

ADDENDUM NO. 1

TO THE PLANS AND SPECIFICATIONS FOR:

HCEB Continuing Education Office Remodel Floors 1 & 4

Prepared by

Brigham Young University  
Planning & Construction Dept.  
240 Brewster Physical Plant  
Provo, Utah 84602  
23 February 2024

This Addendum issued 23 February 2024 is for all persons preparing bids and as such shall be made a part of the contract documents. This Addendum consists of this cover sheet and 124 pages. In case of any conflict between the drawings, specifications, and this Addendum, this Addendum shall govern. All changes, corrections, deletions and/or additions to the initial bidding documents shall be included in the Bidder's proposal. Receipt of this Addendum shall be acknowledged on the Bid proposal forms.

Approved by:



Anthony R. Burdette, Director of Construction

23 February 2024

Date

**BRIGHAM YOUNG UNIVERSITY  
CONTINUING EDUCATION OFFICE REMODEL LEVELS 1&4  
Work Order No. N1864-N3482**

**ADDENDUM NO. 1  
21 FEB 2024**

**OWNER/ARCHITECT**

Brigham Young University  
Shelbey King, 255 BRWB, (801) 319-1983

**CHANGES TO CONTRACT**

1. 'INSTRUCTION TO BIDDERS' requires the general contractor to hold their bid for 45 days after bid. That shall be changed to be until May 6, 2024 on this project.
2. See attached Asbestos Survey. It is for "Reference only" and is to be kept on sight by the general contractor and provided to any State or BYU inspector upon request. General contractor is responsible to understand the report. The owner will remove any asbestos on the project. If the general contractor or any of its subcontractors encounter any suspicious or known asbestos during the project, they are to notify BYU immediately and BYU will have it removed. It will be removed by a qualified asbestos abatement contractor.

**CHANGES TO DRAWINGS, See attached Plans**

Architectural

1. Sheet A4.0 Change in hardware for door 111 as noted in attached plans.

Mechanical

1. Add an additional general note to sheets "M0 N1864" and "M0 N3482" and number it, #19, to read "Elements of the mechanical controls shall be owner furnished and contractor installed. Refer to NIC coordination table for specific division of scope of work. Install control systems as indicated on the project documents and drawings for a complete and fully functional controls system."
2. NIC coordination list is redundant on sheets "M0 N3482" and "M1 N3482". Delete redundant NIC coordination list on sheet "M1 N3482".
3. Delete general note #2 from sheet "M2 N1864"
4. Delete general note #12 from sheet "M2 N3482"

5. Move the thermostat shown in room 111E on sheet "M2 N1864" further west along the wall so that it is not behind the door. Coordinate final location and placement with architect.
6. Move the return air grille in room 117 on sheet "M1 N1864". See drawing update
7. Move the thermostat in room 117 on sheet "M2 N1864". See drawing update.
8. Mechanical specifications, including sections 210500, 210553, 211300, 220529, 220548, 230100, 230517, 230523, 230529, 230548, 230553, 230593, 230713, 230719, 230800, 232113, 232114, 233100, 233300, 233600, and 233700 were incomplete and issued only showing the first page of each section. Mechanical specifications are reissued in full.
9. Update all mechanical sheets that do not have the correct designer and drawn by fields to show "J. Jensen".

## Electrical

1. Sheet E1.0 added location of electrical panel.
2. Sheet E1.0 added Thermostat pathways to electrical sheet to match mechanical sheets.
3. Sheet E1.0 added Junction box above doorway 111 level 1
4. Sheet E2.0 added exit sign, fire strobe and smoke detector locations.
5. Sheet E2.0 added Motion sensor locations.
6. Sheet E2.0 changes to lighting fixture schedule
7. Sheet E5.0 Change in General Note 3
8. Sheet E5.2 added detail for thermostat pathway.



**226 East 4800 South  
Murray, Utah 84107  
Phone 385-321-9701**

**A LIMITED ASBESTOS SURVEY AND ASSESSMENT FOR**



**Brigham Young University  
Harman Continuing Education Building  
Testing Center  
770 East University Parkway  
Provo, Utah 84604  
2 December, 2023**

**Prepared by:  
Scott Bainbridge #ASB-6822  
Annabelle Mitchell #ASB-8012  
Air Quality Consulting, LLC #603**

**385-321-9701  
[scott@airqualityconsult.com](mailto:scott@airqualityconsult.com)**

## **Executive Summary**

Asbestos-containing material (ACM) was not found in the suspect materials around Room 111.

\* - Denotes less than 1% asbestos which is regulated by OSHA, it is recommended to review their regulations before removal

## **Building Description**

**Structure:** Block, Framed

**Roof:** Membrane

**Siding:** Brick

**Foundation:** Concrete


**Insulation:** Fiberglass

**Walls:** Drywall

**Ceiling:** Ceiling Panel

**Flooring:** Carpet (no vinyl tile or mastic under)

### Non-ACM Results by Material

Sample Number	MaterialDescription/Lab Results	Amount	Homogeneous Area
<b>Ceiling Panel</b>			
HBCE-112723-1	2'x2' Recessed Ceiling Panel/None Detected	4,200 SF	Testing Center
HBCE-112723-4	2'x2' Recessed Ceiling Panel/None Detected	4,200 SF	Testing Center
HBCE-112723-11	2'x2' Recessed Ceiling Panel/None Detected	4,200 SF	Training Center
			
<b>Drywall System</b>			
HBCE-112723-2	Drywall System/None Detected	4,200 SF	Training Center
HBCE-112723-3	Drywall System/None Detected	4,200 SF	Training Center
HBCE-112723-5	Drywall System/None Detected	4,200 SF	Training Center
HBCE-112723-6	Drywall System/None Detected	4,200 SF	Training Center
<b>Caulking</b>			
HBCE-112723-7	Gray Caulking/None Detected	88 SF	Doors and Windows
HBCE-112723-8	Gray Caulking/None Detected	88 SF	Doors and Windows
HBCE-112723-9	Gray Caulking/None Detected	88 SF	Doors and Windows





**Utah Asbestos Sampling Worksheet**

**Facility name, address:** Testing Center, Harman Building, 770 E University Parkway, Provo, UT 84604

**Scope:** Test all suspect ACM for renovation


**Anticipation of work:** Collect samples of all homogenous, suspect materials

Suspect ACM	Quantity	Location	Sampled/ Assumed	RACM/ CAT 1/ CAT 2
HBCE-112723-1 Ceiling Panel	50 sf	Room 111C	Sampled	ND
HBCE-112723-2 Drywall System	300 sf	Room 111C	Sampled	ND
HBCE-112723-3 Drywall System	300 sf	Room 111A	Sampled	ND
HBCE-112723-4 Ceiling Panel	72 sf	Room 111B	Sampled	ND
HBCE-112723-5 Drywall System	2500 sf	Room 111	Sampled	ND
HBCE-112723-6 Drywall System	2500 sf	Room 111	Sampled	ND
HBCE-112723-7 Caulking	4 sf	Room 111A	Sampled	ND
HBCE-112723-8 Caulking	4 sf	Room 111B	Sampled	ND
HBCE-112723-9 Caulking	18 sf	111 Lobby	Sampled	ND
HBCE-112723-10 Drywall System	380 sf	Room 113	Sampled	ND
HBCE-112723-11 Ceiling Panel	90 sf	Room 119	Sampled	ND

**Laboratory Analysis PLM/PCM/TEM** PLM

**Inaccessible areas of suspect ACM**

**Scott Bainbridge Cert #ASB-6822**



**11/27/23**

\* - Denotes less than 1% asbestos which is regulated by OSHA, it is recommended to review their regulations before removal

REFERENCE NOTES



**FACILITIES PLANNING**  
 240 BRWB PROVO, UTAH 84602  
 PHONE: (801) 422-5504  
 FAX: (801) 422-0566

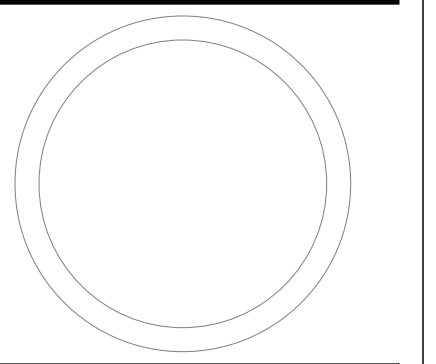
DATE: 4/26/23  
 DESIGNER: SK  
 DRAWN BY: NG

ADA CHECK: \_\_\_\_\_  
 CODE CHECK: \_\_\_\_\_  
 STRUCTURAL: \_\_\_\_\_  
 ENGINEERING: \_\_\_\_\_  
 PLANNING DIR: \_\_\_\_\_

CLIENT APPROVAL \_\_\_\_\_ DATE \_\_\_\_\_

REVISIONS

BRIGHAM YOUNG UNIVERSITY  
 RENOVATE TESTING CENTER SPACE INTO OFFICES 111  
 CONTINUING EDUCATION  
 HARMAN CONTINUING EDUCATION BUILDING (HCEB) - LEVEL 1



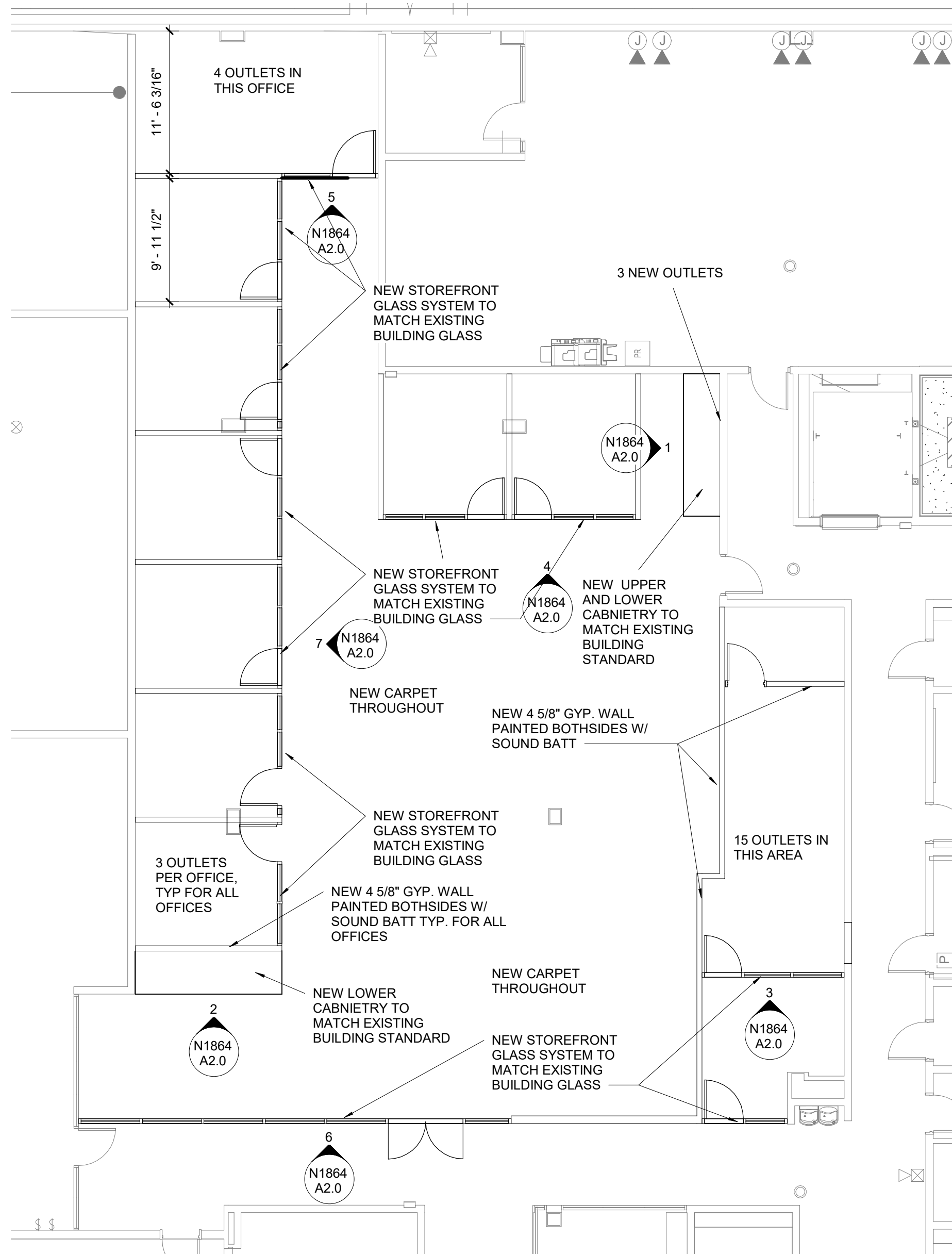
DEMOLITION & NEW FLOOR PLAN

WORK ORDER & SHEET NO.

**N1864  
 A1.0**

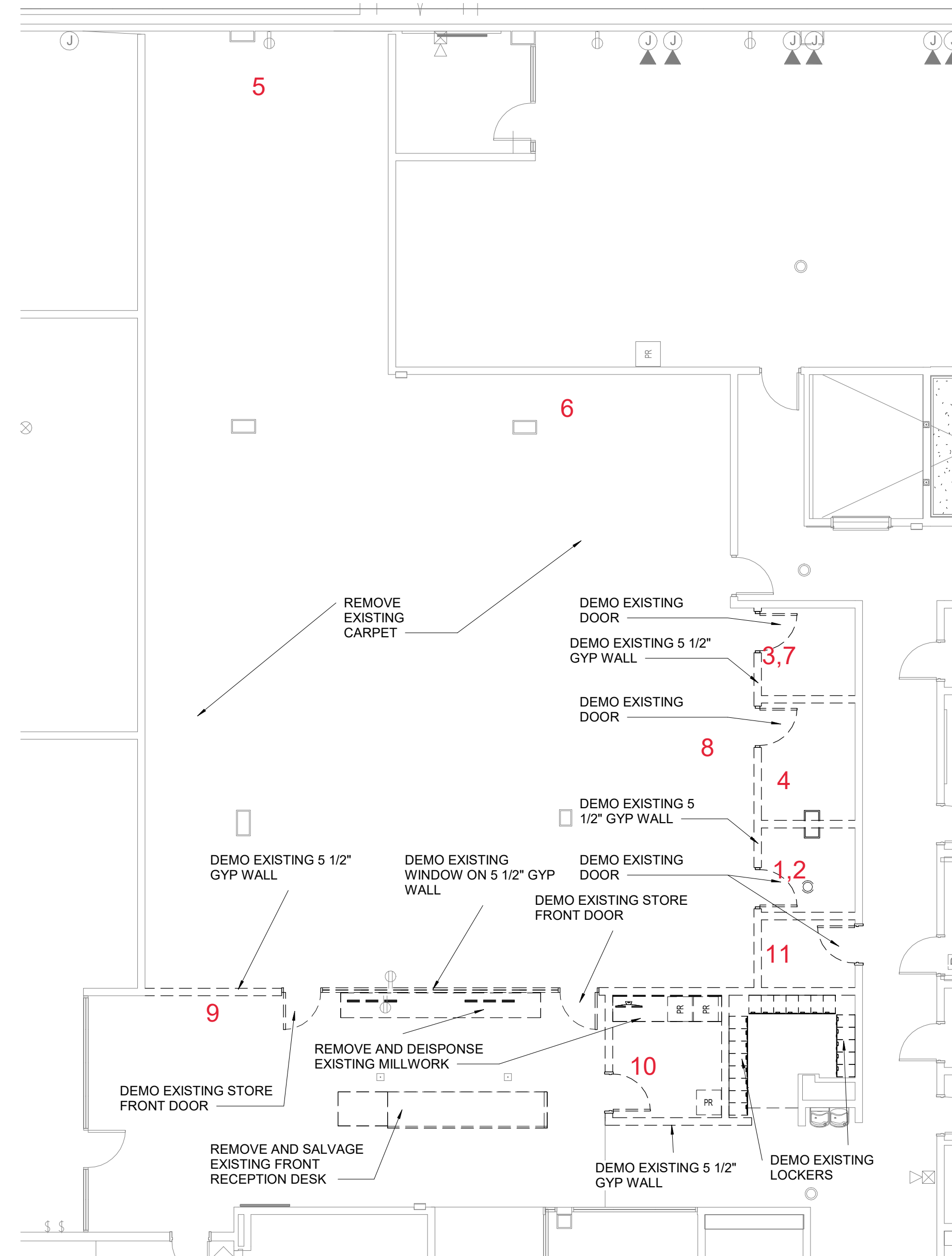
CONSTRUCTION DOCS. - CONTRACT.

HBCE-112723  
 Sample Locations



0 1' 2' 5' 10' 20'  
**NEW FLOOR PLAN**  
 SCALE: 1/8" = 1'-0"

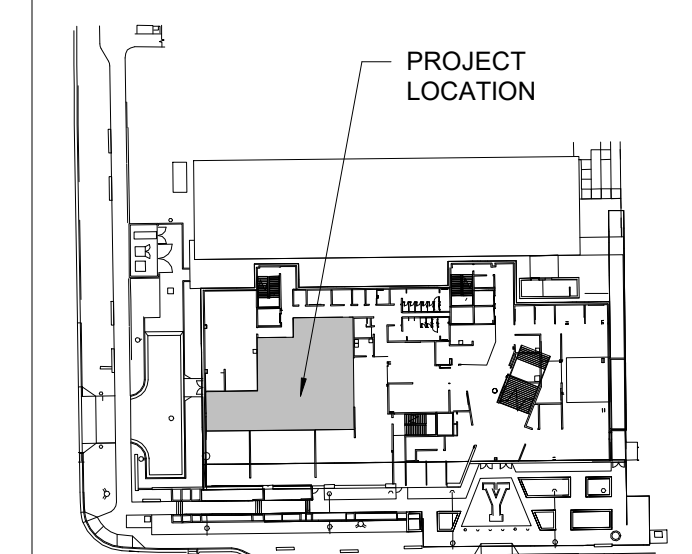
2



0 1' 2' 5' 10' 20'  
**DEMOLITION FLOOR PLAN**  
 SCALE: 1/8" = 1'-0"

1

LOCATION PLAN



HCEB - LEVEL 3

## List of NESHAP Regulated Materials Tested and Found in Surveys

1. Friable asbestos material (>1% asbestos and can be crumbled, pulverized or reduced to powder by hand pressure)

<b>Tested</b>	<b>Materials</b>	<b>Positive</b>
_____	Thermal System Insulation (TSI)	_____
_____	Textured Ceiling Materials (TCM)	_____
_____	Spray-on Insulation or Fireproofing	_____
_____	Blown-in Insulation	_____
_____	Ceiling Tiles/Panels	_____
_____	Plaster, Gypsum Board, Joint Compound	_____
_____	Cloth Materials	_____
_____	Paper Materials	_____
_____	Electrical Wiring Insulation	_____
_____	Sink Undercoating (loose)	_____
_____	Other _____	_____

2. Category I ACM which has become friable

<b>Tested</b>	<b>Materials</b>	<b>Positive</b>
_____	Packings	_____
_____	Gaskets	_____
_____	Vinyl Floor Tile and Sheet Vinyl Flooring	_____
_____	Asphalt Roofing Products	_____

3. Category I ACM that will be or has been subjected to sanding, grinding, cutting or abrading

<b>Tested</b>	<b>Materials</b>	<b>Positive</b>
_____	Packings	_____
_____	Gaskets	_____
_____	Vinyl Floor Tile and Sheet Vinyl Flooring	_____
_____	Asphalt Roofing Products	_____

4. Category II ACM that has a high probability of becoming or has become friable in the course of demolition or renovation operations

<b>Tested</b>	<b>Materials</b>	<b>Positive</b>
_____	Asbestos Cement Materials (transite)	_____
_____	Asphalt, tar and rubber base ACM products other than roofing	_____
_____	Non-asphalt and Non-paper Roofing Products	_____
_____	Paint	_____
_____	Fire Brick and/or Mortar	_____
_____	Stainless Steel Sink Undercoating (solid)	_____
_____	Encapsulated TCM	_____
_____	Encapsulated TSI	_____
_____	Mastic for Floor Tile, Ceiling Tile, Cove Molding, etc.	_____

## List of NESHAP Non-Regulated Materials Tested and Found in Survey

1.  $\geq 1\%$  Asbestos
2. Category I Non-Friable (cannot be crumbled, pulverized or reduced to powder by hand pressure) ACM with  $>1\%$  asbestos by new PLM procedure

<b>Tested</b>	<b>Materials</b>	<b>Positive</b>
_____	Packings	_____
_____	Gaskets	_____
_____	Vinyl Floor Tile and Sheet Vinyl Flooring	_____
_____	Asphalt Roofing Products	_____

3. Category II Non-Friable ACM with  $>1\%$  asbestos by new PLM procedure (category includes items meeting Category I definition but not specifically listed in that category)

<b>Tested</b>	<b>Materials</b>	<b>Positive</b>
_____	Asbestos Cement Materials (transite)	_____
_____	Asphalt, tar and rubber base ACM products other than roofing	_____
_____	Non-asphalt and Non-paper Roofing Products	_____
_____	Paint	_____
_____	Fire Brick and/or Mortar	_____
_____	Stainless Steel Sink Undercoating (solid)	_____
_____	Encapsulated TCM	_____
_____	Encapsulated TSI	_____
_____	Mastic for Floor Tile, Ceiling Tile, Cove Molding, etc.	_____
_____	Other _Fume Hood Base_____	_____

### Notes

1. All materials and conditions are interpreted by Air Quality Consulting LLC
2. The Environmental Protection Agency (EPA) National Emission Standard for Hazardous Air Pollutants (NESHAP) asbestos revision as outlined in 40 CFR, Part 61, became effective November 20, 1990. The asbestos classification system outlined in the revision and included in this section is dynamic in nature. Asbestos materials classified as “Non-Regulated” at the time of the survey may become “Regulated” due to ongoing or planned maintenance, renovation or demolition actions which can transform a material containing greater than 1% asbestos from a “non-friable” and “Non-Regulated” to a “friable” and “Regulated” condition. Classification of ACM in this section and in the executive summary of this report is, therefore, based on the observations of the surveyor at the time of the survey and may or may not be appropriate at later dates.
3. Maintenance, renovation, demolition, weathering, normal wear, water or other damage can alter the “Non-Regulated” status of materials, and necessitate precautions required for handling them as “Regulated” asbestos-materials.
4. Details on testing locations, methods and results can be found on remaining report.



**Built Environment Testing  
Reservoirs**

November 29, 2023

**Subcontractor Number:**

**Laboratory Report:** RES 585141-1

**Project #/P.O. #:** HBCE-112723

**Project Description:** Harman Building

Scott Bainbridge  
Air Quality Consulting, LLC  
226 E 4800 S  
Murray UT 84107

Dear Scott,

Eurofins Reservoirs is an analytical laboratory accredited for the analysis of Industrial Hygiene and Environmental matrices by the National Voluntary Laboratory Accreditation Program (NVLAP), Lab Code 101896-0 for Transmission Electron Microscopy (TEM) and Polarized Light Microscopy (PLM) analysis and the American Industrial Hygiene Association (AIHA LAP, LLC), Lab ID 101533 for Phase Contrast Microscopy (PCM) analysis. This laboratory is currently proficient in both Proficiency Testing and PAT programs respectively.

Eurofins Reservoirs has analyzed the following samples for asbestos content as per your request. The analysis has been completed in general accordance with the appropriate methodology as stated in the attached analysis table. The results have been submitted to your office.

**RES 585141-1** is the job number assigned to this study. This report is considered highly confidential and the sole property of the customer. Eurofins Reservoirs will not discuss any part of this study with personnel other than those of the client. The results described in this report only apply to the samples analyzed, as received and with the information provided by the customer. This report must not be used to claim endorsement of products or analytical results by NVLAP or any agency of the U.S. Government. This report shall not be reproduced except in full, without written approval from Eurofins Reservoirs. Samples will be disposed of after sixty days unless longer storage is requested. If you have any questions about this report, please feel free to call 303-964-1986.

Sincerely,



by Daniel Erhard

Jeanne Spencer  
President



# EUROFINS RESERVOIRS ENVIRONMENTAL, INC

NVLAP Lab Code 101896-0  
AIHA LAP, LLC. LAB ID 101533

**TABLE: I ANALYSIS: PLM BULK ANALYSIS, PERCENTAGE COMPOSITION BY VOLUME**

RES Job Number: **RES 585141-1**  
 Client: **Air Quality Consulting, LLC**  
 Client Project/P.O.: **HBCE-112723**  
 Client Project Description: **Harman Building**  
 Date Samples Received: **November 29, 2023**  
 Analysis Type: **EPA 600/R-93/116 - Short Report, Bulk**  
 Turnaround: **Rush**  
 Date Samples Analyzed: **November 29, 2023**

NA = Not Analyzed  
 NR = Not Received  
 ND = None Detected  
 TR = Trace; <1 % Visual Estimate  
 Trem-Act = Tremolite-Actinolite

Laboratory Sample ID  Client Sample Number	L A Y E R	Physical Description	Sub Part  (%)	Asbestos Content		Non-Asbestos Fibrous Components  (%)	Non-Fibrous Components  (%)
				Mineral	Visual Estimate  (%)		
585141 - 1-Ceiling Panel	A	White ceiling tile	100		ND	75	25
585141 - 2-Drywall System	A	White texture w/ light gray paint	32		ND	0	100
	B	Light pink/tan drywall	68		ND	14	86
585141 - 3-Drywall System	A	White texture w/ light gray paint	28		ND	0	100
	B	Light pink/tan drywall	72		ND	18	82
585141 - 4-Ceiling Panel	A	White ceiling tile	100		ND	75	25
585141 - 5-Drywall System	A	Light pink/tan drywall	40		ND	20	80
	B	White texture w/ light gray paint	60		ND	0	100
585141 - 6-Drywall System	A	Light pink/tan drywall w/ blue paint	100		ND	17	83
585141 - 7-Caulking	A	Gray caulk w/ black foamy material	100		ND	0	100
585141 - 8-Caulking	A	Gray caulk	100		ND	0	100
585141 - 9-Caulking	A	Gray caulk	100		ND	0	100
585141 - 10-Drywall System	A	Light gray/tan drywall w/ light gray paint	100		ND	16	84
585141 - 11-Ceiling Panel	A	White ceiling tile	100		ND	70	30

TEM Analysis recommended for organically bound material (i.e. floor tile) if PLM results are <1%.



Daniel Erhard  
Analyst

<b>SUBMITTED BY</b>	<b>INVOICE TO</b>	<b>CONTACT INFORMATION</b>	<b>SERIES</b>
Company: <b>Air Quality Consulting, LLC</b>	Company: <b>Air Quality Consulting, LLC</b>	Contact: <b>Scott Bainbridge</b>	<b>-1 PLM Rush *NO VERBALS*</b>
Address: <b>226 E 4800 S</b>	Address: <b>226 E 4800 S</b>	Phone: <b>(385) 321-9701</b>	
<b>Murray, UT 84107</b>	<b>Murray, UT 84107</b>	Fax:	
Project Number and/or P.O. #: <b>HBCE-112723</b>		Cell: <b>(385) 321-9701</b>	
Project Description/Location: <b>Harman Building</b>		<b>Final Data Deliverable Email Address:</b> <b>scott@airqualityconsult.com</b>	

ASBESTOS LABORATORY HOURS: Weekdays: 7am - 7pm & Sat. 8am - 5pm		REQUESTED ANALYSIS				VALID MATRIX CODES		LAB NOTES				
<b>PLM</b> / PCM / TEM	DTL <b>RUSH</b> PRIORITY STANDARD	<b>PLM - PLM Short Report (EPA/600/R-93/116)</b> TEM - AHERA (+/- or Quantified), Microvacc (+/- or Quantified), Wipe (+/- or Quantified), NIOSH 7402, Yamate Level III, ISO 10312, ISO 13794, Chatfield, Drinking Water, Waste Water, Bulk +/-, C/BB, Modified Ahera PCM - 7400A, 7400B, OSHA DUST - Total, Respirable METALS - Analyte(s) Lead Only (7082, 7420, Waste Water, Foodware), Multi Metals (7303, 6020A, 200.8, Waste Water, Foodware, OSHA ID-125G), pH (Liquid or Non-Liquid), TCLP, RCRA, & Scan, Wetting, Fume Scan, Full Metals Scan ORGANICS - Methamphetamine, TSS VIABLES - Campylobacter, Bacillus, Salmonella (Culturable or 1-2), Listeria, E.coli O157:H7, E.coli Coliforms - Plated, S.aureus, Yeast & Mol, Aerobic Plate Count, Coliforms/E.coli - (State Water, Drinking Water, Non-Drinking Water, +/-, Quantification), Lactic Acid, Viable Microbial Count (w/o ID or w/ID), Enterococcus (+/- or Quantification), Legionella (P, NP, C) MEDICAL - Biberden, LAL MOLD - Spore Trap, Bulk Mold, Particulate Identification	Air = A                      Bulk = B Dust = D                      Food = F Paint = P                      Soil = S Surface = SU                      Swab = SW Tape = T                      Wipe = W Drinking Water = DW Waste Water = WW **ASTM E1792 approved wipe media only**									
<b>CHEMISTRY LABORATORY HOURS: Weekdays: 8am - 5pm</b>												
<b>Dust</b>	RUSH PRIORITY STANDARD											
<b>Metals</b>	RUSH PRIORITY STANDARD					*PRIOR NOTICE REQUIRED FOR SAME DAY TAT						
<b>Organics*</b>	SAME DAY RUSH PRIORITY STANDARD											
<b>MICROBIOLOGY LABORATORY HOURS: Weekdays: 8am - 5pm</b>												
<b>Viability Analysis**</b>	PRIORITY STANDARD					**TAT DEPENDENT ON SPEED OF MICROBIAL GROWTH						
<b>Medical Device Analysis</b>	RUSH STANDARD											
<b>Mold Analysis</b>	RUSH PRIORITY STANDARD											
<b>**Turnaround times establish a laboratory priority, subject to laboratory volume and are not guaranteed. Additional fees apply for afterhours, weekends and holidays.**</b>												
<b>Special Instructions:</b>												
<b>Client Sample ID Number</b>	(Sample ID's must be unique)	<b>ASBESTOS</b>	<b>CHEMISTRY</b>	<b>MICROBIOLOGY</b>	<b>ICO</b>	Sample Volume (L) / Area	Length (or Aliquots) x Width (or Area per Aliquot)	Matrix Code	# of Containers	Date Collected mm/dd/yy	Time Collected hh:mm	<b>Laboratory Analysis Instructions</b>
1	1-Ceiling Panel	X						B				
2	2-Drywall System	X						B				
3	3-Drywall System	X						B				
4	4-Ceiling Panel	X						B				
5	5-Drywall System	X						B				
6	6-Drywall System	X						B				
7	7-Caulking	X						B				
8	8-Caulking	X						B				
9	9-Caulking	X						B				
10	10-Drywall System	X						B				
11	11-Ceiling Panel	X						B				

EREI establishes a unique Lab Sample ID, for each sample, by preceding each unique Client Sample ID with the laboratory RES Job Number.

EREI will analyze incoming samples based on information received and will not be responsible for errors or omissions in calculations resulting from the inaccuracy of original data. By signing, client/company representative agrees that submission of the following samples for requested analysis as indicated on this Chain of Custody shall constitute an analytical services agreement with payment terms of NET 30 days. Failure to comply with payment terms may result in a 1.5% monthly interest surcharge.

Relinquished By:		<b>Scott Bainbridge</b>	Date/Time: <b>11/27/2023 18:55:48</b>	Sample Condition: <b>Acceptable</b>
Received By:		<b>Victoria Hernandez</b>	Date/Time: <b>11/29/2023 13:06:32</b>	Carrier: <b>Fed-Ex</b>

**Asbestos Survey and Assessment Performed at  
Harman Continuing Education Building  
Testing Center  
770 East University Parkway  
Provo, Utah 84604  
2 December, 2023**

**Scope of Work**

We were hired by Brigham Young University to survey the Testing Center in the Harman Building for a pending renovation. Samples were taken by Scott Bainbridge and tested at Reservoirs Environmental in Denver, Colorado. The results are included in this report.

**Methods and Materials**

A survey of the areas outlined in the floorplan sections was conducted to observe, identify, locate and sample any materials suspected of containing asbestos according to NESHAP categories. All accessible areas were identified and documented.

Bulk samples were collected using approved methods and microscopically analyzed for asbestos content by Reservoirs Environmental, Inc. in Denver, Colorado. Reservoirs participates in the National Institute for Standards and Technology's National Voluntary Laboratory Accreditation Program (NVLAP).

Asbestos percentages were estimated utilizing the polarized light microscope (PLM) and dispersion staining methods as prescribed by NIOSH.



