



Mechanical Engineering  
Electrical Engineering  
Technology Engineering  
Acoustical Engineering  
Lighting Design  
Theatre Design  
Fire Protection Engineering  
Building Commissioning

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## Mechanical Addendum #1

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**Date:** February 27, 2026  
**To:** Jay Taggart  
**Company:** Method Studio  
**Job:** Intermountain McKay Dee IR  
Expansion  
**Job No:** 250450

**From:** Alex Boswell  
**Email:** Alex.Boswell@Speceng.com  
**Phone:** 801-834-7031

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This Addendum shall be considered part of the Contract Documents and Project Manual for the above-mentioned project as though it had been issued at the same time and shall be incorporated integrally therewith. Where provisions of the following supplementary data differ from those of the original Contract Documents and Project Manual, the Addendum shall govern and take precedence.

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### Mechanical Addendum

#### Drawings

1. P601 – PLUMBING SCHEDULES
  - a. Changes to plumbing fixture schedule

#### Specifications

2. 220548 – VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
  - a. OSHPD requirement removed
3. 220719 – PLUMBING PIPING INSULATION
  - a. Removed editor notes from specification
4. 224216 – COMMERCIAL SINKS
  - a. Spec removed from project
5. 224223 – COMMERCIAL SHOWERS
  - a. Spec removed from project
6. 224213 - COMMERCIAL WATER CLOSETS



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- a. Spec removed from project
- 7. 224300 – HEALTHCARE PLUMBING FIXTURES
  - a. Spelling errors were fixed
  - b. Basis of design updated to match Plumbing Fixture Schedule
- 8. 226213 – VACUUM PIPING FOR LABORATORY AND HEALTHCARE FACILITIES
  - a. Spelling errors were fixed
- 9. 230529 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
  - a. Removed editor notes from specification
- 10. 233113 – METAL DUCTS
  - a. OSHPD requirement removed
- 11. 233400 – HVAC FANS
  - a. Spec was added
- 12. 233600 - AIR TERMINAL UNITS
  - a. Added critical environment control valve to spec



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## Electrical Addendum #1

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**Date:** February 26, 2026  
**To:** Jay Taggart  
**Company:** Method Studio  
**Job:** Intermountain McKay Dee IR  
Expansion  
**Job No:** 250450  
**From:** Brendan Arita  
**Email:** Brendan.Arita@Speceng.com  
**Phone:** 801-889-7233

