused by human motion.
- I. Passive infrared sensors shall utilize mixed signal ASIC which provides high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line), superior performance, and greater reliability.
- J. Passive infrared sensors shall have a multiple segmented Lodif Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.

- K. Where specified, passive infrared and dual technology sensors shall offer daylighting footcandle adjustment control and be able to accommodate dual level lighting.
- L. Dual technology sensors shall be corner mounted to avoid detection outside the controlled area when doors are left open.
- M. Dual technology sensors shall consist of passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.
- N. Ultrasonic sensors shall utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
- O. Ultrasonic operating frequency shall be crystal controlled at 25 kHz within $\pm 0.005\%$ tolerance, 32 kHz within $\pm 0.002\%$ tolerance, or 40 kHz $\pm 0.002\%$ tolerance to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.
- P. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.
- Q. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.
- R. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.
- S. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.
- T. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.
- U. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.
- V. All sensors shall have UL rated, 94V-0 plastic enclosures.

2.2 OCCUPANCY SENSOR CIRCUIT CONTROL HARDWARE

- A. Control Units - For ease of mounting, installation and future service, control unit(s) shall be able to externally mount through a 1/2" knock-out on a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Control unit shall provide power to a minimum of two (2) sensors.
- B. Relay Contacts shall have ratings of:

13A - 120 VAC Tungsten
20A - 120 VAC Ballast

20A - 277 VAC Ballast

- C. Control wiring between sensors and controls units shall be Class II , 18-24 AWG, stranded U.L. Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.
- D. Minimum acceptable wire gauge from the circuit control hardware relays shall be #14 AWG.

2.3 WIRE AND CABLE

- A. All low voltage cable and wire shall be supplied and installed in accordance with the National Electrical Code and other provisions of Division 26
- B. Cable and wire selected for each application shall be in strict accordance with the original equipment manufacturers recommendations.
- C. All cables and wires shall be permanently tagged at both ends for ease in maintenance.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION AND DOCUMENTATION

- A. Installation - The control system shall be installed and connected as shown on the plans and as directed by the manufacturer. The contractor shall complete all electrical connections to all control circuits, network terminations, RS-232 connections, sensors and override wiring.
- B. Documentation - The contractor shall provide accurate "as built" drawings to the owner indicating the correct and latest program in each controller. The "as-built drawings" shall clearly indicate the lighting control panel identification, the load controlled by each relay, and the device connected to each input.
- C. Operation and Service Manuals – Provide operation and service manuals for all system components as indicated in the General Provisions.

3.2 PRODUCT SUPPORT AND SERVICE

- A. System Start-up: Provide a factory authorized technician to verify the installation, test the system, and train the owner on proper operation and maintenance of the system. Before requesting start-up services, the installing contractor shall verify that:
 - 1. The control system has been fully installed in accordance with manufacturer's installation instructions.
 - 2. Low voltage wiring for overrides and sensors is completed.
 - 3. Accurate "as-built" load schedules have been prepared for each lighting control panel.
 - 4. Proper notification of the impending start-up has been provided to the owner's representative.
- B. Factory Support: Factory telephone support shall be available at no cost to the owner during the warranty period. Factory assistance shall consist of assistance in solving programming or other application issues pertaining to the control equipment. The factory shall provide a toll-free number for technical support.

3.3 OCCUPANCY SENSOR CONTROL INSTALLATION

- A. It shall be the contractor's responsibility to locate and aim sensory in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have ninety (90) to one hundred (100) percent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective room.
- B. It is the contractors responsibility to arrange a pre-installation meeting with the manufacturer's factory authorized representative, at the owner's facility, to verify placement of sensors and installation criteria.
- C. Proper judgment must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. The contractor shall also provide, at the owner's facility, the training necessary to familiarize the owner's personnel with the operation, use, adjustment, and problem solving diagnosis of the occupancy sensing devices and systems.

3.3 WARRANTY

- A. Manufacturer shall provide a one (1) year limited warranty on the lighting control system and software. A ten (10) year limited warranty shall be provided on the lighting control relays.

3.4 TESTS AND REPORTS

- A. Final Acceptance: The system will be accepted only after a satisfactory test of the entire system has been accomplished by a factory-trained distributor in the presence of the Owner's Representative.
- B. On-Site Services: Contractor shall provide the on-site services of an authorized technical representative of the manufacturer, to supervise all connections and fully test all devices and components of the system as installed. Owner's representative shall be instructed in the proper use and testing of the system.

3.5 BASIC OPERATOR TRAINING

- A. Installation Contractor and equipment vendor shall provide all training materials, testing equipment, and demonstration aids required to provide operator, supervision, and maintenance personnel training. At completion of the training period, all training brochures, bulletins, manuals, handbooks, and diagnostic guidelines shall remain with the Owner.

END OF SECTION

SECTION 27 05 00 - COMMUNICATIONS RACEWAY SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Furnish and install backboxes, conduit, sleeves and raceway raceway system for communications (voice/data) system cabling as described herein and indicated on the drawings.
- B. Furnish and install backboxes, junction boxes, conduit and raceway system for future telecommunication systems as indicated on the Drawings.
- C. Provide telephone service raceway and termination backboards as indicated on the drawings.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 26 11 00 Raceways and Boxes
 - 2. 27 10 00 Communications Cabling and Equipment

PART 2 - PRODUCTS

2.1 COMMUNICATIONS RACEWAYS

- A. Communication Outlets: Telecommunication(voice/data) outlets shall be a 4" square box, 2-1/2" depth, with plaster ring for a single device. Stub 3/4" EMT conduit to above accessible ceiling with insulated bushing termination. Refer to the drawings for locations required.
 - 1. In hard ceiling areas, provide 3/4" EMT stub with bushing at back box and cable concealed to main distribution wiring closet.
 - 2. Provide EMT sleeves with bushing at both ends for penetration of masonry walls, floors and ceilings. Provide UL fire stopping at rated penetrations.
- B. Sleeves: Provide EMT conduit sleeves through walls between rooms with insulated bushing at both ends.

PART 3 - EXECUTION

3.1 COMMUNICATION RACEWAY INSTALLATION

- A. The E.C. shall install all required backboxes, conduits, sleeves and conduit fittings for the complete communication raceway system.
 - 1. All empty conduits shall be provided pull wire by E.C.
 - 2. Coordinate all work above the accessible ceilings with other trades.
 - 3. Seal all openings for sleeves between rooms for soundproofing.

END OF SECTION

SECTION 27 10 00 - COMMUNICATION CABLING AND EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. THIS DOCUMENT SPECIFIES THE CITY OF MADISON REQUIREMENTS FOR PRODUCT DESIGN, PERFORMANCE, AND QUALITY ASSURANCE, AND CONTRACTOR RESPONSIBILITIES FOR EXECUTION OF WORK TO INSTALL A COMPLETE CATEGORY 6 STRUCTURED CABLING SYSTEM. EXECUTION OF WORK INCLUDES DELIVERY AND STORAGE OF MATERIALS, PREPARATION, INSTALLATION, FIELD-TESTING, AND PROJECT COMPLETION TASKS. SYSTEM CERTIFICATION AND WARRANTY SUBMITTAL REQUIREMENTS FOR COMPLETED WORK AND FUTURE MOVES, ADDS AND CHANGES (MAC'S) ARE ALSO SPECIFIED IN THIS DOCUMENT. COMPLIANCE TO APPLICABLE CODES, STANDARDS AND REGULATIONS IS REQUIRED FOR ALL CONSTRUCTION WORK PERFORMED.

1.2 SUMMARY

- A. SECTION INCLUDES PRODUCTS AND EXECUTION REQUIREMENTS PERTAINING TO DIVISION 27 SYSTEMS. COPPER AND FIBER BACKBONE AND HORIZONTAL CABLING ALONG WITH SUPPORT SYSTEMS ARE COVERED UNDER THIS DOCUMENT.
- B. PRODUCT SPECIFICATIONS, GENERAL DESIGN CONSIDERATIONS, AND INSTALLATION GUIDELINES ARE PROVIDED IN THIS DOCUMENT. QUANTITIES FOR ALL CABLING PRODUCTS SHALL BE PROVIDED AS REQUIRED TO COMPLETE CABLING TO ALL WORK STATIONS AS SHOWN ON FLOOR PLANS.
- C. THE APPROVED CONTRACTOR SHALL FURNISH, SUPPLY AND INSTALL A COMPLETE CATEGORY 6 CABLING INFRASTRUCTURE SPECIFIED IN THE CONTRACT DOCUMENTS.
- D. CONSTRUCTION WORK SHALL COMPLY WITH CONTRACT DRAWINGS, SPECIFICATIONS, PROJECT COMPLETION SCHEDULES, AND APPLICABLE CODES AND STANDARDS.
- E. WORK SHALL INCLUDE ALL DETAILED EXECUTION REQUIREMENTS, SUCH AS PREPARATION, INSTALLATION, SYSTEM CERTIFICATION, AND PROJECT CLOSEOUT ACTIVITIES ACCORDING TO THE CONTRACT.
- F. SUBSTITUTIONS: NO SUBSTITUTED PRODUCTS SHALL BE INSTALLED EXCEPT WITH WRITTEN APPROVAL BY OWNER.

1.3 DATA AND VOICE COMMUNICATIONS CONTRACT WORK

- A. GENERAL:
 - 1. FURNISH ALL LABOR, MATERIALS, TOOLS, EQUIPMENT AND SERVICES FOR THE INSTALLATION IN ACCORDANCE WITH GENERAL PROVISIONS OF SPECIFICATIONS AND THE CONTRACT DRAWINGS.
 - 2. REPORT PERCENTAGE OF WORK COMPLETED ON A MONTHLY BASIS.
 - 3. COMPLETELY COORDINATE WITH WORK OF ALL OTHER TRADES.
 - 4. PROVIDE ALL SUPPLEMENTARY OR MISCELLANEOUS ITEMS, APPURTENANCES AND DEVICES INCIDENTAL TO OR NECESSARY FOR A

SOUND, SECURE AND COMPLETE INSTALLATION, WHETHER OR NOT SPECIFICALLY INDICATED IN THE CONTRACT DOCUMENTS.

5. PROVIDE LABOR FOR TESTING HORIZONTAL AND BACKBONE CABLING.
6. PROVIDE FIRESTOPPING.
7. PROVIDE TELECOMMUNICATIONS GROUNDING AND BONDING.
8. PROVIDE COMPLETE INSTALLATION FOR STRUCTURED TELECOMMUNICATIONS CABLING SYSTEM INCLUDING BUT NOT LIMITED TO:
 - CATEGORY 6E UTP HORIZONTAL CABLES.
 - SINGLEMODE OPTICAL FIBER BACKBONE CABLES.
 - WORK AREA TELECOMMUNICATION OUTLETS.
 - WALL MOUNTED VOICE OUTLETS.
 - EQUIPMENT MOUNTING RACKS AND RACK ENCLOSURES.
 - CATEGORY 6 MODULAR PATCH PANELS.
 - OPTICAL FIBER PATCH PANELS.
 - OPTICAL FIBER LC CONNECTORS.
 - WIRE MANAGEMENT PANELS.
 - FIELD TESTING.
 - FIRESTOPPING.

1.4 SUBMITTALS

- A. SUBMITTALS SHALL BE COMPLETE AND AT ONE TIME. PARTIAL SUBMITTALS WILL NOT BE CONSIDERED.
- B. MATERIAL LISTS, SCHEDULE OF VALUES, LISTS OF SUBCONTRACTORS, AND PROOF OF CONTRACTOR QUALIFICATIONS SHALL BE PROVIDED TO ENGINEER UPON REQUEST AND SHALL FOLLOW THE GUIDELINES AS STATED IN THE GENERAL REQUIREMENTS (DIVISION 1 OF THE SPECIFICATION).
- C. SHOW DRAWINGS SHALL BE SUBMITTED. ALL COMMUNICATION SYSTEM SHOP DRAWINGS SHALL INCLUDE:
 - MANUFACTURER'S DATA (SPECIFICATIONS, "CUT SHEETS").
 - WIRING DIAGRAMS FOR ALL INSTALLED CABLING.
 - EQUIPMENT RACK/CABINET LAYOUTS.
 - PROPOSED LABELING SCHEMES AND LABELING METHOD.
 - LIST OF CABLING DISTANCES (TYPICAL AND MAXIMUM) FOR ALL STRUCTURED CABLING
 - SUBMIT COPIES OF CERTIFICATIONS FOR ALL TECHNICIANS AND THE PROJECT MANAGER WHO WILL SUPPORT THIS PROJECT. THE CERTIFICATIONS SHALL INCLUDE:
 - a STRUCTURED CABLING AND TERMINATION EQUIPMENT INSTALLATION CERTIFICATIONS FOR COPPER AND OPTICAL FIBER CONNECTIVITY AND CABLING.
 - b APPROVED MANUFACTURER CLASSES SATISFACTORILY COMPLETED.
2. CONTRACTOR SHALL SUBMIT A TEST PLAN THAT DEFINES THE TESTS REQUIRED TO ENSURE THAT THE SYSTEM MEETS TECHNICAL, OPERATIONAL, AND PERFORMANCE SPECIFICATIONS 45 DAYS PRIOR TO PROPOSED TEST DATE.

3. WORK SHALL NOT PROCEED WITHOUT THE OWNER'S APPROVAL OF THE SUBMITTED ITEMS.
- D. DRAWINGS & INSPECTION OF SITE:
1. COMMUNICATIONS FLOOR PLAN DRAWINGS ARE TO SCALE AND TYPICALLY ARE NOT DIMENSIONED. THE CONTRACTOR SHALL NOT SCALE DRAWINGS FOR EQUIPMENT PLACEMENT AND CLEARANCES. DIMENSIONS GIVEN ON DRAWINGS SHALL ALWAYS TAKE PRECEDENCE OVER SCALED DRAWINGS.
 2. ANY EXISTING WIRES, UTILITIES, OR EQUIPMENT SHOWN ON THE DRAWINGS ARE SHOWN FOR GENERAL INFORMATION AND TO THE BEST KNOWLEDGE OF THE ENGINEER. THE CONTRACTOR SHALL FIELD VERIFY ALL EXISTING WIRES, UTILITIES, OR EQUIPMENT.
 3. THE CONTRACTOR SHALL FIELD VERIFY DISTANCES AND EQUIPMENT PLACEMENTS COORDINATING LOCATIONS WITH OTHER TRADES, CONSTRUCTION MANAGERS, AND GENERAL CONTRACTOR PRIOR TO INSTALLATION.
 4. THE CONTRACTOR SHALL REVIEW ALL SITE CONDITIONS PRIOR TO SUBMITTING A BID ON THIS PROJECT. ANY OBVIOUS DISCREPANCIES BETWEEN THE SITE CONDITIONS AND BIDDING DOCUMENTS SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER AT THE TIME OF BIDDING SO CLARIFICATION CAN BE MADE BY ADDENDUM.
 5. CHANGE ORDER REQUESTS FOR ADDITIONAL COSTS RELATED TO THE CONTRACTORS MISUNDERSTANDING RELATED TO THE AMOUNT OF WORK INVOLVED AND LACK OF KNOWLEDGE RELATED TO THE SITE CONDITIONS WILL NOT BE ALLOWED.
- E. TEST REPORTS: SUBMIT COPIES OF COMPLETE REPORTS OF ALL TESTING PERFORMED TO THE GENERAL CONTRACTOR, WITH COPIES TO THE ARCHITECT'S ELECTRICAL ENGINEER UPON COMPLETION OF JOB.

1.5 APPROVED CONTRACTOR QUALIFICATIONS

- A. THE CONTRACTOR SHALL HAVE EXPERIENCE IN THE INSTALLATION AND TESTING OF SIMILAR SYSTEMS AS SPECIFIED HEREIN AND SHALL HAVE COMPLETED AT LEAST TWO PROJECTS OF SIMILAR SIZE AND SCOPE WITHIN THE LAST 24 MONTHS. THE CONTRACTOR SHALL PROVIDE REFERENCES UPON REQUEST (INCLUDING THE PROJECT NAME, ADDRESS, DATE OF IMPLEMENTATION, CLIENT NAME, TITLE, TELEPHONE NUMBER, AND PROJECT DESCRIPTION.”
- B. ALL MEMBERS OF THE INSTALLATION TEAM MUST BE CERTIFIED BY THE MANUFACTURER AS HAVING COMPLETED THE NECESSARY TRAINING TO COMPLETE THEIR PART OF THE INSTALLATION. ALL PERSONNEL SHALL BE ADEQUATELY TRAINED IN THE USED OF SUCH TOOLS AND EQUIPMENT AS REQUIRED.
- C. THE CONTRACTOR BIDDING ON COMMUNICATION SYSTEMS SPECIFIED HEREIN SHALL BE CERTIFIED BY THE CONNECTIVITY MANUFACTURER TO INSTALL, SERVICE, AND WARRANTY THE SPECIFIED PRODUCT PRIOR TO THE TIME OF BID AND THROUGHOUT THE DURATION OF THE INSTALLATION. MANUFACTURER CERTIFICATIONS SHALL NOT BE PROJECT SPECIFIC AND

SHOULD BE VALID FOR ANY AND ALL PROJECTS COMPLETED BY CONTRACTOR.

- D. THE CONTRACTOR SHALL OWN AND MAINTAIN TOOLS, INSTALLATION EQUIPMENT, AND TEST EQUIPMENT NECESSARY FOR SUCCESSFUL INSTALLATION AND TESTING OF OPTICAL AND CATEGORY 5E, 6 & 6A PREMISE DISTRIBUTION SYSTEMS.
- E. THE OWNER RESERVES THE RIGHT TO REQUIRE THE CONTRACTOR TO REMOVE FROM THE PROJECT ANY SUCH EMPLOYEE THE OWNER DEEMS TO BE INCOMPETENT, CARELESS OR INSUBORDINATE.
- F. THE CONTRACTOR MUST MAINTAIN A STATE CONTRACTOR'S LICENSE AS REQUIRED BY THE STATE.

1.6 APPROVED PRODUCT MANUFACTURERS

- A. THE MANUFACTURER OF THE CONNECTIVITY PRODUCTS SPECIFIED IN THIS DOCUMENT, AS REQUIRED FOR CONSTRUCTION OF THE CABLING INFRASTRUCTURE PER CONTRACT DOCUMENTS SHALL BE:
 - HUBBELL PREMISE WIRING
- B. THE MANUFACTURER OF THE CABLING PRODUCTS SPECIFIED IN THIS DOCUMENT, AS REQUIRED FOR CONSTRUCTION OF THE COPPER CABLE INFRASTRUCTURE PER CONTRACT DOCUMENTS SHALL BE:
 - MOHAWK CABLE
- C. THE MANUFACTURER OF THE FIBER OPTIC CABLING PRODUCTS SPECIFIED IN THIS DOCUMENT, AS REQUIRED FOR CONSTRUCTION OF THE FIBER OPTIC CABLE PER CONTRACT DOCUMENTS SHALL BE:
 - MOHAWK CABLE OR EQUAL
- D. PRODUCT SUBSTITUTIONS ARE PERMITTED UNDER THE CONDITIONS STATED BELOW. (1.7 A)

1.7 PRODUCT SUBSTITUTIONS

- A. PRODUCT SUBSTITUTIONS FROM OTHER MANUFACTURERS SHALL REQUIRE THE APPROVAL OF THE OWNER OR OWNER'S REPRESENTATIVE.

1.8 QUALITY ASSURANCE

- A. INSTALLED CATEGORY 6 BALANCED UTP AND FIBER CABLING SYSTEMS, PATHWAYS AND DISTRIBUTION FACILITIES SHALL ADHERE TO MANUFACTURER'S INSTRUCTIONS, CONTRACT DRAWINGS AND SPECIFICATIONS, AND APPLICABLE CODES, STANDARDS AND REGULATIONS.
- B. INSTALLED CATEGORY 6 BALANCED UTP CABLING SYSTEMS AND FIELD TEST RESULTS SHALL STRICTLY ADHERE TO REQUIREMENTS OF ANSI/TIA/EIA-568-C.0 AND ANSI/TIA/EIA-568-C.2.

- C. INSTALLED OPTICAL FIBER CABLING SYSTEMS AND FIELD TEST RESULTS SHALL STRICTLY ADHERE TO REQUIREMENTS OF ANSI/TIA/EIA-568-C.0 AND ANSI/TIA/EIA-568C.3.
- D. WHERE APPLICABLE, ALL EQUIPMENT, COMPONENTS, ACCESSORIES AND HARDWARE SHALL BE UL LISTED FOR THE INTENDED PURPOSE OF THE INSTALLATION.
- E. INSTALLED PRODUCTS SHALL BE MANUFACTURED BY AN ISO 9001 CERTIFIED FACILITY.
- F. INSTALLED PRODUCTS SHALL BE FREE FROM DEFECTS IN MATERIAL OR WORKMANSHIP FROM THE MANUFACTURER, AND SHALL BE OF THE QUALITY INDICATED.
- G. ALL METHODS OF CONSTRUCTION THAT ARE NOT SPECIFIED IN THE CONTRACT DOCUMENTS SHALL BE SUBJECT TO CONTROL AND APPROVAL BY THE OWNER OR OWNER'S REPRESENTATIVE.
- H. INSTALLED PRODUCTS SHALL BE LOT-TRACEABLE BY DATE CODE.
- I. ALL CRITICAL INTERNAL MANUFACTURING OPERATIONS FOR INSTALLED PRODUCTS SHALL HAVE DOCUMENTED IN-PROCESS INSPECTION AND TESTING ACCORDING TO ISO9001.