*Scott Bainbridge*

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Scott Bainbridge  
State of Utah Inspector #ASB-6822 exp. 1/6/24

2 December, 2023

---

Date

*Annabelle Mitchell*

---

Annabelle Mitchell  
State of Utah Inspector #ASB-8012 exp. 2/10/24

2 December, 2023

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Date

**DOOR SCHEDULE**

MARK	DR TYPE	FRM TYPE	LOCATION	DOOR SIZE	DOOR MATL	FRAME MATL	HARDWR GROUP	REMARKS
111	D3	-	OPEN OFFICE/RECEPTION 111	DBL 3'-0" x 7'-0" x 1 3/4"	ALUM./GLASS	ALUM.	H1	ALUMINUM STORE FRONT DOOR SYSTEM
111A	D1	-	OFFICE 111A	3'-0" x 7'-0" x 1 3/4"	WOOD	ALUM.	H2	
111B	D1	-	OFFICE 111B	3'-0" x 7'-0" x 1 3/4"	WOOD	ALUM.	H2	
111C	D1	-	OFFICE 111C	3'-0" x 7'-0" x 1 3/4"	WOOD	ALUM.	H2	
111D	D1	-	OFFICE 111D	3'-0" x 7'-0" x 1 3/4"	WOOD	ALUM.	H2	
111E	D1	-	OFFICE 111E	3'-0" x 7'-0" x 1 3/4"	WOOD	ALUM.	H2	
111F	D1	-	OFFICE 111F	3'-0" x 7'-0" x 1 3/4"	WOOD	ALUM.	H2	
111G	D1	-	OFFICE 111G	3'-0" x 7'-0" x 1 3/4"	WOOD	ALUM.	H2	
111H	D1	-	OFFICE 111H	3'-0" x 7'-0" x 1 3/4"	WOOD	ALUM.	H2	
111J	D1	-	OFFICE 111J	3'-0" x 7'-0" x 1 3/4"	WOOD	ALUM.	H2	
117	D1	-	TESTING CENTER RECEPTION 117	3'-0" x 7'-0" x 1 3/4"	WOOD	ALUM.	H2	
117A	D1	-	OPEN TESTING 117A	3'-0" x 7'-0" x 1 3/4"	WOOD	ALUM.	H2	
117B	D2	F1	PRIVATE TESTING 117B	3'-0" x 7'-0" x 1 3/4"	WOOD/GLASS	ALUM.	H2	WOOD FRAMED HALF LITE KIT INSTALLED

**HARDWARE GROUPS** (LOCKSET CYLINDERS BY OWNER - NIC)

**GROUP H1: STORE FRONT DOOR**

(6) EA.	FULL MORTISE - 5 KNUCKLE HINGE	MCKINNEY	TA2714 4 1/2" x 4 1/2" 26D
(1) EA.	PRECISION KEY REMOVABLE MULLION	-	-
(1) EA.	EO SARGENT 88 SERIES CRASHBAR	-	-
(1) EA.	IN20 88 SERIES CARD READER	-	-
(2) EA.	LCN 4040XP	-	-

**GROUP H2: HALL DOOR**

(6) EA.	FULL MORTISE - 5 KNUCKLE HINGE	MCKINNEY	TA2714 4 1/2" x 4 1/2" 26D
(2) EA.	FLUSH BOLTS	ROCKWOOD	555 26D
(1) EA.	LEVER PULL	SCHLAGE	ND92LD RHO 626
(1) EA.	CONCAVE WALL STOP (AS NEEDED)	ROCKWOOD	409 26D

**REFERENCE NOTES**

**FINISH SCHEDULE:**  
**WALL PAINT**  
 MAIN COLOR: GREEK VILLA SW 67551L  
 ACCENT COLOR: MAREA BAJA SW 9185

**DOOR**  
 NATURAL WALNUT

**MILLWORK**  
 NATURAL WALNUT

**SOLID SURFACE**  
 Formica Classics - Luna Concrete 781

**STORE FRONT SYSTEM**  
 KAWNEER TRIFAB VG 450 4-1/2" DEEP WITH  
 A 1-3/4" SIGHT LINE -  
 CENTER. CLEAR ANODIZED FINISH

**GRID/TILE SYSTEM**  
 TILE: USG FROST 490  
 GRID: BYU SPEC - WHITE



**FACILITIES PLANNING**  
 240 BRWB PROVO, UTAH 84602  
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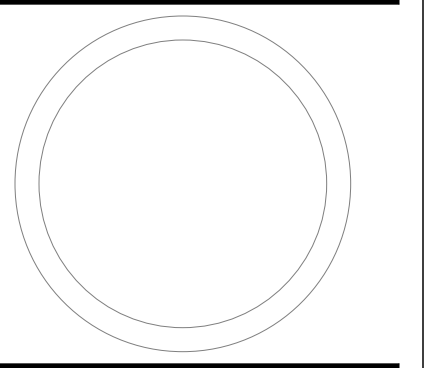
**DATE:** 2/22/24  
**DESIGNER:** S.KING  
**DRAWN BY:** S.KING

**ADA CHECK:**  
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**UTILITIES DIR:**  
**PLANNING DIR:**

**CLIENT APPROVAL** \_\_\_\_\_ **DATE** \_\_\_\_\_

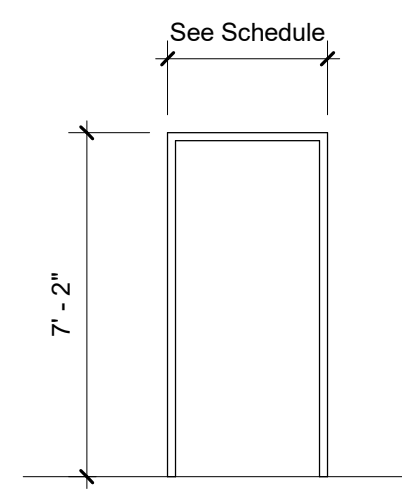
**REVISIONS**

**BRIGHAM YOUNG UNIVERSITY**  
**CONTINUING EDUCATION OFFICE REMODEL LEVELS 1&4**  
**CONTINUING EDUCATION**  
 HARMAN CONTINUING EDUCATION BUILDING - LEVEL 1 - 111 & LEVEL 4 - 403



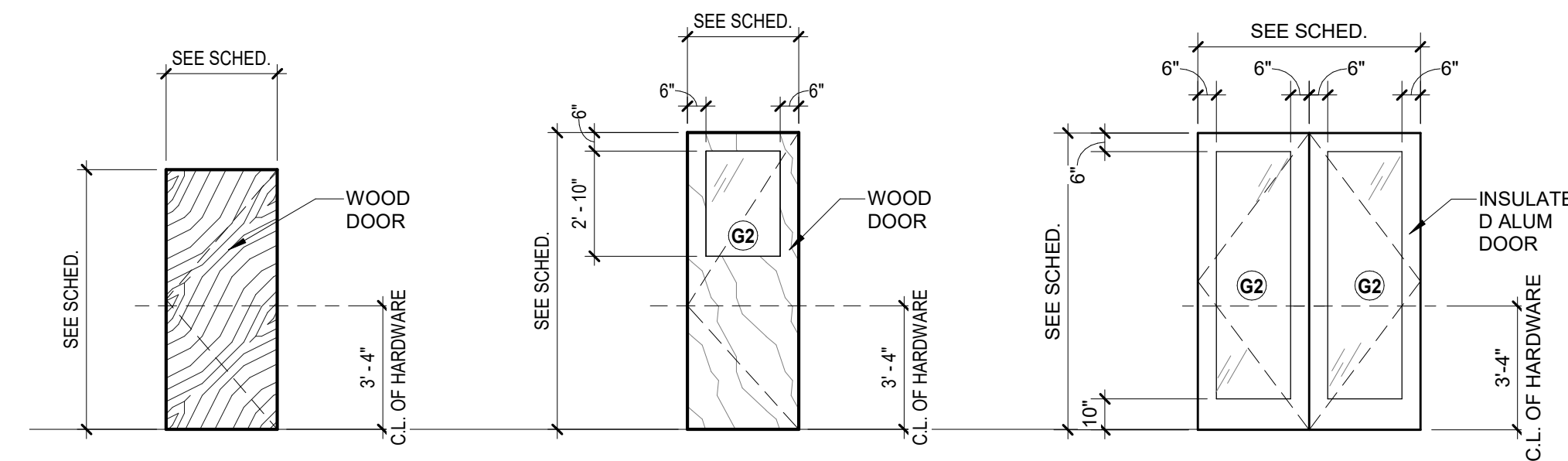
WORK ORDER & SHEET NO.

**N1864**  
**A4.0**



**F1**  
ALUMINUM

ALL FRAMES NOT LISTED HERE WILL BE IN REPRESENTED IN STOREFRONT ELEVATIONS



**D1**  
WOOD

**D2**  
WOOD - HALF LITE

**D3**  
ALUMINUM

**FRAMES**  
SCALE: 1/4" = 1'-0" **2**

**DOOR TYP.**  
SCALE: 1/4" = 1'-0" **1**

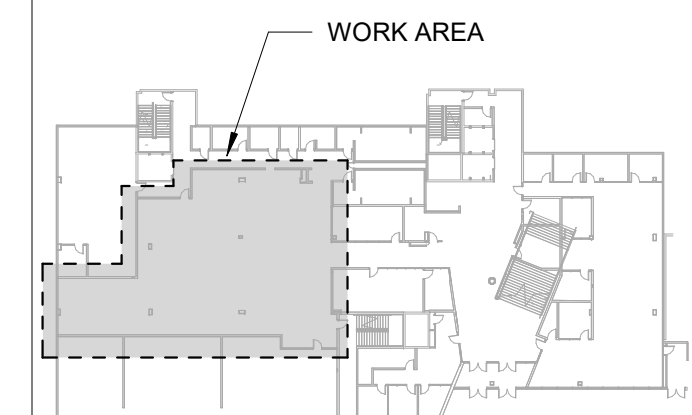
**REFERENCE NOTES**

1. REMOVE EXISTING DUCTWORK AS SHOWN BACK TO ACTIVE MAINS AND CAP. FIELD VERIFY EXISTING CONDITIONS. CONNECT TO EXISTING. FIELD VERIFY EXISTING CONDITIONS.
2. INSTALL EXISTING TRANSFER AIR DUCTS IN NEW LOCATION.
3. SALVAGE EXISTING TRANSFER AIR DUCTS AND RELOCATE TO NEW WALL. SEE NEW PLAN.

**GENERAL NOTES**

1. ALL SUPPLY DIFFUSERS SHALL BE CD AS SCHEDULED. ALL RETURN AIR GRILLES SHALL BE RG AS SCHEDULED.
2. ALL RETURN TRANSFER DUCT BRANCHES ARE 6"x6" UNLESS OTHERWISE NOTED. CONTROL VALVES AND BALANCE VALVES FOR VAV BOXES WILL BE CB1 AND BV1. SEE SCHEDULES.
3. INSULATE ALL NEW OR REPAIRED AND UNLINED SUPPLY AIR DUCTWORK WITH 1" THICK FIBERGLASS INSULATION WITH ALUMINUM FOIL SCRIM KRAFT FACING AND A DENSITY OF 1.5 LB/FT<sup>3</sup>. COORDINATE ALL DIFFUSER LOCATIONS WITH LIGHTING LAYOUT.
4. LAY OUT ALL DUCTWORK SUCH THAT DUCT RUN-OUTS OR DROPS TO DIFFUSERS ARE ALIGNED TO AVOID UNNECESSARY OFFSETS. USE FLEXIBLE DUCT ONLY WHERE HARD DUCTING IS NOT POSSIBLE. FLEXIBLE DUCT SHALL BE INSTALLED SUCH THAT THE CENTER LINE OF THE DIFFUSER NECK SHALL NOT BE OFFSET FROM THE CENTER LINE OF THE DUCT ELBOW BY MORE THAN ONE DUCT RADIUS. NO MORE THAN 24" MAXIMUM LENGTH OF FLEX DUCT AND NO FLEX DUCT ELBOWS ALLOWED.
5. THE JOINTS AND SEAMS OF ALL SUPPLY AIR DUCTWORK SHALL BE SEALED. MASTIC SEALING COMPOUND SHALL BE DURODYNE S-2, 3M EC-750, IRON GRIP 601 or HARDCAST TWO-PART SYSTEM II.
6. AIR BALANCE ALL DIFFUSERS AND VAV BOXES TO AIR VOLUMES NOTED IN SCHEDULE OR ON PLANS.
7. REFER TO THE ARCHITECTURAL REFLECTED CEILING PLANS FOR THE EXACT LOCATION OF ALL DIFFUSERS, GRILLES, FIRE SPRINKLERS, ETC.
8. ALL NEW FIRE SPRINKLER HEADS IN OFFICES WITH LAY-IN CEILINGS SHALL BE CONCEALED TYPE WITH A FRANGIBLE GLASS BULB AND A WHITE COVER PLATE ASSEMBLY.

**LOCATION PLAN**



HCEB — LEVEL 1



**FACILITIES PLANNING**  
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PHONE: (801) 422-5504  
FAX: (801) 422-0566

DATE: 2-21-2024  
DESIGNER: J. Jensen  
DRAWN BY: J. Jensen

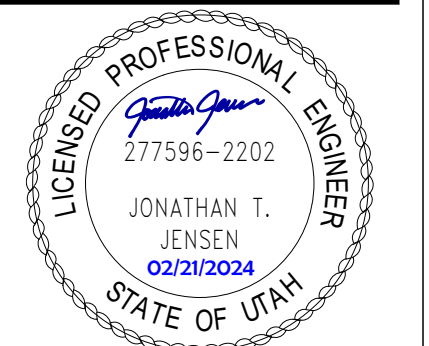
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1. Addendum #1

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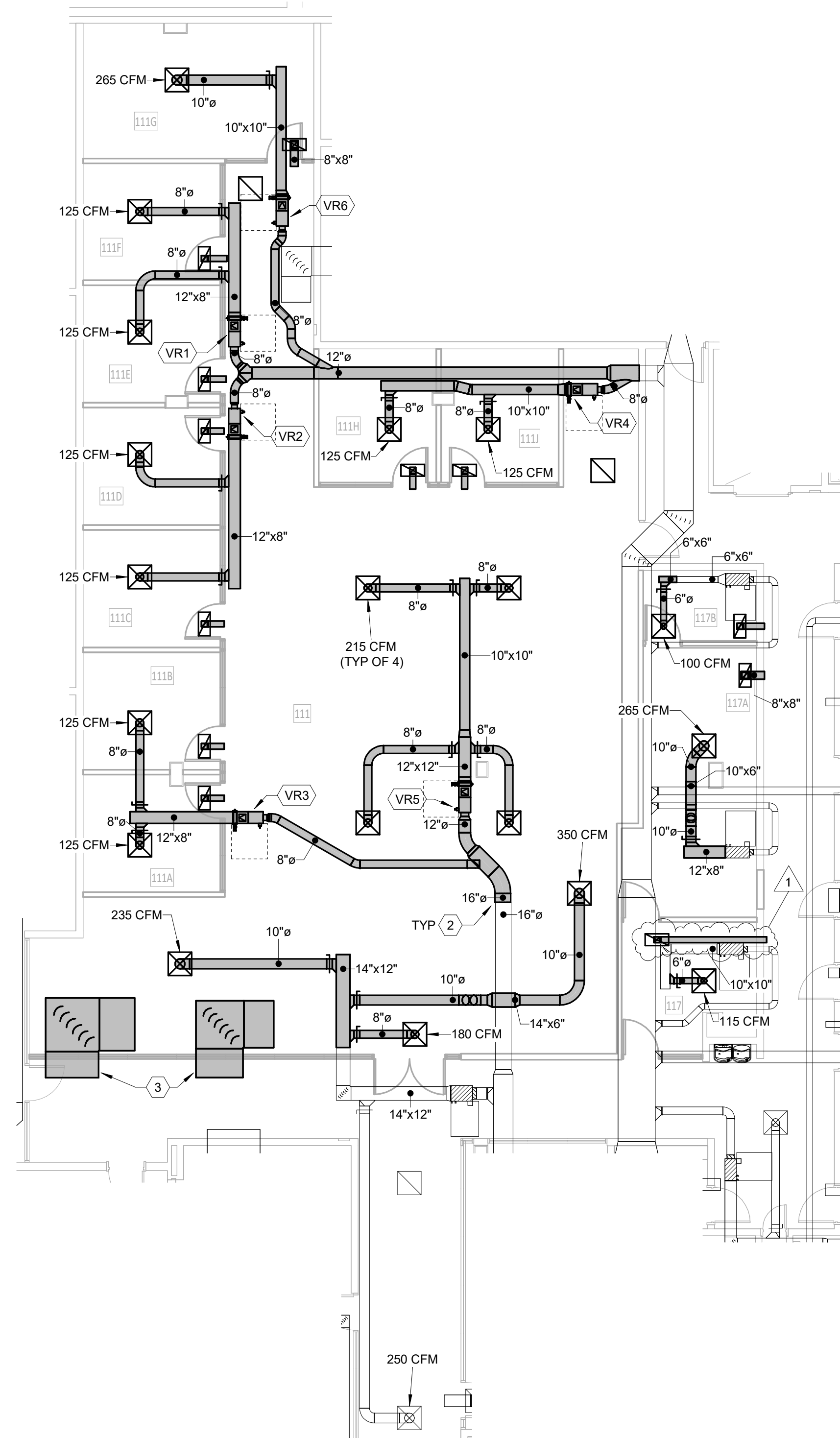


**MECHANICAL PLAN**

WORK ORDER & SHEET NO.

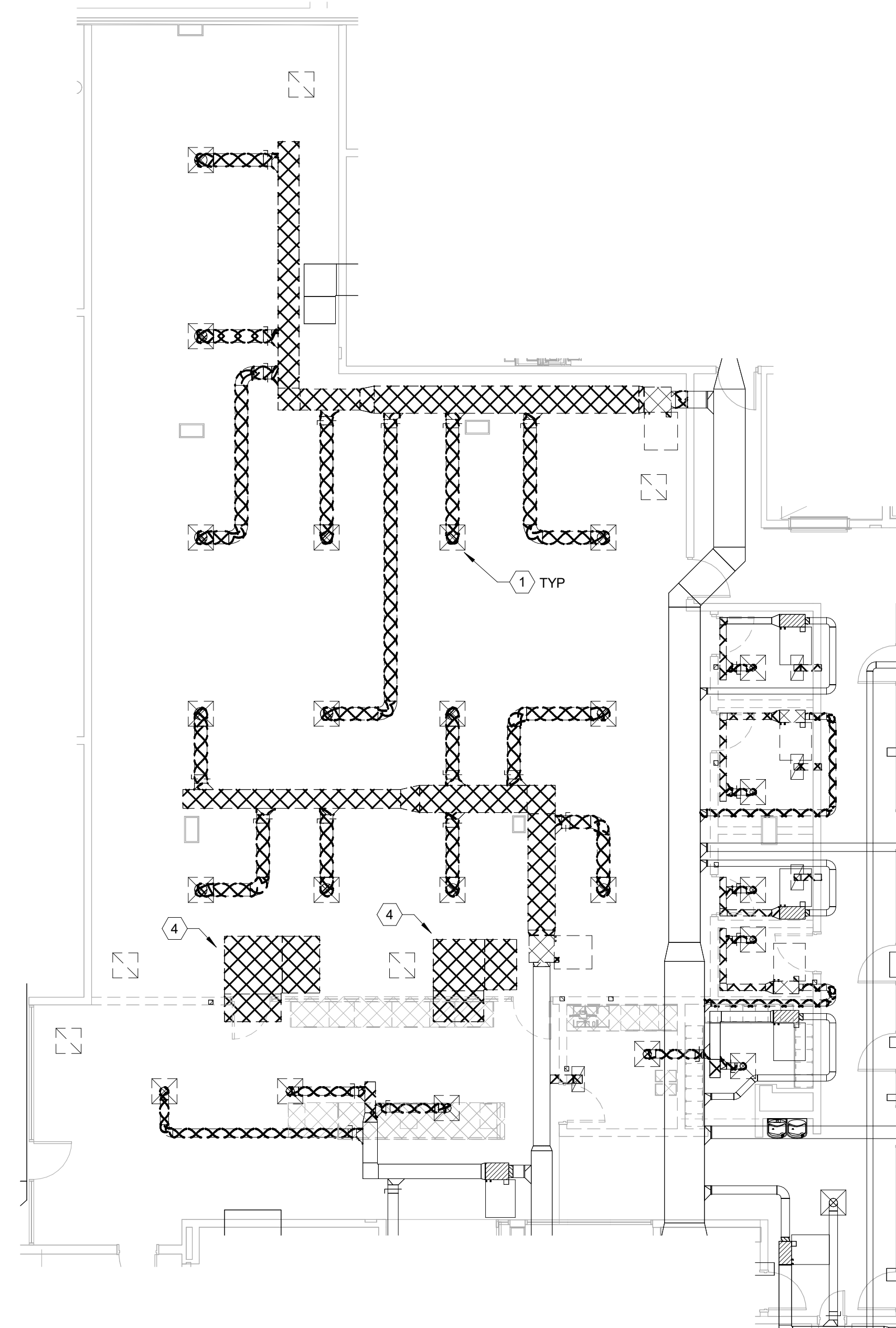
**M1**  
**N1864**

CONSTRUCTION DOCS — CONTRACT



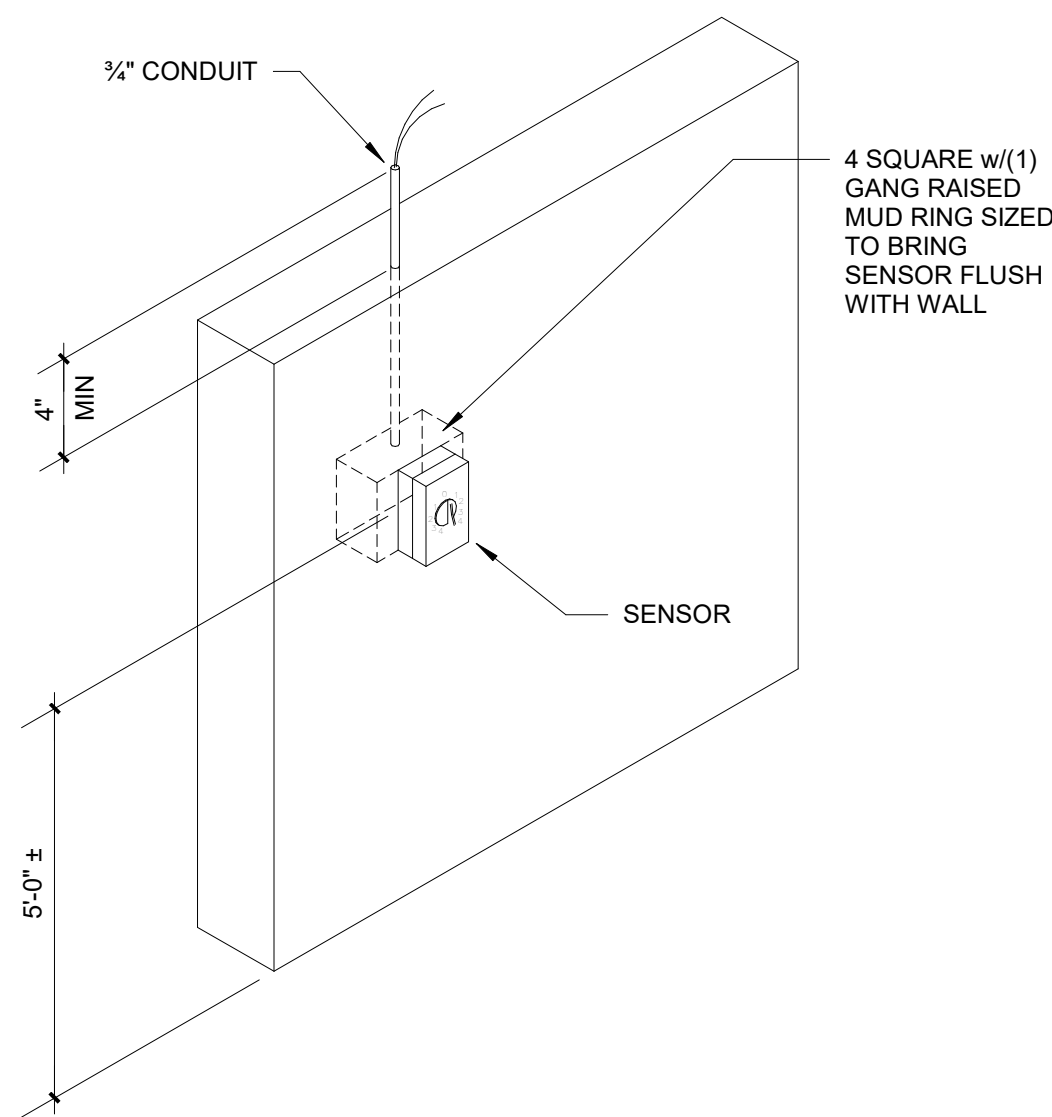
**N1864 MECHANICAL PLAN**  
SCALE: 1/8" = 1'-0"

**2**

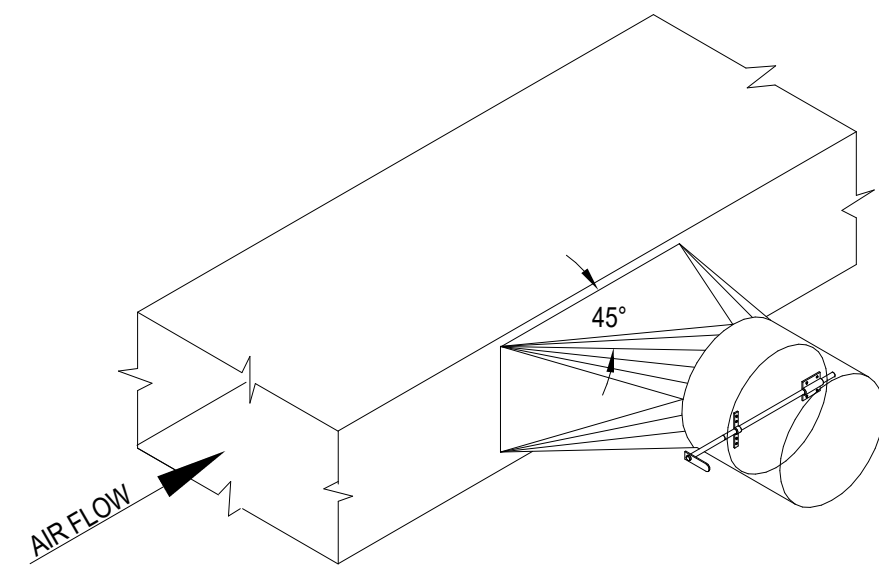


**N1864 MECHANICAL DEMOLITION PLAN**  
SCALE: 1/8" = 1'-0"

**1**



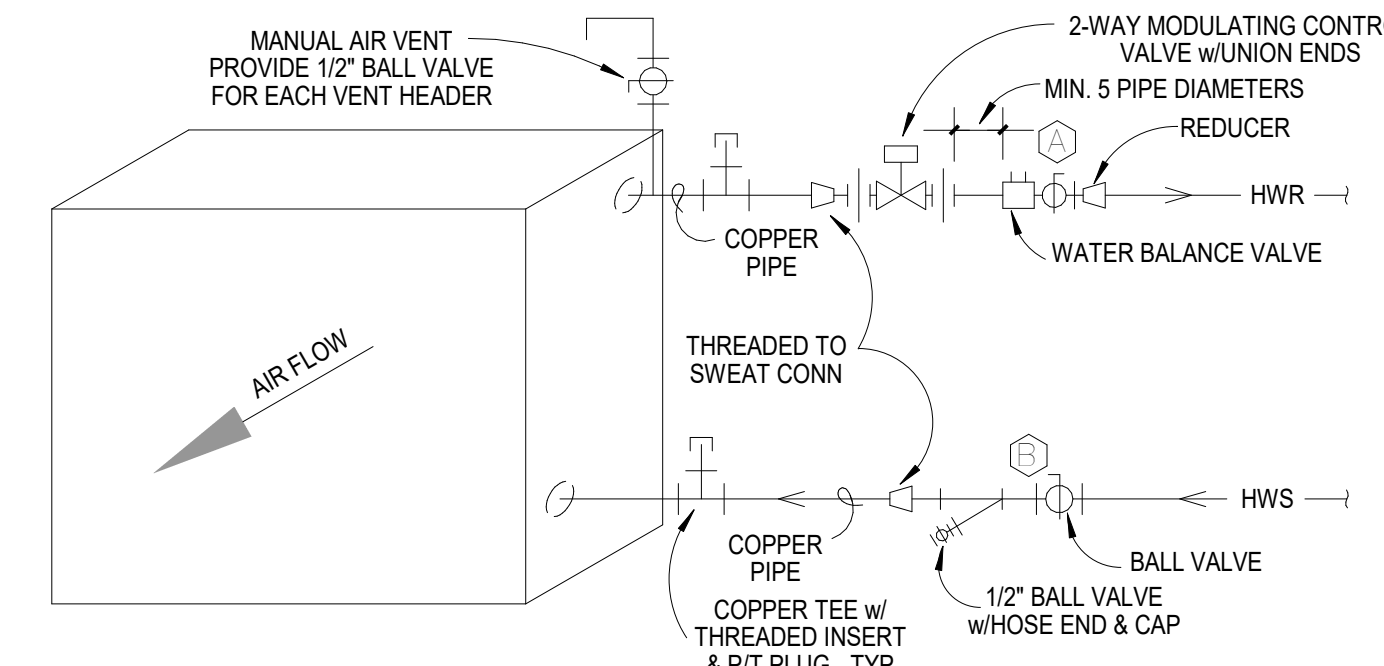
**SENSOR/CONDUIT INSTALLATION DETAIL**  
SCALE — NTS



MANUFACTURED HIGH EFFICIENCY TAKE-OFF w/FLANGE AND 2" DAMPER HANDLE EXTENSION. HET SHALL HAVE AN ADJUSTABLE VOLUME DAMPER AND POSITIVE LOCKING HARDWARE. HET FLANGE SHALL BE SUPPLIED WITH AN ADHESIVE COATED DOUBLE FACED GASKET TO ASSURE A TIGHT SEAL. HET SHALL BE BUILT IN ACCORDANCE WITH SMOCA STANDARDS & SHALL BE TESTED BY ETL TESTING LABS. AS MANUFACTURED BY SHEET METAL CONNECTORS INC., OR EQUAL.

**HIGH EFFICIENCY TAKE-OFF w/DAMPER DETAIL**  
SCALE — NTS

NOTE: TAKE-OFFS SHOULD NOT BE INSTALLED CLOSER THAN TWO DUCT WIDTHS TO ELBOWS or INTERSECTIONS



**NOTES:**  
1. INSTALL VALVES AS CLOSE TO COIL AS POSSIBLE.  
2. VALVE SHALL BE INSTALLED WITHIN 2'-0" OF VALVE .

**2 WAY REHEAT COIL PIPING DIAGRAM**  
SCALE — NTS

**REFERENCE NOTES**

- REMOVE EXISTING PIPING AS SHOWN BACK TO ACTIVE MAINS AND CAP. FIELD VERIFY EXISTING CONDITIONS.
- REMOVE EXISTING VAV BOX, SALVAGE, AND RETURN TO BYU AC SHOP.
- REMOVE EXISTING THERMOSTAT, SALVAGE AND RETURN TO BYU AC SHOP.
- REMOVE EXISTING CO2 SENSOR, SALVAGE AND RETURN TO BYU AC SHOP.
- CONNECT TO EXISTING PIPING. FIELD VERIFY EXISTING CONDITIONS.
- INSTALL THERMOSTAT. COORDINATE EXACT PLACEMENT WITH ARCHITECTURAL.
- INSTALL CO2 SENSOR. COORDINATE EXACT PLACEMENT WITH ARCHITECTURAL.

**GENERAL NOTES**

- ALL NEW OR REPAIRED PIPING SHALL BE INSULATED WITH 1" THICK, SNAP-ON PIPE INSULATION WITH A PVC VAPOR JACKET. FURNISH & INSTALL A PVC JACKET ON ALL FITTINGS.
- INSTALL DIELECTRIC UNIONS AT ALL NEW CONNECTIONS BETWEEN NEW COPPER PIPES AND EXISTING GALVANIZED STEEL PIPING.
- PROVIDE AVERAGING THERMOSTATS WHERE A SINGLE VAV BOX IS CONNECTED TO MULTIPLE SENSORS.