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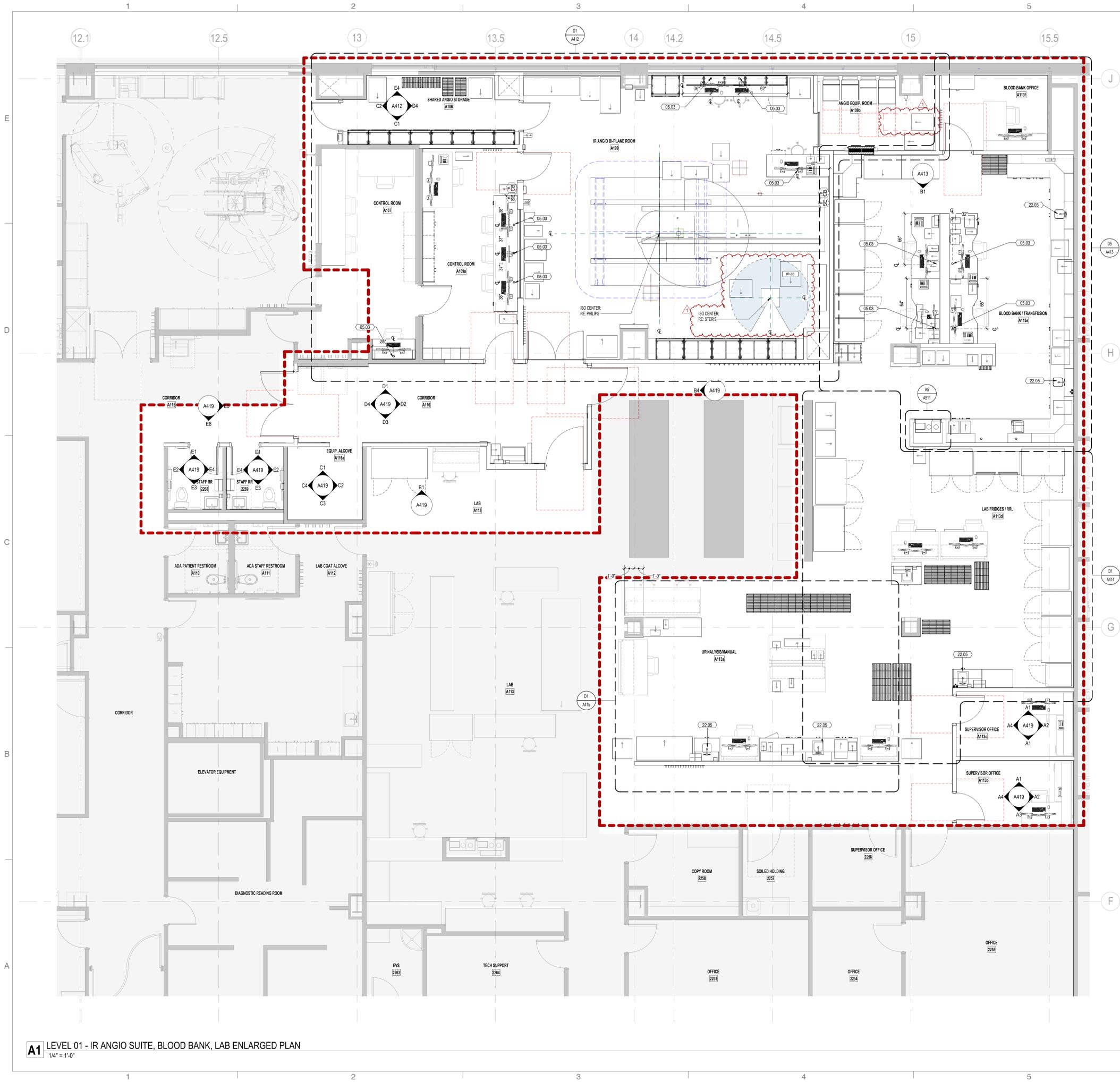
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### Electrical Addendum

#### Drawings

1. EP103A – Level 1 Power Plan – Area A
  - a. Updated boom location.
2. EP501, & EP502 – Phillips Drawings
  - a. Updated vendor drawings.
3. EP503, EP504, EP505, & EP506– GE Drawings
  - a. New sheets.
4. EP101A – Level 1 Lighting Plan – Area A
  - a. Updated lighting layout to coordinate with new boom layout.



**GENERAL NOTES - FLOOR PLAN**

- GENERAL CONTRACTOR SHALL FIELD VERIFY ALL CONDITIONS AND SHALL REPORT TO THE ARCHITECT ANY UNKNOWN CONDITIONS, ERRORS, OR CONFLICTS IN THE DRAWINGS BEFORE BEGINNING WORK
- DO NOT SCALE THE DRAWINGS
- SEE 6000 SERIES SHEETS FOR TYPICAL MOUNTING HEIGHTS; PROVIDE SOLID BLOCKING IN WALLS FOR ALL WALL-MOUNTED ITEMS WHETHER BLOCKING IS DEPICTED IN DRAWINGS OR NOT
- COORDINATE ALL EQUIPMENT AND ACCESSORIES, INCLUDING ITEMS THAT ARE OWNER FURNISHED, OWNER INSTALLED
- SEE SHEET SERIES A400 FOR WALL AND ASSEMBLY TYPES
- SEE SHEET SERIES A400 FOR DOOR AND WINDOW TYPES
- SEE ELEVATIONS AND FINISH SCHEDULES FOR SURFACE TREATMENTS AT WALLS
- SEE ELEVATIONS, SECTIONS, AND DETAILS FOR ADDITIONAL WALL CONSTRUCTION INFORMATION
- DOOR OPENINGS IN FRAME CONSTRUCTION WITH NO SPECIFIED DIMENSION ARE EITHER CENTERED IN THE LENGTH OF WALL RUN OR 3" DRAWN NEAR CORNER LOCATED 4" FROM THE FACE OF ADJACENT STUD. ASSUME CENTERED IN FACE OF JAMB UNLESS NOTED OTHERWISE
- COORDINATE ALL SLAB PENETRATIONS AND UNDER FLOOR DUCTS WITH SIEMENS EQUIPMENT PLANS
- REFER TO UL DESIGNS FOR WALL PENETRATIONS AT RATED WALLS. RE: G100 SHEET SERIES