1.9 DRAWINGS

- A. APPROVED OR PRELIMINARY CONTRACT DRAWINGS FURNISHED AT THE TIME OF BID SOLICITATION SHALL SERVE AS THE BASIS FOR PRODUCT SELECTION, CREATION OF BILLS OF MATERIAL, AND DETERMINATION OF LABOR CONTENT.
- B. CHANGES, ADDITIONS, OR DELETIONS TO CONTRACT DRAWINGS PRIOR TO AWARDING OF THE CONTRACT, SHALL REQUIRE AN AMENDMENT TO THE ORIGINAL BID.
- C. PRIOR TO SUBMITTING THE BID, IN REVIEWING THE CONTRACT DRAWINGS, THE APPROVED CONTRACTOR SHALL:
 - REQUEST THE ATTENTION OF THE ENGINEER, OWNER, OR DESIGN AGENCY TO CLARIFY ANY MATERIALS, APPARATUS OR WORK BELIEVED TO BE INCORRECT, INADEQUATE, OMITTED, OR IN VIOLATION OF APPLICABLE CODES, STANDARDS OR REGULATIONS.
 - NOTE ANY CONTINGENCIES RELATED TO UNKNOWN ASPECTS OF ANY DRAWINGS OR SPECIFICATIONS.
- D. CONTRACT DRAWINGS, PRIOR TO EXECUTION OF THE PROJECT, SHALL BE FORMALLY APPROVED AND RELEASED BY THE ENGINEER OR DESIGN AGENCY, AND SHALL BE APPROVED BY THE OWNER OR OWNER'S REPRESENTATIVE.

- E. EXECUTION OF WORK SHALL BE ACCORDING TO APPROVED DRAWINGS, IN ADDITION TO APPLICABLE SPECIFICATIONS AND CONTRACTUAL OBLIGATIONS.

1.10 APPLICABLE STANDARDS, CODES, AND REGULATIONS

- A. INSTALLATION STANDARDS: CABLE INSTALLATION SHALL COMPLY WITH THE FOLLOWING:
 - 1. AMERICAN NATIONAL STANDARDS INSTITUTE, (ANSI)
 - a ANSI/TIA-568-C.0, "GENERIC TELECOMMUNICATIONS CABLING FOR CUSTOMER PREMISES", PUBLISHED 2009
 - b ANSI/TIA-568-C.1, "COMMERCIAL BUILDING TELECOMMUNICATIONS CABLING STANDARD", PUBLISHED 2009
 - c ANSI/TIA-568-C.2, "BALANCED TWISTED-PAIR TELECOMMUNICATION CABLING AND COMPONENTS STANDARD", PUBLISHED 2009
 - d ANSI/TIA-568-C.3, "OPTICAL FIBER CABLING COMPONENTS STANDARD", PUBLISHED 2008, ERRATA ISSUED IN OCTOBER, 2008
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 - h ANSI/TIA/EIA-942, TELECOMMUNICATIONS INFRASTRUCTURE FOR DATA CENTERS, 2004.
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 - j ANSI/TIA/EIA-598, COLOR CODING OF OPTICAL FIBER CABLES, 2001
 - k ANSI/ICEA S-87-640, FIBER OPTIC OUTSIDE PLANT DISTRIBUTION CABLE, 1999.
 - l ANSI/TIA/EIA-492AAAC, DETAIL SPECIFICATION FOR 850NM LASER-OPTIMIZED 50UM CORE DIAMETER/125 UM CLADDING DIAMETER CLASS 1A GRADED INDEX MULTIMODE OPTICAL FIBERS, 2003.
 - m ANSI/TIA/EIA-492CAAA, DETAIL SPECIFICATION FOR CLASS IVA DISPERSION-UNSHIFTED SINGLEMODE OPTICAL FIBERS, 2002.
 - n ANSI/TIA/EIA-758: CUSTOMER-OWNED OUTSIDE PLANT TELECOMMUNICATIONS CABLING STANDARD, 2004.
 - o ANSI/TIA/EIA-526-7, OPTICAL POWER LOSS MEASUREMENTS OF INSTALLED SINGLEMODE FIBER PLANT: OFSTP-7, 2002.
 - p ANSI/TIA/EIA-526-14-A, OPTICAL POWER LOSS MEASUREMENTS OF INSTALLED MULTIMODE FIBER PLANT: OFSTP-14A, 2003.
 - q ANSI/TIA/EIA-TSB-125, GUIDELINES FOR MAINTAINING OPTICAL FIBER POLARITY THROUGH REVERSE-PAIR POSITIONING, 2001.
 - r ANSI/TIA/EIA-TSB-140, ADDITIONAL GUIDELINES FOR FIELD TESTING LENGTH, LOSS, AND POLARITY OF OPTICAL FIBER CABLING SYSTEMS, 2004.
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- u ANSI/TIA/EIA-604 (SERIES), FOCIS FIBER OPTIC CONNECTOR INTERMATEABILITY STANDARD, 2000-2003.
- 2. NATIONAL FIRE PROTECTION ASSOCIATION, INC., NFPA 70
- 3. NATIONAL ELECTRIC CODE (NEC), 2005.
 - v NEC ARTICLE 250: GROUNDING
 - w NEC ARTICLE 386: SURFACE METAL RACEWAYS
 - x NEC ARTICLE 388: SURFACE NON-METALLIC RACEWAYS
 - y NEC ARTICLE 800: COMMUNICATIONS CIRCUITS
 - z NEC ARTICLE 770: OPTICAL FIBER CABLES AND RACEWAY
- 4. UNDERWRITER'S LABORATORY, INC. (UL)
 - aa UL-5A: STANDARD FOR NON-METALLIC RACEWAYS AND FITTINGS
 - bb UL-5: STANDARD FOR SURFACE METAL RACEWAYS AND FITTINGS
 - cc UL-5C: STANDARD FOR SURFACE RACEWAYS AND FITTINGS FOR USE WITH DATA, SIGNAL, AND CONTROL CIRCUITS
 - dd UL-50: STANDARD FOR ENCLOSURES FOR ELECTRICAL EQUIPMENT
 - ee UL-94-V0: TESTS FOR FLAMMABILITY OF PLASTIC MATERIALS
 - ff UL-498: ATTACHMENT PLUGS AND RECEPTACLES
 - gg UL-1479: FIRE TESTS OF THROUGH-PENETRATION FIRESTOPS (IN ACCORDANCE WITH ASTM E814).
 - hh UL-1863: STANDARD FOR SAFETY OF COMMUNICATIONS CIRCUIT ACCESSORIES
- 5. NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)
 - ii ANSI/NEMA WD-6-2002: WIRING DEVICES – DIMENSIONAL REQUIREMENTS
 - jj NEMA 250-2003: ENCLOSURES FOR ELECTRICAL EQUIPMENT
- 6. ISO/IEC 11801, ED. 2:2002, INFORMATION TECHNOLOGY – GENERIC CABLING FOR CUSTOMER PREMISES, 2002.
- 7. ISO/IEC 18010, INFORMATION TECHNOLOGY – PATHWAYS AND SPACES FOR CUSTOMER PREMISES CABLING, 2005.
- 8. ISO/IEC 14763-1, INFORMATION TECHNOLOGY – IMPLEMENTATION AND OPERATION OF CUSTOMER PREMISES CABLING – PART 1: ADMINISTRATION, 2004.
- 9. CSA C22.1-06, CANADIAN ELECTRIC CODE (CEC), 2006
- 10. FEDERAL COMMUNICATIONS COMMISSION (FCC) TITLE 47, CODE OF FEDERAL REGULATIONS, PART 68: CONNECTION OF TERMINAL EQUIPMENT TO THE TELEPHONE NETWORK, 1998.
- 11. U.S. PUBLIC LAW 336. 101ST CONGRESS, ADA: AMERICANS WITH DISABILITIES ACT OF 1992.
- 12. IEEE 802.3AF, DATA TERMINAL EQUIPMENT (DTE) POWER OVER MEDIA DEPENDENT INTERFACE (MDI), 2003.
- 13. IEEE 802.3AT (CURRENT DRAFT), DATA TERMINAL EQUIPMENT (DTE) ENHANCED POWER OVER MEDIA DEPENDENT INTERFACE (MDI).
- 14. IEEE 802.3AE, SPECIFICATION FOR 10 GBIT/S ETHERNET OPERATION OVER OPTICAL FIBER.
- 15. TELECOMMUNICATIONS DISTRIBUTION METHODS MANUAL, 11TH ED., BUILDING INDUSTRY CONSULTING SERVICES INTERNATIONAL (BICSI), 2006.

16. INFORMATION TRANSPORT SYSTEMS INSTALLATION MANUAL, 4TH ED., BUILDING INDUSTRY CONSULTING SERVICES INTERNATIONAL (BICSI), 2004.
- B. THIS DOCUMENT IS NOT A SUBSTITUTE FOR ANY CODE, STANDARD OR REGULATION. THE APPROVED CONTRACTOR MUST BE AWARE OF LOCAL CODES THAT MAY IMPACT THE BID SUBMITTAL OR EXECUTION OF THE PROJECT. THE CURRENT REVISION OF ANY APPLICABLE CODE, STANDARD, OR REGULATION SHALL TAKE PRECEDENCE AT THE POINT OF PROJECT EXECUTION, UNLESS OTHERWISE RECOGNIZED BY LOCAL AUTHORITIES. APPLICABLE STANDARDS OR CODES THAT AFFECT CONSTRUCTION, WHICH ARE LISTED AS NORMATIVE REFERENCES WITHIN ANY GOVERNING DOCUMENT, ARE ALSO THE RESPONSIBILITY OF THE APPROVED CONTRACTOR FOR COMPLIANCE.
- C. MATERIALS:
- ALL MATERIALS SHALL BE UL OR ETL LISTED AND VERIFIED AND SHALL BE MARKED AS SUCH.
 - PRODUCTS SHALL BE REGULARLY CATALOGUED ITEMS OF THE MANUFACTURER AND SHALL BE SUPPLIED AS A COMPLETE UNIT IN ACCORDANCE WITH THE MANUFACTURER'S STANDARD SPECIFICATIONS WITH ANY OPTIONAL ITEMS REQUIRED FOR PROPER INSTALLATION UNLESS OTHERWISE NOTED.
 - MATERIAL SHALL BE DELIVERED TO THE SITE IN THE ORIGINAL PACKING.

1.11 MAINTENANCE

- A. ALL MATERIALS USED ON THIS PROJECT SHALL BE NEW. USED AND REFURBISHED EQUIPMENT IS NOT PERMITTED UNLESS APPROVED BY CITY OF MADISON. PROVIDE EQUIPMENT TO SITE IN ORIGINAL PACKAGING WHENEVER PRACTICAL.
- B. THE CONTRACTOR IS RESPONSIBLE FOR SCHEDULING ALL DELIVERIES AND PROVIDING PROPER RECEIPT, HANDLING, AND STORAGE OF ALL MATERIALS. PROTECT ALL EQUIPMENT FROM PHYSICAL DAMAGES (DENTS, SCRATCHES, DUST, WATER, PAINT, CHEMICALS, AND TEMPERATURE EXTREMES) AND VANDALISM, OR THEFT. THE CONTRACTOR SHALL REPLACE ANY DAMAGED OR STOLEN EQUIPMENT. THE CONTRACTOR IS RESPONSIBLE FOR ALL EQUIPMENT UNTIL FINAL PROJECT ACCEPTANCE BY OWNER.
- C. MAINTENANCE OF THE CABLING INFRASTRUCTURE IS TO BE DONE BY AUTHORIZED PERSONNEL ONLY, OR VOID OF MANUFACTURER'S WARRANTY MAY RESULT. IT IS THE RESPONSIBILITY OF THE OWNER OR END USER TO UTILIZE A CERTIFIED INSTALLER TO MAINTAIN WARRANTY COVERAGE ON EXISTING OR NEW CABLING INFRASTRUCTURE.
- D. THE TELECOMMUNICATIONS CONTRACTOR SHALL FURNISH A QUOTATION FOR TIME AND MATERIAL TO PERFORM MAINTENANCE AND REPAIRS. THE OWNER HAS THE FIRST RIGHT OF REFUSAL OF SELECTING A SUITABLE CONTRACTOR OR QUALIFIED INTERNAL PERSONNEL TO PERFORM MAINTENANCE AND REPAIRS ON STRUCTURED CABLING.

- E. ADDITIONS OF NEW CABLING, EITHER HORIZONTAL OR BACKBONE, SHALL BE COMPLETED, TESTED, AND DOCUMENTED INTO PERMANENT BUILDING RECORDS. NEW CABLING INSTALLATIONS INTENDED TO BE COVERED BY THE MANUFACTURER'S WARRANTY SHALL ADHERE TO THE DOCUMENTATION SUBMITTAL AND SYSTEM CERTIFICATION PROVISIONS STATED ABOVE.
- F. THE CONTRACTOR IS RESPONSIBLE FOR CLEANING THE WORKSITE EVERY BUSINESS DAY AND REMOVE DEBRIT FROM THE FACILITY.

1.12 DOCUMENTATION

A. TEST RESULTS

1. ALL TEST RESULTS ARE TO BE SAVED ELECTRONICALLY ON CD. TEST DOCUMENTATION SUBMITTED ON DISK SHALL BE CLEARLY MARKED ON THE COVER WITH THE WORDS "PROJECT TEST DOCUMENTATION", THE PROJECT NAME, AND THE DATE OF COMPLETION (MONTH AND YEAR). FOR MULTIPLE BUILDINGS, THE BUILDING NAME, INCLUDING FLOOR OR WING I.D. SHOULD ALSO BE INCLUDED ON THE TEST RESULTS DISK.
2. FILE NAMES OF THE TEST RESULTS RECORDED FOR EACH LINK SHALL MATCH THE OFFICIAL IDENTIFICATION. TEST RESULTS SHALL INCLUDE A COMPLETE RECORD FOR EACH LINK, INCLUDING TYPE OF TEST, CABLE TYPE, CABLE/PORT I.D., MEASUREMENT DIRECTION, REFERENCE SETUP, DATE, AND TECHNICIAN'S NAME(S).
3. THE TEST EQUIPMENT NAME, MANUFACTURER, MODEL NUMBER, SERIAL NUMBER, SOFTWARE VERSION AND LAST CALIBRATION DATE SHALL ALSO BE PROVIDED IN THE TEST RESULTS DOCUMENTATION.
4. WHEN REPAIRS AND RE-TESTS ARE PERFORMED, THE PROBLEM CAUSE AND CORRECTIVE ACTION TAKEN SHALL BE NOTED, AND BOTH THE FAILED AND PASSED TEST DATA SHALL BE DOCUMENTED.
5. THE OWNER, ENGINEER, LEAD PROJECT MANAGER, OR OWNER'S REPRESENTATIVE RESERVE THE RIGHT TO REQUEST VERIFICATION OF TEST RESULTS WITH A RE-TEST OF INSTALLED CABLES, ON A SAMPLING BASIS. RE-TESTING SHALL BE AT THE EXPENSE OF THE INSTALLER UNLESS OTHERWISE NOTED IN THE CONTRACT DOCUMENTS.

B. AS BUILT DRAWINGS

1. DEVIATIONS FROM THE APPROVED DRAWINGS, WHETHER OR NOT A CHANGE ORDER IS SUBMITTED, SHALL BE CLEARLY DENOTED AS BUILT ON THE WORKING HARD COPY DRAWING BY THE TELECOMMUNICATIONS CONTRACTOR. AS-BUILT DRAWINGS SHALL BE RETURNED PROMPTLY TO THE OWNER OR DESIGN AGENT FOR COMPLETION OF DRAFTING REVISIONS TO THE ORIGINAL DESIGN. SEE "DOCUMENTATION – CHANGE ORDERS" BELOW. MANUFACTURER'S WARRANTY REGISTRATIONS MAY ALSO REQUIRE AS-BUILT DRAWINGS.
2. FLOOR PLAN DRAWINGS SHALL AT MINIMUM INCLUDE DETAILED CABLE AND PATHWAY LAYOUTS, EXACT LOCATIONS OF WORKSTATION OUTLETS, AND CABLE DISTRIBUTION HARDWARE LOCATIONS. WORKSTATION OUTLETS SHALL HAVE ALPHANUMERIC

IDENTIFIERS ON THE DRAWINGS AS SPECIFIED BY THE END USER OR OWNER.

C. CHANGE ORDERS

1. ANY DEVIATION FROM THE APPROVED CONTRACT DRAWINGS OR SPECIFICATIONS SHALL BE SUBMITTED AS A WRITTEN CHANGE ORDER.
2. EXECUTION OF WORK, TO PERFORM CHANGES, SHALL NOT PROCEED WITHOUT PRIOR WRITTEN APPROVAL. ANY CHANGES DONE WITHOUT WRITTEN APPROVAL WILL BE AT NO COST TO CITY OF MADISON . IF THE WORK IS SHOWN TO BE INCORRECT THE CONTRACTOR WILL HAVE TO CORRECT THE PROBLEM AT NO COST TO CITY OF MADISON .
3. SIGNIFICANT CHANGES MAY REQUIRE A WRITTEN QUOTATION OF ADDITIONAL LABOR AND MATERIALS FROM THE TELECOMMUNICATIONS CONTRACTOR.
4. IT IS THE RESPONSIBILITY OF THE OWNER OR OWNER'S REPRESENTATIVE TO BEAR THE ADDED COST OF ANY SUBSTANTIAL CABLING SYSTEM DESIGN CHANGES. THE CONTRACTOR WILL NOT PROCEED WITH ANY CHANGE ORDERS WITHOUT WRITTEN APPROVAL BY THE OWNER'S REPRESENTATIVE. ANY CHANGES NOT APPROVED BY THE OWNER'S REPRESENTATIVE WILL BE RESPONSIBILITY OF THE CONTRACTOR AND AT NO COST TO CITY OF MADISON .
5. FIELD CHANGES THAT ARE COMPLETED WITHOUT ISSUANCE OF REVISED DRAWINGS SHALL BE CLEARLY DENOTED ON THE WORKING AS-BUILT DRAWING. REFER TO "AS-BUILT DRAWINGS" ABOVE.

D. PUNCH LISTS AND CORRECTIVE ACTION

1. AS REQUIRED IN THE CONTRACT DOCUMENTS, THE TELECOMMUNICATIONS CONTRACTOR SHALL CORRECT PUNCH-LISTS ITEMS DETERMINED TO BE IN VIOLATION OF DRAWINGS, SPECIFICATIONS, CODES, STANDARDS OR REGULATIONS.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR TIMELY RE-WORK OF AULTY CABLING OR HARDWARE INSTALLATIONS.
3. OWNER RESERVES THE RIGHT TO WITHHOLD FINAL PAYMENT UNTIL PUNCH LIST ITEMS ARE RESOLVED SATISFACTORILY.

1.13 WARRANTY

- A. THE CITY OF MADISON REQUIRES A PERMANENT LINK WARRANTY FOR THE PROJECT. MANUFACTURER REQUIRES PERMANENT LINK TEST.
- B. THE LENGTH OF THE EXTENDED WARRANTY SHALL BE A MINIMUM OF TWENTY-FIVE (25) YEARS.
- C. WARRANTY COVERING ALL COMPONENTS, EQUIPMENT AND WORKMANSHIP SHALL BE SUBMITTED IN WRITING WITH SYSTEM DOCUMENTATION.
- D. THE WARRANTY PERIOD SHALL BEGIN ON THE SYSTEM'S FIRST USE BY THE OWNER.

- E. SHOULD THE CABLING SYSTEM FAIL TO PERFORM ITS EXPECTED OPERATION WITHIN THIS WARRANTY PERIOD DUE TO INFERIOR OR FAULTY MATERIAL AND/OR WORKMANSHIP, THE CONTRACTOR SHALL PROMPTLY MAKE ALL REQUIRED CORRECTIONS WITHOUT COST TO THE OWNER
- F. UPON COMPLETION OF THE PROJECT THE TELECOMMUNICATION CONTRACTOR SHALL FORWARD THE SIGNED WARRANTY REGISTRATION FORM AND WARRANTY CERTIFICATE TO THE OWNER.
- G. THE MANUFACTURER WARRANTS CATEGORY 6 CABLING, OPTICAL FIBER CABLING AND CONNECTING COMPONENTS FREE OF DEFECTS IN MATERIAL OR WORKMANSHIP.
- H. CATEGORY 6 AND OPTICAL FIBER CABLING AND COMPONENTS ARE WARRANTED TO PERFORM THE INTENDED APPLICATION UPON COMPLETION OF PROPER INSTALLATION AND TESTING.
- I. WARRANTY COVERAGE INCLUDES APPLICATION ASSURANCE AND COMPLIANCE TO APPLICABLE PERFORMANCE SPECIFICATIONS.
- J. INSTALLED CATEGORY 6 CABLING SYSTEMS MAY BE GRANTED A FULL CHANNEL WARRANTY UNDER THE CONDITIONS STATED BELOW.
 - 1. A CERTIFIED INSTALLER REGISTERED WHO HAS COMPLETED A MANUFACTURER'S TRAINING PROGRAM PERFORMS THE CONSTRUCTION.
 - 2. CONTRACTORS PERFORMING THE CERTIFIED INSTALLATION ARE PROPERLY REGISTERED IN THE MANUFACTURER'S WARRANTY PROGRAM.
 - 3. THE CHANNEL COMPONENTS ARE SUPPLIED ENTIRELY BY ONE MANUFACTURER, INCLUDING PATCH CORDS.
 - 4. CABLE USED IN THE INSTALLATION IS QUALIFIED AND RECOGNIZED BY CONNECTIVITY MANUFACTURER.
 - 5. INSTALLED LINK SYSTEMS ARE PROPERLY DOCUMENTED AND TESTED WITH A "PASS" RESULT. THE COUNTY REQUIRES A LINK TEST AND THE USE OF MANUFACTURER PATCH CORDS TO RECEIVE A CHANNEL WARRANTY.
 - 6. FIELD TEST EQUIPMENT USED FOR CATEGORY 6 CABLING IS MINIMUM LEVEL III CLASSIFICATION, AND COMPLIES WITH TIA/EIA-568-B.2 REQUIREMENTS.
 - 7. REQUIRED TEST RESULTS, STORED ON A CD, AND PROJECT DOCUMENTATION INCLUDING AS-BUILT DRAWINGS, ARE SUBMITTED TO THE MANUFACTURER BY THE REGISTERED CONTRACTOR.