**FACILITIES PLANNING**  
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DRAWN BY: J. Jensen

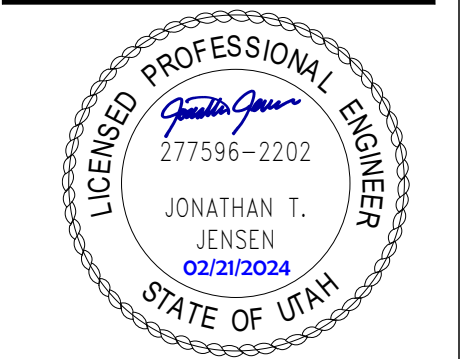
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**REVISIONS**

- Addendum #1

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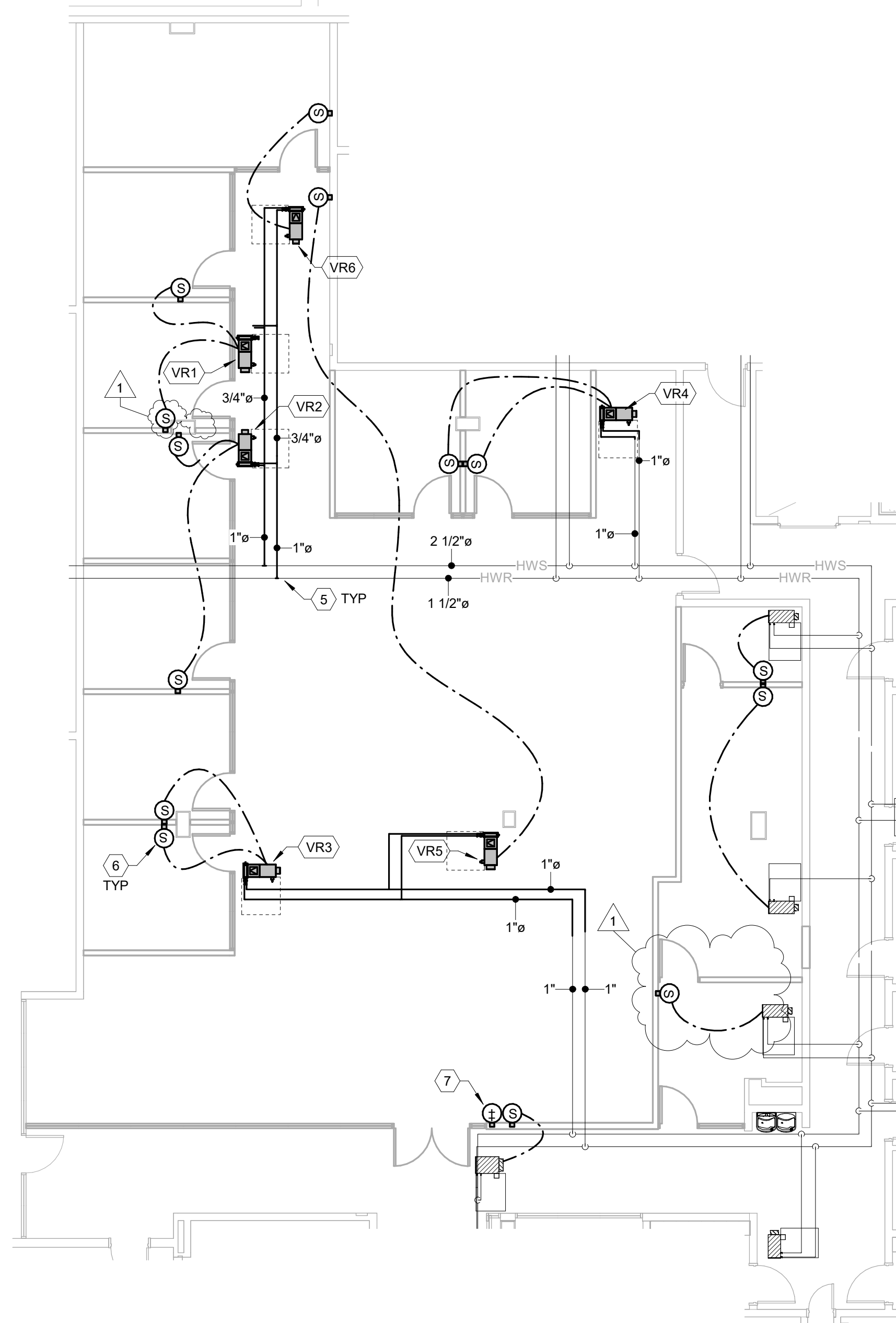


**MECHANICAL PIPING PLAN**

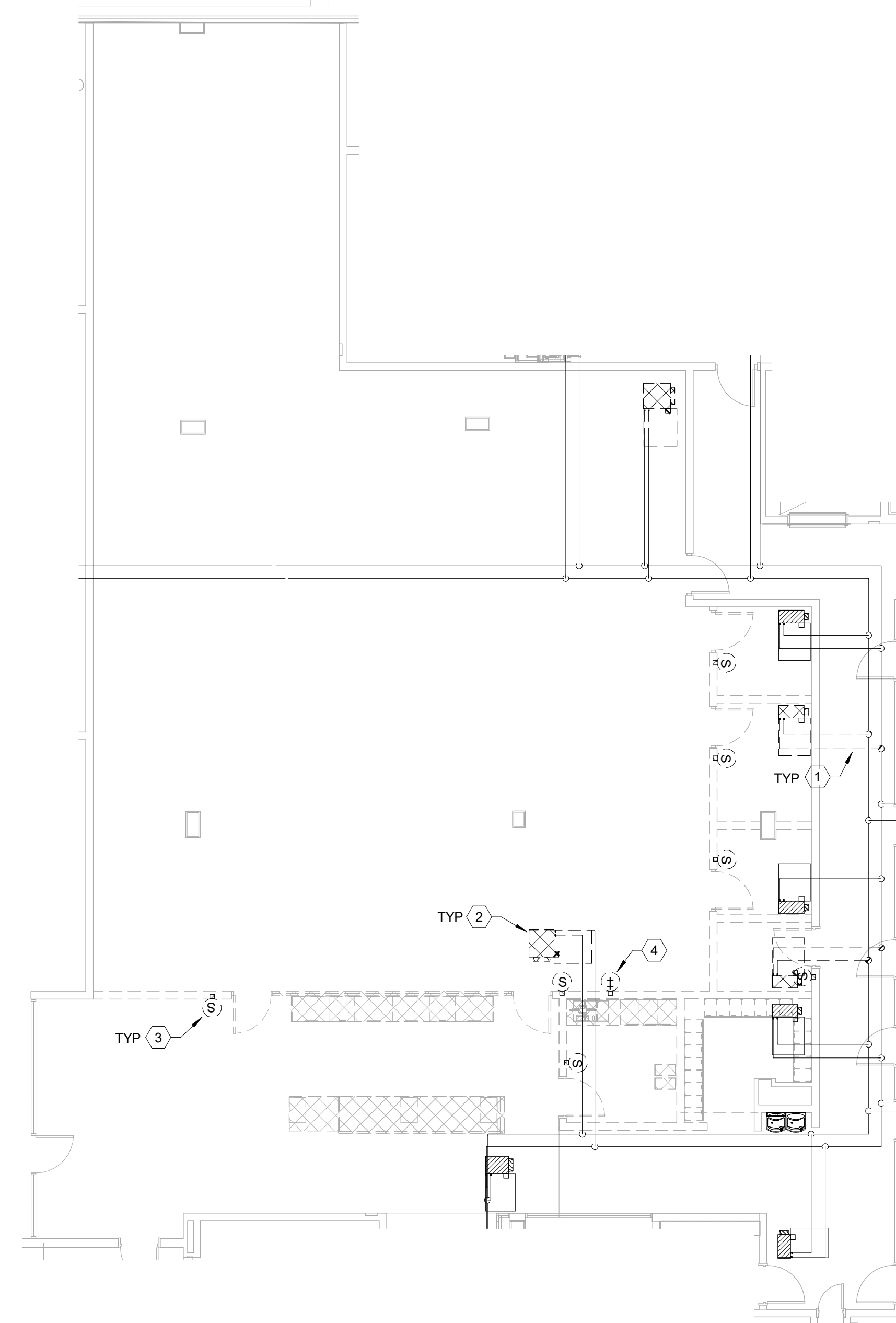
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**M2**  
**N1864**

CONSTRUCTION DOCS — CONTRACT

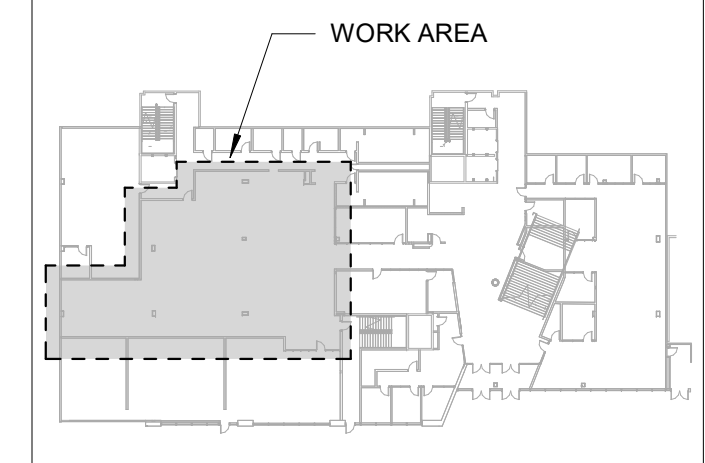


**N1864 MECHANICAL PIPING PLAN**  
SCALE: 1/8" = 1'-0" **2**



**N1864 MECHANICAL PIPING DEMOLITION PLAN**  
SCALE: 1/8" = 1'-0" **1**

**LOCATION PLAN**



HCEB — LEVEL 1



**FACILITIES PLANNING**  
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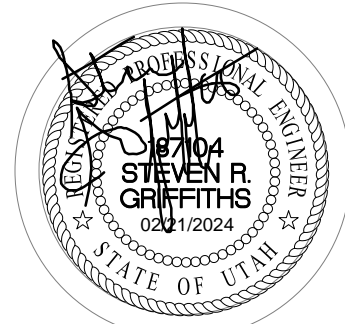
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REVISIONS  
 REVISION #1 02/21/24

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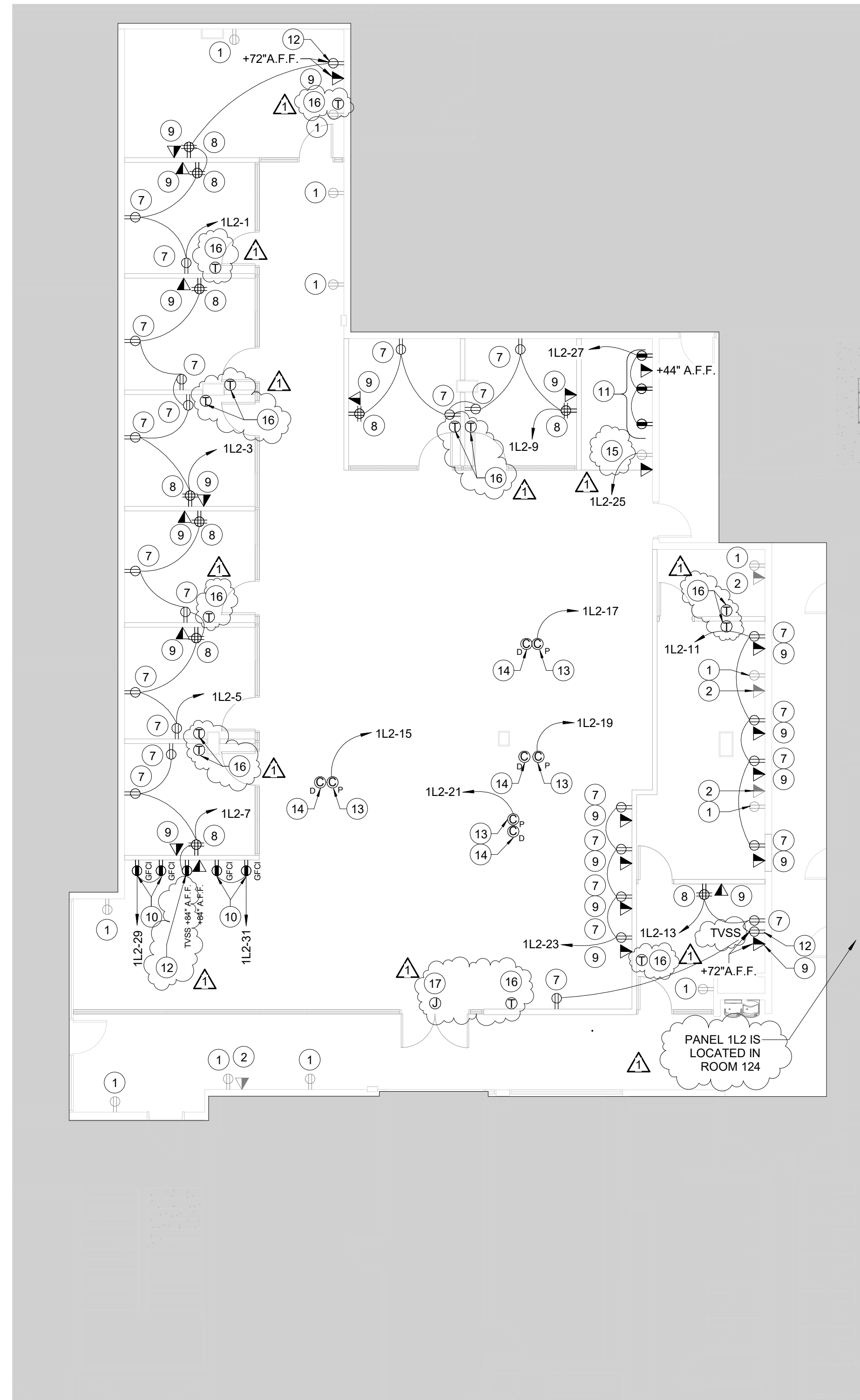
DEMOLITION AND NEW POWER PLAN

WORK ORDER & SHEET NO.

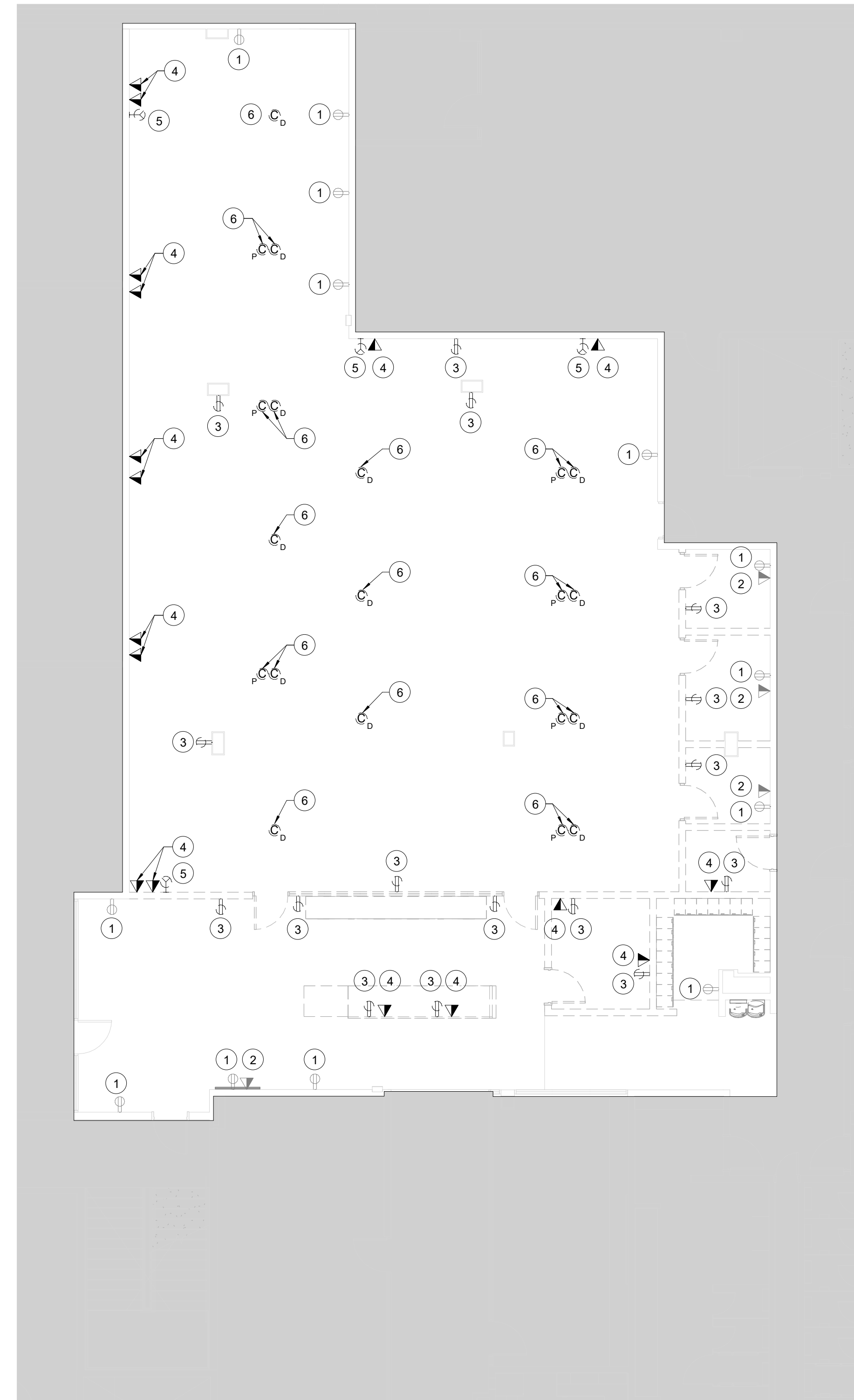
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**REFERENCE NOTES**

- EXISTING RECEPTACLE TO REMAIN. SHOWN FOR REFERENCE PURPOSES ONLY.
- EXISTING DATA JACK TO REMAIN. SHOWN FOR REFERENCE PURPOSES ONLY.
- REMOVE EXISTING RECEPTACLE AND ALL ASSOCIATED ABANDONED CIRCUITING BACK TO SOURCE COMPLETE OR NEAREST ELECTRICAL DEVICE TO REMAIN. MAINTAIN CIRCUIT INTEGRITY TO ANY DOWN STREAM ELECTRICAL DEVICES TO REMAIN.
- REMOVE EXISTING DATA JACK AND ASSOCIATED J-BOX AND CONDUIT BACK TO SOURCE COMPLETE.
- REMOVE EXISTING WALL MOUNTED FURNITURE CONNECTION AND ALL ASSOCIATED CIRCUITING BACK TO SOURCE COMPLETE.
- REMOVE EXISTING CIRCUITING OR DATA CABLING FROM FLOOR CONDUIT BACK TO SOURCE COMPLETE. CAP EXISTING POWER AND DATA FLOOR CONDUITS WITH THREADED KNOCK OUT CAP.
- INSTALL NEW RECEPTACLE. EXTEND A 3/4" W/ (2)#12, (1)#12 GND., THHN, CU. FROM RECEPTACLE TO CIRCUIT INDICATED ON DRAWING.
- INSTALL NEW QUAD RECEPTACLE. EXTEND A 3/4" W/ (2)#12, (1)#12 GND., THHN, CU. FROM RECEPTACLE TO CIRCUIT INDICATED ON DRAWING.
- INSTALL NEW DATA LOCATION. SEE DETAIL 2 ON SHEET E5.2 FOR INSTALLATION DETAIL.
- INSTALL NEW GFCI RECEPTACLE AT 6" TO CENTER OF RECEPTACLE ABOVE COUNTER TOP OR BACK SPLASH. EXTEND A 3/4" C WITH (2)#12, (1)#12 GND., THHN, CU. FROM THE RECEPTACLE TO CIRCUIT INDICATED ON DRAWING.
- INSTALL NEW RECEPTACLE AT 6" TO CENTER OF RECEPTACLE ABOVE COUNTER TOP OR BACK SPLASH. EXTEND A 3/4" C WITH (2)#12, (1)#12 GND., THHN, CU. FROM THE RECEPTACLE TO CIRCUIT INDICATED ON DRAWING.
- INSTALL NEW TVSS RECEPTACLE AT HEIGHT INDICATED ON DRAWING. PROVIDE 3/4" C WITH (2)#12, (1)#12 GND., THHN, CU. FROM RECEPTACLE TO CIRCUIT INDICATED ON DRAWING.
- INSTALL NEW POWER CONDUIT THROUGH FLOOR FOR FURNITURE CONNECTION. SEE DETAIL 1 ON SHEET E5.2 FOR INSTALLATION DIAGRAM. VERIFY EXACT LOCATION WITH FURNITURE INSTALLER PRIOR TO CORE DRILL.
- INSTALL NEW DATA CONDUIT THROUGH FLOOR. SEE DETAIL 3 ON SHEET E5.2 FOR INSTALLATION DIAGRAM. VERIFY EXACT LOCATION WITH FURNITURE INSTALLER PRIOR TO CORE DRILL.
- CONNECT EXISTING RECEPTACLE TO DEDICATED CIRCUIT. EXTEND A 3/4" W/ (2)#12, (1)#12 GND., THHN, CU. FROM RECEPTACLE TO CIRCUIT INDICATED ON DRAWING.
- INSTALL THERMOSTAT PATHWAY. SEE DETAIL 4 ON THIS SHEET FOR INSTALLATION DETAIL.
- PROVIDE DOUBLE GANG JUNCTION ABOVE ACCESSIBLE CEILING. ABOVE DOOR JUNCTION BOX SHALL BE ACCESSIBLE FROM INTERIOR OF ROOM. EXTEND A 3/4" CONDUIT FROM JUNCTION BOX TO NEAREST CABLE TRAY.



**N1864 NEW POWER PLAN**  
 SCALE: 1/8" = 1'-0"



**N1864 DEMOLITION POWER PLAN**  
 SCALE: 1/8" = 1'-0"

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**REFERENCE NOTES**

- 1 REMOVE EXISTING LIGHT FIXTURE. PREPARE EXISTING LIGHTING CIRCUIT FOR CONNECTION TO NEW LIGHT FIXTURE AND CONTROLS.
- 2 REMOVE EXISTING LIGHT SWITCH AND ALL ASSOCIATED CIRCUITING BACK TO SOURCE COMPLETE.
- 3 REMOVE EXISTING CEILING MOUNTED OCCUPANCY SENSOR AND ALL ASSOCIATED CIRCUITING BACK TO SOURCE COMPLETE.
- 4 REMOVE EXISTING CEILING MOUNTED FIRE ALARM HORN/STROBE DEVICE AND ALL ASSOCIATED CIRCUITING BACK TO FIRE ALARM LOOP DEVICE.
- 5 REMOVE EXISTING WALL MOUNTED FIRE ALARM HORN/STROBE DEVICE AND ALL ASSOCIATED CIRCUITING BACK TO FIRE ALARM LOOP DEVICE.
- 6 REMOVE EXISTING CEILING MOUNTED SMOKE DETECTOR AND ALL ASSOCIATED CIRCUITING BACK TO FIRE ALARM LOOP.
- 7 INSTALL NEW WALL MOUNTED OCCUPANCY SENSOR LIGHT SWITCH. SEE DETAIL 9 ON SHEET E5.1 FOR WIRING DIAGRAM AND SWITCH TYPE.
- 8 INSTALL NEW LOW VOLTAGE LIGHT SWITCH. SEE DETAIL 8 ON SHEET E5.1 FOR WIRING DIAGRAM AND SWITCH TYPE.
- 9 INSTALL NEW ROOM CONTROLLER ABOVE ACCESSIBLE CEILING. SEE DETAIL 8 ON SHEET E5.1 FOR WIRING DIAGRAM AND ROOM CONTROLLER TYPE.
- 10 INSTALL NEW CEILING MOUNTED OCCUPANCY SENSOR. SEE DETAIL 8 ON SHEET E5.1 FOR WIRING DIAGRAM AND SENSOR TYPE.
- 11 INSTALL NEW CEILING MOUNTED SMOKE DETECTOR. CONNECT TO EXISTING FIRE ALARM LOOP. PROVIDE ALL NECESSARY WIRE AND CONDUIT AS REQUIRED FOR A COMPLETE INSTALLATION.
- 12 INSTALL NEW ADA COMPLIANT CEILING MOUNTED FIRE ALARM HORN/STROBE DEVICE. CONNECT TO EXISTING FIRE ALARM LOOP. PROVIDE ALL NECESSARY WIRE AND CONDUIT AS REQUIRED FOR A COMPLETE INSTALLATION.
- 13 INSTALL ADA COMPLIANT CEILING MOUNTED FIRE ALARM STROBE LIGHT. 15CD. CONNECT TO EXISTING FIRE ALARM LOOP. PROVIDE ALL NECESSARY WIRE AND CONDUIT AS REQUIRED FOR A COMPLETE INSTALLATION.
- 14 CONNECT TO CORRIDOR LIGHTING CIRCUIT AND CONTROLS.
- 15 CONNECT EMERGENCY LIGHT FIXTURE AND EXIT SIGN TO NEAREST UNSWITCHED EMERGENCY LIGHTING CIRCUIT.
- 16 CONNECT TO EXISTING UNSWITCHED LIGHTING CIRCUIT SERVING THIS SPACE. EXTEND A 3/4" W/ (2) #12, (1) #12, GND., THHN, CU, FROM THE LIGHT FIXTURE TO THE EXISTING UNSWITCHED LIGHTING CIRCUIT. AS REQUIRED FOR A COMPLETE INSTALLATION.
- 17 EXISTING FIRE ALARM HORN STROBE DEVICE TO REMAIN. SHOWN FOR REFERENCE PURPOSES ONLY.
- 18 EXISTING EXIT SIGN TO REMAIN. SHOWN FOR REFERENCE PURPOSES ONLY.
- 19 EXISTING CEILING MOUNTED SMOKE DETECTOR TO REMAIN. SHOWN FOR REFERENCE PURPOSES ONLY.
- 20 EXISTING CEILING MOUNTED OCCUPANCY SENSOR TO REMAIN SHOWN FOR REFERENCE PURPOSES ONLY.
- 21 CAREFULLY REMOVE EXISTING CEILING MOUNTED OCCUPANCY SENSOR. PREPARE FOR RELOCATION AND RECONNECTION.
- 22 INSTALL REMOVED CEILING MOUNTED OCCUPANCY SENSOR IN LOCATION INDICATED. RECONNECT TO CORRIDOR LIGHTING CIRCUIT AND CONTROLS.

**GENERAL NOTES**

1. IF THERE ARE ANY DESIGN OR BUDGET PROBLEMS WITH THIS PROJECT, CONTACT THE DESIGNER ABOVE AS SOON AS POSSIBLE.
2. FOLLOW THE DESIGN AS PER THESE STANDARD PLANS. ANY CHANGES, ADDITIONS, OR ADJUSTMENTS SHALL BE REVIEWED WITH THE PERSON WHOSE ENGINEERING STAMP IS HERE ATTACHED.
3. ALL CONDUIT PENETRATIONS THROUGH WALLS, FLOORS, AND CEILINGS SHALL BE FIRE CAULKED AS REQUIRED BY CODE.



**FACILITIES PLANNING**  
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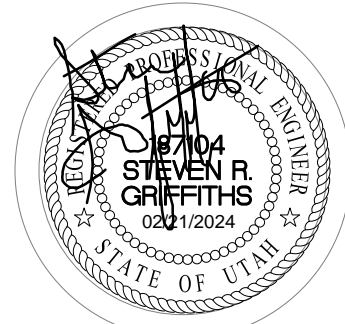
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**REVISIONS**  
 REVISION #1 02/21/24

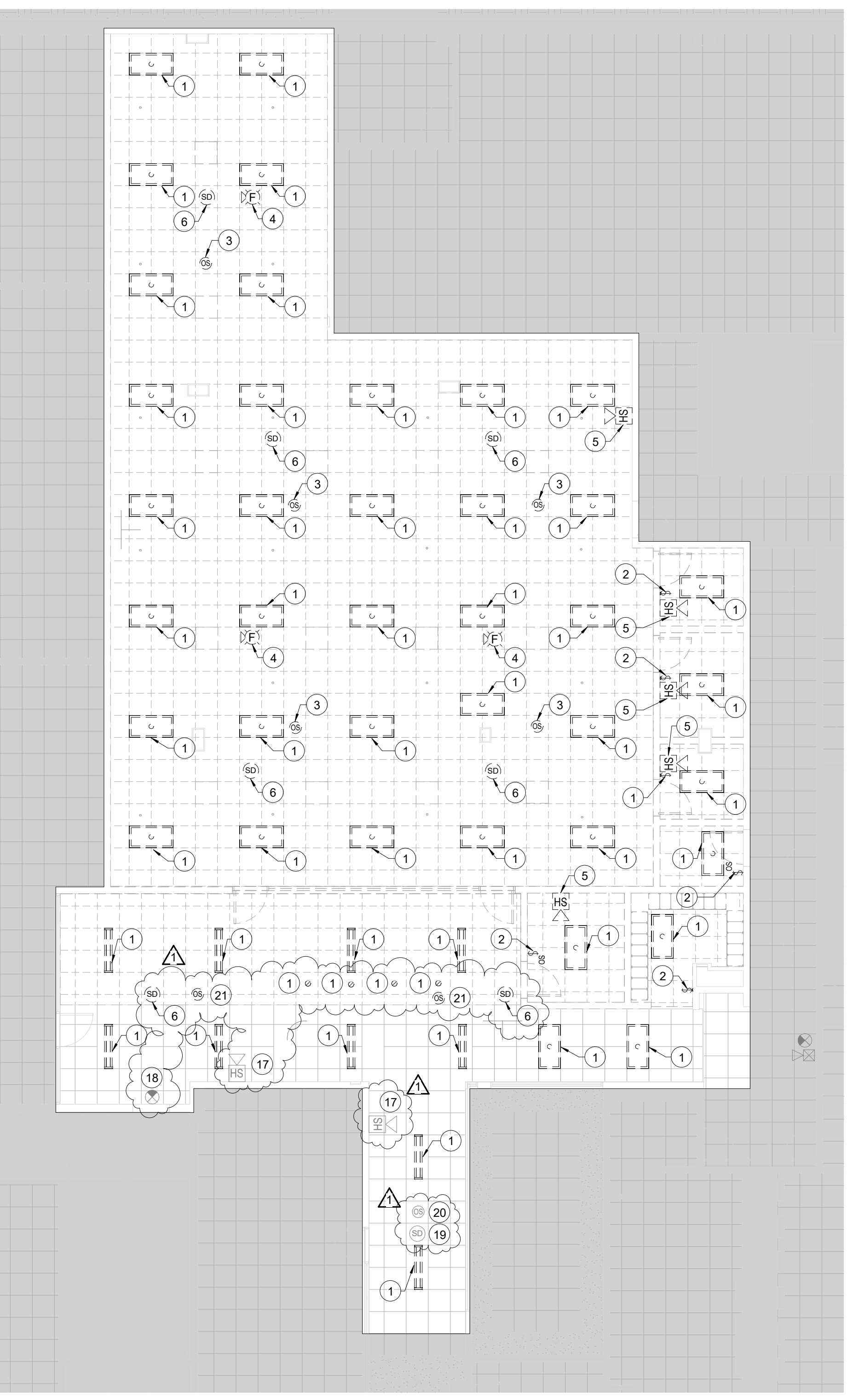
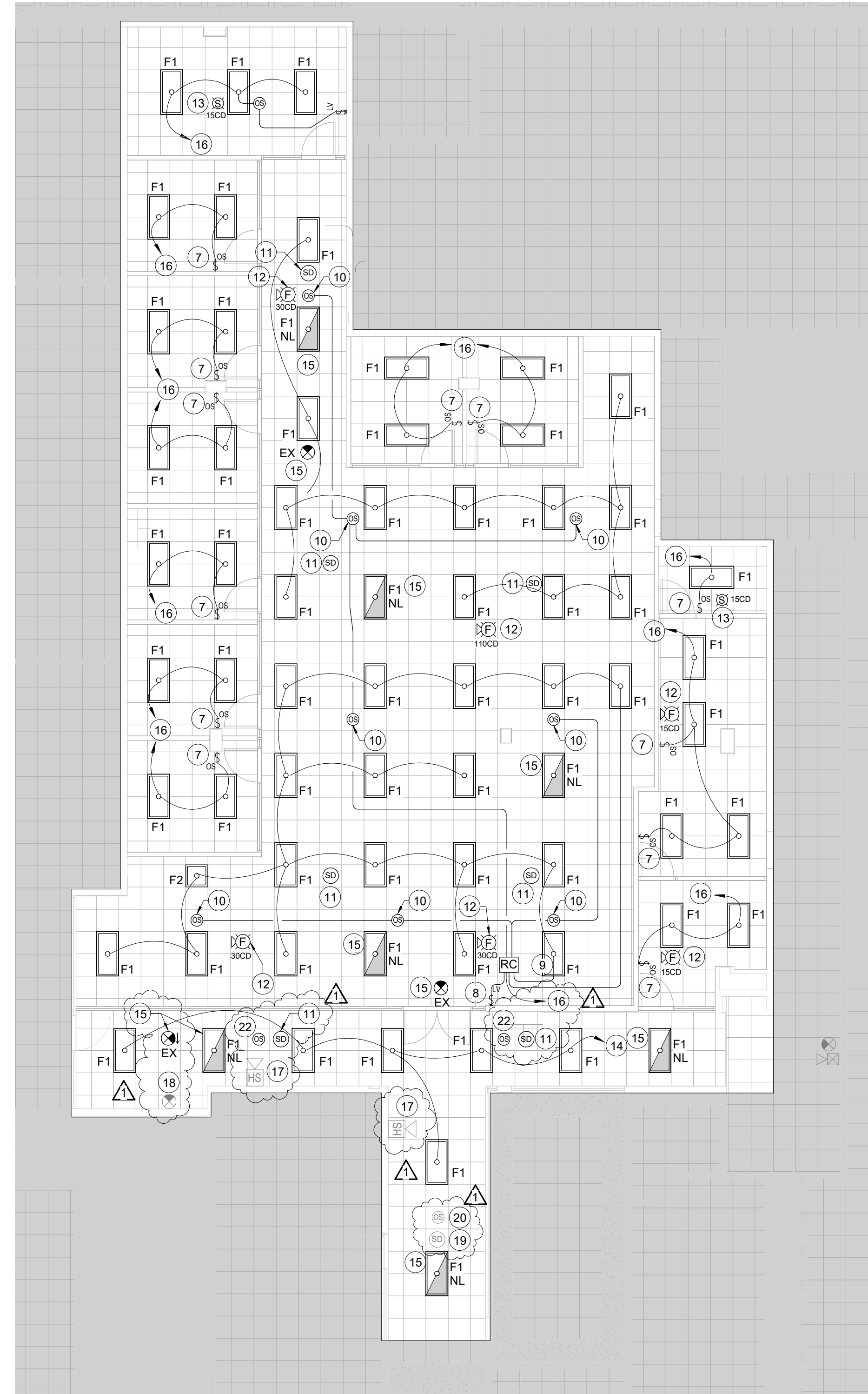
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**DEMOLITION AND NEW LIGHTING PLAN**

WORK ORDER & SHEET NO.

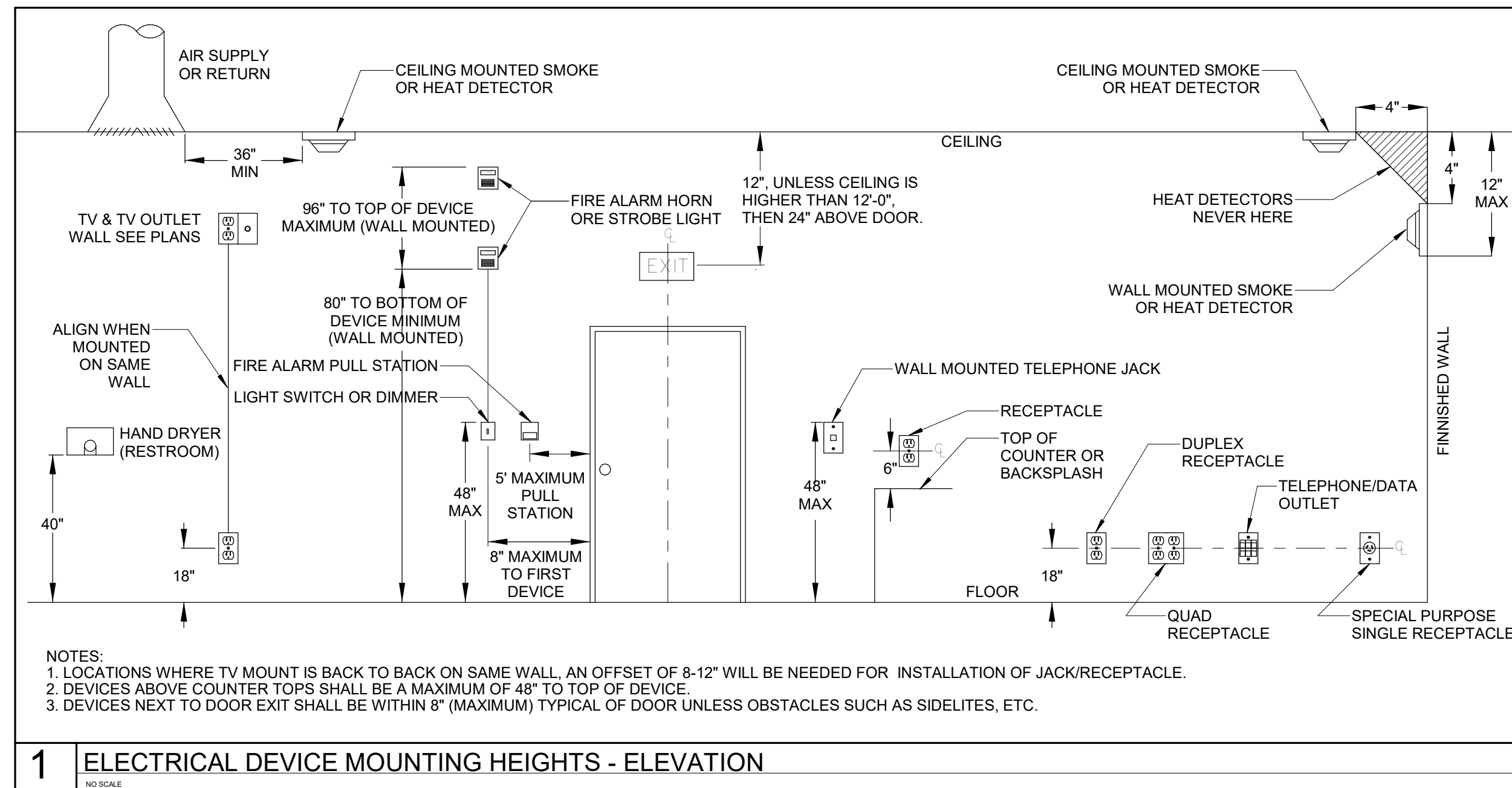
**N1864 E2.0**



**LIGHTING FIXTURE SCHEDULE**

FIXTURE NUMBER	MANUFACTURER	FIXTURE CATALOG NUMBER	FIXTURE				FIXTURE DESCRIPTION	REMARKS
			LUMENS	CCT	VOLTS	WATTS		
F1	LITHONIA SLG BLG SYLVANIA COOPER	CPX 2X4 AL08 SWW7 TPS2435/45/55G2FSK LPX-24-CP4 PANELF3B504SUNVD8699 24CGT5-L3C3	SELECTABLE	SELECTABLE	UNV	50	CEILING TROFFER	2X4 LED FLAT PANEL TROFFER SELECTABLE FIXTURE SETTINGS: OUTPUT - MEDIUM COLOR TEMP. - 4000K
F2	PHILIPS LITHONIA METALUX SLG	25BP3040LRCS-2-UN3-DIM CPX 2X2 AL07 SWW7 M4 22CIG5-L3C3 TPS 22 35 G1 FSK	SELECTABLE	SELECTABLE	UNIV	37.3W	RECESSED GRID	2X2 LED FLAT PANEL RECESSED GRID TROFFER SELECTABLE FIXTURE SETTINGS: OUTPUT - MEDIUM COLOR TEMP. - 4000K
EX	DUAL LITE	SESGW (SINGLE FACE) SEDGW (DOUBLE FACE)	STANDARD	STANDARD	UNIV	2.1	WALL / CEILING	WALL OR CEILING MOUNTED EXIT SIGN WITH SINGLE OR DOUBLE FACE LETTERING AND BREAK OUT CHEVRONS FOR DIRECTION ARROWS.