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project:  
**IHC McKay  
Dee IR  
Expansion**

MCKAY DEE HOSPITAL  
4401 HARRISON BLVD  
OGDEN, UTAH 84403

project#: 25.0200  
date: 02 FEB 2026

revisions:  
1 Add 1 2/27/2026

**PROJECT SCOPE LEGEND -  
NEW CONSTRUCTION**

- EXISTING TO REMAIN
- PROJECTED SCOPE OF WORK FROM LEVEL ABOVE
- SCOPE OF WORK
- PROJECTED SCOPE OF WORK FROM LEVEL BELOW

**LEVEL 1 KEY PLAN**

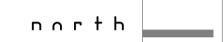


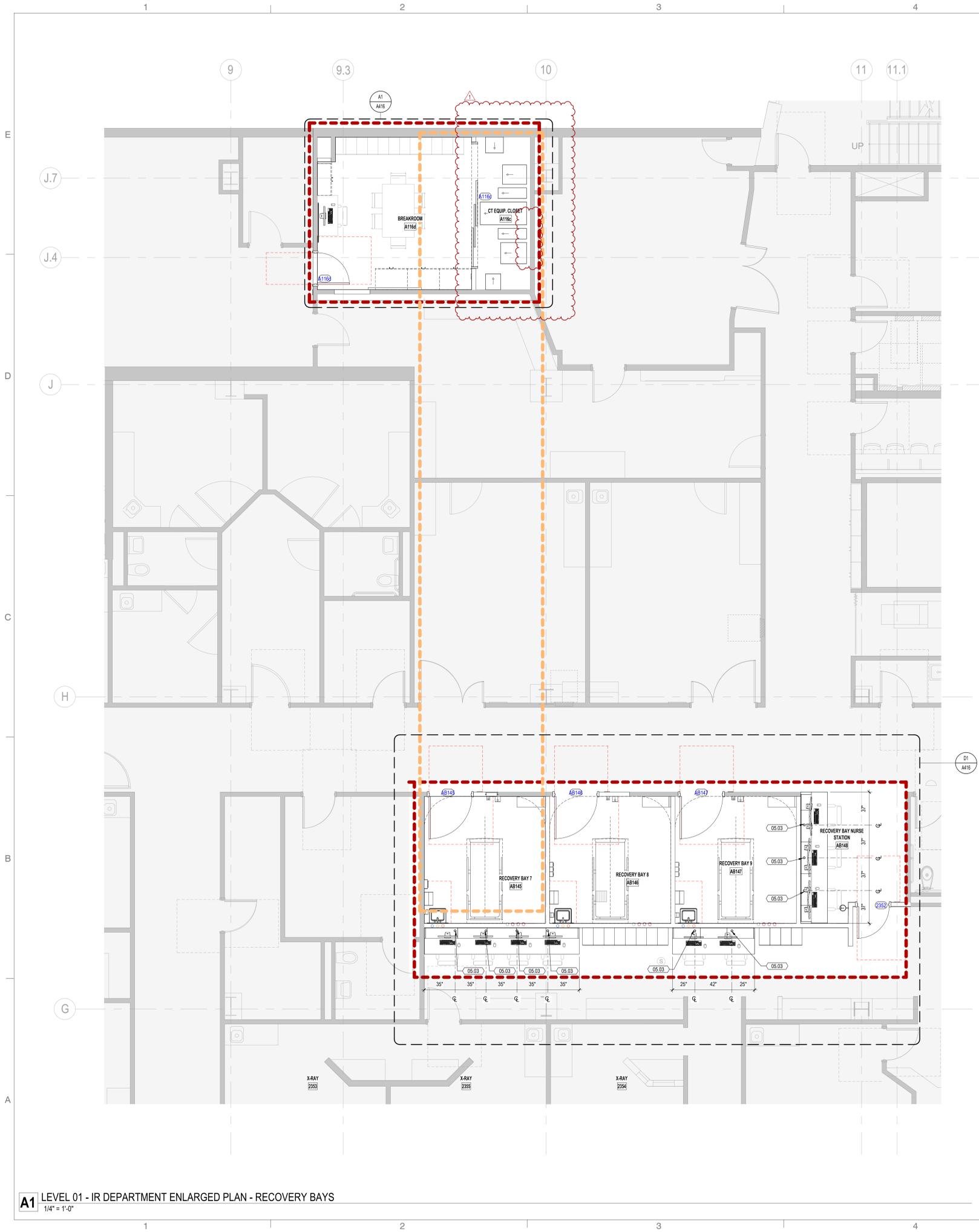
title:  
**LEVEL 01 -  
ENLARGED  
FLOOR PLAN  
- IR ANGIO  
SUITE,  
BLOOD  
BANK & LAB**