1.14 MOVES, ADDS AND CHANGES

- A. MOVES, ADDS AND CHANGES INITIATED BY THE OWNER, END USER, PROJECT MANAGER, OR DESIGN AGENT, WHICH ARE BEYOND THE SCOPE OF WORK IN THE ORIGINAL CONTRACT, SHALL REQUIRE A REVISED QUOTATION BY THE TELECOMMUNICATIONS CONTRACTOR.

- B. IT IS THE RESPONSIBILITY OF THE OWNER OR OWNER'S REPRESENTATIVE TO BEAR THE ADDED COST OF ANY SUBSTANTIAL CABLING SYSTEM DESIGN CHANGES.
- C. MOVES, ADDS AND CHANGES SHALL EITHER BE ISSUED IN REVISED DRAWINGS, OR OTHERWISE SHALL BE CLEARLY DENOTED ON AS-BUILT DRAWINGS.
- D. MOVES, ADDS AND CHANGES THAT AFFECT INSTALLATIONS COVERED IN A MANUFACTURER'S WARRANTY SHALL BE PERFORMED BY A CERTIFIED CONTRACTOR THAT IS PROPERLY REGISTERED IN THE MANUFACTURER'S WARRANTY PROGRAM.

1.15 CLEANUP

- A. THE COMMUNICATIONS CONTRACTOR SHALL CLEAN UP ALL DEBRIS RELATED TO THIS WORK ON A REGULAR BASIS LEAVING THE JOB SITE IN A CLEAN, SAFE CONDITION.
- B. PROTECT ALL EQUIPMENT FROM DAMAGE DURING CONSTRUCTION. EQUIPMENT NOT PROTECTED SHALL BE REPLACED AT THE CONTRACTOR'S EXPENSE.

PART 2 - PRODUCTS

2.1 WORK AREA CONNECTORS

- A. CATEGORY 6 JACKS
 - 1. JACKS SHALL BE STANDARD 8-POSITION, RJ-45 STYLE, UN-KEYED, FCC COMPLIANT.
 - 2. JACKS SHALL BE DESIGNED FOR 4-PAIR, 100 OHM BALANCED UNSHIELDED TWISTED PAIR (UTP) CABLE.
 - 3. JACKS SHALL TERMINATE 26-22 AWG SOLID OR STRANDED CONDUCTORS.
 - 3. JACKS SHALL INCLUDE A DUST CAP FOR WIRE RETENTION.
 - 4. JACKS SHALL ACCEPT FCC COMPLIANT 6 POSITION PLUGS.
 - 5. JACKS SHALL HAVE ATTACHED WIRING INSTRUCTION LABELS TO PERMIT EITHER T568A OR T568B WIRING CONFIGURATIONS.
 - 6. CATEGORY 6 JACKS SHALL BE BACKWARD COMPATIBLE WITH EXISTING CATEGORY 3, 5, AND 5E CABLING SYSTEMS FOR FIT, FORM, AND FUNCTION.
 - 7. JACKS SHALL BE MANUFACTURED IN THE USA.
 - 8. CATEGORY 6 JACKS SHALL MEET OR EXCEED CATEGORY 6 TRANSMISSION REQUIREMENTS FOR CONNECTING HARDWARE, AS SPECIFIED IN ANSI/TIA/EIA-568-C.2, TRANSMISSION PERFORMANCE SPECIFICATIONS FOR 4-PAIR 100 OHM
 - 9. JACKS SHALL BE UL LISTED AND CSA CERTIFIED.
 - 10. COLORS TO SPECIFIED BY END USER
 - 11. CATEGORY 6 MODULAR JACKS, AS SPECIFIED IN THE CONTRACT DOCUMENTS, SHALL BE:
 - HUBBELL HXJ6EI (CATEGORY 6)

2.2 FACE PLATES

A. REAR LOADING W/DESIGNATION WINDOW

1. FACEPLATES SHALL BE CONSTRUCTED OF HIGH IMPACT, UL94 V-0 RATED THERMOPLASTIC.
2. FACEPLATES SHALL BE COMPATIBLE WITH STANDARD NEMA OPENINGS AND BOXES.
3. FACEPLATES SHALL BE 2.75" W X 4.5" H (69.8 MM X 114.3 MM) FOR SINGLE GANG AND 4.5" X 4.5" (114.3 X 114.3 MM) FOR DOUBLE GANG.
4. PORT SIZE IN EACH FACEPLATE SHALL FIT THE CATEGORY 6 MODULAR JACK OR SNAP-FIT FIBER OPTIC, AUDIO, AND VIDEO MODULES FOR MULTIMEDIA APPLICATIONS.
5. FACEPLATES SHALL BE PROVIDED WITH CLEAR PLASTIC AND COLOR-MATCHED LABEL FIELD COVERS. FACEPLATES SHALL PROVIDE FOR ANSI/TIA/EIA-606-A COMPLIANT WORKSTATION OUTLET LABELING.
6. #6-32 PAN HEAD PHILLIPS/SLOTTED MOUNTING SCREWS SHALL BE INCLUDED WITH EACH FACEPLATE.
7. FACEPLATES SHALL BE UL LISTED AND CSA CERTIFIED.
8. WORK AREA FACEPLATES, AS SPECIFIED IN THE CONTRACT DOCUMENTS, SHALL BE HUBBELL (IFP SERIES) IFP14EI (4-PORT)

2.3 CABLE

A. CATEGORY 6 UTP

1. PLENUM - CABLE CONSTRUCTION SHALL BE FOUR TWISTED PAIRS OF 23 AWG INSULATED SOLID CONDUCTORS, WITH A RIPCORD, SURROUNDED BY A TIGHT OUTER JACKET.
2. NON-PLENUM - CABLE CONSTRUCTION SHALL BE FOUR TWISTED PAIRS OF 24 AWG INSULATED SOLID CONDUCTORS, WITH A RIPCORD, SURROUNDED BY A TIGHT OUTER JACKET.
3. NO MINIMUM COMPLIANT CABLE WILL BE ACCEPTED. THE FACILITY REQUIRES ADDITIONAL BANDWIDTH.
4. RIPCORD SHALL BE DIRECTLY UNDERNEATH THE OUTER JACKET.
5. CABLE SHALL BE MARKED WITH MANUFACTURER AND PERTINENT INFORMATION. UL, ETL, OR CSA AGENCY CERTIFICATION OR VERIFICATION MARKINGS SHALL BE MARKED ON THE CABLE JACKET ACCORDING TO THE CERTIFYING AGENCY'S REQUIREMENTS.
6. COLOR CODING OF THE PAIRS SHALL BE AS FOLLOWS:
 - PAIR 1: WHITE/BLUE; BLUE
 - PAIR 2: WHITE/ORANGE; ORANGE
 - PAIR 3: WHITE/GREEN; GREEN
 - PAIR 4: WHITE/BROWN; BROWN
7. PLENUM OR RISER RATED JACKETS
8. CABLE SHALL BE SUPPLIED IN 1000 FT SPOOLS OR 1000 FT REELEX BOXES.
9. CABLE SHALL EXCEED CATEGORY 6 TRANSMISSION REQUIREMENTS SPECIFIED IN ANSI/TIA/EIA-568-C.2.
10. CABLE SHALL BE UL AND C(UL) LISTED.

11. CABLE SHALL EXCEED THE REQUIREMENTS OF TIA/TSB-155: 10 GB/S ETHERNET OPERATION OVER 37 METERS CHANNEL LENGTH.
12. CATEGORY 6 UTP HORIZONTAL DISTRIBUTION CABLE, AS SPECIFIED IN THE CONTRACT DOCUMENTS, SHALL BE
 - MOHAWK ADVANCENET CABLE
PLENUM M57193
RISER M57202

B. BACKBONE DISTRIBUTION CABLE – FIBER OPTIC

1. SINGLEMODE FIBER BACKBONE DISTRIBUTION CABLE SHALL BE AVAILABLE IN MULTI-STRAND CONSTRUCTIONS FOR INTRABUILDING APPLICATIONS.
2. OFNR OR OFNP WILL BE DETERMINED AT EACH SITE. THE CONTRACTOR WILL BE RESPONSIBLE TO ASSURE THAT THE PROPER TYPE OF JACKETING IS BEING USED. FAILURE TO MEET THE LOCAL CODE WILL BE CAUSE FOR REPLACEMENT OF CABLE AT NO EXPENSE TO CITY OF MADISON.
3. SINGLEMODE FIBER SHALL BE DISPERSION UN-SHIFTED FIBER IN COMPLIANCE WITH ANSI/TIA/EIA-492CAA.
4. INTRABUILDING FIBER DISTRIBUTION CABLE DESIGN SHALL BE ACCORDING TO ANSI/ICEA S-83-596.
5. SINGLEMODE BACKBONE FIBER DISTRIBUTION CABLE, WHEN INSTALLED, SHALL EXCEED THE PERFORMANCE REQUIREMENTS OF ANSI/TIA/EIA-568-C.3.
6. SINGLEMODE OPTICAL FIBER BACKBONE FIBER DISTRIBUTION CABLE, AS SPECIFIED IN THE CONTRACT DOCUMENTS, SHALL BE
 - MOHAWK CABLE (BASIS OF DESIGN) OR EQUAL
 - SINGLEMODE RISER M9W042 (12 STRAND) – UNLESS OTHERWISE SPECIFIED BY THE CITY OF MADISON.
 - SINGLEMODE PLENUM M9W048 (12 STRAND) - UNLESS OTHERWISE SPECIFIED BY THE CITY OF MADISON.

2.4 CONNECTORS – FIBER OPTIC

- A. PRE-POLISHED FIBER CONNECTOR BASIC DESIGN SHALL BE A FACTORY PRE-POLISHED LC-STYLE OPTICAL FIBER CONNECTOR WITH A ZIRCONIUM CERAMIC FERRULE.
- B. INDEX-MATCHING GEL IS FACTORY-INJECTED INTO THE CLEAVED FIBER STUB SPLICE TO MINIMIZE CONNECTOR INSERTION LOSS.
- C. LC SINGLEMODE FACTORY PRE-POLISHED CONNECTORS SHALL HAVE PRE-INSTALLED FIBERS.
- D. CONNECTOR MATERIALS SHALL BE DESIGNED WITH THERMAL STABILITY TO COMPLY WITH ENVIRONMENTAL REQUIREMENTS OF ANSI/TIA/EIA-568-B.3 AND TELCORDIA GR-1081-CORE.
- E. PRE-POLISHED LC CONNECTORS SHALL REQUIRE NO FIELD POLISHING AND REQUIRE NO ADHESIVES FOR TERMINATION.

- F. CONNECTOR DESIGN AND TERMINATION TECHNIQUE SHALL BE INDEPENDENT OF CABLE TYPE OR MANUFACTURER, AND SHALL BE COMPATIBLE FOR EITHER 900 MICRON BUFFER OR 250 MICRON BUFFER DISTRIBUTION CABLES.
- G. PRE-POLISHED LC FIBER CONNECTORS, WHEN PROPERLY INSTALLED ONTO QUALIFIED CABLE, SHALL MEET THE 10 GB/S ETHERNET PERFORMANCE REQUIREMENTS OF IEEE802.3.
- H. LC FIBER CONNECTORS, PROPERLY INSTALLED ONTO QUALIFIED CABLE, SHALL EXCEED THE MECHANICAL AND ENVIRONMENTAL PERFORMANCE REQUIREMENTS OF ANSI/TIA/EIA-568-C.3.
- I. MULTIMODE OPTICAL FIBER HORIZONTAL DISTRIBUTION CABLE, AS SPECIFIED IN THE CONTRACT DOCUMENTS, SHALL BE
 - 1. HUBBELL (PROCLICK) SINGLEMODE LC - FCLC900KSM12
 - 2. AFL (FAST) SINGLEMODE LC – FAST-LC-SM

2.5 PATCH PANELS – CATEGORY 6

- A. CATEGORY 6 PATCH PANELS SHALL BE STANDARD 8-POSITION, RJ-45 STYLE, UN-KEYED, FCC-COMPLIANT RECEPTACLE, IN 24- AND 48-PORT CONFIGURATIONS.
- B. PANEL FRAMES SHALL BE BLACK POWDER COATED 14-GAGE STEEL WITH ROLLED EDGES TOP AND BOTTOM FOR PROPER STIFFNESS.
- C. PANELS SHALL ACCOMMODATE A MINIMUM OF 24 PORTS FOR EACH RACK MOUNT UNIT (1 RMU = 1.75 IN.). 48 PORTS ARE RECOMMENDED.
- D. PANELS SHALL BE DESIGNED FOR 4-PAIR, 100 OHM BALANCED UNSHIELDED TWISTED PAIR (UTP) CABLE.
- E. PANELS SHALL TERMINATE 26-22 AWG SOLID CONDUCTORS.
- F. PANELS SHALL HAVE INDIVIDUAL PORT IDENTIFICATION NUMBERS ON THE FRONT AND REAR OF THE PANEL. PANELS SHALL HAVE THE CATEGORY 6 DESIGNATION, VISIBLE FROM THE FRONT WHEN INSTALLED.
- G. PRINTED CIRCUIT BOARDS SHALL BE FULLY ENCLOSED FRONT AND REAR FOR PHYSICAL PROTECTION.
- H. PANEL CONTACTS SHALL ACCEPT A MINIMUM OF 2000 MATING CYCLES WITHOUT DEGRADATION OF ELECTRICAL OR MECHANICAL PERFORMANCE.
- I. PANEL TERMINATION METHOD SHALL FOLLOW THE INDUSTRY STANDARD 110 IDC PUNCH-DOWN, USING A STANDARD 110 IMPACT TERMINATION TOOL.
- J. CATEGORY 6 PANELS SHALL BE BACKWARD COMPATIBLE WITH EXISTING CATEGORY 3, 5, AND 5E CABLING SYSTEMS FOR FIT, FORM, AND FUNCTION.

- K. CATEGORY 6 PATCH PANELS, WHEN INSTALLED, SHALL EXCEED THE LINK OR CHANNEL PERFORMANCE REQUIREMENTS OF ANSI/TIA/EIA-568-C.2.
- L. CATEGORY 6 PATCH PANELS SHALL BE ABLE TO ACCOMMODATE 10G IN A 37 METER CHANNEL PER TSB-155.
- M. CATEGORY 6 PATCH PANELS, AS SPECIFIED IN THE CONTRACT DOCUMENTS, SHALL BE:
 - 1. HUBBELL (NEXTSPEED 6 SERIES)
 - a 24 PORT - P6E24U
 - b 48 PORT - P6E48U

2.6 RACKS – FREE STANDING – 2 POST

- A. RACK MATERIAL SHALL BE STRUCTURAL ALUMINUM WITH A DURABLE BLACK POLYURETHANE POWDER COAT FINISH.
- B. INSTALLED RACKS SHALL HAVE A STATIC LOAD CAPACITY OF 500 LBS.
- C. RACKS SHALL BE AVAILABLE IN EITHER 19-INCH OR 23-INCH STANDARD RACK CONFIGURATIONS.
- D. TAPPED HOLES IN THE VERTICAL RAILS FOR MOUNTING OF PANELS SHALL BE #12-24 THREAD SIZE. COATING SHALL NOT INTERFERE WITH THREAD FIT.
- E. STANDARD RACK HEIGHTS OF 7 FT (84 IN), AND HAVE A CAPACITY OF 45 RMU.
- F. RACK BASE ANGLES SHALL BE PRE-DRILLED FOR FLOOR MOUNTING, AND FOR ASSEMBLY TO VERTICAL RAILS.
- G. EACH RACK SHALL BE PROVIDED WITH, RACKS SHALL ACCOMMODATE EXPANSION OF CABLE CAPACITY AND ADDED VOLUME FOR CATEGORY 6 CABLING.

NOTE: EACH BASIC RACK DELIVERED SHALL CONSIST OF: EQUIPMENT RACK, ISOLATION PADS, 18" WIDE BLACK LADDER RACK & MOUNTS TO SECURE TO RACK, A VERTICAL ELECTRICAL 20 AMP OUTLET STRIP (MINIMUM 6 RECEPTACALS) WITH MOUNTING BRACKETS.

- H. FREE STANDING RACKS AND ACCESSORIES, AS SPECIFIED IN THE CONTRACT DOCUMENTS, SHALL BE:
 - 1. HUBBELL (NEXTFRAME SERIES)
 - a HPW84RR19

2.7 CABLE MANAGEMENT – VERTICAL CABLE MANAGEMENT

- A. Z-CHANNEL DESIGN OFFERS:
 - 1. AIRFLOW
 - 2. MINIMIZES WEIGHT
 - 3. MAXIMUM CABLE CAPACITY WITH UNOBSTRUCTED ACCESS TO CABLE

- B. SNAP IN SPOOLS WITH ABILITY TO PUT THEM WHERE THEY WILL DO THE MOST GOOD.
- C. REAR CABLE MANAGEMENT ALLOWS CABLE TO BE RUN ON BOTH LEFT AND RIGHT SIDES, WHILE LEAVING THE AREA BEHIND THE ELECTRONICS AND PATCH PANELS OPEN FOR INCREASED AIRFLOW.
- D. CONSTRUCTION:
 - 1. COLD ROLLED STEEL Z-CHANNELS
 - 2. COLD ROLLED STEEL COVERS
- E. MOUNTS TO 84" EQUIPMENT RACKS.
- F. CHANNEL WIDTH: 6"W.
- G. VERTICAL CABLE MANAGEMENT AND ACCESSORIES, AS SPECIFIED IN THE CONTRACT DOCUMENTS, SHALL BE:
 - 1. HUBBELL (NEXTFRAME SERIES) VS76

2.8 CABLE MANAGEMENT – HORIZONTAL

- A. HORIZONTAL MANAGEMENT WILL BE CONSTRUCTED OF 14 GA COLD-ROLLED STEEL (CRS).
- B. FINISH SHALL BE A DURABLE, BLACK POWDER COAT.
- C. SIZE: 2RU.
- D. FRONT RING DEPTH: 3.5" .
- E. ALL STEEL CONSTRUCTION - RUGGED, NON-FLAMMABLE, NO FASTENERS TO WEAR OR BREAK, NO FINGERS TO FUSS WITH.
- F. MODULAR COMPONENTS EASILY CONFIGURED IN FIELD TO ADAPT TO DEMANDING APPLICATIONS.
- G. HINGED FRONT COVER - LOCKS IN PLACE WHEN COMPLETELY OPEN TO PREVENT COVER FROM BEING REMOVED OR LOST.
- H. HORIZONTAL CABLE MANAGEMENT AND ACCESSORIES, AS SPECIFIED IN THE CONTRACT DOCUMENTS, SHALL BE:
 - 1. HUBBELL (NEXTFRAME SERIES) HC219CE3N
- I. ENCLOSURES – FIBER RACK MOUNT:
 - 1. RACK-MOUNTED, POWDER COATED FORMED COLD ROLLED STEEL ENCLOSURE.
 - 2. SWING-OUT OR PULL-OUT INNER TRAY SHALL PROVIDE ACCESS TO INNER CABLES AND CONNECTIONS, AND MAINTAIN PROPER CABLE BEND RADIUS THROUGHOUT THE RANGE OF MOTION.

3. FIBER RACK-MOUNT ENCLOSURES SHALL BE A 19-INCH FORMED/WELDED AND POWDER COATED MODULAR DESIGN, SIZED ACCORDING TO THE CABLE INSTALLATION.
4. FIBER RACK-MOUNT ENCLOSURES MAY SERVE AS A MAIN, HORIZONTAL, OR INTERMEDIATE CROSS CONNECT FACILITY.
5. PANEL MOUNTING BRACKETS SHALL BE CONFIGURABLE TO EITHER 19" OR 23" RACKS PER ANSI/EIA-310-D.
6. ENCLOSURE CHASSIS SHALL HAVE TWO MOUNTING BRACKET LOCATIONS FOR EITHER FLUSH MOUNT OR CENTER MOUNT ON THE RACK.
7. INNER TRAY SHALL HAVE A THREADED MOUNTING BOSS TO ACCEPT A MOUNTING STUD FOR SPLICE TRAYS. SPLICE TRAY CAPACITY SHALL BE (2) 10" SPLICE TRAYS, EACH WITH 24-SPLICE CAPACITIES (48 SPLICES TOTAL). SPLICE TRAY MOUNTING BOSS SHALL ALSO ACCEPT A STUD FOR MOUNTING 1-RMU BLOWN FIBER ADAPTER BRACKETS.
 - INNER TRAY MOUNTING POSTS FOR MODULAR PANELS SHALL ALSO ACCEPT 12-FIBER MTP-STYLE CASSETTES FOR "PLUG & PLAY" INSTALLATIONS.
 - INNER TRAY SHALL HAVE REAR CABLE TIE-DOWN FEATURES TO ACCEPT VARIOUS DIAMETER BACKBONE CABLES ENTERING THE ENCLOSURE.
 - ENCLOSURES SHALL BE CONSTRUCTED OF 16 GAGE COLD ROLLED STEEL (CRS)
 - FIBER RACK-MOUNT ENCLOSURES AND ACCESSORIES, AS SPECIFIED IN THE CONTRACT DOCUMENTS, SHALL BE:
 - CLEARFIELD – FIELDSMART FIBER CROSSOVER DISTRIBUTION SYSTEM.