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**1 ELECTRICAL DEVICE MOUNTING HEIGHTS - ELEVATION**

**DEVICES AND PATHWAYS**

	WIRING SYSTEM CONCEALED IN WALL OR CEILING.
	BRANCH CIRCUIT HOMERUN TO PANEL.
	JUNCTION BOX WITH CONNECTION TO EQUIPMENT SERVED. 4" SQUARE BOX WITH A SINGLE-GANG OPENING AND PLASTER RING.
	DUPLEX RECEPTACLE, 20 AMP, 120 VOLT (USE 20 AMP FOR SINGLE RECEPTACLE ON A CIRCUIT).
	DUPLEX RECEPTACLE MOUNTED 6" ABOVE COUNTER BACKSPASH, OR AT HEIGHT NOTED.
	QUAD RECEPTACLE. TWO NEMA 5-20R DUPLEX RECEPTACLES.
	GROUND FAULT RECEPTACLE. NEMA 5-20R DUPLEX. ALL RECEPTACLES INSTALLED OUTSIDE, WITHIN 6' OF A SINK OR IN A KITCHEN SHALL BE GFCI.
	DUPLEX RECEPTACLE, 20 AMP, 120 VOLT (USE 20 AMP FOR SINGLE RECEPTACLE ON A CIRCUIT). T.V. RECEPTACLE MOUNTED AT 72" A.F.F. OR AT HEIGHT NOTED ON DRAWING.
	TELEVISION RECEPTACLE, 20 AMP, 120 VOLT (USE 20 AMP FOR SINGLE RECEPTACLE ON A CIRCUIT). MOUNTED AT HEIGHT SPECIFIED BY OIT.
	MODULAR FURNITURE CONNECTION. PROVIDE DOUBLE-GANG BARRIERED J-BOX FOR POWER & TELE/DATA. EXTEND 1-1/4" EC TO ABOVE ACCESSIBLE CEILING FOR TELE/DATA. CONNECT POWER AS INDICATED.
	3/4" CONDUIT PENETRATION THROUGH FLOOR FOR FURNITURE CONNECTION. SEE DETAIL 1 IN SHEET E5.2 FOR DETAILS.
	1" CONDUIT PENETRATION THROUGH FLOOR FOR FURNITURE CONNECTION. SEE DETAIL 1 IN SHEET E5.2 FOR DETAILS.

**PANELS, DISCONNECTS**

	PANELBOARD. SEE SCHEDULE FOR MOUNTING. TOP OF PANEL AT 6'-6" AFF.
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**TELECOMMUNICATIONS**

	TELE/DATA OUTLET. 1" EC TO ABOVE NEAREST ACCESSIBLE CEILING FOR J-HOOK SYSTEM OR TO LOCAL CABLE TRAY (WITHIN 6") AS APPLICABLE WITH PULL STRING. 4" SQUARE BOX WITH A SINGLE-GANG OPENING AND PLASTER RING.
--	---

**LIGHTING (SEE FIXTURE SCH.)**

	LED GRID TROFFER LIGHT FIXTURE. SEE FIXTURE SCHEDULE. SUSPEND TWO CORNERS WITH WIRE TO STRUCTURE. DO NOT ALLOW GRID ALONE TO SUPPORT FIXTURE.
	LED LINEAR PENDANT LIGHT FIXTURE.
	LED RECESSED DOWN LIGHT FIXTURE.
	LED FIXTURE CONNECTED TO EMERGENCY LIGHTING CIRCUIT. SEE FIXTURE SCHEDULE FOR FIXTURE TYPE.
	EXIT LIGHT WITH ARROWS AND NUMBERS OF FACES AS INDICATED ON PLANS. CONNECTED TO EMERGENCY LIGHTING CIRCUIT. SEE LIGHTING FIXTURE SCHEDULE.
	SINGLE POLE SWITCH, 20 AMP, 120/277 VOLT.
	THREE WAY SWITCH, 20 AMP, 120/277 VOLT.
	WALL MOUNTED OCCUPANCY SENSOR AND SWITCH WITH DUAL TECHNOLOGY.
	LOW VOLTAGE LIGHT SWITCH.
	CEILING MOUNTED OCCUPANCY SENSOR, DUAL TECHNOLOGY.
	CEILING MOUNTED OCCUPANCY SENSOR POWER PACK.
	LIGHTING ROOM CONTROLLER.
	EMERGENCY LIGHTING CONTROLLER MODULE.

**FIRE ALARM**

	CEILING MOUNTED SMOKE DETECTOR. FA VENDOR PROVIDED.
	ADA COMPLIANT CEILING MOUNTED FIRE ALARM HORN STROBE LIGHT, 15cd, UNLESS OTHERWISE NOTED. WHITE FINISH.**
	ADA COMPLIANT CEILING MOUNTED FIRE ALARM STROBE LIGHT, 15cd, UNLESS OTHERWISE NOTED. WHITE FINISH.
	ADA COMPLIANT WALL MOUNT FIRE ALARM HORN WITH STROBE LIGHT, 15CD UNLESS OTHERWISE NOTED. WHITE FINISH.**.

**GENERAL NOTES**

- IF THERE ARE ANY DESIGN OR BUDGET ISSUES WITH THIS PROJECT, CONTACT THE DESIGNER INDICATED ON THIS SHEET AS SOON AS POSSIBLE
- FOLLOW THE DESIGN AS PER THESE STANDARD PLANS. ANY CHANGES, ADDITIONS, OR ADJUSTMENTS SHALL BE REVIEWED WITH THE PERSON WHOSE ENGINEERING STAMP IS HERE ATTACHED.
- SEE OIT DRAWINGS FOR PATHWAYS AND J-BOXES REQUIRED FOR TELE/DATA AND AUDIO/VISUAL NEEDS. ELECTRICAL CONTRACTOR SHALL INCLUDE ALL REQUIRED PATHWAYS AND BACK BOXES IN THEIR BID.
- ALL CONDUIT PENETRATIONS THROUGH WALLS, FLOORS, AND CEILINGS SHALL BE FIRE CAULKED AS REQUIRED BY CODE.
- ALL SHADED AREAS ARE OUTSIDE SCOPE OF WORK.

**ABBREVIATIONS**

+42"	DIMENSION INDICATES HEIGHT ABOVE FINISHED FLOOR AT WHICH CENTER OF DEVICE IS TO BE MOUNTED. SEE PLANS.
3R	NEMA 3R RATING
AFF	ABOVE FINISHED FLOOR
AHJ	AUTHORITY HAVING JURISDICTION
AHU	AIR HANDLER UNIT
C	CONDUIT WITH PULL CORD
C.B.	CIRCUIT BREAKER
CLG	INSTALLED IN CEILING
EC	EMPTY CONDUIT WITH PULL CORD
E.C.	ELECTRICAL CONTRACTOR
EWC	ELECTRIC WATER COOLER
EWL	ELECTRIC WATER HEATER
FACP	FIRE ALARM CONTROL PANEL
FPN	FUSE PER NAMEPLATE
LC	LIGHTING CONTRACTOR
M.C.	MECHANICAL CONTRACTOR
P.C.	PLUMBING CONTRACTOR
U.G.	UNDERGROUND
WP	WEATHER PROOF
S.E.	SERVICE ENTRANCE
EM	EMERGENCY FIXTURE WITH BATTERY OR GENERATOR BACK-UP
isc	RMS SYMMETRICAL SHORT CIRCUIT CURRENT
AIC	AMPERE INTERRUPTING CAPACITY (EQUIPMENT RATING)
TVSS	TV RECEPTACLE MOUNTED AT HEIGHT DESIGNATED BY OIT.



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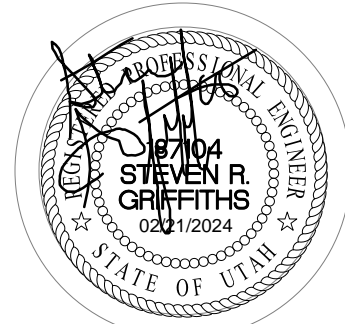
DATE: 02/09/24  
 DESIGNER: LRM  
 DRAWN BY: LRM

ADA CHECK:  
 CODE CHECK:  
 STRUCTURAL:  
 UTILITIES DIR:  
 PLANNING DIR:

CLIENT APPROVAL DATE

**REVISIONS**  
 REVISION #1 02/21/24

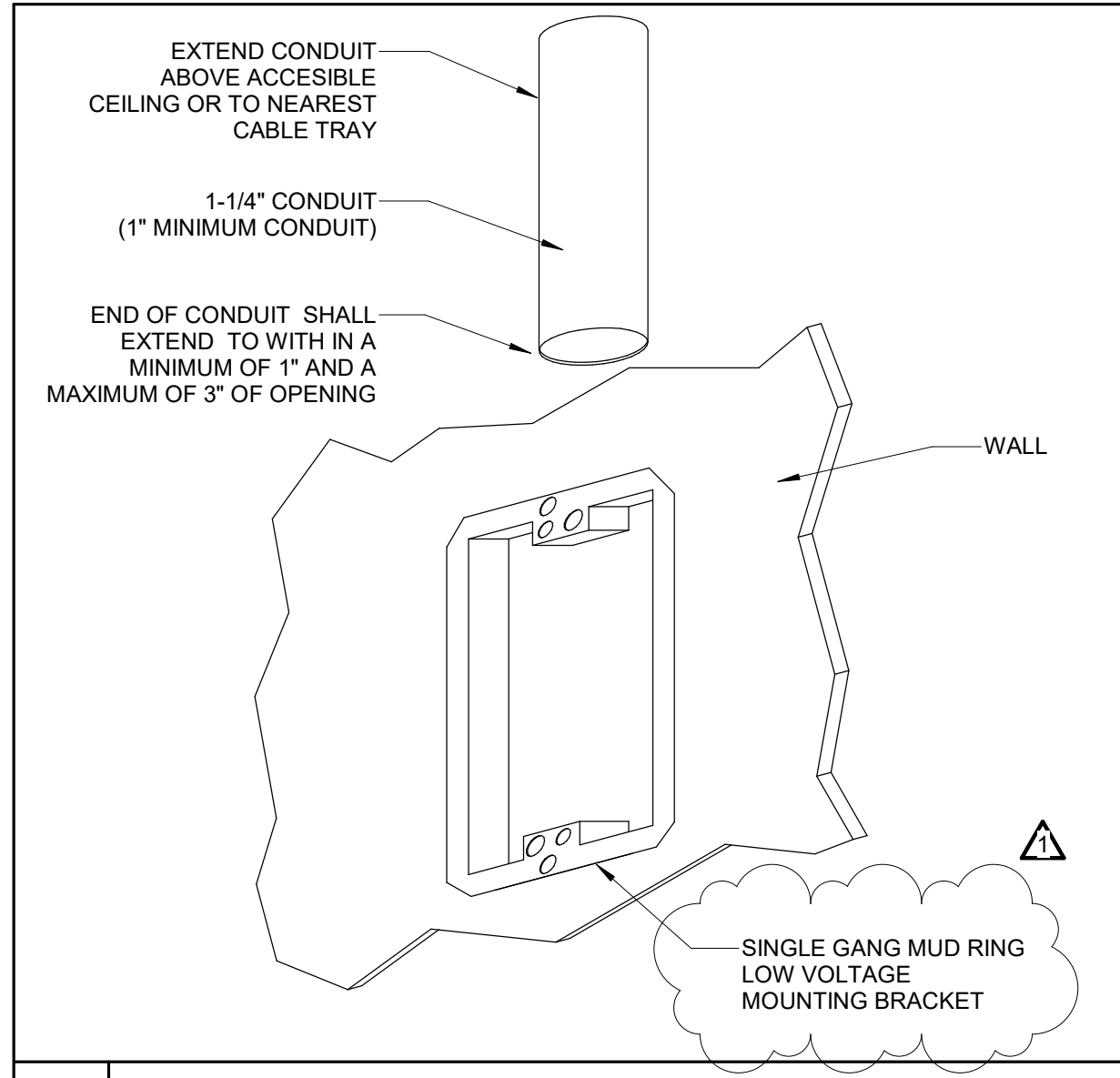
BRIGHAM YOUNG UNIVERSITY  
 CONTINUING EDUCATION OFFICE REMODEL LEVELS 1&4  
 CONTINUING EDUCATION  
 HARMAN CONTINUING EDUCATION BUILDING - LEVEL 1 - 111 & LEVEL 4 - 403



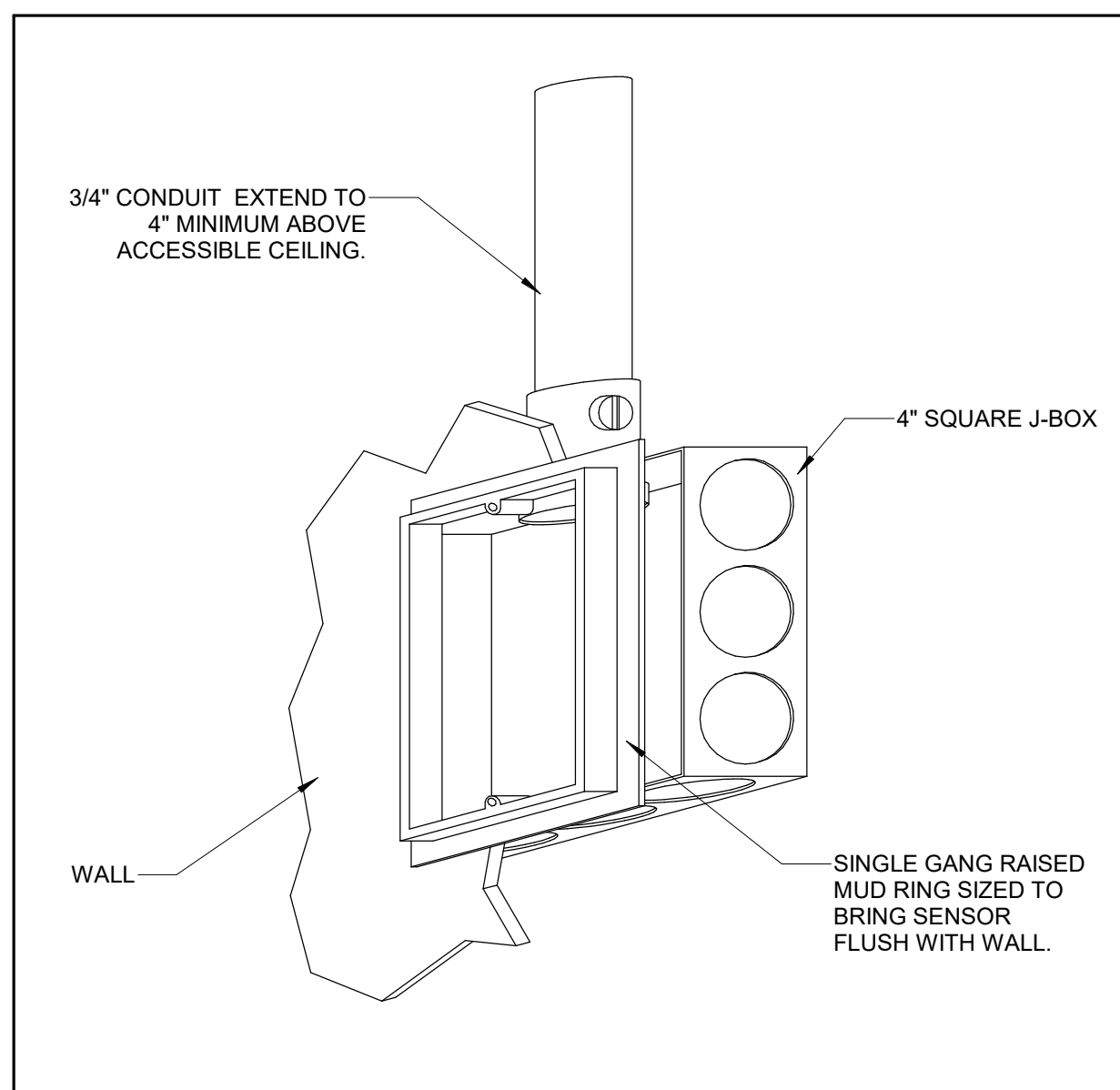
**ELECTRICAL DETAILS, NOTES, LEGENDS**

WORK ORDER & SHEET NO.

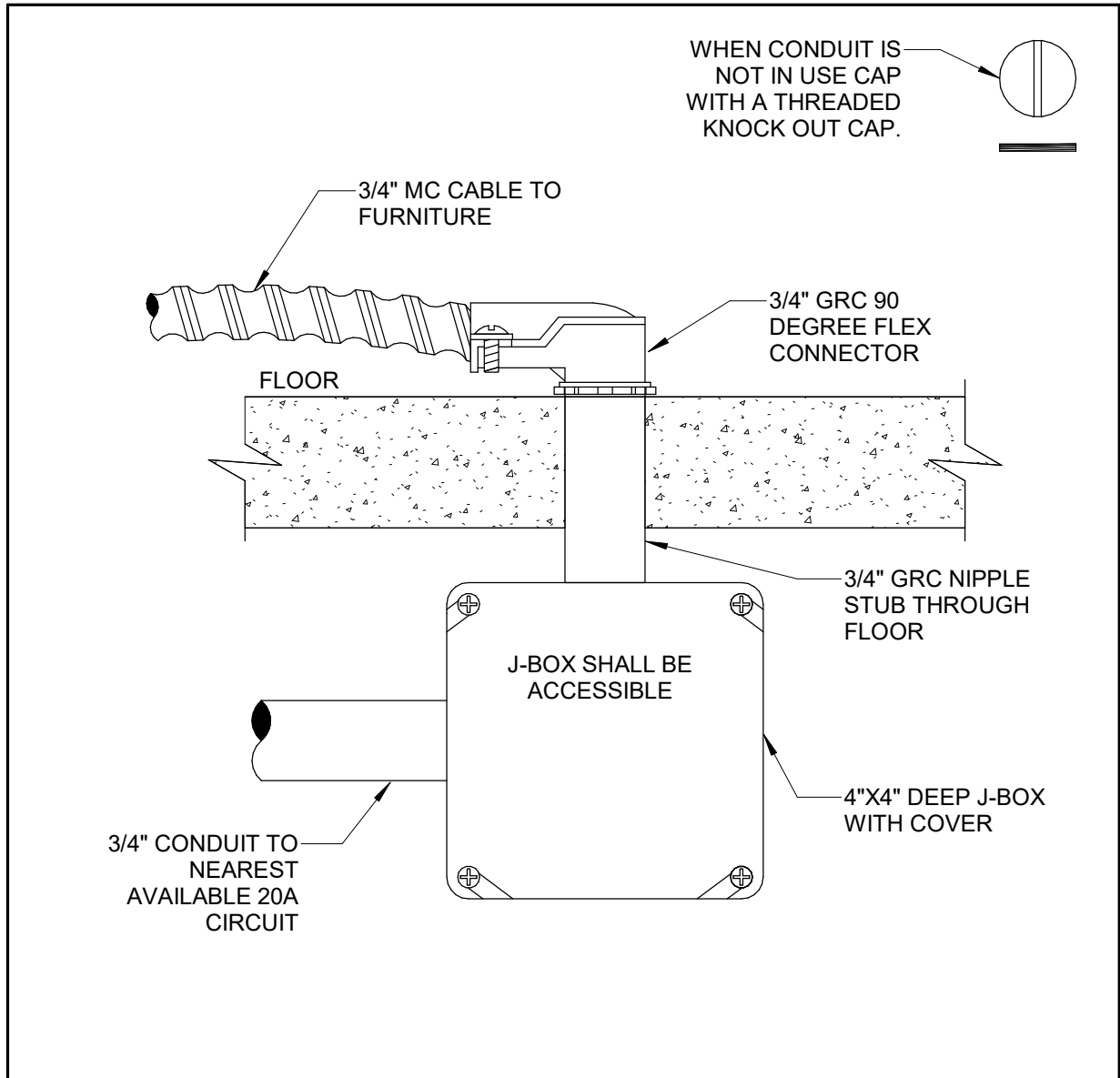
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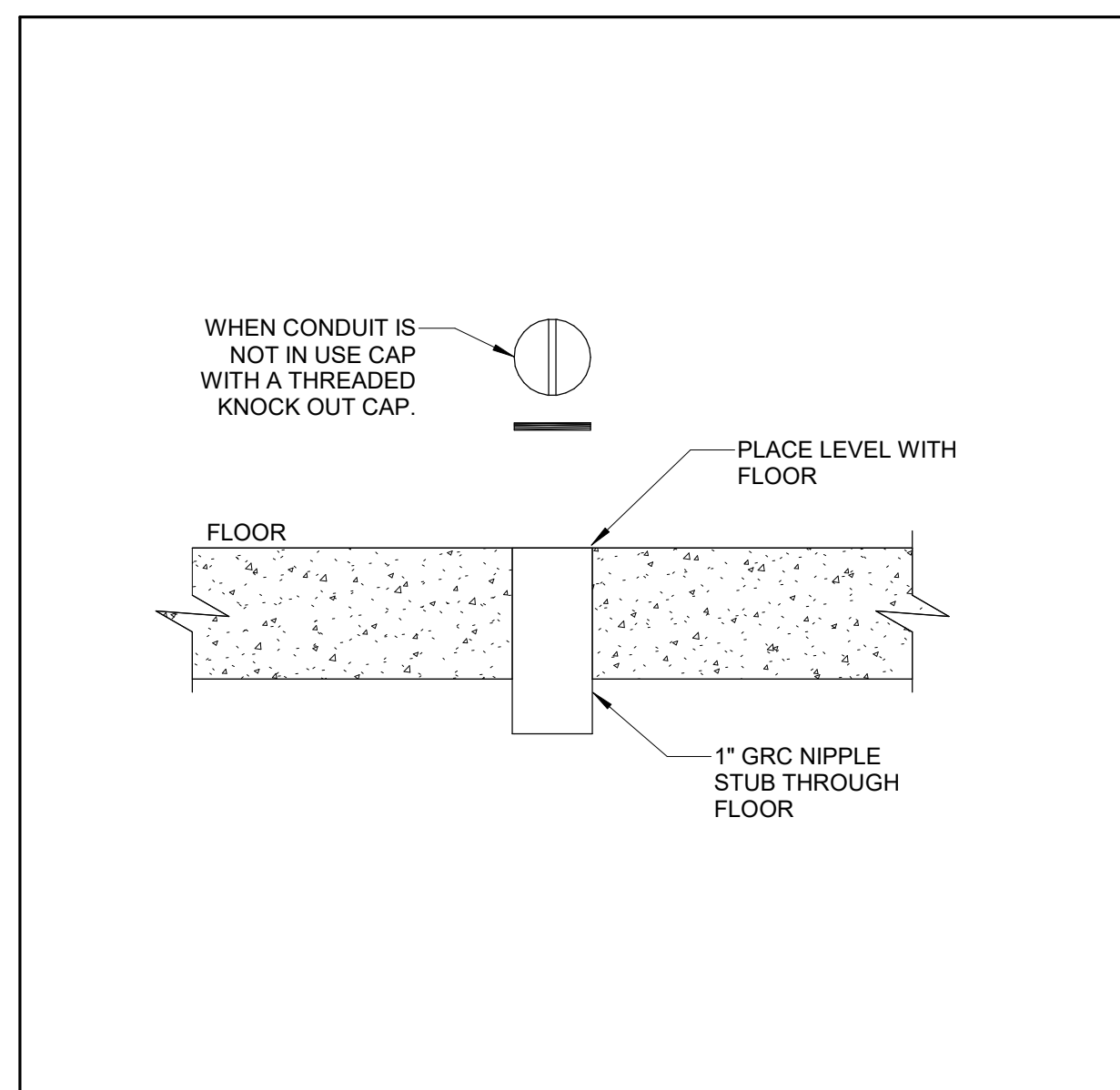
**2** LOW VOLTAGE MUD RING INSTALLATION DETAIL  
NO SCALE



**4** THERMOSTAT ROUGH-IN DETAIL  
NO SCALE



**1** NON-FIRE RATED FLOOR PENETRATION FOR POWER  
NO SCALE



**3** NON-FIRE RATED FLOOR PENETRATION FOR DATA  
NO SCALE

PANEL SCHEDULE "1L2"																						
VOLTAGE: 208 Y/ 120 VOLTS					BUS RATING (AMPS): 250					REMARKS: EXISTING SIEMENS												
ENCLOSURE: NEMA 1					PHASE: 3 MAIN LUGS ONLY																	
					WIRE: 4					MINIMUM EQUIPMENT RATING: 22,000 AMPS (RMS-SYM)												
CIRCUIT BREAKER	CIRCUIT NAME				FEEDER	CKT. LOAD		LOAD/PHASE (VA)			CKT. LOAD		FEEDER	CIRCUIT NAME		CIRCUIT BREAKER						
No.	AMPS	POLE	MOD.		C	WIRE	GRD	DEMAND FACTOR	WATTS	ØA	ØB	ØC	WATTS	DEMAND FACTOR	GRD	WIRE	C	MOD.	POLE	AMPS	No.	
1	20	1	-	RECEP RM 111G & 111F	3/4"	#12	#12	1.00	1,260	2,160			900	1.00	EX	EX	3/4"	EX TUTORING & TA RM 107	-	1	20	2
3	20	1	-	RECEP RM 111E & 111D	3/4"	#12	#12	1.00	1,440				2,340	1.00	EX	EX	3/4"	EX TUTORING & TA RM 107	-	1	20	4
5	20	1	-	RECEP RM 111C & 111B	3/4"	#12	#12	1.00	1,440				2,340	1.00	EX	EX	3/4"	EX TUTORING & TA RM 107	-	1	20	6
7	20	1	-	RECEP RM 111A	3/4"	#12	#12	1.00	900	1,800			900	1.00	EX	EX	3/4"	EX TUTORING & TA RM 107	-	1	20	8
9	20	1	-	RECEP RM 111H & 111J	3/4"	#12	#12	1.00	1,440				2,340	1.00	EX	EX	3/4"	EX TUTORING & TA RM 107	-	1	20	10
11	20	1	-	RECEP RM 117A	3/4"	#12	#12	1.00	720				1,620	1.00	EX	EX	3/4"	EX TUTORING & TA RM 107	-	1	20	12
13	20	1	-	RECEP RM 117	3/4"	#12	#12	1.00	900	1,800			900	1.00	EX	EX	3/4"	EX TUTORING & TA RM 107	-	1	20	14
15	20	1	-	FURNITURE CONNECTION RM 111	3/4"	#12	#12	1.00	1,080				1,980	1.00	EX	EX	3/4"	EX TUTORING & TA RM 107	-	1	20	16
17	20	1	-	FURNITURE CONNECTION RM 111	3/4"	#12	#12	1.00	1,080				1,980	1.00	EX	EX	3/4"	EX TUTORING & TA RM 107	-	1	20	18
19	20	1	-	FURNITURE CONNECTION RM 111	3/4"	#12	#12	1.00	1,080	1,980			900	1.00	EX	EX	3/4"	EX TUTORING & TA RM 107	-	1	20	20
21	20	1	-	FURNITURE CONNECTION RM 111	3/4"	#12	#12	1.00	1,080				1,980	1.00	EX	EX	3/4"	EX TUTORING & TA RM 107	-	1	20	22
23	20	1	-	RECEP RM 111	3/4"	#12	#12	1.00	1,804				2,704	1.00	EX	EX	3/4"	EX TUTORING & TA RM 107	-	1	20	24
25	20	1	-	RECEP PRINTER DED. RM 111	3/4"	#12	#12	1.00	1,000	1,900			900	1.00	EX	EX	3/4"	EX TUTORING & TA RM 107	-	1	20	26
27	20	1	-	RECEP PRINTER COUNTER RM 111	3/4"	#12	#12	1.00	540				1,440	1.00	EX	EX	3/4"	EX TUTORING & TA RM 107	-	1	20	28
29	20	1	-	RECEP RECEPTION COUNTER RM 111	3/4"	#12	#12	1.00	360				1,260	1.00	EX	EX	3/4"	EX TUTORING & TA RM 107	-	1	20	30
31	20	1	-	RECEP RECEPTION COUNTER RM 111	3/4"	#12	#12	1.00	360	1,260			900	1.00	EX	EX	3/4"	EX TUTORING & TA RM 107	-	1	20	32
33	20	1	-	EX TESTING CENTER 111	3/4"	EX	EX	1.00	900				1,800	1.00	EX	EX	3/4"	EX TUTORING & TA RM 107	-	1	20	34
35	20	1	-	EX TESTING CENTER 111	3/4"	EX	EX	1.00	900				1,800	1.00	EX	EX	3/4"	EX TUTORING & TA RM 107	-	1	20	36
37	20	1	-	EX TESTING CENTER 111	3/4"	EX	EX	1.00	900	1,800			900	1.00	EX	EX	3/4"	EX TUTORING & TA RM 107	-	1	20	38
39	20	1	-	EX TUTORING & TA RM 107	3/4"	EX	EX	1.00	900				1,800	1.00	EX	EX	3/4"	EX TUTORING & TA RM 107	-	1	20	40
41	20	1	-	EX TUTORING & TA RM 107	3/4"	EX	EX	1.00	900				1,800	1.00	EX	EX	3/4"	EX TESTING CENTER RM 111	-	1	20	42
43	20	1	-	EX TESTING CENTER 111	3/4"	EX	EX	1.00	900	1,800			900	1.00	EX	EX	3/4"	EX TUTORING & TA RM 107	-	1	20	44
45	20	1	-	EX TUTORING & TA RM 107	3/4"	EX	EX	1.00	900				1,800	1.00	EX	EX	3/4"	EX TUTORING & TA RM 107	-	1	20	46
47	20	1	-	EX EMPLOYEE TESTING RM 123	3/4"	EX	EX	1.00	900				1,800	1.00	EX	EX	3/4"	EX EMPLOYEE TESTING RM 123	-	1	20	48
49	20	1	-	EX EMPLOYEE TESTING RM 123	3/4"	EX	EX	1.00	900	1,800			900	1.00	EX	EX	3/4"	EX EMPLOYEE TESTING RM 123	-	1	20	50
51	20	1	-	EX TUTORING & TA RM 107	3/4"	EX	EX	1.00	900				1,800	1.00	EX	EX	3/4"	EX LOAD	-	1	20	52
53	20	-	-	SPARE				1.00					0					SPARE	-		20	54
55	20	-	-	SPARE				1.00		0			1.00					SPARE	-		20	56
57	20	1	-	EX MEDIUM CONF RM 118	3/4"	EX	EX	1.00	900				900	1.00				SPARE	-		20	58
59	20	-	-	SPARE				1.00					0					SPARE	-		20	60
61	20	-	-	SPARE				1.00		0			1.00					SPARE	-		20	62
63	20	-	-	SPARE				1.00					0					SPARE	-		20	64
65	20	-	-	SPARE				1.00					0					SPARE	-		20	66
67	20	-	-	SPARE				1.00		0			1.00					SPARE	-		20	68
69	20	-	-	SPARE				1.00					0					SPARE	-		20	70
71	20	-	-	SPARE				1.00					0					SPARE	-		20	72

- NOTES:
- EX DENOTES EXISTING CONDITIONS.
  - E.C. SHALL PROVIDE A TYPED UPDATED DOOR MOUNTED PANEL SCHEDULE.
  - ALL CIRCUITS SHOWN IN BOLD ARE NEW OR HAVE BEEN MODIFIED.
  -

ØA	ØB	ØC	TOTALS	
16,300	18,180	15,304	49,784	CONNECTED LOAD (VA)
			138	CONNECTED LOAD (A)
0	0	0	0	DEMAND FACTOR ADJUSTMENTS (VA)
16,300	18,180	15,304	49,784	TOTAL LOAD (VA)
136	151	127	151	TOTAL LOAD (A)
			151	MAXIMUM LOAD (A)
33%	37%	31%		PHASE BALANCE



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DESIGNER: LRM  
DRAWN BY: LRM

ADA CHECK:  
CODE CHECK:  
STRUCTURAL:  
UTILITIES DIR:  
PLANNING DIR:

CLIENT APPROVAL DATE

REVISIONS  
REVISION #1 02/21/24

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**ELECTRICAL SCHEDULES AND DETAILS**

WORK ORDER & SHEET NO.

**N1864 E5.2**





## SECTION 210500

### COMMON WORK RESULTS FOR FIRE SUPPRESSION

#### PART 1 GENERAL

THIS SECTION UPDATED COMPLETE OCTOBER 2020

##### 1.01 SECTION INCLUDES

- A. Above ground piping.
- B. Escutcheons.
- C. Pipe, fittings, sleeves, escutcheons, seals, and connections for sprinkler systems.
- D. Expansion joints.
- E. Expansion loops.
- F. Pipe hangers and supports.
- G. Pipe sleeves.

##### 1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 099113 - Exterior Painting: Preparation and painting of exterior fire protection piping systems.
- C. Section 099123 - Interior Painting: Preparation and painting of interior fire protection piping systems.
- D. Section 210523 - General-Duty Valves for Water-Based Fire-Suppression Piping.
- E. Section 210553 - Identification for Fire Suppression Piping and Equipment: Piping identification.
- F. Section 211200 - Fire-Suppression Standpipes: Standpipe design.
- G. Section 211300 - Fire-Suppression Sprinkler Systems: Sprinkler systems design.
- H. Section 220553 - Identification for Plumbing Piping and Equipment: Piping identification.

##### 1.03 REFERENCE STANDARDS

- A. ASME A112.18.1 - Plumbing Supply Fittings; 2012.
- B. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Procedures; Welders; Braziers; and Welding, Brazing and Fusing Operators; 2017.
- C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2015.
- D. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.
- E. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2016.
- F. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2017.
- G. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings; 2012.
- H. ASME B16.11 - Forged Fittings, Socket-welding and Threaded; 2016 (Errata 2017).
- I. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.
- J. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.
- K. ASME B16.25 - Buttwelding Ends; 2012.
- L. ASME B36.10M - Welded and Seamless Wrought Steel Pipe; 2015.
- M. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999 (Reapproved 2014).

I \_\_\_\_\_ the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers. Downloaded from SpecLink: May 05, 2023

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- N. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- O. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe; 2009 (Reapproved 2014).
- P. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2017.
- Q. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015a.
- R. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).
- S. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2013.
- T. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).
- U. ASTM B75/B75M - Standard Specification for Seamless Copper Tube; 2011.
- V. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2016.
- W. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2016.
- X. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2016.
- Y. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- Z. ASTM D2239 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter; 2012a.
- AA. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe; 2015.
- AB. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a.
- AC. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40; 2015.
- AD. ASTM F439 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2013.
- AE. ASTM F442/F442M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR); 2013.
- AF. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2014.
- AG. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011-AMD 1.
- AH. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (with March 2016 Errata).
- AI. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010.
- AJ. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2012.
- AK. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2017.
- AL. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2009.
- AM. AWWA C606 - Grooved and Shouldered Joints; 2015.
- AN. ITS (DIR) - Directory of Listed Products; current edition.
- AO. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2016.