J. ADAPTER PANELS – OPTICAL FIBER

1. OPTICAL FIBER ADAPTER PANELS SHALL BE A MODULAR DESIGN POWDER COATED STAMPED METAL CONSTRUCTION.
2. ADAPTER PANELS SHALL BE LC.
3. HIGH OR LOW-DENSITY VERSIONS.
4. ADAPTER PANELS SHALL HAVE QUICK-RELEASE SNAP FASTENERS TO FIT DIRECTLY INTO FIBER ENCLOSURES.
5. FIBER PATCH PANELS, AS SPECIFIED IN THE CONTRACT DOCUMENTS, SHALL BE:
 - CLEARFIELD – CLEARVIEW CLASS PATCH ONLY CASSETTE.

2.9 INNER-DUCT

- A. FIBER OPTIC CABLE SHALL BE INSTALLED WITH INNERDUCT FOR PROTECTION OF FIBER CABLES IN A SHARED PATHWAY'
- B. THE INNER DUCT WILL BE RATED FOR THE ENVIRONMENT THAT IT IS BEING INSTALLED IN. PLENUM AND RISER RATED.
- C. THREE INNER DUCTS WILL BE RUN BETWEEN CLOSETS. ONE FOR CURRENT INSTALLATION, TWO SPARE FOR FUTURE APPLICATIONS.
 1. SIZE: 1" CORRUGATED.

2. FLEXIBLE & LIGHTWEIGHT FOR EASE OF HANDLING
3. PRE-THREADED WITH PULL LINE

PART 3 - EXECUTION

3.1 APPROVED CONTRACTOR RESPONSIBILITIES

- A. THE APPROVED CONTRACTOR SHALL ASSUME THE FOLLOWING RESPONSIBILITIES:
 1. EXECUTE CONSTRUCTION IN ACCORDANCE WITH CONTRACT DRAWINGS AND SPECIFICATIONS.
 2. ADHERE TO PROJECT SCHEDULES AND JOB SITE RULES.
 3. ADHERE TO THE QUALITY, REGULATORY, LOGISTICS, AND DOCUMENTATION REQUIREMENTS.
 4. ADHERE TO THE PRODUCT REQUIREMENTS OUTLINED IN PART 2 ABOVE.
 5. ADHERE TO THE EXECUTION GUIDELINES OUTLINED BELOW.
 6. FURNISH THE CABLING SYSTEM CERTIFICATION AND WARRANTY PROVISIONS OUTLINED IN PART 4 BELOW.

3.2 DELIVERY, STORAGE AND HANDLING LOGISTICS

- A. MATERIALS DELIVERED TO THE CONSTRUCTION SITE SHALL BE STORED IN A DRY, SECURE AREA, PREFERABLY INDOORS. STORAGE TEMPERATURE OF MATERIALS SHALL ADHERE TO MANUFACTURER'S RECOMMENDATIONS. MOVEMENT OF PACKAGED MATERIALS SHALL BE IN A MANNER TO AVOID DAMAGE OF CONTENTS. ON-SITE STORAGE, EITHER INDOORS OR TRAILER, SHALL HAVE PERMISSION BY THE OWNER, AND SHALL NOT INTERFERE WITH OTHER CONSTRUCTION ACTIVITY.
- B. INSTALLATION OF CATEGORY 6 CABLE SHALL BE WITHIN THE RECOMMENDED TEMPERATURE RANGE SPECIFIED BY THE MANUFACTURER. CABLE INSTALLATION TEMPERATURE ABOVE 50F IS RECOMMENDED.

3.3 PREPARATION

- A. CABLE PATHWAYS AND FIRESTOPS
 1. CABLE PATHWAYS, INCLUDING CONDUIT, CABLE TRAY, LADDER RACK, RACEWAY, SLOTS, SLEEVES, ETC. SHALL BE LOCATED AND MOUNTED ACCORDING TO CONTRACT DRAWINGS AND MANUFACTURER'S INSTRUCTIONS. PATHWAYS SHALL NOT BE INSTALLED IN WET AREAS.
 2. CABLE PATHWAY FILL RATIO, BEND RADIUS, RUN LENGTH, NUMBER OF BENDS, AND PROXIMITY TO EMI SOURCES SHALL BE IN ACCORDANCE WITH ANSI/TIA/EIA-569-B. MAXIMUM CABLE COUNT OF THE INITIAL INSTALLATION SHALL NOT EXCEED 40% FILL RATIO IN ANY PATHWAY.
 3. IN ACCORDANCE WITH NEC 2005, POWER WIRING AND COMMUNICATIONS CABLING SHALL NOT SHARE THE SAME PATHWAY OR OUTLET UNLESS SEPARATED BY A PHYSICAL BARRIER.

4. CABLE PATHWAYS SHALL BE SECURED TO A STRUCTURAL MEMBER OF THE BUILDING, OR PERMANENT WALL STUDS. WALL SURFACES FOR RACEWAY MOUNTING SHOULD BE FINISHED COMPLETE.
5. METALLIC PATHWAYS SHALL BE ELECTRICALLY CONTINUOUS, FREE OF SHARP EDGES, AND PROPERLY BONDED TO AN APPROVED GROUND. EMI SOURCES SUCH AS BALLASTS, MOTORS, AND BUS CONDUCTORS SHALL BE AVOIDED BY USING PROPER SEPARATION DISTANCES.
6. PATHWAYS THAT PENETRATE FIRE-RATED BARRIERS SHALL BE FIRE STOPPED ACCORDING TO LOCAL CODES AND RECOGNIZED PRACTICES. FIRE STOP MATERIALS OR DEVICES SHALL BE QUALIFIED TO UL-1479, IN ACCORDANCE WITH ASTM E814. FIRE STOP METHOD SHALL HAVE P.E. APPROVAL.
7. CORE DRILLING OF HOLES FOR FIRE-RATED POKE-THROUGH OUTLET DEVICES SHALL HAVE APPROVAL BY A STRUCTURAL ENGINEER OR P.E. ON THE CONTRACT DRAWINGS PRIOR TO START OF WORK.
8. PATHWAYS FOR VERTICAL CABLE RUNS, SUCH AS SLOTS AND SLEEVES, SHALL BE INSTALLED IN THE PROPER LOCATION IN ACCORDANCE WITH APPLICABLE CODES AND STANDARDS.

B. TELECOMMUNICATIONS ROOMS AND EQUIPMENT ROOMS

1. TELECOMMUNICATIONS ROOM (TR) LAYOUT, LOCATION AND DESIGN SHALL BE IN ACCORDANCE WITH THE GUIDELINES OF ANSI/TIA/EIA-569-B. TR'S ON EACH FLOOR OF THE BUILDING SHOULD BE CENTRALLY LOCATED AND VERTICALLY ALIGNED TO SIMPLIFY BACKBONE CABLE AND PATHWAY ROUTING. TR'S SHALL NOT BE INSTALLED IN WET AREAS, OR NEAR EMI SOURCES OR CAUSTIC CHEMICALS.
2. LAYOUT OF RACK, CABINET OR ENCLOSURE LOCATIONS SHALL BE ACCORDING TO CONTRACT DRAWINGS.
3. RACKS AND CABINETS SHALL BE SECURED TO THE FLOOR USING PROPER ANCHORS AND FASTENERS.
4. MOUNT AND ASSEMBLE RACKS, CABINETS, BRACKETS AND ENCLOSURES PER MANUFACTURER'S INSTRUCTIONS. MOUNT PATCH PANELS AND CABLE MANAGEMENT ACCESSORIES IN THE SPECIFIED LOCATIONS.
5. ADJOINING PATHWAYS (LADDER RACK, CABLE TRAY, ETC.) SHALL BE PROPERLY SECURED AND POSITIONED TO ALLOW ADEQUATE BEND RADIUS OF CABLES ENTERING THE RACK OR CABINET.

C. WALL OUTLETS AND RECESSED WALL BOXES

1. WALL OUTLET AND CABLE DROP PATHWAY LOCATION SHALL BE ACCORDING TO CONTRACT DRAWINGS. GUIDELINES FROM ANSI/TIA/EIA-569-B SHOULD BE FOLLOWED FOR LOCATION WITH ELECTRICAL OUTLETS AND OUTLET HEIGHT ABOVE FINISHED FLOOR.
2. OUTLET BOXES SHALL BE FASTENED SECURELY TO A WALL STUD OR STRUCTURAL ELEMENT, IN A MANNER TO PERMIT FLUSH MOUNTING OF THE FACEPLATE WITH THE FINISHED WALL.
3. MULTI-CONNECT BOXES SHALL BE INSTALLED IN A MANNER TO COMPLY WITH SEPARATION RULES FOR POWER AND COMMUNICATIONS WIRING IN CLOSE PROXIMITY.

4. REFER TO SPECIFIC MANUFACTURER'S RECOMMENDATIONS FOR WALL OUTLET SELECTION, CABLE DEPLOYMENT, AND TERMINATION OF JACKS INTO FACEPLATES.

D. SURFACE HOUSINGS AND MUTOA OUTLETS

1. RACEWAY OR CONDUIT SHOULD BE DEPLOYED TO THE SURFACE HOUSING LOCATION. FOR THROUGH-WALL CABLE ENTRY, CUT THE WALL OPENING TO MATCH THE OPENING IN THE HOUSING BASE.
2. LAY OUT MOUNTING HOLES ONTO THE DESIRED WALL LOCATION. FOR WALLBOARD, CONCRETE OR CINDER BLOCK WALLS, DRILL TO THE PROPER DEPTH AND INSTALL ANCHORS.
3. ALWAYS USE PROPER WALL ANCHORS. INSTALLING MOUNTING SCREWS DIRECTLY INTO WALLBOARD WITHOUT USING ANCHORS CAN CAUSE SCREW PULLOUT AND DETACHMENT OF THE SURFACE HOUSING. MOUNTING THE BASE PLATE TO STUDS IS RECOMMENDED.
4. MOUNT BASE PLATE OF SURFACE BOX OR MUTOA TO OUTLET LOCATION USING PROPER FASTENERS. NOTE: FURNITURE AND WALL OUTLET APPLICATIONS REQUIRE MOUNTING OF BASE PLATE PRIOR TO CABLE PULLING AND CONNECTOR TERMINATION.
5. INSTALL COVER ONTO BASE PLATE.
6. REFER TO DETAILED MANUFACTURER'S GUIDELINES FOR CABLE DEPLOYMENT AND TERMINATION OF JACKS INTO SURFACE HOUSINGS. DUE TO THE LARGER SIZE OF CATEGORY 6 CABLES, PROPER CABLE BEND RADIUS MUST BE MAINTAINED. CERTAIN RESTRICTIONS MAY APPLY WHEN DRESSING CATEGORY 6 CABLING INTO SURFACE HOUSINGS.

3.4 INSTALLATION

A. CABLE SUPPORT

1. THIS CONTRACTOR SHALL INSTALL ALL SUPPORTS FOR CABLES SPECIFIED IN THIS SECTION. TRADITIONAL LADDER RACK WILL BE USED IN EACH TELECOMMUNICATIONS ROOM, BASKET TRAY AND J-HOOKS WILL BE USED IN THE HORIZONTAL.
2. CABLE SUPPORTS SHALL BE SPACED RANDOMLY, BUT NO FURTHER THAN 5'-0" APART.
3. INNER-DUCTS WILL BE RUN BETWEEN EACH CLOSET OR TELECOMMUNICATIONS ROOM. ONE FOR CURRENT INSTALLATION WITH THREE MULTI CELLS FOR FUTURE INSTALLATIONS OR CHANGES. IN EACH TELECOMMUNICATIONS ROOM THE INNER-DUCTS ENTERING THE SPACE WILL BE COMBINED, IN A SIZE APPROPRIATE METALIC BOX THAT IS MOUNTED ON THE WALL. THE COMBINED INNERDUCTS WILL THEN BE ROUTED TO THE RACK AND THE FIBER BAY.
4. PROVIDE ALL ADDITIONAL CABLE MANAGEMENT PRODUCTS, SLEEVES OR CONDUIT RACEWAYS AS REQUIRED TO PROTECT EXPOSED CABLING AND COMPLETE THE INSTALLATION OF CABLES IN A NEAT MANNER.
5. A HORIZONTAL CONDUIT SYSTEM CONSISTS OF CONDUITS RADIATING FROM THE TELECOMMUNICATIONS ROOM TO THE WORKSTATION OUTLETS IN THE FLOOR, WALLS, CEILINGS, AND COLUMNS OF A

- BUILDING. WHEN USING A CONDUIT DISTRIBUTION SYSTEM UTILIZE THE MOST DIRECT ROUTE FOLLOWING THE BUILDING LINES.
6. THE SIZE AND NUMBER OF CONDUITS OR SLEEVES USED FOR BACKBONE PATHWAYS DEPENDS ON THE USABLE FLOOR SPACE SERVED BY THE BACKBONE SYSTEM. AT LEAST THREE 4 TRADE SIZE SLEEVES ARE RECOMMENDED.
 7. CONDUIT IS ONLY REQUIRED IF BUILDING CODES OR ENVIRONMENTAL CONDITIONS NECESSITATE IT. RIGID OR EMT METAL CONDUITS ARE DEEMED SUITABLE FOR BUILDING INSTALLATION. ADEQUATE PLANNING SHOULD ALLOW FOR A MINIMUM OF ONE 1-INCH CONDUITS TO EACH WORKSTATION LOCATION IF CODE REQUIRES CONDUIT FOR VOICE AND DATA CABLES.
 8. CONDUIT FILL RATIOS SHALL NOT EXCEED 40%; CONTACT YOUR CABLE MANUFACTURER TO GET RECOMMENDATION ON FILL RATES.
 9. NO CONDUIT RUN SHOULD BE DESIGNED WITH MORE THAN TWO (2), 90 DEGREE BENDS BETWEEN PULL POINTS OR PULL BOXES. IF A RUN REQUIRES MORE THAN TWO 90 DEGREE BENDS, INSTALL A PULL BOX.
 - EXCEPTIONS:
 1. THE TOTAL RUN IS NOT LONGER THAN 33 FT. THE CONDUIT SIZE IS INCREASED TO THE NEXT TRADE SIZE.
 2. ONE OF THE BENDS IS LOCATED WITHIN 12 IN OF THE CABLE FEED END. (THIS EXCEPTION ONLY APPLIES TO PLACING OPERATIONS WHERE CABLE IS PUSHED AROUND THE FIRST BEND.)
 10. ALL CONDUITS WILL BE EQUIPPED WITH A CONTIGUOUS LENGTH OF PLASTIC OR NYLON PULL STRING WITH A MINIMUM RATING OF 200 LBS. (90 KG)
 11. A CONDUIT RUN SHOULD NOT BE DESIGNED WITH CONTINUOUS CLOSED SECTIONS LONGER THAN 100 FT WITHOUT PULL POINTS OR PULL BOXES INSTALLED.
 12. ALL CONDUITS SHOULD TERMINATE ABOVE OR IN THE INSTALLED LADDER RACKS AND ALLOW FOR PROPER CABLE RACKING. CABLE WATERFALLS SHOULD BE CONSIDERED IN AREAS THAT HAVE EXCESSIVE DISTANCE BETWEEN THE CONDUIT AND LADDER RACK.
 13. TRAYS AND CONDUITS LOCATED WITHIN THE CEILING SHALL PROTRUDE INTO THE ROOM A DISTANCE OF 1 TO 2 IN WITHOUT A BEND AND ABOVE 8 FT HIGH. CLEAR, UNOBSTRUCTED ACCESS TO THE LADDER RACK AND CONDUITS SHALL BE PROVIDED WITHIN TELECOMMUNICATIONS ROOMS.
 14. CONDUITS ENTERING THROUGH THE FLOOR SHALL TERMINATE AT LEAST TWO (2) INCHES ABOVE THE FINISHED FLOOR
 15. LOCATE SLOT/SLEEVE SYSTEMS IN PLACES WHERE PULLING AND TERMINATION WILL BE EASY.
 16. IF POSSIBLE, LOCATE SLEEVES, SLOTS, AND/OR CONDUITS ON THE LEFT SIDE OF THE ROOM; THIS PLACEMENT ENHANCES THE USE OF WALL SPACE FROM LEFT TO RIGHT.
 17. WHEN POSSIBLE, ENTRANCE CONDUIT AND DISTRIBUTION CONDUIT/CABLE TRAY SHOULD ENTER AND EXIT ON THE SAME WALL; IF THIS IS NOT POSSIBLE, LADDER RACK INSIDE THE ROOM SHOULD BE PROVIDED FOR DISTRIBUTION FROM WALL TO WALL.

18. ALL FLOOR PENETRATIONS SHALL BE CORE DRILLED WITH A MAXIMUM 1/4 INCH SIZE GREATER THAN THE EXTERIOR DIMENSION OF THE RISER CONDUIT
19. CONDUITS ENTERING THROUGH A WALL SHALL BE REAMED AND BUSHED, AND TERMINATED AS CLOSE AS PRACTICABLE TO THE TERMINATING RACK OR WALL
20. TERMINATING ABOVE A SUSPENDED CEILING MUST TERMINATE NOT LESS 3 INCHES ABOVE FINISHED CEILING AND FINISHED WITH BUSHING OPENING.
 - ALL CONDUIT WILL BE LABELED FOR EASY IDENTIFICATION
 - ALL FLOOR PENETRATIONS SHALL BE AT COLUMNS, EXTERIOR WALLS OR IN EQUIPMENT ROOMS.
21. CABLES SHALL BE SUPPORTED AT HEIGHT OF BOTTOM FLANGE OF STRUCTURAL BEAMS USING A RIGID SUPPORT METHOD (I.E. THREADED ROD, BEAM CLAMPS, ETC.)
22. DO NOT SUPPORT CABLES FROM DUCTWORK, SPRINKLER PIPING, WATER PIPING, WASTE PIPING, CONDUIT, CEILING WIRE, OR OTHER SYSTEM SUPPORTS.
23. THE CONDUITS OR SLEEVE WILL BE INSTALLED PER TIA/EIA-569-B AND SEAL ALL PENETRATION WITH APPROVED FIRE STOP PRODUCT.
24. PROVIDE INDEPENDENT SUPPORT SYSTEM FOR EACH LOW VOLTAGE CABLING SYSTEM.

B. CABLE:

1. CATEGORY 6 CABLE WILL BE RUN FOR DATA. CATEGORY 6 GELLED FILLED CABLE WILL BE RUN IN THE BACKBONE FOR ALL COMMUNICATIONS APPLICATIONS. CERTAIN ENVIRONMENTS MAY REQUIRE THE USE OF DIFFERENT CABLES AND/OR CABLE JACKETS.
 - ***ALL TERMINATIONS WILL UTILIZE T568B WIRING IN THE CITY OF MADISON FACILITY . ANY CONTRACTOR NOT COMPLYING WITH THIS WIRING REQUIREMENT WILL FIX THE PROBLEM AT NO COST TO CITY OF MADISON.***
2. MAXIMUM CABLE LENGTHS TO BE 295 FEET (90 M) INCLUDING SERVICE LOOP. PROVIDE ALL NECESSARY INSTALLATION MATERIALS, TOOLS AND EQUIPMENT TO PERFORM INSULATION DISPLACEMENT TYPE TERMINATIONS AT ALL COMMUNICATIONS OUTLETS, PATCH PANELS.
3. ALL COMMUNICATIONS CABLING THAT HAS BECOME ABANDONED AS PART OF NEW RENOVATION PROJECTS, PREVIOUS RENOVATION PROJECTS, OR TEMPORARY COMMUNICATION CABLES USED DURING THE CONSTRUCTION PROCESS SHALL BE COMPLETELY REMOVED.
4. REFER TO DETAILED MANUFACTURER'S GUIDELINES FOR DEPLOYMENT OF CATEGORY 6 CABLE. CERTAIN RESTRICTIONS APPLY, AND SPECIFIC TECHNIQUES ARE RECOMMENDED.
5. ALL CABLING SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURERS' WRITTEN BEND RADIUS AND PULLING TENSIONS. GENERAL INDUSTRY GUIDELINES RECOMMEND THE FOLLOWING BEND RADIUS AND PULLING TENSIONS:
 - TENSILE LOADING ON A SINGLE 4-PAIR COPPER UTP CABLE ALL NOT EXCEED 25 LBF.
 - BEND RADIUS OF A SINGLE 4-PAIR COPPER UTP CABLE SHALL NOT EXCEED 4 TIMES THE DIAMETER OF THE CABLE.