I \_\_\_\_\_ the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers. Downloaded from SpecLink: May 05, 2023

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



AP. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems; 2016.

AQ. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

AR. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

**1.04 SUMMARY TABLE**

Item	Spec Section	Summary
Design	211300 1.06.B	Design with a margin of safety of 10%.
Submittal	211300 1.05.C	Submit shop drawings, product data, and hydraulic calculations to AHJ and BYU Fire Marshal for approval.
Pipe Thickness	210500 2.02.A	Minimum Pipe Thickness Schedule Mains: Sch 10 Grooved Branch: Sch 10 Threaded Branch: Sch 30
Design	Division 210000	Design does not need to be FM approved.
Drain Discharge	210500 3.03.I	All drain valves shall be discharged to the exterior of the building.
Flex Hose Drops	211300 2.02.F	Minimum capability of 5 bends is required.
Control Valves	210500 3.03.H	To be installed 7'-0" maximum above finish floor.
Flow Switches	211300 2.03.E	To be key operated/activated for testing purposes.
Dry/Pre-action Valves	211300 2.03.A	Victaulic is the only approved manufacturer.
Exposed Pipe Fittings	210500 3.03.F	Shall have a minimum 1" outlet with a bushing to accommodate future remodels.
Exposed Areas	210500 3.03.E	Piping shall be installed as high as possible.
Dry Systems	210500 2.02.A	Black pipe shall be used. Galvanized is not acceptable.

**1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers catalogue information. Indicate valve data and ratings.
- C. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections. Include flow calculations.
- D. Manufacturer's Qualification Statement.
- E. Installer's Qualification Statement.
- F. Project Record Documents: Record actual locations of components and tag numbering.
- G. Operation and Maintenance Data: Include installation instructions and spare parts lists.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 016000 - Product Requirements, for additional provisions.
  - 2. Extra Valve Stem Packings: One for each type and size of valve.
- I. Warranty Materials: Include all warranty certificates and schedule list of start and end dates for manufacturer equipment.

I \_\_\_\_\_ the Principal in Charge on this project have reviewed this section and it is in accordance with the Instructions to Architects & Engineers. Downloaded from SpecLink: May 05, 2023

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



## 1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section.
  - 1. Minimum three years' experience for lead installers.
  - 2. Approved by manufacturer.
- C. Conform to UL (DIR) requirements.
- D. U.S. made domestic equipment, pipes, valves, and fittings.
- E. Valves: Bear UL (DIR) and ITS (DIR) or Warnock Hersey product listing label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- F. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.
- G. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in protected place until installation.

## 1.08 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.
- C. 11 months after substantial completion, contractor shall meet with BYU personnel to ensure integrity of system and to address any warranty issues identified during meeting.

## PART 2 PRODUCTS

### 2.01 FIRE PROTECTION SYSTEMS

- A. Sprinkler Systems: Conform to NFPA 13 (or NFPA 13R as applicable).
- B. Welding Materials and Procedures: Conform to ASME BPVC-IX.

### 2.02 ABOVE GROUND PIPING

- A. Steel Pipe: ASTM A795 Schedule 10, ASTM A53 Schedule 40, ASTM A135/A135M Schedule 10, or ASTM A795 Schedule 40 \_\_\_\_\_.
  - 1. Minimum Pipe Thickness Schedule
    - a. Mains: Sch 10
    - b. Grooved Branch: Sch 10
    - c. Threaded Branch: Sch 30
  - 2. Use Schedule
    - a. Conditioned Space: black pipe
    - b. Unconditioned Space: galvanized pipe
    - c. Dry System: black pipe
  - 3. Steel Fittings: ASME B16.9, wrought steel, buttwelded, ASME B16.25, buttweld ends, ASTM A234/A234M, wrought carbon steel or alloy steel, ASME B16.5, steel flanges and fittings, or ASME B16.11, forged steel socket welded and threaded.

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4. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
  5. Malleable Iron Fittings: ASME B16.3, threaded fittings and ASTM A47/A47M.
  6. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
  7. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.
  8. Mechanical Saddle Tee: Victaulic 920, 920N, or 920 CROSS
- B. Copper Tube: ASTM B75/B75M or ASTM B88 (ASTM B88M), H58 drawn temper.
1. Type: Type L (B).
  2. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze solder joint, pressure type.
  3. Joints: AWS A5.8M/A5.8 Classification BCuP-3 or BCuP-4 copper/silver braze or ASTM B32, alloy Sn95 solder.
- C. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), H58 drawn.
1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze, grooved.
  2. Mechanical Grooved Couplings: Ductile iron housing with alkyd enamel paint coating clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers.

### 2.03 PIPE SLEEVES

- A. Vertical Piping:
1. Sleeve Length: 1 inch above finished floor.
  2. Provide sealant for watertight joint.
  3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
  4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- B. Plastic, Sheet Metal, or Moisture-Resistant Fiber: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- C. Pipe Passing Through Below Grade Exterior Walls:
1. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
- D. Pipe Passing Through Quarry Tile, Terrazzo, or Ceramic Tile Floors:
1. Connect sleeve with floor plate.
- E. Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:
1. Galvanized steel pipe or black iron pipe with asphalt coating.
  2. Connect sleeve with floor plate except in mechanical rooms.
- F. Pipe Passing Through Mechanical, Laundry, and Animal Room Floors above Basement:
1. Galvanized steel pipe or black iron pipe with asphalt coating.
  2. Connect sleeve with floor plate except in mechanical rooms.
- G. Not required for wall hydrants for fire department connections or in drywall construction.
- H. Penetrations in concrete beam flanges are permitted but are prohibited through ribs or beams without prior approval from the Architect.
- I. Clearances:
1. Wall, Floor, Floor, Partitions, and Beam Flanges: 2 inch greater than external; pipe diameter.
  2. All Rated Openings: Caulked tight with fire stopping material conforming to ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.

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## 2.04 MANUFACTURED SLEEVE-SEAL SYSTEMS

- A. Manufacturers:
  - 1. Advance Products & Systems, Inc; \_\_\_\_\_: www.apsonline.com
  - 2. The Metraflex Company; \_\_\_\_\_: www.metraflex.com
  - 3. Trumbull Industries.
  - 4. Garlock
  - 5. Substitutions: See Section 016000 - Product Requirements.
- B. Modular/Mechanical Seal:
  - 1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.
  - 2. Provide watertight seal between pipe and wall/casing opening.
  - 3. Elastomer element size and material in accordance with manufacturer's recommendations.
  - 4. Glass reinforced plastic pressure end plates.

## 2.05 ESCUTCHEONS

- A. Manufacturers:
  - 1. Victaulic.
  - 2. Globe
  - 3. Reliable
  - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Material:
  - 1. Fabricate from nonferrous metal.
  - 2. Chrome-plated.
  - 3. Grade TP304, seamless tube, ASTM A269/A269M stainless steel.
  - 4. Metals and Finish: Comply with ASME A112.18.1.
- C. Construction:
  - 1. One-piece for mounting on chrome-plated tubing or pipe and one-piece or split-pattern type elsewhere.
  - 2. Internal spring tension devices or setscrews to maintain a fixed position against a surface.

## 2.06 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
- B. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
- C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- D. Wall Support for Pipe Sizes to 3 inches: Unistrut with clamp
- E. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
- F. Vertical Support: Steel riser clamp.
- G. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- H. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- I. Seismic Hangers and Couplings:
  - 1. Provide coupling with a factory set disengagement rating of 140 percent to 160 percent of the static weight.
  - 2. Provide resettable and reusable, break away couplings.
  - 3. Provide tether cables to avoid excessive seismic joint movement.
  - 4. Coupling to be manufactured from non-corrosive materials.

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5. Manufacturers:
  - a. The Metraflex Company; Seismic Breakaway Hanger: [www.metrafire.com](http://www.metrafire.com)
  - b. Substitutions: See Section 016000 - Product Requirements.

## 2.07 MECHANICAL COUPLINGS

- A. Manufacturers:
  1. Victaulic Company; FireLock Style 009H: [www.victaulic.com](http://www.victaulic.com)
  2. Grinnell.
  3. Gruvlok.
  4. Substitutions: See Section 016000 - Product Requirements.
- B. Rigid Mechanical Couplings for Grooved Joints:
  1. Dimensions and Testing: Comply with AWWA C606.
  2. Minimum Working Pressure: 300 psig.
  3. Housing Material: Fabricate of ductile iron conforming to ASTM A536.
  4. Housing Coating: Factory applied orange enamel.
  5. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
  6. Bolts and Nuts: Hot dipped galvanized or zinc electroplated steel.
  7. Provide stops for direct stab installation without field assembly.

## PART 3 EXECUTION

### 3.01 INSTALLERS

- A. Western Automatic Sprinkler.
- B. Frontier Fire
- C. Delta Fire
- D. Kimco
- E. The Safety Team / Triple A Fire
- F. Preferred Fire
- G. Substitutions: See Section 016000 - Product Requirements.

### 3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

### 3.03 INSTALLATION

- A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.
- B. Install standpipe piping, hangers, and supports in accordance with NFPA 14.
- C. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- D. Install piping to conserve building space, to not interfere with use of space and other work.
- E. In areas with no ceiling, piping shall be installed as high as possible.
- F. In exposed piping situations, head fittings shall have a 1" minimum outlet with a bushing to accommodate future remodel work.
- G. Group piping, whenever practical, at common elevations.

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- H. Floor control valves shall be installed 7'-0" maximum above finish floor, unless prior approval is received from BYU.
- I. All drain valves shall be discharged to the exterior of the building. In a below grade application, drain lines shall tie to an auxiliary drain, not a mop sink. Do not tie into any drain line without BYU approval.
- J. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- K. Inserts:
  - 1. Provide inserts for placement in concrete formwork.
  - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
  - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
  - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
- L. Pipe Hangers and Supports:
  - 1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
  - 2. Place hangers within 12 inches of each horizontal elbow.
  - 3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
  - 4. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
  - 5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
  - 6. Provide copper hangers and supports for copper piping.
  - 7. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
    - a. Painting of interior fire suppression systems is specified in Section 099123.
    - b. Painting of exterior fire suppression systems is specified in Section 099113.
- M. Slope piping for dry systems and arrange all systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- N. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
  - 1. Painting of interior fire suppression systems is specified in Section 099123.
  - 2. Painting of exterior fire suppression systems is specified in Section 099113.
- O. Structural Considerations:
  - 1. Do not penetrate building structural members unless indicated.
  - 2. Locate flexible expansion loops at or near the building seismic joint.
- P. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
  - 1. Aboveground Piping:
    - a. Pack solid using mineral fiber conforming to ASTM C592.
    - b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
  - 2. All Rated Openings: Caulk tight with fire stopping material conforming to ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.

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3. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.

Q. Escutcheons:

1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.
3. Attach plates at the underside only of suspended ceilings.
4. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.

R. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

S. Die cut threaded joints with full cut standard taper pipe threads with Teflon tape and non-toxic joint compound applied to male threads only.

**3.04 CLEANING**

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.
- C. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

**END OF SECTION**

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## SECTION 210553

### IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

#### PART 1 GENERAL

THIS SECTION UPDATED COMPLETELY OCTOBER 2020

##### 1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Laminated Fire Sprinkler Zone Plans

##### 1.02 REFERENCE STANDARDS

- A. NFPA 13
- B. ASME A13.1 - Scheme for the Identification of Piping Systems; 2015.
- C. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

##### 1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number. Shall be in laminated design drawings hung at each control valve.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation instructions.
- F. Project Record Documents: Record actual locations of tagged valves to be submitted to owner.

#### PART 2 PRODUCTS

##### 2.01 IDENTIFICATION APPLICATIONS

- A. Automatic Controls: Nameplates.
- B. Instrumentation: Nameplates.
- C. Pumps: Nameplates.
- D. Small-sized Equipment: Nameplates.
- E. Floor Control Valves: Nameplates and Laminated Fire Sprinkler Zone Plans

##### 2.02 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved letters.
  - 1. Letter Color: Red.
  - 2. Letter Height: 1/2 inch.
  - 3. Background Color: White.
  - 4. Thickness: 1/16" - 1/8" inch.
  - 5. Plastic: Conform to ASTM D709.

##### 2.03 LAMINATED FIRE SPRINKLER ZONE PLANS

- A. Description: 11"x17" laminated fire sprinkler zone plan at each control valve indicating portion of system controlled by each valve. Hang plans from valve.

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## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Degrease and clean surfaces to receive adhesive for identification materials.

### **3.02 INSTALLATION**

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install nameplates with corrosion resistant chain, when used.

**END OF SECTION**

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**SECTION 211300**  
**FIRE-SUPPRESSION SPRINKLER SYSTEMS**  
**UPDATED MAY 2023**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Wet-pipe sprinkler system.
- B. System design, installation, and certification.

**1.02 RELATED REQUIREMENTS**

- A. Section 078400 - Firestopping.
- B. Section 083477 - Smoke and Fire Protective Curtain Assemblies: Smoke and fire curtains to be released by activation of sprinkler system.
- C. Section 210500 - Common Work Results for Fire Suppression: Pipe and fittings.
- D. Section 210523 - General-Duty Valves for Water-Based Fire-Suppression Piping.
- E. Section 210548 - Vibration and Seismic Controls for Fire Suppression Piping and Equipment.
- F. Section 210553 - Identification for Fire Suppression Piping and Equipment.
- G. Section 211200 - Fire-Suppression Standpipes.
- H. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.
- I. Section 284600 - Fire Detection and Alarm.

**1.03 REFERENCE STANDARDS**

- A. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2015.
- B. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2015.
- C. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.
- D. ITS (DIR) - Directory of Listed Products; current edition.
- E. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2016.
- F. NFPA 13R - Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies; 2016.
- G. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Conduct a preinstallation meeting prior to the start of the work of this section; require attendance by all affected installers. First install scope shall be determined at this meeting.

**1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Shop Drawings:
  - 1. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
  - 2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, seismic bracing, sprinklers, components and accessories. Indicate system controls.

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3. Submit shop drawings, product data, and hydraulic calculations to AHJ and BYU Fire Marshal for approval. Submit proof of approval to Architect.
- D. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.
- E. Designer's Qualification Statement.
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.
- H. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. See Section 016000 - Product Requirements, for additional provisions.
  2. Extra Sprinklers: Type and size matching those installed, in quantity required by referenced NFPA design and installation standard.
  3. Sprinkler Wrenches: For each sprinkler type.
- J. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

#### **1.06 QUALITY ASSURANCE**

- A. Designer Qualifications: Professional Fire Protection Engineer Utah or NICET Level III Technician.
- B. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
- C. Water Velocity: the maximum water velocity shall not exceed 32 fps.
- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- E. Installer Qualifications: Company specializing in performing the work of this section with minimum three years' experience and approved by manufacturer.
- F. Equipment and Components: Provide products that bear UL (DIR) label or marking. All products shall be domestic only.
- G. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

#### **1.07 FIRST INSTALL**

- A. Provide components for installation in first install.
- B. First install may remain as part of the Work.
- C. Owner shall be invited to participate.

#### **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.
- B. Schedule inspection of material with Owner prior to first install.

### **PART 2 PRODUCTS**

#### **2.01 SPRINKLER SYSTEM**

- A. Sprinkler System: Provide coverage for entire building.
- B. Occupancy: comply with NFPA 13.

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- C. Pipe Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
  - 1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
  - 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
  - 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
  - 4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.

## 2.02 SPRINKLERS

- A. Suspended Ceiling Type: Concealed pendant type with matching screw on escutcheon plate.
  - 1. Response Type: Quick. **Updated May 2023: Concealed noted above**
  - 2. Coverage Type: Standard.
  - 3. Finish: Brass.
  - 4. Escutcheon Plate Finish: Enamel, color as selected.
  - 5. Fusible Link: Glass bulb type temperature rated for specific area hazard.
  - 6. Manufacturers:
    - a. Victaulic \_\_\_\_\_.
    - b. Globe \_\_\_\_\_.
    - c. Reliable \_\_\_\_\_.
- B. Flexible Drop System: Stainless steel, minimum of 5 bends.
  - 1. Application: Use to properly locate sprinkler heads.
  - 2. Include all supports and bracing.
  - 3. Provide braided type tube as required for the application.
  - 4. Manufacturers:
    - a. Victaulic Company; AH2 or AH2CC: [www.victaulic.com](http://www.victaulic.com).
    - b. Viking; Superflex \_\_\_\_\_.
    - c. Substitutions: See Section 016000 - Product Requirements.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install in accordance with referenced NFPA design and installation standard.
- B. Install equipment in accordance with manufacturer's instructions.
- C. Provide complete set of 11"x17" laminated fire protection plans at the main control valve of sprinkler system.
- D. Place pipe runs to minimize obstruction to other work.
- E. Place piping in concealed spaces above finished ceilings.
- F. Place piping in exposed spaces as high as possible.
- G. Center sprinklers in two directions in ceiling tile and provide piping offsets as required.
  - 1. Exceptions as approved by Owner.
- H. Install air compressor on vibration isolators. Refer to Section 220548.
- I. Install guards on sprinklers where indicated.

### END OF SECTION

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## SECTION 220529

### HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Support and attachment components for equipment, piping, and other plumbing work.
- B. Retrofit piping cover system.

##### 1.02 RELATED REQUIREMENTS

- A. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

##### 1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General - Purpose Piping; 2014.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999 (Reapproved 2014).
- F. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2015.
- G. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2014.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- I. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- J. MFMA-4 - Metal Framing Standards Publication; 2004.
- K. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.
- L. NFPA 101 - Life Safety Code; 2015.
- M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

##### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
  - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
  - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
  - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

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- B. Sequencing:
  - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

### 1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
  - 1. Fiberglass Channel (Strut) Framing Systems: Include requirements for strength derating according to ambient temperature.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

### 1.06 QUALITY ASSURANCE

- A. Comply with current adopted version of IMC and/or ANSI/MSS SP-58.
- B. Installer Qualifications for Field-Welding: As specified in Section 055000.

### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## PART 2 PRODUCTS

### 2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
  - 1. Comply with current adopted version of IMC and/or ANSI/MSS SP-58.
  - 2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
  - 3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
  - 4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor as specified by structural engineer. Include consideration for vibration, equipment operation, and shock loads where applicable.
  - 5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
  - 6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
    - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
    - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
    - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Materials for Metal Fabricated Supports: Comply with Section 055000.
- C. Metal Channel (Strut) Framing Systems:
  - 1. Manufacturers:
    - a. Cooper B-Line, a division of Eaton Corporation; \_\_\_\_\_: [www.cooperindustries.com](http://www.cooperindustries.com)

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- b. Thomas & Betts Corporation; \_\_\_\_\_: www.tnb.com
- c. Unistrut, a brand of Atkore International Inc; \_\_\_\_\_: www.unistrut.com
- d. Miro Industries \_\_\_\_\_.
- e. Substitutions: See Section 016000 - Product Requirements.
- 2. Comply with MFMA-4.
- 3. Channel Material:
  - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
  - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
- 4. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch.
- 5. Minimum Channel Dimensions: 1-5/8 inch width by 1-5/8 inch height.
- D. Fiberglass Channel (Strut) Framing Systems: Factory-fabricated continuous-slot fiberglass channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
  - 1. Channel Material: Use polyester resin or vinyl ester resin.
  - 2. Minimum Channel Dimensions: 1-5/8 inch width by 1 inch height.
  - 3. Flammability: Fire retardant with NFPA 101, Class A flame spread index (maximum of 25) when tested in accordance with ASTM E84; self-extinguishing in accordance with ASTM D635.
- E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
  - 1. Minimum Size, Unless Otherwise Indicated or Required:
    - a. Equipment Supports: 1/2 inch diameter.
    - b. Piping 2" and smaller: 3/8 inch diameter.
    - c. Piping 2-1/2" to 4": 1/2 inch diameter.
    - d. Piping larger than 4": refer to engineered drawings and/or manufacturer's requirements.
    - e. Trapeze Support for Multiple Pipes: refer to engineered drawings and/or manufacturer's requirements.
- F. Thermal Insulated Pipe Supports:
  - 1. General Construction and Requirements:
    - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
    - b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with 1 or 1.
    - c. Pipe supports to be provided for nominally sized, 2-1/2 inch to 18 inch iron pipes.
    - d. Insulation inserts to consist of calcium silicate insulation surrounded by a 90 degree galvanized steel jacketing.
  - 2. PVC Jacket:
    - a. Minimum Service Temperature: Minus 40 degrees F.
    - b. Maximum Service Temperature: 180 degrees F.
    - c. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
    - d. Thickness: 60 mil.
    - e. Connections: Brush on welding adhesive.
  - 3. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.
- G. Pipe Supports:
  - 1. Liquid Temperatures Up To 140 degrees F:
    - a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
    - b. Support From Below: MSS SP-58 Types 35 through 38.
  - 2. Operating Temperatures from 140 to 446 degrees F:

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- a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
  - b. Roller Support: MSS SP-58 Types 41 or 43 through 46, with appropriate saddle of MSS SP-58 Type 39 for insulated pipe.
  - c. Sliding Support: MSS SP-58 Types 35 through 38.
- H. Beam Clamps: MSS SP-58 Types 19 through 23, 25 or 27 through 30 based on required load.
- 1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
  - 2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- I. Riser Clamps:
- 1. Provide copper plated clamps for copper tubing support.
  - 2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
- J. Strut Clamps: Two-piece pipe clamp.
- K. Strut-Mount Vibration-Damping Routing Clamps (for refrigeration piping).
- 1. Zinc-plated steel or stainless steel clamp with TPE cushion.
    - a. Adjustable metal body with oil and chemical resistant TPE cushion.
    - b. Manufacturers:
      - 1) Hydra-Zorb:
      - 2) Substitutions: See Section 016000 - Product Requirements.
- L. Insulation Clamps: Two bolt-type clamps designed for installation under insulation.
- M. Pipe Hangers: For a given pipe run, use hangers of the same type and material.
- 1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
  - 2. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
- N. Intermediate Pipe Guides: Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
- 1. Pipe Diameter 6 inches and Smaller: Provide minimum clearance of 0.16 inch.
  - 2. Pipe Diameter 8 inches: Provide U-bolts with double nuts providing minimum clearance of 0.28 inch.
  - 3. Pipe Diameter 8 inches: 0.625 inch U-bolt.
  - 4. Pipe Diameter 10 inches: 0.75 inch U-bolt.
  - 5. Pipe Diameter 12 to 16 inches: 0.875 inch U-bolt.
  - 6. Pipe Diameter 18 to 30 inches: 1 inch U-bolt.
- O. Pipe Alignment Guides: Galvanized steel.
- 1. Pipe Diameter 8 inches and Smaller: Spider or sleeve type.
  - 2. Pipe Diameter 10 inches and Larger: Roller type.
  - 3. Pipe Diameter 18 to 30 inches: 1 inch U-bolt.
- P. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- Q. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
- 1. Manufacturers:
    - a. Cooper B-Line, a division of Eaton Corporation; \_\_\_\_\_: [www.cooperindustries.com](http://www.cooperindustries.com)
    - b. Unistrut, a brand of Atkore International Inc; \_\_\_\_\_: [www.unistrut.com](http://www.unistrut.com)
    - c. Miro Industries.
    - d. Substitutions: See Section 016000 - Product Requirements.

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2. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified. Ensure that slip sheet is provided between the pipe support and roofing membrane.
  3. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
  4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
  5. Mounting Height: Provide minimum clearance of 12 inches under supported component to top of roofing.
- R. Pipe Shields for Insulated Piping:
1. General Construction and Requirements:
    - a. Surface Burning Characteristics: Comply with 1 or 1.
    - b. Shields Material: 180 degree galvanized steel or aluminum jacketing.
    - c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
    - d. Minimum Service Temperature: Minus 40 degrees F.
    - e. Maximum Service Temperature: 178 degrees F.
    - f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- S. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
  2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
  3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
  4. Hollow Masonry: Use toggle bolts.
  5. Hollow Stud Walls: Use toggle bolts.
  6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
  7. Sheet Metal: Use sheet metal screws.
  8. Wood: Use wood screws.
  9. Plastic and lead anchors are not permitted.
  10. Powder-actuated fasteners are permitted only as follows:
    - a. Where approved by Architect.
    - b. Use only threaded studs; do not use pins.
  11. Hammer-driven anchors and fasteners are permitted only as follows:
    - a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction (when specified).
    - b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction (when specified).
  12. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    - a. Comply with MFMA-4.
    - b. Channel Material: Use galvanized steel.
    - c. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch minimum base metal thickness.
  13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
- T. Pipe Installation Accessories:
1. Copper Pipe Supports: Use pre-manufactured support.
  2. PEX Pipe Supports: Use pre-manufactured support, except where allowed by Architect.

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3. CPVC Pipe Supports: Use pre-manufactured support, except where allowed by Architect.
4. Thermal Insulated Pipe Supports: Use pre-manufactured support, except where allowed by Architect.
5. Overhead Pipe Supports: Use pre-manufactured support, except where allowed by Architect.
6. Plenum Pipe Supports: Use pre-manufactured support, except where allowed by Architect.
7. Telescoping Pipe Supports: Use pre-manufactured support, except where allowed by Architect.
8. Inserts and Clamps: Use pre-manufactured support, except where allowed by Architect.

## 2.02 RETROFIT PIPING COVER SYSTEM

### A. General Requirements:

1. Surface Burning Characteristics: Flame spread index/smoke developed index of 20/250, maximum, when tested in accordance with ASTM E84 or UL 723.

### B. Materials:

1. Piping Cover System: Removal-resistant, modular, snap-fit cover units, clips, and anchors for use with CPVC, steel, and copper piping systems.
2. Cover Units: L-shaped and U-shaped cross-section units of flame retardant resin material, paintable finish.
3. Unit Length: Per manufacturer.
4. Provide coupling fittings for joining units end to end and prefabricated inside and outside corner fittings and end caps as required.
5. Provide mounting clips to secure covers to wall-ceiling per manufacturer requirements.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- D. Do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Field-Welding (where approved by Architect): Comply with Section 055000.
- H. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- I. Equipment Support and Attachment:
  1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
  2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.

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3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
  4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 4 inch high concrete pad constructed in accordance with Section 033000.
  5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- J. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
- K. Secure fasteners according to manufacturer's recommended torque settings.
- L. Remove temporary supports.

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

**END OF SECTION**

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## SECTION 220548

### VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Seismic control requirements.
  - 1. Includes requirements for seismic qualification of equipment not specified in this section.
- B. Seismic restraints for suspended components and equipment.

##### 1.02 RELATED REQUIREMENTS

- A. Section 014533 - Code-Required Special Inspections: Statement of Special Inspections; additional requirements for code-required special inspections.
- B. Section 033000 - Cast-in-Place Concrete.
- C. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.
- D. Section 220529 - Hangers and Supports for Plumbing Piping and Equipment.
- E. Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment.

##### 1.03 DEFINITIONS

- A. Plumbing Component: Where referenced in this section in regards to seismic controls, applies to any portion of the plumbing system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., piping).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

##### 1.04 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
- B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.
- C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; 2015.
- D. ICC (IBC) - International Building Code; 2015.
- E. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2015).
- F. MFMA-4 - Metal Framing Standards Publication; 2004.
- G. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; 2017.
- H. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; Sheet Metal and Air Conditioning Contractors' National Association; 2008.

##### 1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
  - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
  - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.

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4. Seismic Controls:
    - a. Coordinate the arrangement of seismic restraints with piping, conduit, equipment, and other potential conflicts installed under other sections or by others.
    - b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
  5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

#### 1.06 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
  1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
  2. Seismic Controls: Include seismic load capacities.
- D. Shop Drawings - Vibration Isolation Systems:
  1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
  2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.
- E. Shop Drawings - Seismic Controls:
  1. Include dimensioned plan views and sections indicating proposed plumbing component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
  2. Identify mounting conditions required for equipment seismic qualification.
  3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
  4. Indicate proposed arrangement of distributed system trapeze support groupings.
  5. Indicate proposed locations for distributed system flexible fittings and/or connections.
  6. Indicate locations of seismic separations where applicable.
  7. Include point load drawings indicating design loads transmitted to structure at each attachment location.
- F. Seismic Design Data:
  1. Compile information on project-specific characteristics of actual installed plumbing components necessary for determining seismic design forces required to design appropriate seismic controls.
  2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.

#### 1.07 QUALITY ASSURANCE

- A. Comply with ICC (IBC).
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

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- C. Seismic Controls Designer Qualifications: Registered professional engineer licensed in Utah and with minimum five years' experience designing seismic restraints for nonstructural components.
  - 1. Designer may be employed by the manufacturer of the seismic restraint products.
- D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

### 1.08 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## PART 2 PRODUCTS

### 2.01 VIBRATION ISOLATION REQUIREMENTS

- A. Provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing plumbing equipment and/or plumbing connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
  - 1. Select vibration isolators to provide required static deflection.
  - 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
  - 3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
  - 4. Select vibration isolators for outdoor equipment to comply with wind design requirements.
- D. Equipment Isolation: As indicated on drawings.

### 2.02 SEISMIC CONTROL REQUIREMENTS

- A. Provide plumbing component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor plumbing components.
- B. Seismic Design Criteria: As indicated on drawings.
- C. Component Importance Factor ( $I_p$ ) [if building is determined to be Risk Category IV]: Plumbing components essential to life safety to be assigned a component importance factor ( $I_p$ ) of 1.5 as indicated or as required. This includes but is not limited to :
  - 1. Plumbing components required to function for life safety purposes after an earthquake.
  - 2. Plumbing components that support or otherwise contain hazardous substances.
- D. Seismic Qualification of Equipment [if building is determined to be Risk Category IV]:
  - 1. Provide special certification for plumbing equipment furnished under other sections and assigned a component importance factor ( $I_p$ ) of 1.5, certifying that equipment will remain operable following a design level earthquake.
  - 2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
  - 3. Notify Architect and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
  - 4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.

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- E. Premanufactured Modular Plumbing Equipment: Where not otherwise seismically qualified, premanufactured modules 6 feet high and taller furnished under other sections to be designed in accordance with seismic provisions for nonbuilding structures.
- F. Seismic Restraints:
  - 1. Provide seismic restraints for plumbing components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
  - 2. Seismic Restraint Exemptions:
    - a. Exemptions for Seismic Design Category D, E, and F:
      - 1) Discrete plumbing components that are positively attached to the structure where either of the following apply:
        - (a) The component weighs 400 pounds or less, has a center of mass located 4 feet or less above the adjacent floor level, flexible connections are provided between the component and associated ductwork, piping, and conduit, and the component importance factor ( $I_p$ ) is 1.0.
        - (b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
      - 2) Plumbing piping with component importance factor ( $I_p$ ) of 1.0 and nominal pipe size of 3 inch or less, or with component importance factor ( $I_p$ ) of 1.5 and nominal pipe size of 1 inch or less, where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, and where piping is positively attached to the structure; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
    - b. Plumbing Piping Exemptions, All Seismic Design Categories:
      - 1) Plumbing piping where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, where piping is positively attached to the structure, and where one of the following apply:
        - (a) Trapeze supported piping weighing less than 10 pounds per foot, where all pipes supported meet size requirements for exemption as single pipes described under specific seismic design category exemptions above.
        - (b) Trapeze supported piping with trapeze assemblies using 3/8 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor ( $I_p$ ) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds or less.
        - (c) Trapeze supported piping with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor ( $I_p$ ) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 200 pounds or less.
        - (d) Trapeze supported piping with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 24 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor ( $I_p$ ) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds or less.

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- (e) Hanger supported piping with individual rod hangers 3/8 inch or 1/2 inch in diameter not exceeding 12 inches in length from support point connection to the supporting structure, where pipe has a component importance factor ( $I_p$ ) of 1.0 and meets size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single rod is 50 pounds or less.

3. Seismic Restraint Systems:

- a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
- b. Use only cable restraints to restrain vibration-isolated plumbing components, including distributed systems.
- c. Use only one restraint system type for a given plumbing component or distributed system (e.g., piping) run; mixing of cable and rigid restraints on a given component/run is not permitted.
- d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain plumbing component in all lateral directions; consider bracket geometry in anchor load calculations.
- e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported plumbing component weight.
- f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported plumbing component weight.
- g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
- h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
- i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.

G. Seismic Attachments:

- 1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
- 2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
- 3. Do not use power-actuated fasteners.
- 4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
- 5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.

H. Seismic Interactions:

- 1. Include provisions to prevent seismic impact between plumbing components and other structural or nonstructural components.
- 2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
- 3. Comply with minimum clearance requirements between plumbing equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs.

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- I. Seismic Relative Displacement Provisions:
  - 1. Use suitable fittings or flexible connections to accommodate:
    - a. Relative displacements at connections between components, including distributed systems (e.g., piping); do not exceed load limits for equipment utility connections.
    - b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
    - c. Design displacements at seismic separations.
    - d. Anticipated drifts between floors.

**2.03 SEISMIC RESTRAINT SYSTEMS**

- A. Manufacturers:
  - 1. Seismic Restraint Systems:
    - a. AFCON, a brand of Anvil International; \_\_\_\_\_: www.anvilintl.com
    - b. Eaton Corporation; \_\_\_\_\_: www.eaton.com
    - c. Kinetics Noise Control, Inc; \_\_\_\_\_: www.kineticsnoise.com
    - d. Mason Industries; \_\_\_\_\_: www.mason-ind.com
    - e. Substitutions: See Section 016000 - Product Requirements.
- B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.
- C. Cable Restraints:
  - 1. Comply with ASCE 19.
  - 2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
  - 3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
  - 4. Use protective thimbles for cable loops where potential for cable damage exists.
- D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that conditions are satisfactory for installation prior to starting work.

**3.02 CODE-REQUIRED SPECIAL INSPECTIONS (ENGINEER OF RECORD TO VERIFY APPLICABILITY OF THIS SECTION)**

- A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 014533 and statement of special inspections as required by applicable building code.
- B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
  - 1. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.
- C. Seismic special inspections include, but are not limited to:
  - 1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with the certificate of compliance.
  - 2. Installation and anchorage of piping systems designed to carry hazardous materials and their associated mechanical units for Seismic Design Categories C, D, E, and F; periodic inspection.

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3. Installation and anchorage of vibration isolation systems for Seismic Design Categories C, D, E, and F where the approved Contract Documents require a nominal clearance of 1/4 inch or less between equipment support frame and seismic restraint; periodic inspection.
  4. Verification of required clearances between plumbing equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs for Seismic Design Categories C, D, E, and F; periodic inspection.
- D. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.
- E. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

### 3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Field-Welding (where approved by Architect): Comply with Section 055000.
- E. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- F. Seismic Controls:
  1. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
  2. Seismic Restraint Systems:
    - a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
    - b. Install restraints within permissible angles in accordance with seismic design.
    - c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
    - d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
    - e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

### 3.04 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Vibration Isolation Systems:
  1. Verify isolator static deflections.
  2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- D. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.
- E. Submit detailed reports indicating inspection and testing results and corrective actions taken.