- BEND RADIUS OF MULTI-PAIR COPPER UTP AND OPTICAL FIBER CABLE SHALL NOT EXCEED 10 TIMES THE DIAMETER OF THE CABLE.
- 6. ALL CONDUITS AND CONDUIT SLEEVES SHALL HAVE BUSHINGS OR GROMMETS SHALL BE INSTALLED PRIOR TO THE INSTALLATION OF COMMUNICATIONS CABLES TO AVOID DAMAGE AND ABRASIONS TO CABLE SHEATHING AND INSULATION. IF BUSHINGS HAVE ARE INSTALLED BY THE ELECTRICAL CONTRACTOR, THE COMMUNICATIONS CABLING CONTRACT SHALL FURNISH AND INSTALL BUSHINGS PRIOR TO PULLING COMMUNICATIONS CABLING.
- 7. HORIZONTAL CABLE LENGTH FOR 4-PAIR COPPER UTP CABLES SHALL NOT EXCEED 295 FEET. PRIOR TO BIDDING AND INSTALLATION, THE CONTACTOR SHALL REVIEW THE DRAWINGS AND VERIFY NO CABLE RUN EXCEEDS 295 FEET AND NOTIFY THE COMMUNICATIONS DESIGNER OF CABLE RUNS THAT MAY EXCEED 295 FEET.
- 8. SPLICES ARE NOT PERMITTED IN ANY VOICE OR DATA CABLE UNLESS OTHER SPECIFIED OR SHOWN ON DRAWINGS.
- 9. AVOID PLACING COPPER CABLES NEAR SOURCES OF EXTREME HEAT (I.E. BOILERS, RADIATORS, HEAT COILS).
- 10. MAINTAIN CABLE TWISTS FOR ALL UTP CABLES. FOR TERMINATIONS CABLE SHEATHING SHALL BE STRIPPING BACK NO MORE THAN ½” BACK FROM TERMINATION POINT FOR ALL CATEGORY 6 CABLES.
- 11. ALL CABLES SHALL BE SUPPORTED BY CABLE TRAY, CABLE RUNWAY, OR J-HOOKS. WHEN LARGE QUANTITIES OF CABLES LEAVE TRAYS OR RUNWAYS, CABLES SHALL BE SUPPORTED BY DROP-OUTS OR CABLE SUPPORT HARDWARE MANUFACTURED SPECIFICALLY FOR THE PURPOSE OF SUPPORTING CABLES. J-HOOKS SHALL BE INSTALLED A MINIMUM OF EVERY 5 FEET AND CABLING SHALL MAINTAIN MINIMAL DEFLECTION AND STRAIN (LESS THAN 12” DEFLECTION). CABLES SHALL NOT BE SUPPORTED FROM CEILING GRID WIRES. CABLES SHALL NOT RUN ABOVE IRON JOISTS.
 - ALL CABLES SHALL BE SEPARATED AND BUNDLED INTO LIKE GROUPS.
 - SERVICE LOOPS SHALL BE PROVIDED AT BOTH ENDS OF INSTALLED HORIZONTAL AND BACKBONE CABLING. A 12” SERVICE LOOP SHALL BE INSTALLED IN THE CEILING SPACE NEAR WORKSTATION OUTLETS (EXCESSIVE CABLE SHALL NOT BE COILED IN OUTLET BOXES). A 10’ SERVICE LOOP SHALL BE PROVIDED IN COMMUNICATION ROOMS AND SHALL BE INSTALLED TO ALLOW FOR FUTURE EQUIPMENT RACK/CABINET RELOCATIONS WITHOUT THE NEED TO RE-TERMINATE PATCH PANELS; THE 10’ SERVICE LOOP SHALL BE NEATLY BUNDLED AND SECURED IN CEILING SPACE WITH LARGE D-RINGS OR PLACE IN CABLE TRAYS. CABLE SLACK AND SERVICE COILS SHALL BE STORED PROPERLY ABOVE THE CEILING OR UNDER THE ACCESS FLOOR. A “FIGURE-EIGHT” SERVICE LOOP IS RECOMMENDED FOR CATEGORY 6 CABLING TO REDUCE EMI COUPLING. LOOSE, RANDOM BUNDLING IS RECOMMENDED.
- 12. ANY CABLING INSTALLING IN EQUIPMENT ROOMS SHALL BE NEATLY PLACED IN CABLING TRAYS, CABLING RUNWAYS, OR HORIZONTAL AND VERTICAL RACK/CABINET CABLE MANAGERS

13. VELCRO STRAPS SHALL BE UTILIZED IN THE TR AND INSIDE TC ENCLOSURES FOR ALL CABLE BUNDLING. TIE WRAPS SHALL BE PROHIBITED IN THE TELECOMMUNICATION ROOMS.
14. SEPARATION: MAINTAIN THE FOLLOWING DISTANCES BETWEEN CABLES, OTHER SYSTEM CABLES AND OTHER BUILDING SYSTEMS:
 - ONE (1) FOOT FROM FLUORESCENT LIGHTS.
 - ONE (1) FOOT FROM POWER CABLE IN PARALLEL
 - ONE (1) FOOT FROM ELECTRICAL CONDUITS, OTHER SYSTEMS CABLES OR OTHER ELECTRICAL EQUIPMENT.
 - FOUR (4) FEET FROM MOTORS AND TRANSFORMERS
 - THREE (3) FEET FROM HOT WATER PIPING OR OTHER MECHANICAL EQUIPMENT.
 - TEN (10) FEET FROM BUS CONDUCTORS OR HIGH-CURRENT BRANCH CIRCUITS
 - ALL LOW VOLTAGE CABLES SHALL BE RUN PARALLEL OR AT RIGHT ANGLES TO BUILDING STRUCTURAL FRAMEWORK. DO NOT RUN CABLES DIAGONALLY ACROSS CEILING SPACE WITHOUT WRITTEN AUTHORIZATION BY THE ARCHITECT'S ELECTRICAL ENGINEER OR CITY OF MADISON REPRESENTATIVE.
 - COMMUNICATIONS CABLING THAT MUST CROSS POWER CABLES OR CONDUIT SHALL CROSS AT A 90-DEGREE ANGLE, AND SHALL NOT MAKE PHYSICAL CONTACT.
15. FIRE SEAL AROUND ALL CABLES RUNNING THROUGH RATED FLOORS AND WALLS. FIRESTOP ALL CABLES AND PATHWAYS THAT PENETRATE FIRE-RATED BARRIERS USING APPROVED METHODS AND ACCORDING TO LOCAL CODES.
16. LEAVE SPARE PULL STRING WITH EVERY OUTLET INSTALLED.
17. DO NOT INSTALL CABLE IN WET AREAS, OR IN PROXIMITY TO HOT WATER PIPES OR BOILERS.
18. CABLE ENDS FOR TERMINATION SHALL BE CLEAN AND FREE FROM CRUSH MARKS, CUTS, OR KINKS LEFT FROM PULLING OPERATIONS. INSTALLED CABLE JACKETS SHALL HAVE NO ABRASIONS WITH EXPOSED CONDUCTOR INSULATION OR BARE COPPER "SHINERS". THE INSTALLER IS RESPONSIBLE TO REPLACE DAMAGED CABLES.
19. BACKBONE CABLES SHALL BE INSTALLED AND BUNDLED SEPARATELY FROM HORIZONTAL DISTRIBUTION CABLES. BACKBONE AND HORIZONTAL CABLE BUNDLES SHALL BE LOOSE AND RANDOM.
20. BACKBONE CABLES SPANNING MORE THAN THREE FLOORS SHALL BE SUPPORTED AT THE TOP OF THE CABLE RUN WITH A WIRE MESH GRIP AND ON ALTERNATING FLOORS, UNLESS OTHERWISE SPECIFIED BY LOCAL CODES OR MANUFACTURER'S GUIDELINES.
21. VERTICAL RUNS OF BACKBONE CABLES ENTERING EACH TR SHALL BE SECURELY FASTENED ALONG A PROPERLY PREPARED WALL IN THE TR ON EACH FLOOR. USE OF CABLE LADDER IS RECOMMENDED.

c. COMMUNICATIONS INFRASTRUCTURE

1. MAXIMUM CABLE LENGTHS TO BE 295 FEET (90 M) INCLUDING SERVICE LOOP. PROVIDE ALL NECESSARY INSTALLATION MATERIALS, TOOLS AND EQUIPMENT

2. SUPPORT AND SECURE CABLES AT PATCH PANELS USING REAR CABLE MANAGEMENT BRACKET, SPOOLS OR MANAGEMENT DEVISE.
3. CROSS-CONNECTS SHALL BE COMPLETED AS PER CONSTRUCTION SCHEDULE.

D. OPTICAL FIBER CABLE:

1. INNER-DUCTS OF THE PROPER RATING WILL BE RUN BETWEEN EACH CLOSET.
2. CABLES FOR DIRECT BURIAL, AERIAL, OR OTHER OUTSIDE APPLICATIONS SHALL BE DESIGNED SPECIFICALLY FOR THE INTENDED PURPOSE.
3. ALL OPTICAL FIBER INSTALLATIONS SHALL BE INSTALLED USING OPEN CABLING METHODS. LIMIT CABLE-BENDING RADIUS TO 20 TIMES THE CABLE DIAMETER DURING INSTALLATION, AND 10 TIMES THE DIAMETER AFTER INSTALLATION. PROVIDE ALL REQUIRED TOOLS, MATERIALS, CONSUMABLES, AND EQUIPMENT NECESSARY FOR FIELD MOUNTING OF LC CONNECTORS.
4. DO NOT EXCEED THE MAXIMUM PULL TENSION SPECIFIED BY THE CABLE MANUFACTURER. USE APPROPRIATE LUBRICANTS AS REQUIRED TO REDUCE PULLING FRICTION. AVOID KINKING AND TWISTING OF CABLES DURING INSTALLATION.
5. LABEL EACH END OF EACH CABLE AS TO SOURCE AND DESTINATION. TERMINATE OPTICAL FIBERS IN CONSISTENT, CONSECUTIVE MANNER AT EACH END. PLACE ALL MATERIAL IN INNER-DUCT BETWEEN LABEL OPTICAL FIBER RACEWAY CABLE WITH YELLOW "CAUTION - OPTICAL FIBER CABLE" TAGS EVERY 10 FEET. LEAVE 10 FEET OF SLACK AT EACH FIBER TERMINATION POINT. NEATLY COIL SLACK OPTICAL FIBER CABLE ON TOP OF RACK ABOVE OPTICAL FIBER PATCH PANEL ENCLOSURE AT EACH RACK LOCATION.
6. OPTICAL FIBER CABLE TERMINATIONS SHALL UTILIZE ENCLOSURES AND COMPONENTS IN QUANTITIES CONSISTENT WITH THE REQUIRED FIBER COUNTS AT EACH END OF EACH SEGMENT.
7. DURING OPTICAL FIBER CONNECTOR TERMINATION, VISUALLY INSPECT ALL TERMINATIONS WITH A 200 OR 400-POWER MICROSCOPE.
8. FOLLOW ALL OF THE CONNECTOR MANUFACTURER'S RECOMMENDATIONS.
9. UNACCEPTABLE FLAWS IN THE TERMINATIONS WILL INCLUDE, BUT NOT LIMITED TO, SCRATCHES, FULL OR PARTIAL CRACKS, BUBBLES, PITS, EPOXY RESIDUAL, DIRT, DUST, OIL, MOISTURE, GRINDING AND SANDING DEBRIS. THE ACCEPTABLE TERMINATION WILL SHOW A CONNECTOR TIP THAT IS FREE OF ALL IMPERFECTIONS IN 100% OF THE CORE AND 80% OF THE CLADDING. ALL UNACCEPTABLE CONNECTORS SHALL BE INSPECTED AFTER REWORK.
10. DURING INSTALLATION OF OPTICAL FIBER CABLE DO NOT ALLOW PULLING TENSION TO EXCEED CABLE MANUFACTURER'S SPECIFICATION FOR THE CABLE BEING INSTALLED. ONLY THE STRENGTH MEMBER OF THE CABLE SHALL BE SUBJECTED TO THE PULLING TENSION.
11. CLEAN ALL OPTICAL FIBER CONNECTOR TIPS PRIOR TO INSERTING THEM INTO MATTING RECEPTACLES OR BULKHEADS. INSTALL ALL DUST COVERS

12. USING APPROVED METHODS, PULL CABLE INTO CONDUIT, OR PLACE INTO RACEWAY OR CABLE TRAY AS SPECIFIED. A PULL CORD (NYLON; 1/8" MINIMUM) SHALL BE CO-INSTALLED WITH ALL CABLE INSTALLED IN ANY CONDUIT.
13. WHERE CABLES ARE INSTALLED IN AIR RETURN PLENUM, RISER RATED CABLE SHALL BE INSTALLED IN METALLIC CONDUIT.
14. BACKBONE AND HORIZONTAL CABLES SHALL BE INSTALLED AND BUNDLED SEPARATELY IN ANY PATHWAY.
15. CABLES ABOVE CEILINGS OR BELOW ACCESS FLOORS SHALL BE INSTALLED IN CABLE TRAY OR OPEN-TOP CABLE HANGERS.
16. CABLE SLACK AND SERVICE COILS SHALL BE STORED PROPERLY ABOVE THE CEILING OR UNDER THE ACCESS FLOOR. PATHWAY FILL RATIO IN CONDUIT, TRAY, RACEWAY, ETC. SHALL NOT EXCEED 40% OF PATHWAY CROSS-SECTIONAL AREA.
17. A SERVICE COIL OF AT LEAST 1 METER IS RECOMMENDED WITHIN WORKSTATION OUTLETS, AND AT LEAST 2 METERS IS RECOMMENDED FOR TELECOMMUNICATIONS ENCLOSURES. MAIN TRUNK AND OSP CABLES SHALL ALSO HAVE A LARGE DIAMETER SERVICE COIL IN THE SPECIFIED LOCATION.
18. RECOMMENDED MAXIMUM SPACING OF CABLE SUPPORTS ABOVE THE CEILING IS 60 IN.
19. BACKBONE CABLES SPANNING MORE THAN THREE FLOORS SHALL BE SECURELY ATTACHED AT THE TOP OF THE CABLE RUN WITH A WIRE MESH GRIP AND ON ALTERNATING FLOORS OR AS REQUIRED BY LOCAL CODES.
20. VERTICAL RUNS OF CABLE SHALL BE SUPPORTED TO MESSENGER STRAND, CABLE LADDER, OR OTHER APPROVED STRUCTURE TO SUPPORT THE WEIGHT OF THE CABLE. DO NOT EXCEED MAXIMUM CABLE VERTICAL RISE LIMITS.
21. CABLES THAT ARE DAMAGED DURING INSTALLATION SHALL BE REPLACED BY THE CONTRACTOR.

E. RACKS AND ENCLOSURES:

1. FREESTANDING EQUIPMENT RACKS AND ENCLOSURES SHALL BE PROTECTED FREE OF ALL DUST, DEBRIS AND OTHER ENVIRONMENTAL ELEMENTS DURING CONSTRUCTION UNTIL SUBSTANTIAL COMPLETION WALK-THROUGH.
2. EACH RACK, ENCLOSURE SHALL HAVE A DEDICATED #6 AWG GROUND WIRE TO A GROUNDING BUSBAR OR BUILDING GROUND AS DEFINED BY NEC.
3. SECURE RACKS AND ENCLOSURES TO FLOOR USING RACK INSTALLATION KIT.

F. CATEGORY 6 JACKS:

1. REFER TO SPECIFIC MANUFACTURER'S GUIDELINES FOR TERMINATION OF JACKS AND DRESSING CATEGORY 6 CABLES INSIDE WALL OUTLETS AND SURFACE HOUSINGS. DUE TO THE LARGER SIZE OF CATEGORY 6 CABLE, SERVICE COILS IN OUTLET BOXES AND SURFACE HOUSINGS ARE NOT RECOMMENDED.
2. TERMINATE JACKS ACCORDING TO MANUFACTURER'S INSTRUCTIONS.

3. ALL JACK WILL BE WIRED UTILIZING T568B.
4. TO ASSURE 10GBASE-T PERFORMANCE, MAINTAIN WIRING PAIR TWISTS AS CLOSE AS POSSIBLE TO THE POINT OF TERMINATION. ALSO MINIMIZE THE LENGTH OF EXPOSED PAIRS FROM THE JACKET TO THE IDC TERMINATION POINT DURING INSTALLATION.
5. THE LENGTH OF WIRING PAIR UN-TWIST IN EACH TERMINATION SHALL BE LESS THAN 0.5 INCHES (13 MM).
6. JACKS SHALL BE PROPERLY MOUNTED IN PLATES, FRAMES, OR HOUSINGS WITH DUST CAPS FULLY INSTALLED OVER IDC CONTACTS.
7. HORIZONTAL CABLES EXTENDING FROM MOUNTED JACKS SHALL MAINTAIN A MINIMUM BEND RADIUS OF AT LEAST 4 TIMES THE CABLE DIAMETER, UNLESS SPACE IS RESTRICTED. NOTE: REFER TO SPECIFIC MANUFACTURER'S RECOMMENDATIONS FOR RESTRICTED CABLE BEND RADIUS.
8. CABLE TERMINATIONS SHALL MINIMIZE TENSILE OR BENDING STRAIN ON IDC CONTACTS AFTER ASSEMBLY OF FACEPLATE OR HOUSING TO THE WALL OUTLET.

G. CATEGORY 6 PATCH PANELS

1. PROPERLY MOUNT PATCH PANELS INTO THE DESIGNATED RACK, CABINET, OR BRACKET LOCATIONS WITH THE #12-24 SCREWS PROVIDED.
2. TERMINATE CABLES BEHIND THE PATCH PANEL ACCORDING TO MANUFACTURER'S INSTRUCTIONS.
3. TO ASSURE PERFORMANCE, MAINTAIN WIRING PAIR TWISTS AS CLOSE AS POSSIBLE TO THE POINT OF TERMINATION. ALSO MINIMIZE THE LENGTH OF EXPOSED PAIRS FROM THE JACKET TO THE IDC TERMINATION POINT DURING INSTALLATION.
4. THE LENGTH OF WIRING PAIR UN-TWIST IN EACH TERMINATION SHALL BE LESS THAN 0.5 INCHES (13 MM), AND SHALL BE KEPT TO A MINIMUM.
5. EACH TERMINATED AND DRESSED CABLE SHALL BE MAINTAINED PERPENDICULAR TO THE REAR COVER USING THE RECOMMENDED CABLE MANAGEMENT HARDWARE.
6. HORIZONTAL OR BACKBONE CABLES EXTENDING FROM THE REAR PANEL TERMINATIONS SHALL MAINTAIN A MINIMUM BEND RADIUS OF AT LEAST 4 TIMES THE CABLE DIAMETER.
7. CABLE TERMINATIONS SHALL HAVE MINIMAL TENSILE OR BENDING STRAIN ON PANEL IDC CONTACTS IN EACH INSTALLED LOCATION.
8. PANELS SHALL BE PROPERLY LABELED ON THE FRONT AND BACK WITH THE CABLE NUMBER AND PORT CONNECTIONS FOR EACH PORT.

H. HARSH ENVIRONMENT HOUSING AND CONNECTIVITY

1. MOUNT CONNECTOR HOUSING FROM FRONT OF DEVICE, BUT INSTALL GASKET OR OPTIONAL PROTECTIVE CAP BEFORE MOUNTING CONNECTOR HOUSING INTO DEVICE.
2. SECURE CONNECTOR HOUSING TO DEVICE USING SUPPLIED PLASTIC NUT. TIGHTEN NUT WITH 6-7 INCH/POUNDS OF TORQUE.
3. ENSURE THAT MOUNTING SURFACE IS CLEAN AND FREE OF DEBRIS.
4. INSTALLING THE JACK INTO THE MOUNTED CONNECTOR HOUSING.