### END OF SECTION

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**SECTION 230100**

**MECHANICAL OPERATION AND MAINTENANCE MANUALS**

**PART 1 GENERAL**

**THE 230000 HAS BEEN COMPLETELY UPDATED**

**1.01 SECTION INCLUDES**

**FEBRUARY 2023**

- A. Operation and Maintenance Data.

**1.02 RELATED REQUIREMENTS**

- A. Section 013000 - Administrative Requirements: Submittal procedures, project meetings, progress schedules and documentation, reports, coordination.
- B. Section 017800 - Closeout Submittals: Project record documents, operation and maintenance (O&M) data, warranties and bonds.

**1.03 SUMMARY**

- A. Furnish one set of bound operation and maintenance manuals and two thumb drives with electronic copies of maintenance manuals in pdf format.

**1.04 PURPOSE**

- A. The Operation and Maintenance Manual is prepared to provide a ready reference to all important pieces of mechanical and electrical equipment installed on the project including completed start-up documentation. It is also to provide the necessary operating and maintenance data for use by service personnel. It is also to provide information required for checking equipment performance or for planning of physical plant expansion or redesign.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 ASSEMBLY OF DURABLE OPERATION AND MAINTENANCE MANUALS**

- A. Assemble operation and maintenance data into durable manual(s) for Owner's personnel use, with data arranged in divisions as outlined below.
- B. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 4 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings. The number of binders, however, shall be based upon not filling them beyond 2 1/2 inch thickness.
- C. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- D. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- E. Tables of Contents: List every division separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
  - 1. Master Table of Contents shall be (Include, in Project Operation and Maintenance Manual, only divisions used in project. Modify Table of Contents for each project manual.):
    - a. Plumbing Equipment
      - 1) 1131 - Plumbing Air System
      - 2) 1132 - Water Softener
      - 3) 1133 - Plumbing Pressure System
      - 4) 1135 - Water Heater
      - 5) 1136 - Plumbing Pump
      - 6) 1138 - Plumbing Delivery System

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- 7) 1139 - Water Cooler
- 8) 113A - Grease Trap / Septic Tanks
- 9) 113C - Fire Sprinkling System
- 10) 113D - Gas Suppression System
- 11) 113E - Pool Treatment System
- 12) 113F - Lab Vacuum System
- 13) 113G - Backflow Preventer

b. HVAC Equipment

- 1) 1141 - Boilers and Boiler Accessories
- 2) 1143 - Thermal Storage System
- 3) 1144 - Steam Condensate System
- 4) 1145 - HVAC Piping System
- 5) 1146 - Heating Water Pump
- 6) 1147 - HVAC Expansion Tanks
- 7) 1148 - Terminal Heating/Cooling Units
- 8) 1149 - Furnace
- 9) 114A - Coil
- 10) 114B - Filter / Filter Rack
- 11) 114C - Damper
- 12) 114D - Motor Speed Controller (VFD)
- 13) 114F - Chiller
- 14) 114G - Packaged Heating/Cooling Unit
- 15) 114H - Humidifier / Dehumidifier
- 16) 114I - Cooling Tower
- 17) 114J - Chilled Water Pump
- 18) 114K - Condenser Water Pump
- 19) 114L - Condensing Unit
- 20) 114M - Air Handling Unit
- 21) 114N - Exhaust Fan
- 22) 114O - Air Control (VAV) Box
- 23) 114R - Heat Exchanger
- 24) 114S - Evaporative Cooler
- 25) 114T - Temperature Control System
- 26) 114U - HVAC Water Filter / Treatment
- 27) 114W - Fume Hoods
- 28) 114X - Dust Collector / Paint Booth
- 29) 114Y - HVAC Delivery System

- F. Dividers: Provide tabbed dividers for each division of equipment; identify the division name on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- G. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- H. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- I. Arrangement of Contents: Organize each volume in parts as follows:
1. Project Directory.
  2. Table of Contents, of all volumes, and of current volume.
  3. Operation and Maintenance Data: Arranged by division, and then by piece of equipment.
    - a. Source data.

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- b. Outline drawings, special construction details, “as built” electrical wiring and control diagrams for all major and supplementary systems.
- c. Manufacturer's test or calculated performance data and certified test curves (where applicable).
- d. Installation, operating, and maintenance instructions, including a complete parts list and sectional drawing with parts identification numbers. Mark with model, size and plan number.
- e. Manufacturer’s brochure marked to indicate exact equipment purchased. Brochures on component parts supplied by a manufacturer with their equipment, but not manufactured directly by them, shall also be included.
- f. The serial numbers of each item of equipment installed are to be listed with the model numbers and plan symbols.
- g. A copy of the approved submittals for each piece of equipment.
- h. A copy of the completed equipment start up report.
- i. A copy of all testing, adjusting and balancing reports.
- j. Wiring diagrams, marked with model and size and plan symbol.
- k. The index shall contain the name and address of the manufacturer and, if different, where replacement and repair parts may be obtained.

**3.02 ORGANIZATION OF DIGITAL OPERATION AND MAINTENANCE MANUAL**

- A. Assemble operation and maintenance data into an electronic format for Owner's use, with data arranged in divisions.
- B. Furnish two electronic copies of Mechanical Operation and Maintenance Manual to owner on a readable and downloadable thumb drive.
- C. Create a directory for each division used in project. Name directories using the same format as the Master Table of Contents, shown above.
- D. Compile scanned PDF files or manufacturer furnished PDF files together into a single division PDF file duplicating divisions found in the durable Operation and Maintenance Manual.
- E. Populate the division directories/folders with the division PDF files.
- F. No Table of Contents is required for the electronic copy of the Mechanical Operation and Maintenance Manual.

**END OF SECTION**

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**SECTION 230517**  
**SLEEVES AND SLEEVE SEALS FOR HVAC PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Pipe sleeves.

**1.02 RELATED REQUIREMENTS**

- A. Section 078400 - Firestopping.
- B. Section 099113 - Exterior Painting: Preparation and painting of exterior piping systems.
- C. Section 099123 - Interior Painting: Preparation and painting of interior piping systems.
- D. Section 220523 - General-Duty Valves for Plumbing Piping.
- E. Section 220553 - Identification for Plumbing Piping and Equipment: Piping identification.
- F. Section 220716 - Plumbing Equipment Insulation.
- G. Section 220719 - Plumbing Piping Insulation.
- H. Section 230523 - General-Duty Valves for HVAC Piping.
- I. Section 230553 - Identification for HVAC Piping and Equipment: Piping identification.
- J. Section 230716 - HVAC Equipment Insulation.
- K. Section 230719 - HVAC Piping Insulation.

**1.03 REFERENCE STANDARDS**

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2016.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified this section.
  - 1. Minimum three years' experience.
  - 2. Approved by manufacturer.
- C. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

**1.07 WARRANTY**

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

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## PART 2 PRODUCTS

### 2.01 PIPE SLEEVES

- A. Manufacturers:
  - 1. Flexicraft Industries; Pipe Wall Sleeve: [www.flexicraft.com/#sle](http://www.flexicraft.com/#sle).
  - 2. Link Seal.
  - 3. Substitutions: See Section 016000 - Product Requirements.
- B. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- C. Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:
  - 1. Galvanized steel pipe or black iron pipe with asphalt coating.
  - 2. Connect sleeve with floor plate except in mechanical rooms.
- D. Penetrations in concrete beam flanges are permitted but are prohibited through ribs or beams without prior approval from the Architect.
- H. Clearances:
  - 1. Provide allowance for insulated piping.
  - 2. Wall, Floor, Partitions, and Beam Flanges: 1 inch greater than external, including insulation; pipe diameter.
- I. Penetrations:
  - 1. All Rated Openings: Caulked tight with fire stopping material conforming to ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.
  - 2. Non-rated Openings: Floor assemblies that are penetrated shall be sealed and draft stopped to prevent the effects of fire moving from floor to floor in accordance with Section 078400. See IBC 714.5.
  - 3. Sound-rated Openings: Refer to acoustic sealing details in drawings.

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.

### 3.02 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Inserts:
  - 1. Provide inserts for placement in concrete formwork.
  - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
  - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
  - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
- E. Structural Considerations:
  - 1. Do not penetrate building structural members unless indicated.

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- F. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
  - 1. All Rated Openings: Caulk tight with fire stopping material conforming to ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.
- G. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

### **3.03 CLEANING**

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.
- C. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

**END OF SECTION**

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**SECTION 230523**  
**GENERAL-DUTY VALVES FOR HVAC PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Applications.
- B. General requirements.
- C. Ball valves.
- D. Check valves.
- E. Flow control valves.

**1.02 RELATED REQUIREMENTS**

- A. Section 078400 - Firestopping.
- B. Section 083100 - Access Doors and Panels.
- C. Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- D. Section 230553 - Identification for HVAC Piping and Equipment.
- E. Section 230716 - HVAC Equipment Insulation.
- F. Section 230719 - HVAC Piping Insulation.
- G. Section 232113 - Hydronic Piping.
- H. Section 232213 - Steam and Steam Condensate Piping.

**1.03 ABBREVIATIONS AND ACRONYMS**

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene.
- G. RS: Rising stem.
- H. SWP: Steam working pressure.
- I. TFE: Tetrafluoroethylene.
- J. WOG: Water, oil, and gas.

**1.04 REFERENCE STANDARDS**

- A. API STD 594 - Check Valves: Flanged, Lug Wafer, and Butt-Welding; 2017.
- B. ASME B1.20.1 - Pipe Threads, General Purpose (Inch); 2013.
- C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2015.
- D. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2017.
- E. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2017.
- F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.
- G. ASME B16.34 - Valves - Flanged, Threaded and Welding End; 2017.

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- H. ASME B31.1 - Power Piping; 2016.
- I. ASME B31.9 - Building Services Piping; 2014.
- J. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators; 2017.
- K. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2003 (Reapproved 2016).
- L. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2014).
- M. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service; 2016.
- N. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2014).
- O. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).
- P. ASTM A582/A582M - Standard Specification for Free-Machining Stainless Steel Bars; 2012 (Reapproved 2017).
- Q. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings; 2015.
- R. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
- S. AWWA C606 - Grooved and Shouldered Joints; 2015.
- T. MSS SP-45 - Bypass and Drain Connections; 2003 (Reaffirmed 2008).
- U. MSS SP-67 - Butterfly Valves; 2011.
- V. MSS SP-68 - High Pressure Butterfly Valves with Offset Design; 2011.
- W. MSS SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends; 2011.
- X. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends; 2011.
- Y. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010.
- Z. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.
- AA. MSS SP-125 - Gray Iron and Ductile Iron In-Line, Spring-Loaded, Center-Guided Check Valves; 2010.

#### 1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

#### 1.06 QUALITY ASSURANCE

- A. Manufacturer:
  - 1. Obtain valves for each valve type from single manufacturer.
  - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Welding Materials and Procedures: Conform to ASME BPVC-IX.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:

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1. Protect valve parts exposed to piped medium against rust and corrosion.
  2. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
  3. Secure check valves in either the closed position or open position.
- B. Use the following precautions during storage:
1. Maintain valve end protection and protect flanges and specialties from dirt.
    - a. Provide temporary inlet and outlet caps.
    - b. Maintain caps in place until installation.
  2. Store valves in shipping containers and maintain in place until installation.
    - a. Store valves indoors in dry environment.
    - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.
- C. Exercise the following precautions for handling:
1. Handle large valves with sling, modified to avoid damage to exposed parts.
  2. Avoid the use of operating handles or stems as rigging or lifting points.

## **PART 2 PRODUCTS**

### **2.01 APPLICATIONS**

- A. See Drawings for specific valve locations.
- B. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).
- C. Provide the following valves for the applications if not indicated on Drawings:
1. Throttling (Hydronic): Butterfly and Ball.
  2. Isolation (Shutoff): Butterfly and Ball.
  3. Swing Check (Pump Outlet):
    - a. 2 1/2 NPS and Smaller: Bronze.
    - b. 3 NPS and Larger: Iron.
- D. Substitutions of valves with higher CWP classes or SWP ratings for same valve types are permitted when specified CWP ratings or SWP classes are not available.
- E. Required Valve End Connections for Non-Wafer Types:
1. Steel Pipe:
    - a. 2 NPS and Smaller: Threaded, mechanical compression coupling.
    - b. 2-1/2 NPS and Larger: Flanged, grooved ends.
  2. Copper Tube:
    - a. 2 NPS and Smaller: Threaded, mechanical compression coupling (Exception: Solder-joint valve-ends).
    - b. 2-1/2 NPS and Larger: Flanged, grooved ends.
  3. Steam and Steam Condensate Pipe: Grooved ends not acceptable.
- F. Chilled Water, Heating Water, and Condenser Water Valves:
1. 2 NPS and Smaller, Brass, Bronze and Stainless Steel Valves:
    - a. Ball type.
    - b. Swing Check.
  2. 2-1/2 NPS and Larger, Iron Valves:
    - a. Lug Wafer Butterfly.
    - b. Grooved-End Butterfly.
    - c. Swing Check.
    - d. Center-Guided Check.

### **2.02 GENERAL REQUIREMENTS**

- A. General: Provide factory fabricated valves recommended by manufacturer for use in service indicated on drawings. Provide valves of types and pressure ratings indicated; provide proper selection as

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determined by installer to comply with installation requirements. Provide end connections which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's choice.

- B. Valve Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.
- C. Valve Operators:
  - 1. Hand Lever: Quarter-turn valves 4 NPS and smaller, except iron grooved butterfly valves.
- D. Valves in Insulated Piping: Provide 2-inch stem extensions and the following features:
  - 1. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
  - 2. Memory Stops: Fully adjustable after insulation is installed.
- E. Valve-End Connections:
  - 1. Threaded End Valves: ASME B1.20.1.
  - 2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
  - 3. Pipe Flanges and Flanged Fittings 1/2 NPS through 24 NPS: ASME B16.5.
  - 4. Solder Joint Connections: ASME B16.18.
  - 5. Grooved End Connections: AWWA C606.
  - 6. Mechanical Press Connections: ASME B16.51.
- F. General ASME Compliance:
  - 1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
  - 2. Power Piping Valves: ASME B31.1.
  - 3. Building Services Piping Valves: ASME B31.9.
- G. Bronze Valves:
  - 1. Fabricate from dezincification resistant material.
  - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- H. Valve Bypass and Drain Connections: MSS SP-45.
- I. Source Limitations: Obtain each valve type from a single manufacturer.

### 2.03 BRONZE OR BRASS BALL VALVES

- A. Two Piece, Full Port with Stainless Steel Trim:
  - 1. Comply with MSS SP-110.
  - 2. SWP Rating: 150 psig.
  - 3. CWP Rating: 600 psig.
  - 4. Body: Forged bronze or brass.
  - 5. Ends: Threaded, Grooved, or Mechanical press.
  - 6. Seats: PTFE.
  - 7. Stem: Stainless Steel.
  - 8. Ball: Stainless Steel.
  - 9. Manufacturers:
    - a. Milwaukee; \_\_\_\_\_
    - b. Apollo;
    - c. Hammond;
    - d. Nibco;
    - e. Watts;
    - f. Substitutions: See Section 016000 - Product Requirements.
- B. Three Piece, Full Port with Stainless Steel Trim:
  - 1. Comply with MSS SP-110.
  - 2. SWP Rating: 150 psig.

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3. CWP Rating: 600 psig.
4. Body: Forged brass.
5. Ends: Threaded, Grooved, or Propress.
6. Seats: PTFE or TFE.
7. Stem: Stainless steel.
8. Ball: Stainless steel, vented.
9. Manufacturers:
  - a. Milwaukee; \_\_\_\_\_
  - b. Apollo;
  - c. Hammond;
  - d. Nibco;
  - e. Watts;
  - f. Substitutions: See Section 016000 - Product Requirements.

#### **2.04 IRON, GROOVED-END BALL VALVES**

- A. Class 125:
  1. Body: Ductile iron; ASTM A536, Grade 65-45-12.
  2. Ends: Grooved.
  3. Seats: Teflon.
  4. Stem: Stainless steel.
  5. Ball: Stainless steel.
  6. Manufacturers:
    - a. Anvil International;Gruvlock.
    - b. Victaulic;
    - c. Grinnell;
    - d. Substitutions: See Section 016000 - Product Requirements.

#### **2.05 BRONZE SWING CHECK VALVES**

- A. Class 125: CWP Rating: 200 psig (1380 kPa).
  1. Comply with MSS SP-80, Type 3.
  2. Body Design: Horizontal flow.
  3. Body Material: Bronze, ASTM B62.
  4. Ends: Threaded.
  5. Disc: Bronze, Brass, or PTFE.
- B. Manufacturers:
  1. Apollo; \_\_\_\_\_
  2. Nibco;
  3. Crane;
  4. Milwaukee;
  5. Substitutions: See Section 016000 - Product Requirements.

#### **2.06 IRON, FLANGED END SWING CHECK VALVES**

- A. Class 125: CWP Rating: 200 psig (1380 kPa) with Metal Seats.
  1. Comply with MSS SP-71, Type I.
  2. Design: Clear or full waterway with flanged ends.
  3. Body: Gray iron with bolted bonnet in accordance with ASTM A126.
  4. Trim: Bronze.
  5. Disc Holder: Bronze.
  6. Disc: Cast iron or bronze.
  7. Gasket: Asbestos free.

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- B. Manufacturers:
  - 1. Milwaukee; \_\_\_\_\_
  - 2. Apollo;
  - 3. Nibco;
  - 4. Crane;
  - 5. Mueller;
  - 6. Substitutions: See Section 016000 - Product Requirements.

**2.07 IRON, GROOVED-END SWING CHECK VALVES**

- A. 300 CWP:
  - 1. Body Material: ASTM A536, Grade 65-45-12 ductile iron.
  - 2. Seal: EPDM or Nitrile.
  - 3. Disc: Ductile iron.
  - 4. Coating: Black, non-lead paint.
- B. Manufacturers:
  - 1. Grinnell; \_\_\_\_\_
  - 2. Anvil International; Gruvlock.
  - 3. Victaulic;
  - 4. Substitutions: See Section 016000 - Product Requirements.

**2.08 IRON, CENTER-GUIDED CHECK VALVES**

- A. Class 125, Compact-Wafer:
  - 1. Comply with MSS SP-125.
  - 2. 2-1/2 NPS to 12 NPS, CWP Rating: 200 psig.
  - 3. 14 NPS to 24 NPS, CWP Rating: 150 psig.
  - 4. Body Material: ASTM A126, cast iron.
  - 5. Seat: Stainless steel.
  - 6. Seat Rings: EPDM or Nitrile (BUNA-N).
  - 7. Spring and Stem: Stainless steel.
  - 8. Disc: Aluminum bronze.
  - 9. Manufacturers:
    - a. Apollo Valves;
    - b. Metraflex; \_\_\_\_\_
    - c. Milliken, a Mueller brand;
    - d. Substitutions: See Section 016000 - Product Requirements.
- B. Class 125, Globe Style:
  - 1. Comply with MSS SP-125.
  - 2. 2-1/2 NPS to 12 NPS, CWP Rating: 200 psig.
  - 3. 14 NPS to 24 NPS, CWP Rating: 150 psig.
  - 4. Body Material: ASTM A126, cast iron.
  - 5. Seat: Stainless steel.
  - 6. Seat Rings: EPDM or Nitrile (BUNA-N).
  - 7. Spring and Stem: Stainless steel.
  - 8. Disc: Aluminum bronze.
  - 9. Manufacturers:
    - a. Metraflex; \_\_\_\_\_
    - b. Milliken, a Mueller brand;
    - c. Substitutions: See Section 016000 - Product Requirements.

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## 2.09 MANUAL BALANCING VALVES

- A. 2 NPS and Smaller:
  - 1. Brass or bronze body with union, venturi with temperature and pressure test plug on inlet and outlet, and threaded or sweat end connections.
  - 2. Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.
  - 3. Provide schedule showing pressure drop and flow rate of each valve.
- B. If improperly sized balance valves are found during the test and balance work, the improperly sized balance valves shall be replaced by the installing contractor at no additional cost to the Owner or project.
- C. Manufacturers:
  - 1. ITT Bell & Gossett;
  - 2. Taco, Inc.;
  - 3. IMI Flow Design;
  - 4. Gerund;
  - 5. Nexus;

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve be determined to be defective, replace with new valve.

### 3.02 INSTALLATION

- A. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- B. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- C. Install check valves where necessary to maintain direction of flow as follows:
  - 1. Swing Check: Install horizontal maintaining hinge pin level.
  - 2. Orient center-guided into horizontal or vertical position, between flanges.

**END OF SECTION**

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**SECTION 230529**

**HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. See specification section 220529 for requirements for this section.

**END OF SECTION**

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## SECTION 230548

### VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Match specification section 220548 for requirements for seismic control requirements.
- B. Match specification section 220548 for requirements for seismic restraints for suspended components and equipment.

##### 1.02 RELATED REQUIREMENTS

- A. Section 014533 - Code-Required Special Inspections.
- B. Section 033000 - Cast-in-Place Concrete.
- C. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

##### 1.03 DEFINITIONS

- A. HVAC Component: Where referenced in this section in regards to seismic controls, applies to any portion of the HVAC system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., ductwork, piping).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

##### 1.04 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
- B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.
- C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; 2015.
- D. ICC (IBC) - International Building Code (current adopted version)
- E. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2015).
- F. MFMA-4 - Metal Framing Standards Publication; 2004.
- G. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; 2017.
- H. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; Sheet Metal and Air Conditioning Contractors' National Association; 2008.

##### 1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
- C. Seismic Design Data:
  - 1. Compile information on project-specific characteristics of actual installed HVAC components necessary for determining seismic design forces required to design appropriate seismic controls.
    - a. Component operating weight and center of gravity.
    - b. Component elevation in the building in relation to the roof elevation (z/h).
    - c. Component importance factor (I<sub>p</sub>).
    - d. For distributed systems, component materials and connection methods.

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- e. Component amplification factor ( $a_p$ ) and component response modification factor ( $R_p$ ), determined in accordance with ASCE 7 tables.
- 2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Field quality control test reports.

**1.06 QUALITY ASSURANCE**

- A. Comply with applicable building code.
- B. Seismic Controls Designer Qualifications: Registered professional engineer licensed in Utah and with minimum five years' experience designing seismic restraints for nonstructural components.
  - 1. Designer may be employed by the manufacturer of the seismic restraint products.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

**PART 2 PRODUCTS**

**2.01 SEISMIC CONTROL**

- A. Refer to Part 2 of specification section 220548.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

**3.02 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Secure fasteners according to manufacturer's recommended torque settings.

**3.03 INSTALLATION - SEISMIC**

- A. Comply with:
  - 1. ASHRAE (HVACA) Handbook - HVAC Applications.
  - 2. SMACNA (SRM).
- B. Suspended Mechanical Equipment:
  - 1. Provide supports and bracing to resist seismic design force in any direction.
  - 2. Provide flexible connections between equipment and interconnected piping.
  - 3. Brace equipment hung from spring mounts using cable or other bracing that will not transmit vibration to the structure.
  - 4. Use of proprietary restraint systems with a certificate of compliance, verified and listed by an accredited inspection body is acceptable (pending shop drawing approval), as an alternative to project specific seismic bracing design.
- C. Ductwork:

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1. Provide seismic bracing for ducts with cross sectional area greater than 6 sq ft (independent of duct contents).
2. Provide seismic bracing for all ducts containing hazardous materials.
3. Provide supports, braces, and anchors to resist gravity and seismic design forces.
4. Install ducts and duct risers designed to accommodate interstory drift.
5. Independently support in-line devices weighing more than 20 pounds.
6. Independently support and brace all in-line devices weighing more than 75 pounds.
7. Provide unbraced piping attached to braced in-line equipment with adequate flexibility to accommodate differential displacements.
8. Positively attach dampers, louvers, diffusers and similar appurtenances to ductwork with mechanical fasteners.
9. Install duct supports designed to resist not less than 150 percent of the duct weight.
10. The use of power driven fasteners is prohibited in the hanging of ducts weighing over 10 pounds per lineal foot for seismic design categories D, E, and F.
11. Use of proprietary restraint systems with a certificate of compliance, verified and listed by an IAS AC172 accredited inspection body or otherwise accepted by applicable codes is acceptable (pending shop drawing approval), as an alternative to project specific seismic bracing design.

#### **3.04 FIELD QUALITY CONTROL**

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.
- D. Submit detailed reports indicating inspection and testing results and corrective actions taken.

#### **3.05 SCHEDULE - AS SPECIFIED ON DRAWINGS.**

**END OF SECTION**

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**SECTION 230553**  
**IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Nameplates.
- B. Tags.
- C. Pipe markers.

**1.02 RELATED REQUIREMENTS**

- A. Section 099123 - Interior Painting: Identification painting.

**1.03 REFERENCE STANDARDS**

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2015.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- E. Project Record Documents: Record actual locations of tagged valves.

**PART 2 PRODUCTS**

**2.01 IDENTIFICATION APPLICATIONS**

- A. Scheduled Equipment: Nameplates.
- B. Air Terminal Units: Adhesive label or legible hand-written permanent marker.
- C. Automatic Control Sensors, Relays, Actuators: Adhesive label or legible hand-written permanent marker at closest junction box.
- D. Control Panels: Nameplates.
- E. Dampers: Adhesive label or legible hand-written permanent marker at closest junction box.
- F. Piping: Pipe markers.
- G. Valves: Tags.

**2.02 NAMEPLATES**

- A. Manufacturers:
  - 1. Advanced Graphic Engraving, LLC; \_\_\_\_\_
  - 2. Brimar Industries, Inc; \_\_\_\_\_: [www.pipemarker.com](http://www.pipemarker.com)
  - 3. Craftmark Pipe Markers; \_\_\_\_\_
  - 4. Kolbi Pipe Marker Co; \_\_\_\_\_
  - 5. Seton Identification Products, a Tricor Direct Company; \_\_\_\_\_
  - 6. Substitutions: See Section 016000 - Product Requirements.
- B. Letter Color: White.
- C. Letter Height: 1/4 inch.
- D. Background Color: Black.
- E. Plastic: Comply with ASTM D709.

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## 2.03 TAGS

- A. Manufacturers:
  - 1. Advanced Graphic Engraving; \_\_\_\_\_: [www.advancedgraphicengraving.com](http://www.advancedgraphicengraving.com)
  - 2. Brady Corporation; \_\_\_\_\_
  - 3. Brimar Industries, Inc; \_\_\_\_\_
  - 4. Craftmark Pipe Markers; \_\_\_\_\_
  - 5. Kolbi Pipe Marker Co; \_\_\_\_\_
  - 6. Seton Identification Products, a Tricor Company; \_\_\_\_\_
  - 7. Substitutions: See Section 016000 - Product Requirements.
- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
- C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

## 2.04 PIPE MARKERS

- A. Manufacturers:
  - 1. Brady Corporation; \_\_\_\_\_
  - 2. Brimar Industries, Inc; \_\_\_\_\_
  - 3. Craftmark Pipe Markers; \_\_\_\_\_
  - 4. Kolbi Pipe Marker Co; \_\_\_\_\_
  - 5. Seton Identification Products, a Tricor Company; \_\_\_\_\_
  - 6. Substitutions: See Section 016000 - Product Requirements.
- B. Color: Comply with ASME A13.1.
- C. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

### 3.02 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion.
- B. Install tags with corrosion resistant chain.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

### END OF SECTION

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**SECTION 230593**

**TESTING, ADJUSTING, AND BALANCING FOR HVAC**

**PART 1 GENERAL**

**UPDATED FULL SECTION**

**1.01 GENERAL CONDITIONS**

**FEBRUARY 2023**

- A. Mechanical Contractor shall be responsible to verify if a Commissioning Agent is retained by Owner for the current project. If no Commissioning Agent is hired, then it shall be the responsibility of the Mechanical Contractor to provide commissioning services as per specification section 230800.
- B. The Testing, Adjusting, and Balancing (TAB) Contractor is responsible for all work in this section in coordination with BYU Construction Project Manager.
- C. Work of this section shall be subject to the requirements of the General Conditions of this contract, the General Mechanical Requirements, General Electrical Requirements and other sections where this work shares a responsibility.
- D. Startup of mechanical systems shall be the responsibility of the Mechanical Contractor and his subcontractors with the participation of the Electrical Contractor related to electrical work and the General Contractor related to general construction items.
- E. Testing and balancing shall be the responsibility of the Mechanical Contractor under the direction of the General Contractor with the full participation of all the mechanical and electrical trades employed on the project and shall include the participation of an independent testing and balance contractor to coordinate all elements of the TAB work and to perform special technical services outlined herein.
- F. TAB Contractor shall coordinate all work with BYU Construction Project Manager. BYU Construction Project Manager shall coordinate work with BYU Commissioning representatives, BYU Air Conditioning Shop representatives, BYU Mechanical Shop representatives, and Owner contracted Digital Controls Supplier and Programmer.

**1.02 SECTION INCLUDES**

- A. Testing, Adjustment, and Balancing of:
  - 1. Air conditioning equipment including air distribution devices, supply ducts, air handling units, condensing units, fans, coils, and related equipment.
  - 2. Hydronic systems including pumps, water distributions systems, chillers, boilers, heat exchangers, coils and related equipment.
- B. System Commissioning - Extent of Work:
  - 1. The work required by this section includes, but is not necessarily limited to the following:
    - a. The pre-startup inspection of all systems and subsequent correction of any incorrect items. (PFAT)
    - b. The initial first run inspections. (FAT)
    - c. System operations inspections.
  - 2. The intent of this work is to provide for proper installation, startup, service and operation of the mechanical systems in preparation for system balance.
  - 3. Repair, replacement or adjustment of each item shall be performed by the installing contractor.
  - 4. Involves all new construction and those elements of existing construction which are affected by this project.
- C. Testing and Balancing - Extent of Work:
  - 1. This work incorporates a confirming checkout of construction work, an individual component activation and an overall system activation into one work program which shall serve as the transition period from Contractor's job to Owner's facility.
  - 2. The TAB Contractor shall be skilled in the operation and manipulation of systems and in the direction of parties involved in the work.

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3. Conduct and participate in the startup and verification of all mechanical systems installed and modified in the contract; test, adjust and balance these systems to obtain optimum performance at a level which minimizes the required energy input, prepare and submit at completion a report of work done and the final system condition obtained, participate in the instruction of Owner's personnel in the proper operation of systems and equipment.
4. Involves all new construction and those elements of existing construction which are affected by this project.

### 1.03 RELATED REQUIREMENTS

- A. Section 012100 - Allowances: Inspection and testing allowances.
- B. Section 014000 - Quality Requirements: Employment of testing agency and payment for services.
- C. Section 019113 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.
- D. Section 250500 - Common Work Results for Integrated Automation.

### 1.04 REFERENCE STANDARDS

- A. Testing, Adjusting, and Balancing Bureau (TABB) - International Standards for Environmental Systems Balance.
- B. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.
- C. ASHRAE Std 110 - Methods of Testing Performance of Laboratory Fume Hoods; 2016.
- D. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008.
- E. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems; 2015, with Errata (2017).
- F. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2002.

### 1.05 DEFINITIONS

- A. Adjusting: Varying of system flow by modifying settings of dampers and valves, in combination with varying speeds to obtain optimum operating conditions for the entire system.
- B. Balancing: Proportioning of air and hydronic flows through system mains, branches, and terminal devices using standardized procedures to obtain specified air or hydronic flow while imposing the least amount of restriction on the HVAC system.
- C. Testing: Use of specialized and calibrated instruments to measure temperatures, pressures, rotational speeds, electrical characteristics, air and hydronic flow in velocities or quantities used in evaluating the performance of a HVAC system.

### 1.06 QUALITY ASSURANCE

- A. Representatives of the General Contractor, Mechanical Contractor, etc., and the Electrical Contractor shall be available on a daily basis through the commissioning and adjustment period. These representatives shall be experienced journeymen with prior experience in system operation and with specific experience on the construction project.
- B. Qualifications of Test and Balance Firm:
  1. Testing and Balancing shall be performed by a testing agency who specializes in testing, adjusting and balancing of heating, ventilating, air-moving equipment, air-conditioning systems and hydronic systems and have a minimum of one year of experience.
  2. Testing agency shall have successfully completed a minimum of five projects of similar size and scope.
  3. Testing agency shall be a certified member to TABB, AABC, and/or NEBB.

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- 4. Test and Balance Firm shall provide documentation of items 1 - 3 prior to start of project.
- 5. Balance agencies approved for this work:
  - a. Payson Sheet Metal, Payson, UT. (801) 465-3018
  - b. Substitutions: See Section 012500. Alternate contractors require owner approval. See Mechanical Bid Breakdown form.

- C. Certifications:
  - 1. TAB technician shall be certified by a nationally recognized certifying agency.
- D. Perform total system balance in accordance with Testing, Adjusting and Balancing Bureau (TABB) – Quality Assurance Program for Environmental Systems Balance, AABC National Standards for Field Measurements and Instrumentation and/or Total System Balance and/or NEBB Quality Assurance Program – Conformance Certification.
- E. The balancing work including air and hydronic portions shall be performed by the same firm having total responsibility for the final testing, adjusting and balancing of the entire system.
- F. The independent testing and balancing firm shall furnish all necessary tools, scaffolding and ladders that are required and shall provide all required instruments, take all readings and make all necessary adjustments.
- G. After all tests and adjustments are made, a detailed written report shall be prepared and submitted for review, and shall bear the signature of the professional supervising the work. Final acceptance of this project will not be made until a complete and satisfactory report is received. Furnish two (2) copies of the report.

**1.07 PROJECT CONDITIONS**

- A. Testing, adjusting and balancing shall commence after HVAC systems installation is complete and in working order. Associated areas of general construction shall be in place including interior and exterior doors, windows, walls and ceilings.

**1.08 SPECIAL WARRANTY**

- A. Provide warranty for period of 120 days following submission of completed report, during which time, Owner may request a recheck of up to 10% of total number of terminals, or resetting of any outlet, coil, or device listed in the report.
- B. Warranty shall meet the requirements of the following program(s):
  - 1. TABB – International Quality Assurance Program
  - 2. AABC - National Project Performance Guarantee
  - 3. NEBB - Conformance Certification

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 PFAT (PRE-FUNCTIONAL ACCEPTANCE TESTING)**

- A. If a Commissioning Agent other than the balance firm is employed on the project, the PFAT requirements shall be performed by the commissioning firm. Otherwise the requirements shall be performed by the balance firm.
- B. Prior to the commencing of testing, adjusting and balancing of environmental system(s), verify the following conditions:
  - 1. Removal of shipping stops.
  - 2. Vibration isolators properly aligned and adjusted.
  - 3. Flexible connections properly aligned.
  - 4. Belts properly adjusted.
  - 5. Belts guards and safety shields in place.

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6. Systems are started and operating in a safe and normal condition.
7. Thermal overload protection is in place for fans, pumps, chillers, and other equipment.
8. Safety controls, safety valves and high or low limits in operation.
9. All systems properly filled.
10. Pumps are rotating correctly.
11. Start-up/construction strainers have been removed and all pertinent strainers are clean and in place.
12. Gauges and/or test ports are properly located for balancing.
13. Service and balance valves are fully open.
14. Hydronic systems are pressure tested, flushed, filled, and properly vented.
15. Leak testing on duct system has been performed in accordance with SMACNA standards or as specified.
16. Air coil fins are cleaned and combed.
17. Access doors are closed and duct end caps are in place.
18. Air outlets are installed and connected.
19. Fans and motors are rotating correctly.
20. Duct and fan systems are clean.
21. Final filters are clean and properly installed.
22. Automatic and manual dampers are installed correctly, operable and fully open.
23. Fire and volume dampers are in place and open.
24. Temperature control systems are installed, complete and operable.
25. Voltages match nameplate.
26. All interlocks are wired and verified.
27. All other items necessary to provide for proper startup.
  - a. If deficiencies are evident, submit Deficiency Report to Engineer/Architect. Do not begin testing, adjusting and balancing of environmental systems until deficiencies have been remedied.

### 3.02 FIRST RUN INSPECTION

- A. If a Commissioning Agent other than the balance firm is employed on the project, the first run inspection requirements shall be performed by the commissioning firm. Otherwise the requirements shall be performed by the balance firm.
- B. Verify that Prestartup Inspection has been successfully completed to ensure proper operation.
- C. Check for the following items:
  1. All specified air and water filters installed.
  2. Excessive vibration or noise.
  3. Loose components.
  4. Initial control settings.
  5. Motor amperages.
  6. Heat buildup in motors, bearings, etc.
  7. Control system is properly calibrated and functioning as required.
- D. Correct all items which are not operating properly.

### 3.03 FAT (FUNCTIONAL ACCEPTANCE TESTING)

- A. If a Commissioning Agent other than the balance firm is employed on the project, the FAT requirements shall be performed by the commissioning firm. Otherwise the requirements shall be performed by the balance firm.
- B. Observe mechanical systems under operating conditions for up to six months' time (one seasonal change) to insure proper operation under varying conditions, such as day-night and heating-cooling.

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1. Check the following items:
  - a. Visual checks to air flow for “best guess” settings for preparation for system air balancing under section applying.
  - b. Control operation, on-off sequences, system cycling, etc.
  - c. Visual checks of water flow, seals, packing safety valves, operation pressures and temperature.
  - d. Cleaning of excessive oil or grease.
  - e. Dampers close tightly.
  - f. Valves close tightly.
  - g. System leaks.
  - h. All other items pertaining to the proper operation of the mechanical system whether specifically listed or not.

### **3.04 TOTAL MECHANICAL SYSTEM BALANCE**

- A. The mechanical systems balance involves elements of the work of the General Contractor, the Electrical Contractor, the Mechanical Contractor, the Sheet Metal Contractor and the Controls Contractor. Total system balance requires all elements be not only individually correct, but also correct as a composite system. Therefore, participation of all parties shall be required in the test and balance procedure.
- B. Prior to the beginning of the work, a written description of the balance methods, equivalent to be used, and procedures of action shall be submitted to the Engineer/Owner for review and comment.
- C. The testing and balance specialist shall review the contract drawings during the bid period and shall advise the Engineer of any modifications to the layout which may be needed to facilitate the balance procedure. Modifications will be incorporated into the contract by Addendum during the bidding period.
- D. The test and balance specialist shall visit the project at 50%, 80% and 90% completion, making a thorough inspection of those items which will affect his subsequent work and provide a report. Mechanical Contractor shall coordinate progress visits with test and balance specialist and BYU Project Manager. Test and balance specialist shall advise the Contractor in writing, with a copy to the Engineer/Architect, of any work required by the contract which is not being performed adequately. This is in addition to the regular inspection efforts of the Architect and Engineer. Particularly note the needed valves, dampers, access doors, thermometers, pressure gauges, belts and drives, diffuser styles, strainers and filters, etc.

### **3.05 MAJOR EQUIPMENT**

- A. The Testing and Balancing Contractor shall work with the Controls Contractor, and Electrician in placing heat exchangers, pumps, fans and other major equipment in operation. The factory representative of the equipment manufacturer shall also participate in a team effort to place the system(s) in operation, adapt to all anticipated operating modes and make adjustments as required to obtain correct operation. The Design Engineer and the Owner’s Representative shall witness the final operating sequences.

### **3.06 CONTROL SYSTEMS**

- A. The Testing and Balancing Contractor shall go through the entire control system with the Controls Contractor, verifying proper operation of each and every device and the proper function of each system. Certify such effort in the report.

### **3.07 AIR SYSTEM BALANCE**

- A. Before any adjustments are made, check the systems for such items as dirty filters, duct leakage, filter leakage, damper leakage, equipment vibrations, correct damper operations, etc. Adjust all fan systems major duct sections, registers, diffusers, etc., to deliver design air quantities within  $\pm 5\%$ .

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Individual air outlets, when one of three or more serve a space may have a tolerance of  $\pm 10\%$  of the average.

- B. Adjust supply, exhaust and recirculation air systems toward air quantities shown on drawings. Establish a proper relationship between supply and exhaust. Follow proportional balance procedures outlined by AABC, SMACNA and/or TABB for such work.
- C. All thermal boxes, air flow measuring stations, and other devices shall be calibrated and verified for proper function.
- D. Distribution system shall be further adjusted to obtain uniform space temperatures free from objectionable drafts and noise within the capabilities of the system. Any changes to the design are to be submitted for approval and fully documented.
- E. Exchange sheaves and/or belts as needed to adjust the RPM of all fans so they handle specified air quantity.
- F. All balance procedures shall follow allowed procedure from the REFERENCE STANDARDS section (1.04 above).
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

### 3.08 HYDRONIC SYSTEMS

- A. Before adjustments are made, clean strainers, check temperature control valve operations, check pump rotation, adjust pressure reducing valves, as required by sections, 3.01, 3.02, 3.03 of this specification section. Assure that system water treatment has been inspected and approved by Owner water treatment specialist.
- B. Using system flow meters, pressure gauges, and/or contact pyrometer, adjust the quantity of fluid handled by each pump and supplied to each coil, heat exchanger, etc., to meet design requirements. Adjust hydronic systems to provide  $\pm 10\%$  of required design quantities.
  - 1. Remove and trim pump impellers where throttling, and/or speed control exceeds 10% of adequate flow.
- C. Verify all hydronic system controls for proper function for coils, heat exchangers, and all other equipment with control valves.
- D. Use proportional balance techniques so that in every case, at least one terminal valve is set for full flow at wide open, and at least one branch is wide open at full flow, other equivalent.

### 3.09 MISCELLANEOUS

- A. Observe and note all furnished thermal overload protection in the data sheets. If thermal overload protection is incorrect, the trade which furnished the overload devices shall furnish and install the correct size overload protection devices. It shall be the responsibility of the balancing firm to confirm that proper overload protection has been installed at the completion of the job.
- B. Measure and set any special conditions such as minimum air quantities; coordinate outside air, return air and relief air damper operation; check and adjust outside and return air intakes so that the system will deliver substantially the same volume on either; make tests and record data as required in "REPORT" below.
- C. Permanently mark setting of valves, dampers, and other adjustment devices allowing for settings to be restored. Set and lock memory stops.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- E. Upon request, based on perceived need, make 24-hour space temperature recordings. Any required re-balance of the system shall be performed without additional cost to the project.

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- F. Upon request, a representative of the balancing firm performing the work shall demonstrate fluid flow quantities shown in the report by reading back outlets or terminals selected specifically or at random by the Design Engineer, or the Owner. It is understood that the operating mode of the system shall be the same for read-back as it was during balancing. If any system is found to be outside the specified balance requirements, the balancing agency shall re-balance the entire system and resubmit a new balance report at no cost to the Owner.

### 3.10 REPORT

- A. Provide (1) one bound report and (1) one searchable electronic pdf copy containing a general information sheet listing instruments used, method of balancing, altitude correction, and manufacturer's grille, register and diffuser data.
- B. Heating Coils and ATU Reheat Coils:
  - 1. Identification/number.
  - 2. Location, clearly identified on the balance reports, and clearly shown on a set of 11"x17" mechanical plans.
  - 3. Service.
  - 4. Manufacturer.
  - 5. Water flow, design and actual.
- C. Duct Traverses:
  - 1. System zone/branch.
  - 2. Duct size.
  - 3. Area.
  - 4. Design air flow.
  - 5. Test velocity.
  - 6. Test air flow.
  - 7. Duct static pressure.
  - 8. Air temperature.
  - 9. Air correction factor, if required, by necessary device..
- D. Duct Leak Tests:
  - 1. Description of ductwork under test.
  - 2. Duct design operating pressure.
  - 3. Duct design test static pressure.
  - 4. Duct capacity, air flow.
  - 5. Maximum allowable leakage duct capacity times leak factor.
  - 6. Test apparatus:
    - a. Blower.
    - b. Orifice, tube size.
    - c. Orifice size.
    - d. Calibrated.
  - 7. Test static pressure.
  - 8. Test orifice differential pressure.
  - 9. Leakage.
- E. Air Terminal Unit Data:
  - 1. Manufacturer.
  - 2. Type, constant, variable, cooling only, dual duct.
  - 3. Identification/number.
  - 4. Location, clearly identified on the balance reports, and clearly shown on a set of 11"x17" mechanical plans.
  - 5. Inlet size.

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6. K-factor
  7. Minimum design air flow.
  8. Maximum cooling design air flow.
  9. Maximum cooling actual air flow.
  10. Maximum heating design air flow.
  11. Maximum heating actual air flow.
  12. Unoccupied design air flow.
  13. Unoccupied actual air flow.
- F. Air Distribution Tests:
1. Air terminal number
    - a. This number is to correlate to a set of 11"x17" mechanical plans with the numbers clearly identified, and in which it is easy to see supply, return, and exhaust air ducts, see section above.
  2. Room number/location, the room numbers shown on the report are to correlate to a set of 11"x17" mechanical plans with the numbers clearly identified, and in which it is easy to see supply, return, and exhaust air inlets and outlets.
  3. Terminal type.
  4. Terminal size.
  5. Area factor, when used for balancing, all units for area shall be clearly identified and shall all be recorded on the report using the same units. If different units are used on the report, then the report will be rejected, and the balance report will be changed such that only one unit of area is shown on the reports.
  6. Design air flow.
  7. Test (final) air flow.
  8. Percent of design air flow.
- G. Water Flow Balancing Valves:
1. Identification/location, the numbers on the report are to correlate to a set of 11"x17" mechanical plans with the numbers clearly identified, and in which it is easy to see supply and return; and the difference between chilled water and heating water
  2. Manufacturer.
  3. Design flow rate.
  4. Actual inlet and outlet pressure.
  5. Actual flow rate (GPM), all pressure dependent valves with fixed or changing orifice type valves shall have recorded flow rates. For systems that have automatic or pressure independent control valves, the actual flows shall not be recorded unless there is a measuring device in the piping. Pressure readings that show the valve has the required pressures to function is all that is required. For valves that have flow setpoints that need to be set, the reports shall clearly show the final setpoints on these types of valves.
  6. Setpoint identification/number.
- H. Balancing data sheets shall indicate the required and actual CFM of all supply, return and exhaust outlets or inlets, and be totaled and summarized by systems.
- I. Hydronic balancing data sheets shall list required temperature or pressure differentials used for balancing coils, radiators, condensers, etc. Sheets shall show in comparison final as-balanced versus design values.
- J. Include a reduced set of contract drawings with inlets, and outlets marked for easy identification using the same identification method used in the data sheets.
- K. Note any abnormal or notable conditions not covered in the above.

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- L. Keep a daily log of all work performed, with a list of work scheduled for each day and the workers on the job.

**END OF SECTION**

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**SECTION 230713  
DUCT INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Duct insulation.
- B. Duct liner.
- C. Insulation jackets.

**1.02 RELATED REQUIREMENTS**

- A. Section 078400 - Firestopping.
- B. Section 099113 - Exterior Painting: Painting insulation jackets.
- C. Section 099123 - Interior Painting: Painting insulation jackets.
- D. Section 220553 - Identification for Plumbing Piping and Equipment.
- E. Section 230553 - Identification for HVAC Piping and Equipment.
- F. Section 233100 - HVAC Ducts and Casings: Glass fiber ducts.

**1.03 REFERENCE STANDARDS**

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2013.
- D. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.
- E. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2016.
- F. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.
- G. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014.
- H. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2013).
- I. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2014.
- J. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2016.
- K. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts; 2016.
- L. ASTM C1410 - Standard Specification for Cellular Melamine Thermal and Sound-Absorbing Insulation; 2014.
- M. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- N. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- O. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.

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- P. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).
- Q. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of experience.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.
- C. Materials not protected will be rejected and replaced at installers expense.

**1.07 FIELD CONDITIONS**

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

**PART 2 PRODUCTS**

**2.01 REGULATORY REQUIREMENTS**

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

**2.02 GLASS FIBER, FLEXIBLE**

- A. Manufacturer:
  - 1. CertainTeed Corporation; \_\_\_\_\_: [www.certainteed.com/#sle](http://www.certainteed.com/#sle).
  - 2. Johns Manville; \_\_\_\_\_
  - 3. Knauf Insulation;
  - 4. Owens Corning Corporation; \_\_\_\_\_
  - 5. Substitutions: See Section 016000 - Product Requirements.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
  - 1. 'K' value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
  - 2. Maximum Service Temperature: 250 degrees F.
  - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
- C. Vapor Barrier Jacket:
  - 1. 0.0032 inch vinyl or Kraft paper with glass fiber yarn and bonded to aluminum film.
  - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.

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3. Secure with staples, bands, wires, pressure sensitive tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer.
- D. Vapor Barrier Tape:
1. Vinyl or kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- E. Outdoor Vapor Barrier Mastic:
1. Manufacturers:
    - a. Carlisle HVAC Products; \_\_\_\_\_
    - b. Childers; \_\_\_\_\_
    - c. Henry Co.;
    - d. W. R. Meadows;
    - e. Substitutions: See Section 016000 - Product Requirements.
  2. Single component, liquid applied, elastomeric polymer based vapor barrier and insulation adhesive.
- F. Tie Wire: Stainless steel, 16 gage, 0.0508 inch diameter.

### 2.03 GLASS FIBER, RIGID

- A. Manufacturer:
1. CertainTeed Corporation; \_\_\_\_\_: [www.certainteed.com/#sle](http://www.certainteed.com/#sle).
  2. Johns Manville; \_\_\_\_\_
  3. Knauf Insulation; \_\_\_\_\_
  4. Owens Corning Corporation;
  5. Substitutions: See Section 016000 - Product Requirements.
- B. Insulation: ASTM C612; rigid, noncombustible blanket.
1. 'K' Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
  2. Maximum Service Temperature: 250 degrees F.
  3. Maximum Water Vapor Absorption: 5.0 percent.
  4. Maximum Density: 10 lb./cu ft.
- C. Indoor Vapor Barrier Jacket:
1. Vinyl or Kraft paper with glass fiber yarn and bonded to aluminized film.
  2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
  3. Secure with pressure sensitive tape.
- D. Vapor Barrier Tape:
1. Vinyl or Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
  2. Vapor barrier tape shall be compatible with vapor barrier.
- E. Indoor Vapor Barrier Finish:
1. Vinyl emulsion type acrylic, compatible with insulation, white color.
- F. Exterior Vapor Barrier Finish:
1. Manufacturers:
    - a. Carlisle HVAC Products, Hard cast;
    - b. Childers;
    - c. Henry Co.;
    - d. W. R. Meadows;
  2. Single component, liquid applied, elastomeric polymer based vapor barrier and insulation adhesive.
- G. Insulation Fastening:

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1. Stick pins: Galvanized steel, welded with integral or press-on head or mastic applied.
2. Tie Wire: Stainless steel, 16 gage, 0.0508 inch diameter.

#### 2.04 JACKETS

- A. Aluminum Jacket: ASTM B209 (ASTM B209M). Use only where specified on drawings.
  1. Thickness: 0.016 inch sheet.
  2. Finish: Smooth.
  3. Joining: Longitudinal slip joints and 2 inch laps.
  4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
  5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

#### 2.05 DUCT LINER

- A. Manufacturers:
  1. CertainTeed Corporation; \_\_\_\_\_: [www.certainteed.com/#sle](http://www.certainteed.com/#sle).
  2. Johns Manville; \_\_\_\_\_
  3. Knauf Insulation; \_\_\_\_\_
  4. Owens Corning Corporation;
  5. Substitutions: See Section 016000 - Product Requirements.
- B. Glass Fiber Insulation: Non-corrosive, incombustible glass fiber complying with ASTM C1071; flexible blanket; impregnated surface and edges coated with poly vinyl acetate polymer, acrylic polymer, or black composite.
  1. Fungal Resistance: No growth when tested according to ASTM G21.
  2. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F.
  3. Service Temperature: Up to 250 degrees F.
  4. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm, minimum.
  5. Minimum Noise Reduction Coefficients:
    - a. 1/2 inch Thickness: 0.30.
    - b. 1 inch Thickness: 0.45.
    - c. 1-1/2 inches Thickness: 0.60.
    - d. 2 inch Thickness: 0.70.
- C. Adhesive: Waterproof, fire-retardant type, ASTM C916.
- D. Liner Fasteners: Galvanized steel, welded with integral or press-on head.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verify that ducts have been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

#### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Insulated ducts conveying air below ambient temperature:
  1. Provide insulation with vapor barrier jackets.
  2. Insulate all unlined ductwork with 1" thick flexible glass fiber insulation, unless otherwise noted on drawings.
  3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
  4. Insulate entire system including fittings, joints, and flanges. Finish with tape.
- D. Insulated ducts conveying air above ambient temperature:
  1. Provide with or without standard vapor barrier jacket.

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2. Insulate all unlined ductwork with 1" thick flexible glass fiber insulation, unless otherwise noted on drawings.
  3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
  4. Insulate entire system including fittings, joints, and flanges. Finish with tape.
- E. Lined Ductwork:
1. Except as otherwise indicated, omit external insulation on ductwork where internal insulation or sound absorbing linings have been installed.
  2. Line all supply air ductwork mains with 1" thick acoustic lining, unless otherwise noted on drawings.
- F. Duct Liner Application:
1. Adhere insulation with adhesive for 90 percent coverage.
  2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
  3. Seal and smooth joints. Seal and coat transverse joints.
  4. Seal liner surface penetrations with adhesive.
  5. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

**END OF SECTION**

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**SECTION 230719  
HVAC PIPING INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Flexible removable and reusable blanket insulation.
- B. Jackets and accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 078400 - Firestopping.
- B. Section 099123 - Interior Painting: Painting insulation jacket.
- C. Section 232113 - Hydronic Piping: Placement of hangers and hanger inserts.

**1.03 REFERENCE STANDARDS**

- A. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).
- B. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2013).
- C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.
- D. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2013.
- E. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2016.
- F. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2017.
- G. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2016a.
- H. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.
- I. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2016.
- J. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing; 2010 (Reapproved 2016).
- K. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation; 2017.
- L. ASTM C610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation; 2016.
- M. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2013).
- N. ASTM C1410 - Standard Specification for Cellular Melamine Thermal and Sound-Absorbing Insulation; 2014.
- O. ASTM C1695 - Standard Specification for Fabrication of Flexible Removable and Reusable Blanket Insulation for Hot Service; 2010 (Reapproved 2015).
- P. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-- Tension; 2016.
- Q. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2010).

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- R. ASTM D1056 - Standard Specification for Flexible Cellular Materials--Sponge or Expanded Rubber; 2014.
- S. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2012.
- T. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- U. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- V. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

#### 1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

#### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.
- C. Materials not protected will be rejected and replaced at installers expense.

#### 1.07 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

### PART 2 PRODUCTS

#### 2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.
- B. Insulation shall have a 'K' value that meets the minimum requirements of the latest International Energy Conservation Code (IECC).

#### 2.02 GLASS FIBER

- A. Manufacturers:
  - 1. CertainTeed Corporation
  - 2. Johns Manville Corporation
  - 3. Knauf Insulation;
  - 4. Owens Corning Corporation;
  - 5. Armstrong World Industries;
  - 6. Substitutions: See Section 016000 - Product Requirements.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
  - 1. 'K' Value: ASTM C177, 0.24 at 75 degrees F.

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2. Maximum Service Temperature: 850 degrees F.
  3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
1. 'K' Value: ASTM C177, 0.23 at 75 degrees F.
  2. Maximum Service Temperature: 220 degrees F.
  3. Maximum Moisture Absorption: 0.2 percent by volume.
- D. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
1. 'K' Value: ASTM C177, 0.24 at 75 degrees F.
  2. Maximum Service Temperature: 650 degrees F.
  3. Maximum Moisture Absorption: 0.2 percent by volume.
- E. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.
- F. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- G. Vapor Barrier Lap Adhesive: Compatible with insulation.
- H. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
- I. Fibrous Glass Fabric:
1. Cloth: Untreated; 9 oz/sq yd weight.
  2. Blanket: 1.0 lb./cu ft density.
  3. Weave: 5 by 5.
- J. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight.
  2. Vinyl emulsion type acrylic, compatible with insulation, black or white color.
- K. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- L. Outdoor Breather Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- M. Insulating Cement: ASTM C449.

### 2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturers:
1. Aeroflex USA, Inc; Aerocel Stay-Seal with Protape (SSPT):
  2. Armacell LLC; AP Armaflex:
  3. K-Flex USA LLC; K-Flex Titan:
  4. Substitutions: See Section 016000 - Product Requirements.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
1. Minimum Service Temperature: Minus 40 degrees F.
  2. Maximum Service Temperature: 180 degrees F.
  3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

### 2.04 JACKETS

- A. PVC Plastic.
1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
    - a. Minimum Service Temperature: 0 degrees F.

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- b. Maximum Service Temperature: 150 degrees F.
- c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
- d. Thickness: 10 mil.
- e. Connections: Brush on welding adhesive.
- 2. Covering Adhesive Mastic: Compatible with insulation.
- B. ABS Plastic:
  - 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
    - a. Minimum Service Temperature: Minus 40 degrees F.
    - b. Maximum Service Temperature: 180 degrees F.
    - c. Moisture Vapor Permeability: 0.012 perm inch, when tested in accordance with ASTM E96/E96M.
    - d. Thickness: 30 mil.
    - e. Connections: Brush on welding adhesive.
- C. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
  - 1. Thickness: 0.016 inch sheet.
  - 2. Finish: Embossed.
  - 3. Joining: Longitudinal slip joints and 2 inch laps.
  - 4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
  - 5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
- D. Stainless Steel Jacket: ASTM A666, Type 304 stainless steel.
  - 1. Thickness: 0.010 inch.
  - 2. Finish: Smooth.
  - 3. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

## 2.05 ACCESSORIES

- A. General Requirements:
  - 1. Provide required accessories in accordance with and subject to the recommendations of the insulation manufacturer.
  - 2. Furnish compatible materials which do not contribute to corrosion, soften, or otherwise attack surfaces to which applied, in either the wet or dry state.
  - 3. Comply with ASTM C795 requirements for materials to be used on stainless steel surfaces.
  - 4. Supply materials that are asbestos free.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Insulated pipes conveying fluids below ambient temperature; insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, in-line pump bodies, and expansion joints.
- D. Orient all insulation and jacketing seams on bottom of pipe.
- E. Glass fiber insulated pipes conveying fluids below ambient temperature:

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1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
  2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- G. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.
- H. For fan coil unit and VAV reheat coil piping, conveying fluids over 140 degrees F, do not insulate (valve train) shut-off valves, strainers, control valve, air bleeds, circuit setters, and unions at equipment. Insulate pipe from last fitting to coil if 12" long or greater. Bevel and seal ends of insulation.
- I. Glass fiber insulated pipes conveying fluids above ambient temperature.
1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
  2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- J. Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
  2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
  3. Insert location: Between support shield and piping and under the finish jacket.
  4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
  5. Insert Material: Hydrous calcium silicate insulation, for 2-1/2" pipe or larger, or other heavy density insulating material suitable for the planned temperature range.
- K. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 078400.

### 3.03 PIPING INSULATION SCHEDULE

- A. Heating Hot Water Supply and Return, 200 Deg F and below:
1. 1 1/2 inch and smaller:
    - a. Glass fiber:
      - 1) 1 1/2 inch thick.
  2. 2 inch and larger:
    - a. Glass fiber:
      - 1) 2 inch thick.

### 3.04 INDOOR FIELD APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory applied jacket, install the field applied jacket over the factory applied jacket
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping:
1. PVC:
    - a. White: 30 mils thick.

### END OF SECTION

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**SECTION 230800  
COMMISSIONING OF HVAC**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. See Section 019113 - General Commissioning Requirements for overall objectives; comply with the requirements of Section 019113.
- B. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.
- C. The Commissioning Authority (CxA) will be employed by the owner and directs and coordinates all commissioning activities and provides Prefunctional Checklists and Functional Test Procedures for Contractor's use.
- D. The entire HVAC system is to be commissioned, including commissioning activities for the following specific items:
  - 1. Control system.
  - 2. Major and minor equipment items.
  - 3. Piping systems and equipment.
  - 4. Ductwork and accessories.
  - 5. Terminal units.
  - 6. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.
- E. The Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

**1.02 RELATED REQUIREMENTS**

- A. Section 017800 - Closeout Submittals: Scope and procedures for operation and maintenance manuals and project record documents.
- B. Section 017900 - Demonstration and Training: Scope and procedures for Owner personnel training.
- C. Section 019113 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.
- D. Section 230923 - Direct-Digital Control System for HVAC.
- E. Section 230913 - Instruments and Control Elements.
- F. Section 230993 - Sequence of Operations for HVAC Controls.
- G. Section 230593 - Testing, Adjusting, and Balancing for HVAC.

**1.03 REFERENCE STANDARDS**

- A. ASHRAE Guideline 1.1 - The HVAC&R Technical Requirements for the Commissioning Process; 2007 (Errata 2012).

**1.04 SUBMITTALS**

- A. Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.
- B. Prefunctional Checklists and Functional Test Procedures for Control System: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the control system prior to full system Functional Testing; include at least the following for each type of equipment controlled:

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1. System name.
  2. List of devices.
  3. Step-by-step procedures for testing each controller after installation, including:
    - a. Process of verifying proper hardware and wiring installation.
    - b. Process of downloading programs to local controllers and verifying that they are addressed correctly.
    - c. Process of performing operational checks of each controlled component.
    - d. Plan and process for calibrating valve and damper actuators and all sensors.
    - e. Description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
  4. Copy of proposed log and field checkout sheets to be used to document the process; include space for initial and final read values during calibration of each point and space to specifically indicate when a sensor or controller has “passed” and is operating within the contract parameters.
  5. Description of the instrumentation required for testing.
  6. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the Commissioning Authority and TAB contractor for this determination.
- C. Startup Reports, Prefunctional Checklists, and Trend Logs: Submit for approval of Commissioning Authority.
- D. HVAC Control System O&M Manual Requirements. In addition to documentation specified elsewhere, compile and organize at minimum the following data on the control system:
1. Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the detailed technical manual for programming and customizing control loops and algorithms.
  2. Full as-built set of control drawings.
  3. Full as-built sequence of operations for each piece of equipment.
  4. Full points list; in addition to the information on the original points list submittal, include a listing of all rooms with the following information for each room:
    - a. Floor.
    - b. Room number.
    - c. Room name.
    - d. Air handler unit ID.
    - e. Reference drawing number.
    - f. Air terminal unit tag ID.
    - g. Heating and/or cooling valve tag ID.
    - h. Minimum air flow rate.
    - i. Maximum air flow rate.
  5. Full print out of all schedules and set points after testing and acceptance of the system.
  6. Full as-built print out of software program.
  7. Electronic copy on disk of the entire program for this facility.
  8. Marking of all system sensors and thermostats on the as-built floor plan and HVAC drawings with their control system designations.
  9. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
  10. Control equipment component submittals, parts lists, etc.
  11. Warranty requirements.

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12. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
13. Organize and subdivide the manual with permanently labeled tabs for each of the following data in the given order:
  - a. Sequences of operation.
  - b. Control drawings.
  - c. Points lists.
  - d. Controller and/or module data.
  - e. Thermostats and timers.
  - f. Sensors and DP switches.
  - g. Valves and valve actuators.
  - h. Dampers and damper actuators.
  - i. Program setups (software program printouts).
- E. Project Record Documents: See Section 017800 for additional requirements.
  1. Submit updated version of control system documentation, for inclusion with operation and maintenance data.
  2. Show actual locations of all static and differential pressure sensors (air, water and building pressure) and air-flow stations on project record drawings.
- F. Training Plan: In addition to requirements specified in Section 017900, include:
  1. Follow the recommendations of ASHRAE Guideline 1.1.
  2. Control system manufacturer's recommended training.
  3. Demonstration and instruction on function and overrides of any local packaged controls not controlled by the HVAC control system.
- G. Training Manuals: See Section 017900 for additional requirements.
  1. Provide a USB drive with one electronic copy of the controls training manuals in a separate manual from the O&M manuals.

## **PART 2 PRODUCTS**

### **2.01 TEST EQUIPMENT**

- A. CxA shall provide all standard testing equipment required to verify startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become the property of Owner.
- B. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists and Functional Test Procedures.
- B. Furnish additional information requested by the Commissioning Authority.
- C. Prepare a preliminary schedule for HVAC pipe and duct system testing, flushing and cleaning, equipment start-up and testing, adjusting, and balancing start and completion for use by the Commissioning Authority; update the schedule as appropriate.
- D. Notify the Owner's representative at least 48 hours before pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and testing, adjusting, and balancing will occur; when commissioning activities not yet performed or not yet scheduled will delay construction, notify at least

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48 hours ahead of time and be proactive in seeing that the Owner's representative has the scheduling information needed to efficiently execute the commissioning process.

- E. Upon approval from the Owner's representative, put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.
  - 1. Include cost of sheaves and belts that may be required for testing, adjusting, and balancing.
- F. Provide test holes in ducts and plenums to allow air measurements and air balancing; close with an approved plug.
- G. Provide temperature and pressure taps in accordance with Contract Documents.

### 3.02 INSPECTING AND TESTING - GENERAL

- A. CxA shall submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment or other assembly to be commissioned.
- B. CxA shall perform the Functional Tests for each item of equipment or other assembly to be commissioned.
- C. Valve stroke, damper stroke, and VFD speed setup and check (CxA to coordinate this work with the control contractor through Owner's representative. Control contractor to initiate commands and adjustment of devices. CxA to verify.) :
  - 1. For all valve/damper actuator positions and VFD speeds checked, verify the actual position or speed against the control system readout.
  - 2. Set pump/fan to normal operating mode.
  - 3. If valve/damper: command closed; visually verify that valve/damper is closed and adjust output zero signal as required. If VFD: command to minimum speed; visually verify VFD at minimum speed and adjust output zero signal as required.
  - 4. If valve/damper: command open; visually verify that valve/damper is open and adjust output signal as required. If VFD: command to maximum speed if conditions allow (if unable to run equipment at full speed test VFD with load disconnected); visually verify VFD at maximum speed and adjust output signal as required.
  - 5. Command valve/damper or VFD speed to a few intermediate positions. Verify position/signal.
  - 6. If actual valve/damper position or VFD speed does not reasonably correspond, replace actuator, signal conditioner, or add pilot positioner (for pneumatics).
- D. Coil Valve Leak Through Check:
  - 1. Air Handler and FCU Coil Drain Down: Not for 3-way valves.
    - a. Put systems in normal mode.
    - b. If cooling coil valve, remove all call for cooling; if heating coil valve, put system in full cooling.
    - c. Close isolation valve on supply side of coil, open air bleed cap, open drain-down cock and drain water from coil.
    - d. If water does not stop draining, there may be a leak through the control valve.
    - e. Return all to normal when done.
- E. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

### 3.03 TAB COORDINATION

- A. TAB: Testing, adjusting, and balancing of HVAC.
- B. Coordinate commissioning schedule with TAB schedule through the Owner's representative.

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### 3.04 CONTROL SYSTEM FUNCTIONAL TESTING

- A. Prefunctional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of Contract Documents and the detailed Sequences of Operation documentation submittal.
- B. Do not start Functional Testing until all controlled components have themselves been successfully Functionally Tested in accordance with Contract Documents.
- C. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Authority.
- D. Functional Testing of the control system constitutes demonstration and trend logging of control points monitored by the control system.
  - 1. Perform all trend logging specified in Prefunctional Checklists and Functional Test procedures.
- E. Functionally Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including any interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.
- F. Demonstrate the following to the Commissioning Authority during testing of controlled equipment; coordinate with commissioning of equipment.
  - 1. Setpoint changing features and functions.
  - 2. Sensor calibrations.
- G. Demonstrate to the Commissioning Authority:
  - 1. That all specified functions and features are set up, debugged and fully operable.
  - 2. That scheduling features are fully functional and setup, including holidays.
  - 3. That all graphic screens and value readouts are completed.
  - 4. Correct date and time setting in central computer.
  - 5. That field panels read the same time as the central computer; sample 10 percent of field panels; if any of those fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Owner.
  - 6. Functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad; demonstrate 100 percent of panels and 10 percent of ports; if any ports fail, sample another 10 percent; if any of those fail, test all remaining units at no extra cost to Owner.
  - 7. Power failure and battery backup and power-up restart functions.
  - 8. Global commands features.
  - 9. Security and access codes.
  - 10. Occupant over-rides (manual, telephone, key, keypad, etc.).
  - 11. O&M schedules and alarms.
  - 12. Occupancy sensors and controls.
  - 13. All control strategies and sequences not tested during controlled equipment testing.
- H. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to Owner.

### 3.05 OPERATION AND MAINTENANCE MANUALS

- A. See Section 017800 for additional requirements.
- B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
- C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
- D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

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### 3.06 DEMONSTRATION AND TRAINING

- A. See Section 017900 for additional requirements.
- B. Demonstrate operation and maintenance of HVAC system to Owner's personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.
- C. These demonstrations are in addition to, and not a substitute for, Prefunctional Checklists and demonstrations to the Commissioning Authority during Functional Testing.
- D. Provide hands-on training of Owner's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned. Provide durations of training as sufficient or as needed.
- E. TAB Review: Instruct Owner's personnel during and concurrent with TAB, on the following:
  - 1. Review final TAB report, explaining the layout and meanings of each data type.
  - 2. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
  - 3. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
  - 4. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
  - 5. Other salient information that may be useful for facility operations, relative to TAB.
- F. Provide the services of manufacturer representatives to assist where necessary.

**END OF SECTION**

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## SECTION 232113 HYDRONIC PIPING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Hydronic system requirements.
- B. Heating water piping, above grade.
- C. Equipment drains and overflows.
- D. Pipe hangers and supports.
- E. Unions, flanges, mechanical couplings, and dielectric connections.