5. INSTALL THE TERMINATED JACK INTO THE MOUNTED CONNECTOR HOUSING BY TILTING THE JACK AND SECURING THE FIXED LATCH IN THE CONNECTOR OPENING. ROTATE THE JACK, SECURING THE SPRING LATCH.
 6. CLEAN AND REMOVE ANY OBSTRUCTIONS FROM THE SURFACE THAT THE WALL PLATE ASSEMBLY WILL BE INSTALLED AGAINST.
 7. PLACE WASHERS PROVIDED WITH HI IMPACT SERIES PLATES ONTO SCREWS. ALIGN RUBBER GASKET ON BACK SIDE OF PLATE PRIOR TO INSTALLING TO BOX/WALL BY PLACING SCREWS THROUGH PLATE AND RUBBER GASKET.
 8. SECURE THE WALL PLATE ASSEMBLY TO BOX/WALL BY TIGHTENING SCREWS WITH 5 INCH/POUNDS OF TORQUE.
 9. ATTACH PATCH CORDS AND FIELD TERM PLUG ASSEMBLIES (SOLD SEPARATELY) TO THE MOUNTED CONNECTOR.
- I. OPTICAL FIBER CONNECTORS, HORIZONTAL AND BACKBONE
1. INSTALLED FIBER CONNECTORS SHALL HAVE PROPER CABLE SUPPORT, ROUTING AND STRAIN RELIEF.
 2. INSTALLED CONNECTORS SHALL BE INSPECTED 100% FOR POLISH QUALITY, AND CONTAMINATION.
 3. FUSION SPLICES FOR PIGTAIL CONNECTIONS SHALL BE PROTECTED IN A SUITABLE ENCLOSURE.
- J. GROUNDING AND BONDING SYSTEMS: BASIC GUIDELINES
1. TELECOMMUNICATIONS GROUNDING AND BONDING SYSTEM SHALL BE INSTALLED IN ACCORDANCE WITH NEC REQUIREMENTS, AND PER THE GUIDELINES OF ANSI J-STD-607-A.
 2. THE TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB) SHALL BE BONDED TO THE BUILDING MAIN ELECTRICAL SERVICE GROUND (GROUNDING ELECTRODE CONDUCTOR OR GEC), USING APPROVED LUGS OR EXOTHERMIC WELD METHODS. BONDING TO THE GEC OR TMGB WITH SHEET METAL SCREWS IS PROHIBITED.
 3. THE TELECOMMUNICATIONS BONDING BACKBONE SHALL BE A MINIMUM 6 AWG COPPER WIRE CONDUCTOR. A TELECOMMUNICATIONS GROUNDING BUSBAR (TGB) SHALL BE INSTALLED IN THE TR ON EACH FLOOR, AND SHALL BE BONDED TO THE TBB. ALL METAL RACKS, CABINETS, PATHWAY AND ENCLOSURES SHALL BE BONDED TO THE TGB.
 4. TELECOMMUNICATIONS EQUIPMENT SHALL BE GROUNDED ACCORDING TO MANUFACTURER'S INSTRUCTIONS AND IN ACCORDANCE WITH APPLICABLE CODES.
 5. ALL METALLIC PATHWAYS, INCLUDING CONDUIT, RACEWAY LADDER OR CABLE TRAYS SHALL BE ELECTRICALLY CONTINUOUS AND SHALL BE BONDED TO GROUND ON EACH END.
 6. OSP CABLE ENTERING THE BUILDING OR BACKBONE CABLES HAVING METAL SHEATHS SHALL HAVE ISOLATION PROTECTION. ISOLATION PROTECTORS SHALL BE BONDED TO THE TMGB.

3.5 LABELING

A. GENERAL:

1. ***ALL LABELS SHALL BE PERMANENT, MACHINE GENERATED LABELS PRODUCED BY A LABELING MACHINE.*** LABELS SHALL BE A PERMANENT POLYESTER MATERIAL CLEAR IN COLOR WITH LABEL LETTERING BLACK IN COLOR. NO HAND WRITTEN LABELS WILL BE ACCEPTED.
2. LABELING INFORMATION WILL BE REVIEWED AT PRE-INSTALL MEETING, AND THE OWNER SHALL APPROVE THE LABELING SCHEME PRIOR TO THE INSTALLATION OF ANY CABLING.
3. SURFACES SHALL BE CLEANED BEFORE ATTACHING LABELS. ALL LABELS SHALL BE ATTACHED FIRMLY AND VERTICALLY PLUMB ON EQUIPMENT, FACEPLATES, PATCH PANELS TERMINATION BLOCKS, ETC.
4. LABELING OF CABLES, EQUIPMENT, AND COMPONENTS SHALL BE INCLUDED IN AS-BUILT DOCUMENTATION, FLOOR PLAN DRAWINGS, AND SCHEMATIC DEIGNS.

B. CABLING

1. ALL STRUCTURED CABLES (HORIZONTAL AND BACKBONE) SHALL BE LABELED AT BOTH ENDS WITHIN 6" OF CABLE TERMINATION POINT. WHERE VOICE BACKBONE CABLES EXTEND BEHIND TERMINATION BLOCKS, CABLE LABELS SHALL BE PLACED AT A LOCATION ON THE CABLE WHERE THE LABELS ARE VISIBLE FROM THE FRONT OF THE TERMINATION BLOCKS.
2. LABELS SHALL HAVE AN ADHESIVE BACKING AND SHALL WRAP COMPLETELY AROUND THE CIRCUMFERENCE OF THE CABLE JACKET. LABEL AND LETTERING SIZES SHALL BE OF APPROPRIATE SIZE IN REGARDS TO CABLE DIAMETER.

C. EQUIPMENT RACKS, TERMINATION HARDWARE, AND FACEPLATES

1. LABELING SCHEME TO BE SPECIFIED BY OWNER.

3.6 TESTING

A. CATEGORY 6 CABLE TESTING

1. PERMANENT LINK TESTING SHALL BE COMPLETED ON ALL HORIZONTAL (STATION) CABLES. THE CONTRACTOR WILL BE RESPONSIBLE TO SUPPLY A CHANNELL WARRANTY, BUT CITY OF MADISON IS REQUIRING THAT THE CONTRACTOR SUPPLY ALL MANUFACTURER PATCH CORDS PER THE CONTRACT.
2. CATEGORY 6 CABLING SYSTEMS SHALL BE TESTED AS AN INSTALLED HORIZONTAL PERMANENT LINK CONFIGURATION. JACKS AND FACEPLATES SHALL BE ASSEMBLED COMPLETE AND PROPERLY MOUNTED INTO OUTLET BOXES. PANELS SHALL BE TERMINATED COMPLETE AND FULLY DRESSED WITH PROPER CABLE MANAGEMENT
3. ALL WIRING SHALL BE CERTIFIED TO MEET OR EXCEED THE SPECIFICATIONS AS SET FORTH IN TIA-568C FOR CATEGORY 6 REQUIREMENTS FOR PERMANENT LINK. ALL TEST WILL BE PERFORMED TO 250MHZ.

4. FIELD TESTING SHALL INCLUDE THE FOLLOWING PARAMETERS FOR EACH PAIR OF EACH CABLE INSTALLED:
 - NAME OF THE PERSON PERFORMING THE TEST.
 - TEST EQUIPMENT MANUFACTURER AND MODEL NUMBER.
 - CABLE I.D. THE TEST SHEETS WILL BE IN NUMERICAL ORDER BY CABLE ID.
 - DATE OF TEST.
 - WIRE MAP (PIN TO PIN CONNECTIVITY AND POLARITY CHECK)
 - LENGTH (IN FEET)
 - INSERTION LOSS.
 - NEAR END CROSSTALK (NEXT).
 - POWER SUM NEAR END CROSSTALK (PSNEXT).
 - EQUAL-LEVEL FAR END CROSSTALK (ELFEXT).
 - POWER SUM EQUAL-LEVEL FAR END CROSSTALK (PSELFEXT).
 - RETURN LOSS.
 - DELAY SKEW.
 - ATTENUATION TO CROSSTALK RATIO (ACR).
5. A "PASS" INDICATION SHALL BE OBTAINED FOR EACH LINK, USING AT MINIMUM A LEVEL III TESTER THAT COMPLIES WITH TIA/EIA-568-B.2 FIELD TEST REQUIREMENTS.
6. RECORD TEST RESULTS FOR EACH CABLE AND TURN OVER TO THE GENERAL CONTRACTOR UPON COMPLETION OF THE JOB. CORRECT MALFUNCTIONS WHEN DETECTED, AND RE-TEST TO DEMONSTRATE COMPLIANCE. NOTE: TEST EQUIPMENT SHALL BE A TYPE III CABLE TESTER.

B. OPTICAL FIBER TESTING:

1. TEST PROCEDURES SHALL BE AS DESCRIBED BY THE TIA/EIA-568-B: COMMERCIAL BUILDING TELECOMMUNICATIONS CABLING STANDARD, PARTS 2 AND 3 AND TIA/EIA-526-14-A-1998 - OPTICAL POWER LOSS MEASUREMENTS OF INSTALLED MULTIMODE FIBER CABLE PLANT-OFSTP-14A
2. PREINSTALLATION TESTING:
 - TEST EACH CONDUCTOR OF EVERY OPTICAL FIBER CABLE ON THE REEL WITH A LIGHT SOURCE AND A POWER METER.
 - OBTAIN THE CABLE MANUFACTURER POWER METER TEST RESULTS FOR EACH REEL USED ON THE PROJECT. USING THE ATTACHED OPTICAL FIBER TEST FORM RECORD THE READINGS AND THE MANUFACTURER'S REEL NUMBER. PRIOR TO COMPLETION OF PROJECT, TURN OVER THE COMPLETED OPTICAL FIBER TEST FORM, OPTICAL FIBER CABLE REEL ID TAGS AND OPTICAL FIBER CABLE MANUFACTURER'S TEST RESULTS.
3. ACCEPTANCE TESTING:
 - EACH TERMINATED FIBER STRAND IN THE HORIZONTAL OR BACKBONE INFRASTRUCTURE SHALL BE TESTED INDIVIDUALLY AS A PERMANENT LINK. A FIBER PERMANENT LINK IS DEFINED AS A LENGTH OF INDIVIDUAL FIBER STRAND WITH A CONNECTOR TERMINATED ON EACH END.

- TESTING FOR MULTIMODE SHALL BE AT 850 AND 1300 NANOMETERS. TOTAL LINK INSERTION LOSS (DB) SHALL BE WITHIN THE SPECIFIED LINK LOSS BUDGET.
- TIER 1 TESTING FOR EACH INSTALLED SINGLEMODE LINK SHALL BE PERFORMED AS AN OPTICAL POWER INSERTION LOSS MEASUREMENT, AS DEFINED BY ANSI/TIA/EIA-526-7. TESTING FOR SINGLEMODE SHALL BE AT 1310 AND 1550 NANOMETERS. TOTAL LINK INSERTION LOSS (DB) SHALL BE WITHIN THE SPECIFIED LINK LOSS BUDGET.
- TIER 2 TESTING, IF REQUIRED FOR EACH INSTALLED SINGLEMODE OR MULTIMODE LINK, SHALL BE PERFORMED AS ANOTHER MEASUREMENT, AS DEFINED IN TIA-TSB-140. WE REQUIRE TIER 2 TESTING ON ALL FIBERS INSTALLED IN THE FACILITY FOR FUTURE TROUBLESHOOTING.
- MULTIMODE OPTICAL FIBER ATTENUATION SHALL BE TESTED ON ALL INDIVIDUAL FIBERS OF EACH CABLE SEGMENT USING AN LED LIGHT SOURCE AND POWER METER TO DETERMINE THE ACTUAL LOSS. THESE TESTS SHALL BE PERFORMED AT THE 850NM AND 1300NM WINDOWS IN BOTH DIRECTIONS. TEST SET UP AND PERFORMANCE SHALL BE IN ACCORDANCE WITH ANSI/TIA/EIA-526-14A, METHOD B.
- A REFERENCE POWER MEASUREMENT SHALL BE OBTAINED BY CONNECTING ONE END OF TEST JUMPER 1 TO THE LIGHT SOURCE AND THE OTHER END TO THE POWER METER. AFTER RECORDING THE REFERENCE POWER MEASUREMENT, TEST JUMPER 1 SHALL BE DISCONNECTED FROM THE POWER METER WITHOUT DISTURBING THE LIGHT SOURCE AND ATTACHED TO THE CABLE PLANT. THE POWER METER SHALL BE MOVED TO THE FAR END OF THE CABLE PLANT AND ATTACHED TO THE CABLE PLANT WITH TEST JUMPER 2.
- READINGS MUST NOT BE HIGHER THAN THE “OPTIMAL ATTENUATION LOSS.” THE OAL WILL BE CALCULATED USING THE MANUFACTURER’S FACTORY CERTIFIED TEST RESULTS, (DB/KM) CONVERTED TO THE ACTUAL INSTALLED LENGTHS PLUS THE MANUFACTURER’S BEST PUBLISHED ATTENUATION LOSSES FOR THE CONNECTOR AND/OR SPLICE INSTALLED ON THIS PROJECT. (0.30+/-0.30 FOR CONNECTORS AND 0.10 FOR SPLICES). THE CONSTRUCTION MANAGER SHALL USE THE OAL FOR COMPARISON WITH THE END TO END POWER LOSS TEST RESULTS PRIOR TO ACCEPTANCE.
- TEST RESULTS: MUST BE COMPLETED AND TURNED OVER TO THE GENERAL CONTRACTOR PRIOR TO ACTIVE EQUIPMENT INSTALLATION. SPECIFIC DUE DATES FOR OPTICAL FIBER WILL BE ESTABLISHED AT PRE-INSTALL MEETING.

END OF SECTION

SECTION 27 21 33
WIRELESS ACCESS POINTS (WAP)

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SCOPE 1
6 1.2. RELATED SPECIFICATIONS 1
7 1.3. SUBMITTALS 1
8 PART 2 - PRODUCTS 1
9 2.1. WIRELESS ACCESS POINT (WAP) DEVICES 1
10 PART 3 - EXECUTION 1
11 3.1. OWNER RESPONSIBILITIES 1
12 3.2. CONTRACTORS RESPONSIBILITIES 2
13 3.3. FINAL TESTING 2
14 3.4. WARRANTY 2
15

16 **PART 1 – GENERAL**

17
18 **1.1. SCOPE**

- 19 A. The work under this section is for the installation of OWNER PROVIDED, CONTRACTOR INSTALLED Wireless
20 Access Points (WAP).
21 B. The WAPs shall be installed by the contractor providing and installing the Communications Cable and Equipment.
22 All contractor qualifications and certifications for that section shall apply to this section.
23

24 **1.2. RELATED SPECIFICATIONS**

- 25 A. The Contractor shall be responsible for reviewing all other specifications for requirements associated with the
26 complete installation of WAP's. This includes but is not limited to the following:
27 1. 01 31 23 Project Management Web Site
28 2. 01 33 23 Submittals
29 3. 27 00 05 Communications Cable and Equipment
30

31 **1.3. SUBMITTALS**

- 32 A. Contractor licenses and qualifications are required as part of the complete Division 27 submittal package as
33 indicated under Specification 27 00 05.
34 B. No submittals are required for the owner provided WAP.
35 C. Submittals are required for installation/hanger equipment, connectors, and any other required
36 equipment/material required for a complete WAP installation.
37

38 **PART 2 - PRODUCTS**

39
40 **2.1. WIRELESS ACCESS POINT (WAP) DEVICES**

- 41 A. The City of Madison Information Technology Department (CoM-IT) will be providing the WAP devices for this
42 project.
43 B. The WAP device being used will be as manufactured by the Cisco, Model 3700E and shall be used for all types of
44 ceiling mounted installations (suspended, gyp board, open truss, etc).
45

46 **PART 3 - EXECUTION**

47
48 **3.1. OWNER RESPONSIBILITIES**

- 49 A. The CoM-IT shall be responsible for ordering, making payment (including shipping fees), and configuring all WAP
50 devices in a timely manner to comply with the Contractors schedule.
51 B. The CoM-IT shall configure and test each WAP to CoM-IT specifications prior to providing them to the contractor
52 for installation.
53 C. The CoM-IT shall number each WAP and provide the contractor with a location map indicating where each WAP
54 will be installed.
55 C. The CoM-IT shall test all WAP's after installation to verify configuration and signaling is correct prior to accepting
56 the final installation of the WAP system.
57

- 1 **3.2. CONTRACTORS RESPONSIBILITIES**
2 A. The Contractor shall be solely responsible for coordinating with CoM-IT the scheduling and receipt of all WAP
3 devices with his/her installation schedule.
4 B. The Contractor shall inspect all WAP devices upon receipt for damage. CoM-IT shall be notified immediately of
5 any damage.
6 C. The Contractor shall provide all mounting hardware, blocking, and other items required for a complete
7 installation to the manufacturers installation requirements.
8 D. The Contractor shall install all WAP devices per plans and specifications including cable connections.
9 E. The Contractor shall be responsible to pick up WAP devices from City IT and delivery to the jobsite.

- 10
11 **3.3. FINAL TESTING**
12 A. Contractor shall provide final testing of all WAP devices after installation is complete.
13 B. In the event any WAP device is not operating properly the contractor shall trouble shoot the installation and
14 work with the CoM-IT to determine if re-configuration of the device will be required.
15 C. The CoM-IT shall be responsible for reconfiguring WAP's as needed after installation is complete. The contractor
16 shall be responsible for verifying connections, cabling and connectivity of the installation is correct.
17

- 18 **3.4. WARRANTY**
19 A. The CoM-IT will be responsible for registering any warranty information associated with the purchase and
20 ownership of all WAP devices.
21 B. The Contractor shall warrant the installation of the WAP device for one (1) year per the terms of this contract.
22

23

END OF SECTION

SECTION 28 13 00
ACCESS CONTROL SYSTEM (KEYSCAN)

1
2
3
4 PART 1 - GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 1.3. RELATED DRAWINGS 1
8 1.4. REFERENCES 2
9 1.5. CONTRACTORS QUALIFICATIONS 2
10 1.6. SUBMITTALS 2
11 1.7. WARRANTY 2
12 1.8. QUALITY ASURANCE 2
13 PART 2 - PRODUCTS 2
14 2.1. EXISTING SYSTEM PRODUCTS OVERVIEW 3
15 2.2. NEW EQUIPMENT AND COMPONENTS 3
16 2.3. DISTRIBUTION SUPPLY PANEL (AC-DS-1) 3
17 2.4. POWER SUPPLY PANEL (AC-PS-1) 3
18 2.5. SECURITY PANEL (AC-SEC-1) 4
19 2.6. ELEVATOR FLOOR ACCESS CONTROL PANEL (EFACP) 4
20 2.7. DOOR CONTROL DEVICES 5
21 2.8. DOOR CONTROL CABLES 5
22 PART 3 - EXECUTION 5
23 3.1. COOPERATION OF THE ACS CONTRACTOR 5
24 3.2. GENERAL EQUIPMENT MOUNTING 5
25 3.3. GENERAL CONDUITS AND WIRING 5
26 3.4. ACS CONTROL OF ELEVATOR EQUIPMENT 6
27 3.5. EQUIPMENT IDENTIFICATION AND LABLEING 6
28 3.6. INSTALLATION TESTING AND ACCEPTANCE 7
29

PART 1 - GENERAL

1.1. SUMMARY

- 33 A. The City of Madison Information Technology Department has been assisting other City agencies with
34 standardizing facilities through the use of access cards, key fobs, and punch pads. All hardware is installed locally
35 at the facility while software controls access to various doors remotely.
36 B. These specifications describe the materials, equipment, and installation requirements to install an integrated,
37 computerized access control and alarm monitoring system utilized by the City of Madison Information
38 Technology (CoM-IT) Department.
39 C. The ACS System Contractor shall be responsible for verifying equipment requirements, locations, and
40 coordination with the General Contractor and all other necessary trades as needed for a complete installation.
41 D. The ACS System Contractor shall be aware that the installation plans and specifications are for two (2)
42 independent buildings on two (2) separate fire alarm systems and shall be wired as such. Refer to the Part 3-
43 Exectuion for additional details.
44

1.2. RELATED SPECIFICATIONS

- 46 A. 01 31 23 Project Management Web Site
47 B. 01 33 23 Submittals
48 C. 08 71 00 Door Hardware
49 D. 14 21 00 Electric Traction Elevator
50 E. 27 05 00 Basic Communication Systems Requirements
51

1.3. RELATED DRAWINGS

- 53 A. Refer to all Electrical drawings for locations of distribution panels and equipment as it relates to standard line
54 voltage locations.
55 B. Refer to all Technical drawings for locations of Access Control System (Keyscan) equipment.
56 C. Refer to the door hardware schedule and Architectural floor plans for information relating to door access
57 locations and specific hardware requirements.
58

1 **1.4. REFERENCES**

- 2 A. The system shall comply with the standards, codes and regulations of the following regulatory bodies:
3 1. Underwriters Laboratories (UL) Std No. 294 – Access Control System Units
4 2. Canadian Standards Association (CSA) Std C22.2 No. 205-M1983 – Signal Equipment
5 3. CE Standards
6 a. EN 55022 RF Emissions
7 b. EN 55024 RF Immunity
8 c. EN 60950-1 Equipment Safety
9 4. FCC Subpart B – RF Emissions
10 5. Industry Canada ICES 003 Emissions
11 6. RoHS

12
13 **1.5. CONTRACTORS QUALIFICATIONS**

- 14 A. The Contractor installing the ACS system shall:
15 1. Be a Certified Keyscan Enterprise Partner
16 2. Utilize installers who are Keyscan Enterprise Certified Technicians
17 3. Be based within 25 radial miles of the project location
18 4. Be able to provide 24/7/365 support during the warranty period of this project
19 5. Be able to respond and repair or replace most components within 4 hours of notification
20

21 **1.6. SUBMITTALS**

- 22 A. The Contractor shall provide a complete submittal package in a timely manner to allow sufficient review time
23 prior to ordering the system components required for a complete installation. The contractor shall be solely
24 responsible for any equipment, purchased/ordered/delivered that is not approved of during the submittal
25 review process.
26 B. The complete submittal package shall include but not be limited to the following:
27 1. All certifications of the contractor and contractor's installation team. Certifications shall be current from
28 the start of the contract through the end of the warranty period.
29 2. Cut sheets indicating, shop drawings, performance data, and other such information that will indicate the
30 component being installed matches the component that was specified.
31 3. Cut sheets and shop drawing of Contractors recommendations for tags and labels.
32

33 **1.7. WARRANTY**

- 34 A. The Contractor shall warrant for one year the complete installation of equipment and components associated
35 with this contract and installation. Contractors warranty shall be in the form of a written letter on company
36 letterhead referring to the contract information, dates of installation and acceptance, signed by an authorized
37 representative of the Contractors Company.
38 1. The Contractors warranty shall include but not be limited to the following:
39 a. Transportation to and from the location as often as needed during the warranty period.
40 b. All labor and materials necessary to properly and thoroughly trouble shoot the system.
41 c. All fees associated with the shipping of any component that needs to be returned or supplied by
42 the manufacturer for repair or replacement.
43 d. All labor and materials required to remove, repair, replace, or re-install any component.
44 B. The Contractor shall also provide all manufacturers warranties/guarantees associated with installed components
45 of the completed installation.
46

47 **1.8. QUALITY ASURANCE**

- 48 A. The Contractor shall be responsible for coordinating his/her Work with other trades and divisions as needed for a
49 complete installation. This shall include pre-installation meetings for locating equipment, conduit, cabling,
50 control devices, and other materials and equipment required by this installation.
51 B. The General Contractor (GC) shall be responsible for ensuring that all doors requiring controlled access are
52 properly prepared and installed per the contract documents. The GC shall further be responsible for ensuring all
53 project coordination, pre-installation meetings, submittals and other such project management responsibilities
54 are conducted efficiently and according to the project specifications and schedules.
55

56 **PART 2 - PRODUCTS**
57

1 **2.1. EXISTING SYSTEM PRODUCTS OVERVIEW**

- 2 A. The City of Madison Information Technology Department (CoM IT) owns and operates a fully licensed copy of the
3 Keyscan Access Control System software.
4 1. The Keyscan Access Control System (ACS) provides controlled access to secured doors and elevators
5 through the use of electronic door latches, proximity readers, control panels, and a proprietary software
6 program.
7 2. The Keyscan software allows CoM-IT and the facility the Owner to customize multiple levels of access and
8 system performance through any combination of the following:
9 a. Calendar and time based lock/unlock controls
10 b. Group access control for common personnel groups
11 c. Individual access control for specialized access control
12 d. Elevator access control for accessing/not accessing various floors
13 e. Temporarily disable access control for a specified time period
14 f. Remotely unlock/lock a door
15 g. Lockdown a facility from one location
16 h. Provide customizable alert notifications
17

18 **2.2. NEW EQUIPMENT AND COMPONENTS**

- 19 A. The Contractor guarantees that all equipment and components shall be furnished new, undamaged, free of
20 defects, and conform to the drawings and specifications of this contract. The contractor is solely responsible for
21 replacing any damaged or defective item.
22 B. New ACS components on interior and exterior access doors shall be able to be integrated with the Owners
23 existing system.
24

25 **2.3. DISTRIBUTION SUPPLY PANEL (AC-DS-1)**

- 26 A. AC-DS-1 brings line voltage into the ACS system with the following performance specifications:
27 1. Input
28 a. 115VAC, 60Hz, 1.45A
29 2. Output
30 a. Eight (8) PTC protected outputs
31 b. 16VAC output
32 c. 16VAC @ 10amp (175 VA) supply current (1.25 amp per device, 2.5 amp max.)
33 d. Outputs rated @ 2.5 amp
34 e. Main fuse rated @ 15 amp/32V
35 f. Surge suppression
36 3. Miscellaneous electrical information
37 a. Operating temperature 0° C to 49°C ambient
38 b. 81.89 BTU/hr
39 c. System AC input VA requirement 166.75 AV
40 4. Miscellaneous required features
41 a. AC power LED indicators
42 b. Illuminated master power disconnect circuit breaker with manual reset
43 5. Agency Approvals
44 a. UL 294 listed for Access Control System Units
45 b. CUL listed-CSA Standard C22.2 No 205-M1983 Signal Equipment
46 B. AC-DS-1 shall be:
47 1. Altronix, AL168175CB
48 2. Pre-approved equal
49

50 **2.4. POWER SUPPLY PANEL (AC-PS-1)**

- 51 A. The AC-PS-1 brings line voltage from the AC-DS-1, reduces then distributes the voltage to the Access Security
52 Panels (AC-SEC-1) with the following performance specifications:
53 1. Input
54 a. 115VAC, 60Hz, 1.9A
55 b. Power supply input options
56 i. One (1) common power input for ACM8 and lock power (factory installed)

- 1 B. EFACP shall be:
- 2 1. Keyscan EC1500 – 1 Cab Elevator Floor Access Control Panel
- 3 C. The EFACP shall be provided, located and mounted by the Contractor in the elevator machine room (B11).
- 4 D. The EFACP requires two (2), 16.5 VAC, 37 or 40VA transformers to be supplied and installed by the Contractor.
- 5

6 **2.7. DOOR CONTROL DEVICES**

- 7 A. The Contractor shall be responsible for verifying the Door Control Device (DCD) quantities and locations with the
- 8 door hardware schedule.
- 9 B. DCD shall be:
- 10 1. Keyscan K-KPR – Keyscan Proximity Reader/Keypad, this reader accepts swipe monitoring of cards, key
- 11 bobs, and other such devices as well as accepting personal identification numbers (PINs)
- 12 i. Plan designation = AC-CR1-W
- 13 2. The K-KPR shall be used for all locations including the elevator cab.
- 14

15 **2.8. DOOR CONTROL CABLES**

- 16 A. The following cables are required for a complete installation of the ACS, per controlled door, as follows:
- 17 1. One (1) 22/6 shielded cable, required; to DCD
- 18 2. One (1) 18/2 un-shielded cable, required; lock power
- 19 3. One (1) 22/2 un-shielded cable, required; door contact
- 20 4. One (1) 22/4 un-shielded cable, required but not used; for future request to exit sensors
- 21 B. At the Contractors option he/she may run a manufactured cable bundle containing all four (4) cables listed
- 22 above. It shall be the sole responsibility of the contractor to appropriately size the conduits for the installation.
- 23

24 **PART 3 - EXECUTION**

25

26 **3.1. COOPERATION OF THE ACS CONTRACTOR**

- 27 A. The Contractor shall be required to coordinate with all trades for a complete and timely installation. This
- 28 includes attending all pre-installation meetings where equipment locations, conduit locations, and control
- 29 devices will be installed or may be in conflict with the installation of other trades. The Contractor shall be solely
- 30 responsible for any additional cost required for removing/replacing/modifying any completed work by other
- 31 trades because the installation was not properly coordinated.
- 32 B. The Contractor shall coordinate with the Owners Representative from City IT for all information necessary to
- 33 complete the installation and integration with the Owners existing hardware and software.
- 34 C. The Contractor shall verify with the appropriate Owners Representative for mounting heights of all hardware
- 35 and equipment prior to installation. This shall be completed at a pre-installation walk through prior to rough-in.
- 36 D. The Contractor shall coordinate with the elevator equipment installer the location and wiring of the EFACP.
- 37 E. The Contractor shall coordinate with the Owner's Representative from City IT to verify all requirements for all
- 38 access controlled doors are properly coordinated and understood prior to roughing in the installation.
- 39

40 **3.2. GENERAL EQUIPMENT MOUNTING**

- 41 A. All ACS equipment shall be mounted to the 3/4" AC fire rated plywood panels provided and installed by the
- 42 General Contractor. Contractor shall tape out all equipment prior to mounting to insure adequate space is
- 43 allotted for the complete installation per the riser diagrams including all related conduits and cables.
- 44 B. The EFACP shall be mounted to the 3/4" AC fire rated plywood panels provided and installed by the General
- 45 contractor in the elevator Equipment Room. The General Contractor shall coordinate the location of the
- 46 plywood panels with the Elevator Equipment Contractor and the ACS Contractor prior to installation.
- 47 C. All equipment shall be neatly arranged so as to meet or exceed the manufacturer's recommended working space
- 48 around each component.
- 49 D. Equipment to be installed on plywood mounting panels shall include but not be limited to the following:
- 50 1. Distribution Service Panel (AC-DS-1)
- 51 2. Power Supply Panel (AC-PS-1)
- 52 3. Access Control Panel (AC-SEC-1)
- 53 4. Elevator Control Panel (EFACP), including transformers
- 54 5. All required conduits, and boxes for line voltage
- 55

56 **3.3. GENERAL CONDUITS AND WIRING**

- 57 A. This section shall apply to both the ACS Contractor and the Electrical Contractor. The following division of
- 58 responsibilities shall apply:

- 1 1. The Electrical Contractor shall be responsible for furnishing, installing, and connecting all conduits,
2 connectors, conductors, and other related materials associated with providing line voltage to the ACS
3 system as follows:
 - 4 a. Providing an 110V, 15A, dedicated circuit from the designated distribution panel to AC-DS-1 as
5 described in Section 2.3 above.
 - 6 b. Providing line voltage from AC-DS-1 to AC-PS-1 as described in Section 2.4 above.
 - 7 c. Providing and installing the required 110V, 20A dedicated duplex outlet in the elevator Equipment
8 Room (B11). Coordinate the location with the ACS Contractor and the Elevator Contractor.
- 9 2. The ACS Contractor shall be responsible for furnishing installing, and connecting all conduits, connectors,
10 conductors and other related materials required to complete the installation of the low voltage wiring
11 and door controller cabling.
- 12 B. All conduits shall be properly sized for the number of wires or wire bundles being pulled through the conduit.
13 The Contractor shall verify with the manufacturer the recommended fill rate by conduit size and shall not exceed
14 the recommendations.
- 15 C. The contractor shall neatly lay out all conduits in such a fashion so as to minimize bending, crossovers, etc.
- 16 D. Bends, pull boxes, and pull points shall be sized and located as per all applicable codes and standards for the
17 number of wires or wire bundles in the bend, pull box, pull point.
- 18 E. CAT6 cables from each AC-SEC-1 and the EFACP shall be neatly run in cable management equipment supplied
19 and installed by the cabling contractor or conduits supplied and installed by the ACS Contractor as needed. The
20 switch to be used for all ACS equipment shall be located in IT CLOSET 130. Cables shall be labeled on both ends
21 per the cabling specification.
- 22 F. The General Contractor and the ACS Contractor shall ensure the following Emergency Access requirements are
23 properly installed and operational prior to the final Madison Fire Department inspection for occupancy.
 - 24 1. CoM IT shall provide a minimum of six (6) swipe cards to each installed Knox Box for emergency
25 entrance. The cards shall be appropriately coded for entry at all controlled access doors.
 - 26 2. The following doors shall be wired to unlock in the event of an emergency.
 - 27 a.

3.4. ACS CONTROL OF ELEVATOR EQUIPMENT

- 30 A. The contractor shall coordinate the installation of all required ACS equipment in the elevator Equipment Room
31 with the Elevator Equipment Contractor and the Electrical Contractor.
- 32 B. The Elevator Equipment Contractor shall provide and install a 6 conductor, shielded 18 gauge cable between the
33 elevator equipment and the elevator cab for use with the ACS control equipment.
- 34 C. The Contractor shall coordinate with the Elevator Equipment Contractor for locating and installing the DCD
35 device (2.7. above) in the elevator cab and for coordinating all wiring between the two systems to attain the
36 desired control specification (3.4.D. below)
- 37 D. Prior to programming the elevator controls, coordinate with the City Project Manager and the appropriate
38 representatives from City IT, for final control parameters.

3.5. EQUIPMENT IDENTIFICATION AND LABELING

- 41 A. The Contractor shall provide and install all equipment identification and labeling to the following specifications.
 - 42 1. Tags and labels shall be permanent rigid plastic or metal tags with engraved or machine stamped
43 lettering. Hand written self stick or metal hand stamped tags will not be accepted.
 - 44 2. The Contractor shall work out the labeling scheme for doors with City IT, Owner, and Architect prior to
45 ordering any labels or tags.
 - 46 3. The Contractor shall provide all labels and tags associated with this specification. This shall include the
47 line voltage feed to each AC-DS-1 from the electrical distribution panel.
- 48 B. Panels and Boxes
 - 49 1. All panels and boxes shall be labeled on the outside cover that readily identifies the panel/box as a
50 "Distribution Supply", "Power Supply", "Access Control Panel", "Elevator Floor Access Control Panel", etc.
51 An associated number shall also be on each tag and the number "1" shall be used even if there is only
52 one of that type panel/box.
 - 53 2. Access Control Panels shall have a card index inside the front cover of each door indicating the controller
54 number, door number, and door location being served by that panel.
- 55 C. Conduits
 - 56 1. Line voltage from electrical distribution panels shall have conduits labeled on both ends as follows:
 - 57 a. At the distribution panel the line voltage conduit shall be labeled with the system supplied, and
58 the ACS distribution supply panel number.

SECTION 28 31 00 - FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Furnish all labor, equipment, materials, and performing all operations in connection with the installation of the Fire Alarm System as shown on the drawings, as hereinafter specified, and as directed by the Engineer.
1. Expand or replace the the existing Simplex 4100 addressable fire alarm system with new addressable devices.
 2. The Contractor shall visit and inspect existing facility to determine extent of fire alarm work and to meet requirements of this specification and existing conditions.
 3. Disconnect and remove existing fire alarm equipment and devices not part of the new fire alarm system.
- B. The Fire Alarm System shall consist of all necessary software, field wiring and equipment to perform all fire alarm, detection, and annunciation operations.
1. Annunciation per NFPA 72 and ADA.
 2. State of Wisconsin SPS code requirements.
 3. Madison Fire Department requirements.
- C. Fire Alarm Equipment shall Include:
1. Existing upgrade or new fire-alarm control panel.
 2. New notification appliances.
 3. Reuse existing and new NAC power panels
 4. Existing digital alarm communicator transmitter.
- D. The Fire Alarm Sub-contractor shall be responsible for advising the Engineer ten(10) days prior to the bidding date of any omissions required to meet the local, state and federal requirements for the fire alarm installation. After this date, the additional requirements for a complete installation of the fire alarm system shall become the responsibility of the Fire Alarm Sub-contractor.
- E. The Fire Alarm Sub-contractor shall provide final fire alarm design responsibility for the project and submit all plans, plan approval fees, calculations and related to the City of Madison Fire Department to provide required approvals necessary to obtain facility occupancy for the Owner.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
1. 26 00 00 Electrical Systems

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
1. National Electric Code, Article 760.

SECTION 28 31 00 - FIRE ALARM SYSTEM

2. National Fire Protection Standards:
 - a. NFPA 71: Central Station Signaling Systems - Protected Premises Unit.
 - b. NFPA 72A: Local Protective Signaling Systems.
 - c. NFPA 72D: Protective Signaling Systems - Protected Premises Unit.
 - d. NFPA 72E: Automatic Fire Detectors.
 3. Local and state building codes.
 4. IBC.
 6. All requirements of the local authority having jurisdiction.
 7. Underwriter's Laboratories: The system and all components shall be listed by Underwriters Laboratories, Inc. for use in fire protective signaling systems under the following standards as applicable.
 - a. UL 864: Control Units for Fire Protective Signaling Systems.
 - b. UL 464: Audible Signaling Appliances.
 - c. UL 1638: Visual Signaling Appliances.
 - d. UL 1481: Power Supplies for Fire Protective Signaling Systems.
- B. The equipment and installation supervision furnished under this specification is to be provided by a manufacturer (independent dealers and/or distributors will NOT be considered) who has been engaged in production of this type (software driven) of equipment for at least five (5) years, and has a fully-equipped service organization within one hundred (100) miles of the installation.
1. All control equipment must have transient protection devices to comply with UL864 requirements.
- C. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- D. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level IV technician.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA70, by a qualified testing agency, and marked for intended location and application.

1.4 SUBMITTALS

- A. Submit in accordance with Division 1 and specified herein.
- B. Submit complete documentation showing the type, size, rating, style, catalog number, manufacturer's names, photos and or catalog data sheets for all items to ensure compliance with these specifications.
- C. Submit complete point to point wiring diagrams.
- D. All references to manufacturer's or supplier's model numbers and other pertinent information herein is intended to establish minimum standards for performance, function and quality. Equivalent equipment (compatible UL listed) from other manufacturers may be substituted for that specified providing the submittal is performed as specified above.
- E. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
 1. Include voltage drop calculations for notification appliance circuits.

SECTION 28 31 00 - FIRE ALARM SYSTEM

2. Include battery-size calculations.
3. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
4. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
5. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

1.5 WARRANTY AGREEMENT

- A. The contractor shall warranty all materials, installation and workmanship for three (3) years from date of acceptance, unless otherwise specified. A copy of the manufacturers' warranty shall be provided with closeout documentation and included with the operation and installation manuals.
- B. Technical Support: Beginning with Substantial Completion, provide software support for three (3) years, shall be included in this project.

1.6 DELIVER, STORAGE AND HANDLING

- A. Deliver equipment individually wrapped in factory fabricated fiberboard type containers.
- B. Store equipment in clean, dry space.
- C. Protect from dirt, fumes, water and physical damage.
- D. Do not install damaged equipment, remove from site.

1.7 GENERAL

- A. Furnish and install a complete Fire Alarm System as described herein and as shown on the plans; to be wired, connected, and left in first class operating condition.
- B. The system shall use closed loop initiating device circuits with individual zone supervision, individual notification appliance circuit supervision, incoming and standby power supervision. Include a control panel, manual pull stations, automatic fire detectors, all wiring, connections to devices, outlet boxes, junction boxes, and all other necessary material for a complete operating system.

1.8 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices:
 1. Manual stations.
 2. Heat detectors.
 3. Smoke detectors.
 4. Sprinkler system flow detection.
- B. Fire-alarm signal shall initiate the following actions:

SECTION 28 31 00 - FIRE ALARM SYSTEM

1. Activate the audio (speakers) and visual notification appliances.
 2. Identify alarm at fire-alarm control unit and remote annunciators.
 3. Transmit an alarm signal to the remote alarm receiving station.
 4. Unlock electric door locks in designated egress paths.
 5. Release fire and smoke doors held open by magnetic door holders.
 6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 7. Record events in the system memory.
 8. Record events by the system printer.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Retain only those devices and actions in subparagraphs below that are applicable to Project.
 2. Coordinate with requirements in other Sections that specify listed devices and systems.
 3. Open circuits, shorts, and grounds in designated circuits.
 4. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 5. Loss of primary power at fire-alarm control unit.
 6. Ground or a single break in fire-alarm control unit internal circuits.
 7. Abnormal ac voltage at fire-alarm control unit.
 8. Break in standby battery circuitry.
 9. Failure of battery charging.
 10. Abnormal position of any switch at fire-alarm control unit or annunciator.
- E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.
- F. General – Audio: Upon alarm activation of any area smoke detector, heat detector, manual pull station, sprinkler waterflow, the following functions shall automatically occur:
1. The internal audible device shall sound at the control panel or command center.
 2. The LCD Display shall indicate all applicable information associated with the alarm condition including: zone, device type, device location and time/date.
 3. All system activity/events shall be documented on the system printer.
 4. Any remote or local annunciator LCD/LED's associated with the alarm zone shall be illuminated.
 5. The following audio messages and actions shall occur simultaneously: An evacuation message shall be sounded for general alarm throughout the building. Owner to select tone and message for review by Dubuque Fire Marshall.
 6. Activate all visual strobes throughout the building. The visual strobe shall continue to flash until the system has been reset. The visual strobe shall not stop operating when the "Alarm Silence" is pressed.
 7. Provide selective paging to each individual floor (zone). In addition to the message/channels detailed above, a dedicated page channel shall be capable of simultaneously providing live voice instructions without interrupting any of the messages listed above shall be provided.
 8. Transmit signal to the central station.

SECTION 28 31 00 - FIRE ALARM SYSTEM

9. Activate automatic smoke control sequences.
10. All automatic events programmed to the alarm point shall be executed and the associated outputs activated.
11. All electrically locked stairwell/exit doors shall unlock throughout the building.
12. All self-closing fire/smoke doors held open shall be released.

1.09 SUPERVISION

- A. Each independently supervised circuit shall include a discrete panel readout to indicate disarrangement conditions per circuit.

1.10 POWER REQUIREMENTS

- A. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120 VAC power in a normal supervisory mode for a period of twenty-four (24) hours with 10 minutes of alarm operation at the end of this period. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic.
 1. All circuits requiring system operating power shall be 24VDC and shall be individually fused at the control panel.

1.11 MULTIPLE ADDRESSABLE PERIPHERAL NETWORK

- A. Communication with addressable devices: The system must provide communication with all initiating and control devices individually. All of these devices are to be individually annunciated at the control panel. Annunciation shall include the following conditions for each point:
 1. Alarm
 2. Trouble
 3. Open
 4. Short
 5. Ground
 6. Device Fail/or Incorrect Device
- B. All addressable devices are to have the capability of being disabled or enabled individually.
- C. Up to 127 addressable devices may be multi-dropped from a single pair of wires. Systems that require factory reprogramming to add or delete devices are unacceptable.
- F. Format: The communication format must be a poll/response protocol to allow t-tapping of the wire to addressable devices and be completely digital. A high degree of communication reliability must be obtained by using parity data bit error checking routines for address codes and check sum routines for the data transmission protocol. Systems that do not utilize full digital transmission protocol (i.e. that may use time pulse width methods to transmit data etc.) will not be acceptable since they are considered unreliable and prone to errors.
- G. Identification of Addressable Devices: Each addressable device must be uniquely identified by an address code entered on each device at time of installation. The use of jumpers to set address will not be acceptable due to the potential of vibration and poor contact.
- H. Wiring Type, Distances, Survivability and Configurations: Wiring types will be approved by the equipment manufacturer. Existing wiring will be utilized in retrofit applications. The

SECTION 28 31 00 - FIRE ALARM SYSTEM

system must allow up to 2,500 feet wire length to the furthest addressable device. Class A (Style 6 Signaling Line Circuit as defined by NFPA-72) communications will be provided where shown on the drawings. Wire will be so routed to maintain sufficient distance between the forward and return loop as called for by the Authority Having Jurisdiction (AHJ). To minimize wire routing and to facilitate future additions, t-tapping of the communications channel will be supported except where Class A wiring is required.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Simplex, Edwards, Notifier, Siemens or approved equal.