#### 1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 083100 - Access Doors and Panels.
- C. Section 099123 - Interior Painting.
- D. Section 220516 - Expansion Fittings and Loops for Plumbing Piping.
- E. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- F. Section 220553 - Identification for Plumbing Piping and Equipment.
- G. Section 220719 - Plumbing Piping Insulation.
- H. Section 230516 - Expansion Fittings and Loops for HVAC Piping.
- I. Section 230523 - General-Duty Valves for HVAC Piping.
- J. Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- K. Section 230553 - Identification for HVAC Piping and Equipment.
- L. Section 230719 - HVAC Piping Insulation.
- M. Section 232114 - Hydronic Specialties.
- N. Section 232500 - HVAC Water Treatment: Pipe cleaning.

#### 1.03 REFERENCE STANDARDS

- A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators; 2017.
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.
- C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.
- D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.
- E. ASME B31.9 - Building Services Piping; 2014.
- F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- G. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service; 2015.
- H. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- I. ASTM A183 - Standard Specification for Carbon Steel Track Bolts and Nuts; 2014.

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- J. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2017.
- K. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).
- L. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).
- M. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2016.
- N. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2017.
- O. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80; 2015.
- P. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2015.
- Q. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992 (Reapproved 2014).
- R. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2015a.
- S. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems; 2011a.
- T. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2013).
- U. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011-AMD 1.
- V. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (with March 2016 Errata).
- W. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2012.
- X. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2017.
- Y. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2009.
- Z. AWWA C606 - Grooved and Shouldered Joints; 2015.
- AA. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the installation of all underground piping at service entrances to buildings including size, location and installation locations, noted on contract documents, with Owner's Project Manager.
- B. Preinstallation Meeting: Conduct a preinstallation meeting prior to the start of the work of this section; required attendance by all affected installers.
- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.
- D. Scheduling: All scheduling shall be coordinated and agreed upon with Owner's Project Manager prior to commencing work.

#### 1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.
- C. Product Data:
  - 1. Include data on pipe materials, pipe fittings, valves, and accessories.
  - 2. Provide manufacturers catalogue information.

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3. Show grooved joint couplings, fittings, and specialties on drawings and product submittals, specifically identified with the manufacturer's style or series designation.
- D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. See Section 016000 - Product Requirements, for additional provisions.

#### 1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with minimum three years of experience.
- C. Provide all flanges, grooved joint couplings, fittings, and grooving tools from a single manufacturer.
- D. Welder Qualifications: Certify in accordance with ASME BPVC-IX.
  1. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
- E. Deliveries shall not be to owner, but directly to the contractor.

### PART 2 PRODUCTS

#### 2.01 HYDRONIC SYSTEM REQUIREMENTS

- A. Comply with ASME B31.9 and applicable federal, state, and local regulations.
- B. Piping: Provide piping, fittings, hangers and supports as required, as indicated, and as follows:
  1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
  2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
  3. Grooved mechanical joints may be used in any location except direct buried.
    - a. Grooved mechanical connections and joints comply with AWWA C606.
      - 1) Steel: Comply with ASTM A106/A106M, Grade B or ASTM A53/A53M.
    - b. Use flexible connectors only at structural expansion joints as indicated by architect or engineer.
    - c. Use gaskets of molded synthetic rubber with central cavity, pressure responsive configuration and complying with ASTM D2000, Grade 2CA615A15B44F17Z for circulating medium up to maximum 230 degrees F or Grade M3BA610A15B44Z for circulating medium up to maximum 200 degrees F.
    - d. Provide steel coupling nuts and bolts complying with ASTM A183.
  4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
- C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

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1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.
- D. Valves: Provide valves where indicated:
  1. Provide drain valves where indicated, and if not indicated provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use ball valves with cap; coordinate with owner, piping to nearest floor drain.
- E. Welding Materials and Procedures: Conform to ASME BPVC-IX.

## 2.02 HEATING WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:
  1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
  2. Threaded Joints: ASME B16.3, malleable iron fittings.
  3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
- B. Steel Pipe Sizes 12 Inch and Greater: ASTM A53/A53M, 3/8 inch wall, black, using one of the following joint types:
  1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
  2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
- C. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn, using one of the following joint types:
  1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
    - a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
    - b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
  2. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.
    - a. Manufacturers:
      - 1) Grinnell Products; \_\_\_\_\_
      - 2) Viega LLC; \_\_\_\_\_
      - 3) Substitutions: See Section 016000 - Product Requirements.
- D. HDPE Pipe: ASTM F2619/F2619M.
  1. Pipe and fittings shall be High-Density Polyethylene material in accordance with ASTM F2619/F2619M.
  2. Manufacturers:
    - a. Nupi
    - b. JM Eagle
    - c. Substitutions: See Section 016000 - Product Requirements.
- E. PP (Pressure-rated Polypropylene): ASTM F2389.
  1. Pipe and fittings shall be polypropylene material of type PP-R or PP-RCT in accordance with ASTM F2389.
  2. Manufacturers:
    - a. Aquatherm
    - b. Nupi
    - c. Substitutions: See Section 016000 - Product Requirements.

## 2.03 PIPE HANGERS AND SUPPORTS

- A. See specification section 220529 for requirements for this section.

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## 2.04 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

- A. Unions for Pipe 4 inches and Less:
  - 1. Ferrous Piping: 150 psig malleable iron, threaded.
  - 2. Copper Pipe: Bronze, soldered or mechanical press joints.
- B. Flanges for Pipe 2 Inches and Greater:
  - 1. Ferrous Piping: 150 psig forged steel, slip-on.
  - 2. Copper Piping: Bronze.
  - 3. Gaskets: 1/16 inch thick preformed compressed fiber gasket.
- C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
  - 1. Dimensions and Testing: In accordance with AWWA C606.
  - 2. Mechanical Couplings: Comply with ASTM F1476.
  - 3. Housing Material: Ductile iron, galvanized complying with ASTM A536.
  - 4. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
  - 5. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
  - 6. Manufacturers:
    - a. Grinnell Products;
    - b. Victaulic Company;
    - c. Anvil International; Gruvlock.
    - d. Substitutions: See Section 016000 - Product Requirements.
- D. Dielectric Connections:
  - 1. Nipples and couplings:
    - a. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
    - b. Dry insulation barrier able to withstand 600 volt breakdown test.
    - c. Suitable for the required operating pressures and temperatures.
  - 2. Flanges:
    - a. Dielectric flanges with same pressure ratings as standard flanges.
    - b. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
    - c. Dry insulation barrier able to withstand 600 volt breakdown test.
    - d. Suitable for the required operating pressures and temperatures.

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.
- C. Remove scale and dirt on inside and outside before assembly.
- D. Prepare piping connections to equipment using jointing system specified.
- E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- F. After completion, fill, clean, and treat systems. Refer to Section 232500 for additional requirements.

### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install heating water piping to ASME B31.9 requirements.

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- C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space and to avoid interference with use of space.
- E. Install valves with stems upright or horizontal, not inverted.
- F. Group piping whenever practical at common elevations.
- G. Provide access where valves are not exposed. Coordinate size and location of access doors with Section 083100.
- H. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.
- I. Slope piping and arrange to drain at low points.
- J. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 230516.
- K. Grooved Joints:
  - 1. Install in accordance with the manufacturer's latest published installation instructions.
  - 2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.
- L. Inserts:
  - 1. Provide inserts for placement in concrete formwork.
  - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  - 3. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- M. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 230719.

**END OF SECTION**

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**SECTION 232114**  
**HYDRONIC SPECIALTIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Strainers.
- B. Air vents.
- C. Pressure-temperature test plugs.
- D. Balancing valves.

**1.02 RELATED REQUIREMENTS**

- A. Section 232113 - Hydronic Piping.
- B. Section 232500 - HVAC Water Treatment: Pipe cleaning.

**1.03 REFERENCE STANDARDS**

- A. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2015.
- B. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2017.
- C. ASME B16.11 - Forged Fittings, Socket-welding and Threaded; 2016 (Errata 2017).
- D. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; 2017.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Conduct a preinstallation meeting prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

**1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.
- C. Certificates: Inspection certificates for pressure vessels from authority having jurisdiction.
- D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- E. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

**1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

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## PART 2 PRODUCTS

### 2.01 AIR VENTS

- A. Manufacturers:
  - 1. Armstrong International, Inc
  - 2. ITT Bell & Gossett
  - 3. Taco, Inc
  - 4. Hoffman Specialty ITT;
  - 5. Spirax Sarco;
  - 6. Spirotech;
  - 7. Substitutions: See Section 016000 - Product Requirements.
- B. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.
- C. Float Type:
  - 1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
  - 2. Cast iron body and cover, float, bronze pilot valve mechanism suitable for system operating temperature and pressure; with isolating valve.
- D. Maximum Fluid Pressure: 150 psi.
- E. Maximum Fluid Temperature: 250 degrees F.

### 2.02 STRAINERS

- A. Manufacturers:
  - 1. Armstrong International, Inc; \_\_\_\_\_
  - 2. Flexicraft Industries; \_\_\_\_\_
  - 3. Grinnell Products, a Tyco Business; \_\_\_\_\_
  - 4. The Metraflex Company;
  - 5. Watts;
  - 6. Victaulic;
  - 7. Spirax Sarco;
  - 8. Substitutions: See Section 016000 - Product Requirements.
- B. Size 2 inch and Under:
  - 1. Screwed brass or iron body for a minimum of 200 psi working pressure, Y pattern with 1/32 inch stainless steel perforated screen, full size drain connection with ball valve.

### 2.03 PRESSURE-TEMPERATURE TEST PLUGS

- A. Manufacturers:
  - 1. Ferguson Enterprises Inc; \_\_\_\_\_
  - 2. Peterson Equipment Company Inc; \_\_\_\_\_
  - 3. Sisco Manufacturing Company Inc; \_\_\_\_\_
  - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Construction: Brass body designed to receive temperature or pressure probe with removable protective cap, and Neoprene rated for minimum 200 degrees F.
- C. Application: Use extended length plugs to clear insulated piping.

### 2.04 BALANCING VALVES

- A. Manufacturers:
  - 1. ITT Bell & Gossett; \_\_\_\_\_
  - 2. Taco, Inc; \_\_\_\_\_

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3. IMI Flow Design;
  4. Nexus Valve;
  5. Substitutions: See Section 016000 - Product Requirements.
- B. Size 2 inch and Smaller:
1. Provide ball or globe style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and NPT threaded or soldered connections.
  2. Metal construction materials consist of bronze or brass.
  3. Non-metal construction materials consist of Teflon or EPDM.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install specialties in accordance with manufacturer's instructions.
- B. Where large air quantities can accumulate, provide enlarged air collection standpipes.
- C. Provide manual air vents at system high points and as indicated.
- D. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

#### **3.02 MAINTENANCE**

- A. See Section 017000 - Execution Requirements, for additional requirements relating to maintenance service.

**END OF SECTION**

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## SECTION 233100 HVAC DUCTS AND CASINGS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Metal ductwork.
- B. Nonmetal ductwork.

#### 1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete.
- B. Section 078400 - Firestopping.
- C. Section 099113 - Exterior Painting: Weld priming, weather resistant, paint or coating.
- D. Section 099123 - Interior Painting: Weld priming, paint or coating.
- E. Section 114000 - Foodservice Equipment: Supply of kitchen range hoods for placement by this Section.
- F. Section 230130.51 - HVAC Air Duct Cleaning: Cleaning ducts after completion of installation.
- G. Section 230593 - Testing, Adjusting, and Balancing for HVAC.
- H. Section 230713 - Duct Insulation: External insulation and duct liner.
- I. Section 233300 - Air Duct Accessories.
- J. Section 233600 - Air Terminal Units.
- K. Section 233700 - Air Outlets and Inlets.

#### 1.03 REFERENCE STANDARDS

- A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; 2017.
- B. ASHRAE Std 126 - Method of Testing HVAC Air Ducts; 2016.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- D. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2016.
- E. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2017.
- F. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2017.
- G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- H. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- I. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2016.
- J. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2015.
- K. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

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- M. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
- N. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2016a.
- O. ASTM E2336 - Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems; 2020.
- P. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2015.
- Q. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2015.
- R. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.
- S. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2016.
- T. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- U. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2018.
- V. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2017.
- W. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).
- X. SMACNA (FGD) - Fibrous Glass Duct Construction Standards; 2003.
- Y. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines; 2001.
- Z. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; 2012, 2nd Edition.
- AA. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.
- AB. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.
- AC. UL 1978 - Grease Ducts; Current Edition, Including All Revisions.
- AD. UL 2221 - Tests of Fire Resistive Grease Duct Enclosure Assemblies; Current Edition, Including All Revisions.

#### 1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for duct materials, duct liner, and duct connections.
- C. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for all duct systems.
- D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK).
- E. Manufacturer's Installation Instructions: Indicate special procedures for glass fiber ducts.
- F. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

#### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum five years of documented experience.

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## 1.06 FIELD CONDITIONS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

## PART 2 PRODUCTS

### 2.01 DUCT ASSEMBLIES

- A. Regulatory Requirements: Construct ductwork to NFPA 90A, NFPA 90B, and NFPA 96 standards, as applicable.
- B. Ducts: Galvanized steel, unless otherwise indicated.
- C. Low Pressure Supply (Heating Systems): 2 inch w.g. pressure class, galvanized steel.
- D. Low Pressure Supply (System with Cooling Coils): 2 inch w.g. pressure class, galvanized steel.
- E. Transfer Air and Sound Boots: 1/2 inch w.g. pressure class, Fibrous glass or sheet metal with acoustic lining.
- F. Medium and High Pressure Supply: 6 inch w.g. pressure class, galvanized steel.
- G. Return and Relief: 1/2 inch w.g. pressure class, galvanized steel.

### 2.02 MATERIALS

- A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
- B. Stainless Steel for Ducts: 1, Type 304.
- C. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
  - 1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
  - 2. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
- D. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
- E. Sheet Metal Strap.
- F. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- G. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
  - 1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
  - 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
  - 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
  - 4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
  - 5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
  - 6. Other Types: As required.

### 2.03 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.
- B. No variation of duct configuration or size permitted except by written permission. Where permitted, size round duct installed in place of rectangular ducts in accordance with ASHRAE (FUND) Handbook - Fundamentals.
- C. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

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- D. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline, or where rectangular elbows are used, provide single width blade with trailing edge turning vanes of galvanized steel sheet metal.
- E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- F. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).

#### **2.04 MANUFACTURED DUCTWORK AND FITTINGS**

- A. Spiral Ducts: Round spiral lock seam duct with galvanized steel outer wall.
  - 1. Manufacture in accordance with SMACNA (DCS).
- B. Round Ducts: Round lock seam duct with galvanized steel outer wall.
  - 1. Manufacture in accordance with SMACNA (DCS).
- C. Flexible Ducts: Woven and coated fiberglass liner permanently bonded to a helically wound coated or galvanized spring steel wire.
  - 1. Class 1.
  - 2. UL labeled.
  - 3. Insulation: Fiberglass insulation with aluminized polyester vapor barrier film.
  - 4. Pressure Rating: 16 inches WG positive for 4"-10" duct, 10 inches WG positive for 12"-16" duct, and 2 inches WG negative.
  - 5. Maximum Velocity Rating: 5500 fpm.
  - 6. Temperature Range: Minus 20 degrees F to 250 degrees F.
  - 7. Manufacturers:
    - a. Flexmaster U.S.A; 3M
    - b. Thermaflex; M-KC
    - c. Hart & Cooley, Inc; F294
    - d. Substitutions: See Section 016000 - Product Requirements.
- D. Transverse Duct Connection System: SMACNA "E" rated rigidly class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).

**END OF SECTION**

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**SECTION 233300**  
**AIR DUCT ACCESSORIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Air turning vanes.
- B. Duct access doors.
- C. High efficiency take-offs with hand dampers.
- D. Hand dampers.
- E. Duct test holes.
- F. Flexible duct connections.
- G. Variable control dampers.
- H. Miscellaneous products:
  - 1. Duct opening closure film.

**1.02 RELATED REQUIREMENTS**

- B. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- C. Section 233100 - HVAC Ducts and Casings.
- D. Section 233600 - Air Terminal Units: Pressure regulating damper assemblies.
- E. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

**1.03 REFERENCE STANDARDS**

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- C. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2017.
- D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, and hardware used. Include electrical characteristics and connection requirements.
- C. Project Record Drawings: Record actual locations of access doors.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the Authority Having Jurisdiction as suitable for the purpose specified and indicated.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Protect dampers from damage to operating linkages and blades. Store in clean, dry location.

**PART 2 PRODUCTS**

**2.01 AIR TURNING DEVICES**

- A. Manufacturers:
  - 1. Carlisle HVAC Products; Model DYN-O-RAIL, DYN-O-RAIL JR.
  - 2. Elgen Manufacturing, Inc; Model EVR-1

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3. Duro Dyne Corp; Model DHVR2, DHVR4
  4. Ductmate Industries, Inc.; MONOrail
  5. Substitutions: See Section 016000 - Product Requirements.
- B. Multi-blade device with radius single wall blades aligned in short dimension of all square duct elbows; steel construction; turning vane spacing per SMACNA (DCS); each blade tack welded or crimped to the vane rail to prevent rattling.

## 2.02 DUCT ACCESS DOORS

- A. Manufacturers:
1. Acudor Products Inc.; \_\_\_\_\_
  2. Elgen Manufacturing, Inc; \_\_\_\_\_
  3. Ductmate Industries, Inc.; \_\_\_\_\_
  4. Nailor Industries, Inc; \_\_\_\_\_
  5. Duro Dyne Corp.; \_\_\_\_\_
  6. SEMCO LLC; \_\_\_\_\_: www.semcohv.com
  7. Substitutions: See Section 016000 - Product Requirements.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Access doors with sheet metal screw fasteners are not acceptable.

## 2.03 HIGH EFFICIENCY TAKE-OFFS WITH MANUAL BALANCING DAMPERS

- A. Manufacturers:
1. Sheet Metal Connectors, Inc.;
  2. Substitutions: See Section 016000 - Product Requirements.
- B. Fabricated in accordance to SPIDA and SMACNA / ASHRAE Leakage Class 3 standards. Testing performed by ETL Testing lab.
- C. Fabricated from minimum 22 gauge galvanized steel (ASTM A653).
- D. 45 degree take-off angle design for optimal air flow.
- E. Supply with gasketed discharge connection.
- F. 1" wide flange with minimum 3/4" wide double faced adhesive gasket to assure tight seal and to hold the fitting securely in position during installation.
- G. 2" rod extension to extend damper handle location beyond duct insulation.
- H. Damper handle with locking hex or wing nut. Position of damper handle shall indicate damper setting.

## 2.04 MANUAL BALANCING DAMPERS

- A. Manufacturers:
1. Greenheck;
  2. Ruskin;
  3. Pottorff;
  4. Substitutions: See Section 016000 - Product Requirements.
- B. Frame: 20 gauge galvanized steel.
- C. Blades: 20 gauge galvanized steel.
- D. Control shafts and axles: 3/8" square plated steel, extended for stand-off.
- E. Bearings: Synthetic.
- F. 1 1/2" high stand-off bracket, minimum, with factory installed manual locking quadrant.
- G. Rated for maximum system velocity of 1500 fpm.

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## 2.05 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

## 2.06 FLEXIBLE DUCT CONNECTIONS

- A. Manufacturers:
  - 1. Carlisle HVAC Products
  - 2. Duro Dyne Corp.; \_\_\_\_\_
  - 3. Ductmate Industries, Inc.; \_\_\_\_\_
  - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Flexible Duct Connections: Fabric crimped into metal edging strip.
  - 1. Fabric: UL listed fire-retardant neoprene or hypalon coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
    - a. Net Fabric Width: Approximately 3.5 inch wide.
  - 2. Metal: 3 inches wide, 24 gage, 0.0239 inch thick galvanized steel.

## 2.07 VARIABLE CONTROL DAMPERS

- A. Manufacturers:
  - 1. Greenheck Fan Company;
  - 2. Ruskin Company;
  - 3. T.A. Morrison & Co. (Tamco);
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Variable Control Dampers:
  - 1. Dampers shall be supported, plenum openings shall be reinforced, the entire assembly shall be sturdy and operate smoothly; install parallel blade dampers to direct outside and return air into each other for mixing; use parallel blade dampers for outside air, return air, use opposed blade dampers for relief air, ventilation air, exhaust air, and supply air.
  - 2. Low leakage type with spring loaded side seals, inflatable butyl or neoprene fabric edge seals, bronze or Teflon bearings, reinforced extruded aluminum airfoil blades, aluminum frame. Action as indicated on drawings. Air leakage not to exceed 5 CFM per square foot at 4" upstream static pressure.
- D. Single Blade Dampers:
  - 1. Fabricate for duct sizes up to 6 by 30 inch.
  - 2. Blade: 24 gage, 0.0239 inch, minimum.
  - 3. Manufacturers:
    - a. Greenheck; VCD-43.
    - b. Ruskin; CD50.
    - c. Tamco; Series 1000.
- E. Multi-Blade Damper: Fabricate of opposed or parallel blade pattern with maximum blade sizes 8 by 60 inch. Maximum individual damper section height, 60". Maximum individual damper section width, 60".
  - 1. Blade: 18 gage, 0.0478 inch, minimum.
  - 2. Manufacturers:
    - a. Greenheck; VCD-43.
    - b. Ruskin; CD50.
    - c. Tamco; Series 1000.

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- F. Quadrants:
  - 1. Provide locking, indicating quadrant regulators on single and multi-blade hand dampers.
  - 2. On insulated ducts, mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
  - 3. Where rod lengths exceed 30 inches provide regulator at both ends.

## 2.08 MISCELLANEOUS PRODUCTS

- A. Duct Opening Closure Film: Mold-resistant, self-adhesive film to keep debris out of ducts during construction.
  - 1. Thickness: 2 mils.
  - 2. High tack water based adhesive.
  - 3. UV stable light blue color.
  - 4. Elongation Before Break: 325 percent, minimum.
  - 5. Manufacturers:
    - a. Carlisle HVAC Products; Dynair Duct Protection Film:
    - b. Elgen Manufacturing; Shrink Wrap w/PSA.
    - c. Substitutions: See Section 016000 - Product Requirements.

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.
- B. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until conditions allow for contamination free duct installation.

### 3.02 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 233100 for duct construction and pressure class.
- B. Provide duct access doors for inspection, cleaning, and maintenance ahead of filters, coils, fans, and automatic dampers, and at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96. Provide duct access door, of adequate size, for equipment requiring hand access or shoulder access, and as indicated. Review duct access door locations with Owner's Representative prior to fabrication.
- C. Install turning vanes in square or rectangular 90 degree elbows in supply air systems, and elsewhere as indicated.
- D. **Furnish and install manual balancing dampers on duct take-offs to diffusers, grilles, and registers on zones with multiple outlets.**

**END OF SECTION**

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**SECTION 233600**  
**AIR TERMINAL UNITS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Air terminal units.
  - 1. Single-duct, variable-volume units.
- B. Hot water reheat coil.

**1.02 RELATED REQUIREMENTS**

- A. Section 230513 - Common Motor Requirements for HVAC Equipment.
- B. Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- C. Section 230913 - Instruments and Control Elements: Thermostats and actuators.
- D. Section 230923 - Direct-Digital Control System for HVAC.
- E. Section 230993 - Sequence of Operations for HVAC Controls.
- F. Section 232113 - Hydronic Piping: Connections to heating coils.
- G. Section 232114 - Hydronic Specialties: Connections to heating coils.
- H. Section 233100 - HVAC Ducts and Casings.
- I. Section 233300 - Air Duct Accessories.
- J. Section 233700 - Air Outlets and Inlets.
- K. Section 238200 - Convection Heating and Cooling Units: Air coils.
- L. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

**1.03 REFERENCE STANDARDS**

- A. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001 (R2011).
- B. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2011 with Addendum 1.
- C. AHRI 885 - Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets; 2008 with Addendum 1.
- D. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2017.
- E. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality; 2016.
- F. ASHRAE Std 130 - Methods of Testing Air Terminal Units; 2016.
- G. ASTM A492 - Standard Specification for Stainless Steel Rope Wire; 1995 (Reapproved 2013).
- H. ASTM A603 - Standard Specification for Zinc-Coated Steel Structural Wire Rope; 1998 (Reapproved 2014).
- I. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2016.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- K. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2015.
- L. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

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- N. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- O. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; Sheet Metal and Air Conditioning Contractors' National Association; 2008.
- P. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.
- Q. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Conduct a preinstallation meeting prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.
- C. Contractor shall provide a first installation of air terminal unit assembly and installation for owner's review. If both dual duct and vav reheat assemblies are used on project, a first installation shall be provided for each type of assembly. First installations, shall be reviewed and approved by owner's representative prior to any additional terminal unit assembly installations for project. After owner approval, all remaining terminal unit assembly installations shall meet standard of approved terminal assembly first installation.

**1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate air flow, static pressure, and NC designation.
- C. Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication, of air terminal unit assembly. Drawings shall confirm spacing between face of coil and damper housing, as indicated in provided details.
- D. Certificates: Certify that coils are tested and rated in accordance with AHRI 410.
- E. Manufacturer's Installation Instructions: Indicate support and hanging details, installation instructions, recommendations, and service clearances required.
- F. Project Record Documents: Record actual locations of units and locations of access doors required for access of valving.
- G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 016000 - Product Requirements, for additional provisions.

**1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- C. Coordinate with Owner's commissioning representative, on first install, to confirm compliance of specification requirements.

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## 1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

## PART 2 PRODUCTS

### 2.01 AIR TERMINAL UNITS

- A. Manufacturers:
1. Titus; \_\_\_\_\_
  2. Krueger; \_\_\_\_\_
  3. Price Industries, Inc; \_\_\_\_\_
- B. Basis of Design: Price Industries, Inc.
1. Single-Duct Terminal Unit: SDV5000.
- C. Acoustic Performance Requirements:
1. Use attenuation values found in appendix E of AHRI 885.
- D. General:
1. Factory-assembled, variable volume air control terminal with damper assembly and flow sensor.
  2. AHRI 880 (I-P) rated.
- E. Unit Casing:
1. Minimum 22 gage, 0.0299 inch galvanized steel.
    - a. Assembled with longitudinal lock seam construction.
    - b. Casing leakage to meet ASHRAE Std 130.
  2. Air Inlet Collar: Provide round, suitable for standard duct sizes 6" dia. and above.
  3. Unit Discharge: Rectangular, with slip-and-drive connections.
  4. Liner:
    - a. 1/2 inch thick, coated, fibrous-glass.
      - 1) Secure with adhesive.
      - 2) Coat edges exposed to airstream with NFPA 90A approved sealant.
      - 3) Insulation shall comply with the requirements of UL 181 (erosion), ASTM C1338 (fungi resistance), ASHRAE 62.1, and ASTM C1071, having a maximum flame/smoke spread of 25/50 for both the insulation and the adhesive when tested in accordance with ASTM E84.
- F. Damper Assembly:
1. The damper assembly shall be minimum 18 gauge, galvanized steel with a solid shaft rotating in bearings.
  2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees. Shaft shall be clearly marked on the end to indicate damper position. The vav box shall incorporate mechanical stops to prevent over stroking of the damper and a synthetic seal to limit close-off leakage.
  3. The damper assembly shall incorporate a peripheral gasket on the damper blades for tight airflow shutoff.
  4. The air leakage past the closed damper shall not exceed two percent of unit maximum airflow at 3 inch wg inlet static pressure, tested in accordance with ASHRAE Std 130.
- G. Airflow Sensor:
1. The airflow sensor shall be a differential pressure airflow device measuring total and static pressures, and shall be factory mounted to the air inlet collar.
  2. Plastic parts shall be fire-resistant, complying with UL 94.
  3. Control tubing shall be protected by grommets at the wall of the airflow sensor's housing.
  4. The airflow sensor signal accuracy shall be plus or minus five percent throughout terminal operating range.

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## 2.02 HOT WATER REHEAT COIL

- A. Coil Construction:
  - 1. Coil Casing: Minimum 22 gage, 0.0299 inch galvanized steel, casing size to match air terminal unit discharge with rectangular outlet, duct connection type. See installation notes and detail for approved installation location of coil.
  - 2. Coil Fins: Aluminum or aluminum plated 0.0045 inch fins, mechanically-bonded to seamless 0.50 by 0.016 inch copper tubes.
    - a. Fins to be formed in a high heat transfer sine wave configuration.
    - b. Two rows with ten fins-per-inch heating capacity density.
  - 3. Coil leak tested to minimum 300 psig.
  - 4. Base performance data on tests run in accordance with AHRI 410 and units to bear AHRI 410 label.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that conditions are suitable for installation.
- B. Verify that field measurements are as indicated on drawings.

### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.
- C. Sheet metal contractor shall remove and dispose of entire control box enclosure from all air terminal units prior to installation.
- D. Sheet metal contractor shall permanently cap or plug all air terminal box airflow sensor tubing except when controls contractor requires airflow sensor use.
- E. See drawings for vav box and reheat coil installation details and the size(s) and duct location(s) of all air terminal units.
- F. Install 12" section of ductwork between any air terminal units with reheat coils. Furnish and install a 9"x9" minimum duct access door with, two (2) cam lock latches, in bottom of duct to facilitate inspection and cleaning of reheat coil. Coordinate installation location of assemblies to facilitate inspection and cleaning.
- G. Install 12" long section of lined ductwork matching discharge size of air terminal box(es) or reheat coil whenever discharge duct size is smaller than the discharge size of air terminal box(es) or reheat coil.
- H. Provide ceiling access doors or locate units above easily removable ceiling components.
- I. Support air terminal units individually from structure with 22 gauge hanger strap in accordance with SMACNA (SRM). See Section 230548.
- J. Embed support anchors in concrete in accordance with ASTM E488/E488M.
- K. Do not support air terminal units and reheat coils from ductwork.
- L. Connect to ductwork in accordance with Section 233100.
- M. Provide 1 inch thick acoustically lined ductwork downstream of units.
- N. Verify that electric power is available and of the correct characteristics.
- O. Install reheat coil piping to provide thermal trap by rising supply/return pipes a minimum of 6" rise within three feet of unit.

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### 3.03 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Test and inspect field-assembled components and equipment installation, including connections. Report results in writing.
  - 1. Leak Test:
    - a. After installation, fill water coils and test for leaks.
    - b. Repair leaks and retest until no leaks exist.
  - 2. Operational Test:
    - a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
    - b. Test and adjust controls and safeties.
    - c. Replace damaged and malfunctioning controls and other equipment.
    - d. Remove and replace malfunctioning units and retest as specified above.

### 3.04 SCHEDULES - SEE DRAWINGS FOR SCHEDULES OF ALL AIR TERMINALS AND REHEAT COILS.

**END OF SECTION**

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**SECTION 233700**  
**AIR OUTLETS AND INLETS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Diffusers.
- B. Registers/grilles.

**1.02 RELATED REQUIREMENTS**

- A. Section 099123 - Interior Painting: Painting of ducts visible behind outlets and inlets.

**1.03 REFERENCE STANDARDS**

- A. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2011 with Addendum 1.
- B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2015.
- C. AMCA 511 - Certified Ratings Program for Air Control Devices; 2010.
- D. AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers; 2015.
- E. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Inlets; 2006 (R2011).
- F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- I. ISO 14644-1 - Cleanrooms and associated controlled environments - Part 1: Classification of air cleanliness by particle concentration; 2015.
- J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.
- K. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- L. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2018.
- M. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.
- N. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission.
- C. Project Record Documents: Record actual locations of air outlets and inlets.

**1.05 QUALITY ASSURANCE**

- A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.
- B. Test and rate louver performance in accordance with AMCA 500-L.
- C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- D. Coordinate with Owner's commissioning representative, on first install, to confirm compliance of specification requirements.

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## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Diffusers and Grilles:
  - 1. Titus, a brand of Air Distribution Technologies;
  - 2. Hart & Cooley, Inc.;
  - 3. Price Industries;
  - 4. Krueger-HVAC, Division of Air System Components; \_\_\_\_\_
- B. Substitutions: See Section 016000 - Product Requirements.

### **2.02 SQUARE CEILING SUPPLY AIR DIFFUSERS - MODULAR T-BAR**

- A. Type: Square, 24" x 24" module, border type for lay-in installation, removable plaque design for all neck sizes. Type as specified on drawings.
- B. Connections: Round.
- C. Frame: Provide inverted T-bar type as indicated on drawings.
- D. Fabrication: Steel with baked enamel finish.
- E. Color: As indicated on drawings.
- F. Accessories: Furnish diffuser with adjustable pattern controller, to adjust discharge pattern from horizontal to vertical, for diffusers installed 12 feet above finished floor and higher.
- G. Models:
  - 1. Titus No. OMNI
  - 2. Price No. SPD
  - 3. Krueger No. PLQ

### **2.03 SQUARE AND RECTANGULAR SUPPLY AIR DIFFUSERS**

- A. Type: Square or rectangular louvered face ceiling diffuser with square or rectangular neck, field removeable core, and with one-, two-, three-, or four-way horizontal discharge pattern.
- B. Connections: Square, rectangular, and transition piece for round.
- C. Frame: Provide surface mount type as indicated on drawings.
- D. Fabrication: Heavy gauge steel with baked enamel finish.
- E. Color: As indicated on drawings.
- F. Accessories: Furnish diffuser with moveable vanes, to adjust discharge pattern from horizontal to vertical, for diffusers installed 12 feet above finished floor and higher.
- G. Models:
  - 1. Titus No. TDC
  - 2. Hart & Cooley No. SRE
  - 3. Price No. SMD
  - 4. Krueger No. SHPC

### **2.04 PERFORATED FACE RETURN AIR GRILLES - T-BAR**

- A. Type: Perforated face, border type for lay-in installation.
- B. Frame: Inverted T-bar type, module sizes 12" x 24" or 24" x 24".
- C. Fabrication: Steel with steel frame and baked enamel finish.
- D. Color: As indicated on drawings.
- E. Models:
  - 1. Titus No. PAR
  - 2. Hart & Cooley No. PDF

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- 3. Price No. PFRF
- 4. Krueger No. 1190

**2.05 PERFORATED FACE RETURN AIR GRILLES - SURFACE MOUNT**

- A. Type: Perforated face, border type for surface installation.
- B. Frame: Surface mount type, size as per drawings.
- C. Fabrication: Steel with steel frame and baked enamel finish.
- D. Color: As indicated on drawings.
- E. Models:
  - 1. Titus No. PAR
  - 2. Hart & Cooley No. PDF
  - 3. Price No. PFRF
  - 4. Krueger No. 1190

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Comply with SMACNA (ASMM) for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.
- C. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- D. Install diffusers to ductwork with air tight connection.
- E. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

**3.02 AIR OUTLET AND INLET SCHEDULE - SEE DRAWING SCHEDULES.**

**END OF SECTION**

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BRIGHAM YOUNG UNIVERSITY

ADDENDUM RECEIPT

DATE: February 23, 2024

PROJECT: HCEB Continuing Education Office Remodel Floors 1 & 4

PROJ. #: WO # N1864 & N3482

We acknowledge receipt of Addendum Number 1.

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

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

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

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