2.2 INTELLIGENT ANALOG SYSTEM SMOKE DETECTORS

- A. General Requirements for Intelligent Analog Detectors:
1. Integral Microprocessor: All decision are made at the detector determining if the device is in the alarm or trouble condition.
 2. Non-Volatile Memory: Permanently stores serial number, and type of device.
 1. Automatically updates historic information including hours of operation, maintenance date, number of alarms and troubles, time of last alarm and analog signal patterns for each sensing element just before last alarm.
 4. Electronic Addressing: Permanently stores programmable system address. It shall be possible to address each intelligent module without the use of DIP or rotary switches. Devices using switches for addressing shall not be acceptable.
 5. Automatic Device Mapping: Each detector transmits wiring information regarding its location with respect to other devices on the circuit, creating an As-Built wiring diagram. This will also provide enhanced supervision of the device physical location and the device message shall reside with the location and not the device address. Devices installed in the wrong location will always report the correct message of the physical location.
 6. Sensitivity Range: Each analog addressable smoke detector's sensitivity shall be capable of being programmed individually as: most sensitive, more sensitive, normal, less sensitive or least sensitive. It shall be possible to automatically change the sensitivity of individual analog/addressable detectors for the day and night periods. It shall be possible to program control panel activity to each level.
 7. Pre-Alarm: Detector stores 20 pre-alarm sensitivity values to alert local personnel prior to the sensor reaching full evacuation sensitivity. Sensitivity values can be set in 5% increments.
 8. Environmental Compensation: The detector's sensing element reference point shall automatically adjust, compensating for background environmental conditions such as dust, temperature, and pressure. Periodically, the sensing element real-time analog value shall be compared against its reference value. The detector shall provide a maintenance alert signal when the detector reaches 75% (Dirty) to 99% (More Dirty) compensation has been used. The detector shall provide a dirty fault signal when 100% or greater compensation has been used.
 9. Twin Status LEDs: Flashing Green LED shows normal; flashing RED shows alarm state; steady RED and steady GREEN show alarm state in stand-alone mode, visible from any direction.
 10. UL Sensitivity Testing: The detector shall utilize a supervised microprocessor that is capable of monitoring the sensitivity of the detector. If the detector sensitivity shifts outside of the UL limits, a trouble signal is sent to the panel.

SECTION 28 31 00 - FIRE ALARM SYSTEM

11. Device Replacement: The system shall allow for changing of detector types for service replacement purposes without the need to reprogram the system. The replacement detector type shall automatically continue to operate with the same programmed sensitivity levels and functions as the detector it replaced. System shall display an off-normal condition until the proper detector type has been installed or change in the application program profile has been made.
- B. Intelligent 4D Multi-sensor Detector (Photo/Ion/Thermal and Time):
1. Provide intelligent analog addressable 4D multi-sensor smoke detectors at the locations shown on the drawings. The 4D Intelligent detector gathers analog information from each of its three fire sensing elements and converts it into digital signals. The detectors on-board microprocessor measures and analyzes these signals separately with respect to a fourth element – Time. It compares the information to historical readings, time patterns and known fire characteristics to make an alarm decision. Digital filters remove signal patterns that are not typical of fires.
 2. Separately mounted combinations of photoelectric detectors, ionization detectors and heat detectors in the same location, clustered at the manufacturer's listed spacing is an acceptable alternative.
- C. Intelligent 3D Multi-sensor Detector (Photo/Thermal and Time):
1. Provide intelligent analog addressable 3D multi-sensor smoke detectors at the locations shown on the drawings. The 3D Intelligent detector gathers analog information from each of its two fire sensing elements and converts it into digital signals. The detectors on-board microprocessor measures and analyzes these signals separately with respect to a third element – Time. It compares the information to historical readings, time patterns and known fire characteristics to make an alarm decision. Digital filters remove signal patterns that are not typical of fires.
- D. Intelligent Photoelectric Detector:
1. Provide intelligent analog addressable photoelectric smoke detectors at the locations shown on the drawings.
- E. Intelligent 135 Degree Fixed Temperature / Rate of Rise Heat Detector:
1. Provide intelligent combination fixed temperature/rate-of-rise heat detectors at the locations shown on the drawings.
 2. The heat detector shall have a low mass thermistor heat sensor and operate at a fixed temperature and at a temperature rate-of-rise. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm.
 3. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. Systems using central intelligence for alarm decisions shall not be acceptable.
 4. The intelligent heat detector shall have a nominal fixed temperature alarm point rating of 135°F (57°C) and a rate-of-rise alarm point of 15°F (9°C) per minute.
 5. The heat detector shall be rated for ceiling installation at a minimum of 70 ft (21.3m) centers and be suitable for wall mount applications.
- B. Fixed Temperature Heat Detector:

SECTION 28 31 00 - FIRE ALARM SYSTEM

1. Provide intelligent fixed temperature heat detectors at the locations shown on the drawings.
2. The heat detector shall have a low mass thermistor heat sensor and operate at a fixed temperature. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data.
3. Systems using central intelligence for alarm decisions shall not be acceptable.
4. The heat detector shall have a nominal alarm point rating of 135°F (57°C).
5. The heat detector shall be rated for ceiling installation at a minimum of 70 ft (21.3m) centers and be suitable for wall mount applications.

C. Detector Base Types

1. Provide standard detector mounting bases suitable for mounting on 1-gang, or 4inch octagon box and 4 inch square box. The base shall, contain no electronics and support all series detector types. Bases with electronics or dip-switches are not acceptable.
2. Provide relay detector mounting bases suitable for mounting on 1-gang, or 4” octagon box and 4” square box. The relay base shall support all Signature Series detector types and have the following minimum requirements:
 - a. The relay shall be a bi-stable type and selectable for normally open or normally closed operation.
 - b. The position of the contact shall be supervised.
 - c. The relay shall automatically de-energize when a detector is removed.
 - d. The operation of the relay base shall be controlled by its respective detector processor or under program control as required by the application. Detector relays not capable of operational programming independent of the detector shall not be considered equal. Form “C” Relay contacts shall have a minimum rating of 1 amp @ 30 Vdc and be listed for “pilot duty”.
 - e. Removal of the respective detector shall not affect communications with other detectors.
3. Provide audible detector mounting bases suitable for mounting on 4” x 4” octagonal concrete ring (mud box) and 4” square x 2-1/8” (54 mm) deep box.
 - a. The base shall support all Signature Series detector types and be capable of single or group operation. The audible base shall emit a temporal alarm tone and be selectable for low or high output.
 - b. The operation of the audible base shall be controlled by its respective detector processor or under program control as required by the application. Detector audible base not capable of operational programming independent of the detector shall not be considered equal.
 - c. The audible bases shall be UL268 and UL464 Listed, and provide a reverberant room sound output per UL464 of 81 dBA at 10ft (3m). and an average anechoic sound output of 90 dBA at 10 ft. (3m).

D. Intelligent Duct Smoke Detector – Photoelectric:

1. Provide intelligent photoelectric duct smoke detector at the locations shown on the drawings.
 - a. One form C auxiliary alarm relay rated at 2amps @ 30Vdc.
 - b. The operating range shall be 100ft/min to 4,000ft/min air velocity and temperature range of -20 to 158F.
 - c. Sample tube can be installed with or without the cover plate and be rotated in 45- degree increments to ensure proper alignment with duct airflow.

SECTION 28 31 00 - FIRE ALARM SYSTEM

- d. Local magnet-activated test switch.
2. Provide remote test station with Alarm LED and Key Switch.
3. Relay Fan Shutdown: Rated to interrupt fan motor control circuit. Furnish and install separate device for each motor start. Connect to motor start as required for fan shutdown during alarm condition.

2.3 INTELLIGENT MODULES

- A. It shall be possible to address each intelligent module without the use of DIP or rotary switches. Devices using switches for addressing shall not be acceptable. The personality of multifunction modules shall be programmable at site to suit conditions and may be changed at any time using a personality code downloaded from the Analog Loop Controller.
1. Integral Microprocessor: All decisions are made at the module determining if the device is alarm or trouble condition.
 2. Non-Volatile Memory: Permanently stores serial number, and type of device. Automatically updates historic information including hours of operation, number of alarms and troubles, time of last alarm.
 3. Automatic Device Mapping: Each detector transmits wiring information regarding its location with respect to other devices on the circuit, creating an As-Built wiring diagram. This will also provide enhanced supervision of the device physical location. The device message shall reside with the location and not the device address. Devices installed in the wrong location will always report the correct message of the physical location.
 4. Twin Status LEDs: The modules shall have a minimum of 2 diagnostic LEDs mounted behind a finished cover plate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status.
 5. Input and output circuit wiring shall be supervised for open and ground faults.
 6. Two styles of modules shall be available; those designed for gang box mounting, and where multiple modules are required in a single location, plug in modules shall be provided with a Universal Input/Output motherboard.
- B. Intelligent Input Module. The Input Module shall provide one or two supervised Class B input circuit capable of a minimum of 4 personalities, each with a distinct operation. The module shall be suitable for mounting on North American 2 1/2" (64mm) deep 1-gang boxes and 1 1/2" (38mm) deep 4" square boxes with 1-gang covers. The single input module shall support the following circuit types:
1. Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
 2. Normally-Open Alarm Delayed Latching (Water flow Switches)
 3. Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
 4. Normally-Open Active Latching (Supervisory, Tamper Switches)
- C. Intelligent Relay Module. Provide addressable control relay circuit modules shall provide one (1) form C dry relay contacts rated at 24Vdc @ 2 amps (pilot duty) to control external appliances or equipment. The position of the relay contact shall be confirmed by the system firmware. The module shall be suitable for mounting on North American 2 1/2" (64mm) deep 1-gang boxes and 1 1/2" (38mm) deep 4" square boxes with 1-gang covers.
- D. NAC Control Module: Provide intelligent NAC control module shall provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation. The gang box -mounted version shall be suitable for mounting in North American 2 1/2" (64mm) deep 2-gang boxes and 1 1/2" (38mm) deep 4" square boxes with 2-

SECTION 28 31 00 - FIRE ALARM SYSTEM

gang covers, or European 100mm square boxes. The plug-In version shall plug into a universal multi-module motherboard. The NAC control module shall support the following operations:

1. 24volt NAC circuit
 2. Audio notification circuit 25v or 70v
 3. Telephone Power Selector with Ring Tone (Firefighter's Telephone)
 4. Visual Synchronized Output to Genesis appliances or to NAC Power Supply.
- E. FA Elevator Interface Cabinet
1. Provide red metal cabinet enclosure with word FIRE in white letters on the cover. Inside will be four intelligent relays (Primary Recall, Alternate Recall, Fire Hat and Shunt Trip), one monitor input (Shunt Trip AC Power Supervision) and 120vac relay (Shunt Trip AC Power Supv).
 2. Label all the relays and input modules for the function.

2.4 NOTIFICATION APPLIANCES

- A. All appliances shall be of the same manufacturer as the Fire Alarm Control Panel specified to insure absolute compatibility between the appliances and the control panels, and to insure that the application of the appliances are done in accordance with the single manufacturers' instructions.
- B. Any appliances, which do not meet the above requirements, and are submitted, for use must show written proof of they're compatibility for the purpose intended. Such proof shall be in the form of documentation from all manufacturers which clearly states that their equipment (as submitted) are 100% compatible with each other for the purposes intended. All appliances shall be UL listed Fire Protective Service. and shall be UL 1971.
- C. Notification Appliances – Visual:
1. Provide wall or ceiling mounted white strobes with in-out screw terminals shall be provided for wiring. Strobes shall provide a smooth light distribution pattern field selectable candela 15 cd, 30 cd, 75 cd, and 110 cd flash output rating.
 2. The strobe (15, 30, 75, 110) candela rating shall be view from the side window to verify the setting.
 3. All strobes shall be synchronization to within 10 milliseconds for an indefinite period shall not require the use of separately installed remote synch modules.
 4. The strobes shall mount to one-gang electrical box. The device shall have plastic protective cover for during installation.
 5. The actual candela setting on the visual shall be marked on the appliance.
- D. Notification Appliance – Horn:
1. Provide low profile wall mount horns at the locations shown on the drawings. The horn shall provide an 95 dBA sound output at 10 ft. when measured in reverberation room per UL-464. The horn shall have a selectable steady or synchronized temporal output. In and out screw terminals shall be provided for wiring. The horn shall mount in a 1-gang box.
 2. The device shall have plastic protective cover for during installation.
- E. Notification Appliance – Horn/Strobe:

SECTION 28 31 00 - FIRE ALARM SYSTEM

1. Provide low profile wall mount horn/strobes at the locations shown on the drawings. The horn/strobe shall provide an audible output of 95 dBA at 10 ft. when measured in reverberation room per UL-464. Strobes shall provide synchronized flash outputs.
2. The strobe output shall be determined as required by its specific location and application from a family of 15cd, 30cd, 60cd, 75cd & 110cd devices. The horn shall have a selectable steady or synchronized temporal output. In and out screw terminals shall be provided for wiring.
3. Low profile horn/strobes shall mount to one-gang box.
4. The device shall have plastic protective cover for during installation.

F. Notification Appliance – Harsh Environment Temporal Horn/Strobes:

1. Provide red electronic horn/strobes at the locations shown on the drawings. Horns shall be temporal output. At the high output setting, the horn shall provide a 85 dBA continuous sound output or a 95 dBA temporal sound output, when measured in reverberation room per UL-464. Strobes shall provide 15 cd, 75 cd, 110 cd synchronized flash outputs without the use of separate “synchronizing” modules. The strobe shall have lens markings oriented for wall or ceiling mounting.
2. In - Out screw terminals shall be provided for wiring. Horns shall mount to a North American 4” electrical boxes (2-1/8” deep) or to a 2-gang (2-3/4” deep) electric box. Weatherproof wall boxes shall be provided for outdoor applications.
3. Provide GE-EST model 757 series.

G. Notification Appliance –Speakers:

1. Provide 4" white speakers at the locations shown on the drawings.
2. Speakers shall have a 4" mylar cone, paper cones are not acceptable.
3. The rear of the speakers shall be completely sealed protecting the cone during and after installation.
4. In and out screw terminals shall be provided for wiring.
5. Speakers shall provide 1/4w, 1/2w, 1w, and 2w power taps for use with 25V or 70V systems.
6. At the 2 watt setting, the speaker shall provide a 90 dBA sound output over a frequency range of 400-4000 Hz. when measured in reverberation room per UL-1480.

H. Notification Appliance –Speakers/Strobes:

1. Provide 4" white speakers/strobes at the locations shown on the drawings.
2. Speakers shall have a 4" mylar cone, paper cones are not acceptable.
3. The rear of the speakers shall be completely sealed protecting the cone during and after installation.
4. In and out screw terminals shall be provided for wiring. Speakers shall provide 1/4w, 1/2w, 1w, and 2w power taps for use with 25V or 70V systems.
5. At the 2 watt setting, the speaker shall provide a 87 dBA sound output over a frequency range of 400-4000 Hz. when measured in reverberation room per UL-1480.
6. Strobes shall provide synchronized flash. Strobe output shall be determined as required by its specific location and application from a family of 15/75cd, 30cd, 60, 75 & 110cd devices.

2.5 GUARDS FOR PHYSICAL PROTECTION

SECTION 28 31 00 - FIRE ALARM SYSTEM

- A. Provide welded mesh of size and shape for the manual pull stations, smoke detectors, notification appliances at location noted on the drawings.

2.6 INSPECTION BAR CODES

- A. Inspection bar codes shall be installed on all initiating devices, annunciators, control panels and power supplies.
- B. Inspection bar codes used by the system must utilize Code 3 of 9 or other approved format, and contain a minimum of eight (8) digits that comprise a unique serial identifier within the Web-based Reporting System. There shall be no duplication of serial numbers. Serial number shall be printed below the bar code for identification purposes.
- C. Inspection bar codes shall be limited in size to no more than 2" (5cm) in width, and 3/8" (2 cm), in height and shall include a Mylar[®] or other protective coating to protect the bar code from fading due to sunlight or exposure.
- D. Inspection bar codes shall be installed on each device in such a manner as to require that scanning of the bar code take place no further than 12" from the device during inspection.

2.7 WIRE AND CABLE

- A. Signaling Line Circuits – Network Data: Twisted pair, not less than No. 18Awg or as recommended by the manufacturer.
- B. Signaling Line Circuits – Intelligent Loop: Twisted pair, not less than No. 18Awg or as recommended by the manufacturer.
 - 1. Circuit Integrity Cable: Provide as required to meet NFPA or Local Code requirements.
 - 2. CI Cable shall meet article 760, power limited fire alarm service.
- C. Notification Appliance Circuits –
 - 1. Audio and Visual. 12 AWG THHN or FPLP or as recommended by the manufacturer.
- D. All low voltage cable and wire shall be supplied and installed in accordance with the National Electrical Code and other provisions of Division 16000.
- E. Cable and wire selected for each application shall be in strict accordance with the original equipment manufacturers recommendations.
- F. All cables and wires shall be permanently tagged at both ends for ease in maintenance.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Notification Appliance Devices: Install between 80 and 96 inches on the wall.

SECTION 28 31 00 - FIRE ALARM SYSTEM

3.2 CABLE WIRING

- A. Cable shall be the type listed for the use as specified under NEC Article 760-30 (bell wire, intercom, or telephone wire are not approved).
1. All cable shall be installed as per NEC Article 760.
 2. Leave 8-inch wire tails at each device box and 36-inch wire tails at the Fire Alarm Control Panel.
 3. Cable for conventional initiating devices shall be looped by zone. Cable shall be installed from the Monitor Module to the first device, then to each succeeding device within each zone loop. An end-of-line resistor device shall be installed at or after the last device on the circuit.
 4. Cable for conventional indicating devices (audible or visual) shall be looped as stated above from the Control Module. An end-of-line resistor device shall be installed at or after the last device on the circuit. Wire may be 16 through 12 AWG.
 5. Cable for SLC loops shall be 18 to 12 AWG twisted pair with a shield jacket. Shield continuity must be maintained and connected to earth ground only at the control panel. Intelligent detector wiring must not be routed adjacent to, or in the same conduit with Audio/Visual power wiring, 120/240 VAC power wiring or other high current circuits.
 6. T-Taps or branch circuit connections are allowed for all Style 4 intelligent loop circuits.
 7. Cable for RS-232c devices (CRT, Printer) shall be dual pair twisted-shielded.
 8. Power wiring shall be 12 AWG.

3.3 DEVICE BOX MOUNTING

- A. Device Box Mounting: Unless otherwise noted on the drawings, plans, specification or by the Engineer; the recommended mounting heights, type of boxes required and other specific requirements are as follows:
1. Signaling Device(s): Standard semi-flush horns, bells and chimes require a 4 inch square, 2-1/8 inch deep, device box with a 2-gang ring (1/2" minimum depth). Install 6" below finished ceiling or 120" maximum height.
 2. Where new devices are mounted at existing locations, provide painted back-up plates to provide a finished appearance.

3.4 FIELD QUALITY CONTROL

- A. All intelligent analog addressable devices shall be tested for current address, sensitivity, and user defined message.
- B. All wiring shall be tested for continuity, shorts, and grounds before the system is activated.
- C. All test equipment, instruments, tools and labor required to conduct the tests shall be made available by the installing contractor.
- D. The system including all its sequence of operations shall be demonstrated to the Owner, his representative, and the local fire inspector. In the event the system does not operate properly, the test shall be terminated. Corrections shall be made and the testing procedure shall be repeated until it is acceptable to the Owner, his representatives and the fire inspector.
- E. At the final test and inspection, a factory trained representative of the system manufacturer shall demonstrate that the system functions properly in accordance with these specifications.

SECTION 28 31 00 - FIRE ALARM SYSTEM

The representative shall provide technical supervision, and participate during all of the testing for the system.

- F. All fire alarm testing shall be in accordance with National Fire Alarm Code, NFPA 72 - 1999, Chapter 7.
- G. A letter from the Contractor certifying that the system is installed entirely in accordance with the system manufacturer's recommendations and within the limitations of the required listings and approvals, that all system hardware and software has been visually inspected and functionally tested by a manufacturer's certified representative, and that the system is in proper working order.

3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 16 Section "Electrical Identification."
- B. Install framed instructions in a location visible from fire-alarm control unit.
- C. All initiating devices shall have bar code label installed visibly on the device. This bar code shall be used for digital inspection of the fire alarm system using Building Reports.Com.

3.6 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.7 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by Architect, Engineer and authorities having jurisdiction.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

SECTION 28 31 00 - FIRE ALARM SYSTEM

3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- F. Fire-alarm system will be considered defective if it does not pass tests and inspections. Prepare test and inspection reports.
- G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- H. Annual Test and Inspection: During the warranty period, each year test fire-alarm system complying with visual and testing inspection requirements in NFPA72. Use forms developed for initial tests and inspections.
- I. Detector Sensitivity Testing: During the warranty period, each year the contractor is to perform detector sensitivity testing and provide report to the Owner. Unless, the system is UL Listed to perform automatic sensitivity testing without any manual intervention and should detector fall outside of sensitivity window, the system will automatically indicated a devices trouble. A copy of UL letter is to be provided as proof of system operation

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION

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