sheet:  
**A101a**

CONSTRUCTION DOCUMENT  
SET

**A1** LEVEL 01 - IR ANGIO SUITE, BLOOD BANK, LAB ENLARGED PLAN  
1/4" = 1'-0"





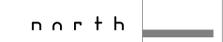
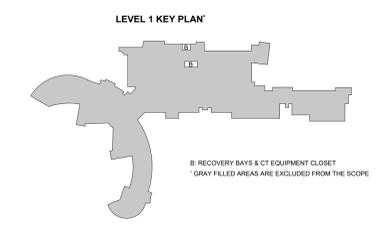
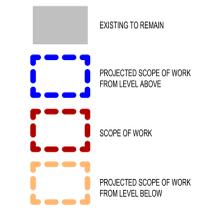
**GENERAL NOTES - FLOOR PLAN**

1. GENERAL CONTRACTOR SHALL FIELD VERIFY ALL CONDITIONS AND SHALL REPORT TO THE ARCHITECT ANY UNKNOWN CONDITIONS, ERRORS, OR CONFLICTS IN THE DRAWINGS BEFORE BEGINNING WORK
2. DO NOT SCALE THE DRAWINGS
3. SEE 600 SERIES SHEETS FOR TYPICAL MOUNTING HEIGHTS. PROVIDE SOLID BLOCKING IN WALLS FOR ALL WALL-MOUNTED ITEMS WHETHER BLOCKING IS DEPICTED IN DRAWINGS OR NOT
4. COORDINATE ALL EQUIPMENT AND ACCESSORIES, INCLUDING ITEMS THAT ARE OWNER FURNISHED, OWNER INSTALLED
5. SEE SHEET SERIES A500 FOR WALL AND ASSEMBLY TYPES
6. SEE SHEET SERIES A600 FOR DOOR AND WINDOW TYPES
7. SEE ELEVATIONS AND FINISH SCHEDULES FOR SURFACE TREATMENTS AT WALLS
8. SEE ELEVATIONS, SECTIONS, AND DETAILS FOR ADDITIONAL WALL CONSTRUCTION INFORMATION
9. DOOR OPENINGS IN FRAME CONSTRUCTION WITH NO SPECIFIED DIMENSION ARE EITHER CENTERED IN THE LENGTH OF WALL RUN OR (IF DRAWN NEAR CORNER) LOCATED 4" FROM THE FACE OF ADJACENT STUD. ASSUME CENTERED IN FACE OF JAMB UNLESS NOTED OTHERWISE
10. COORDINATE ALL SLAB PENETRATIONS AND UNDER FLOOR DUCTS WITH SIEMENS EQUIPMENT PLANS
11. REFER TO UL DESIGNS FOR WALL PENETRATIONS AT RATED WALLS. RE: G100 SHEET SERIES

**KEYED NOTES**

05.03 WORKSURFACE GROMMET, RE: HARDWARE SCHEDULE

**PROJECT SCOPE LEGEND - NEW CONSTRUCTION**



**A1** LEVEL 01 - IR DEPARTMENT ENLARGED PLAN - RECOVERY BAYS  
1/4" = 1'-0"



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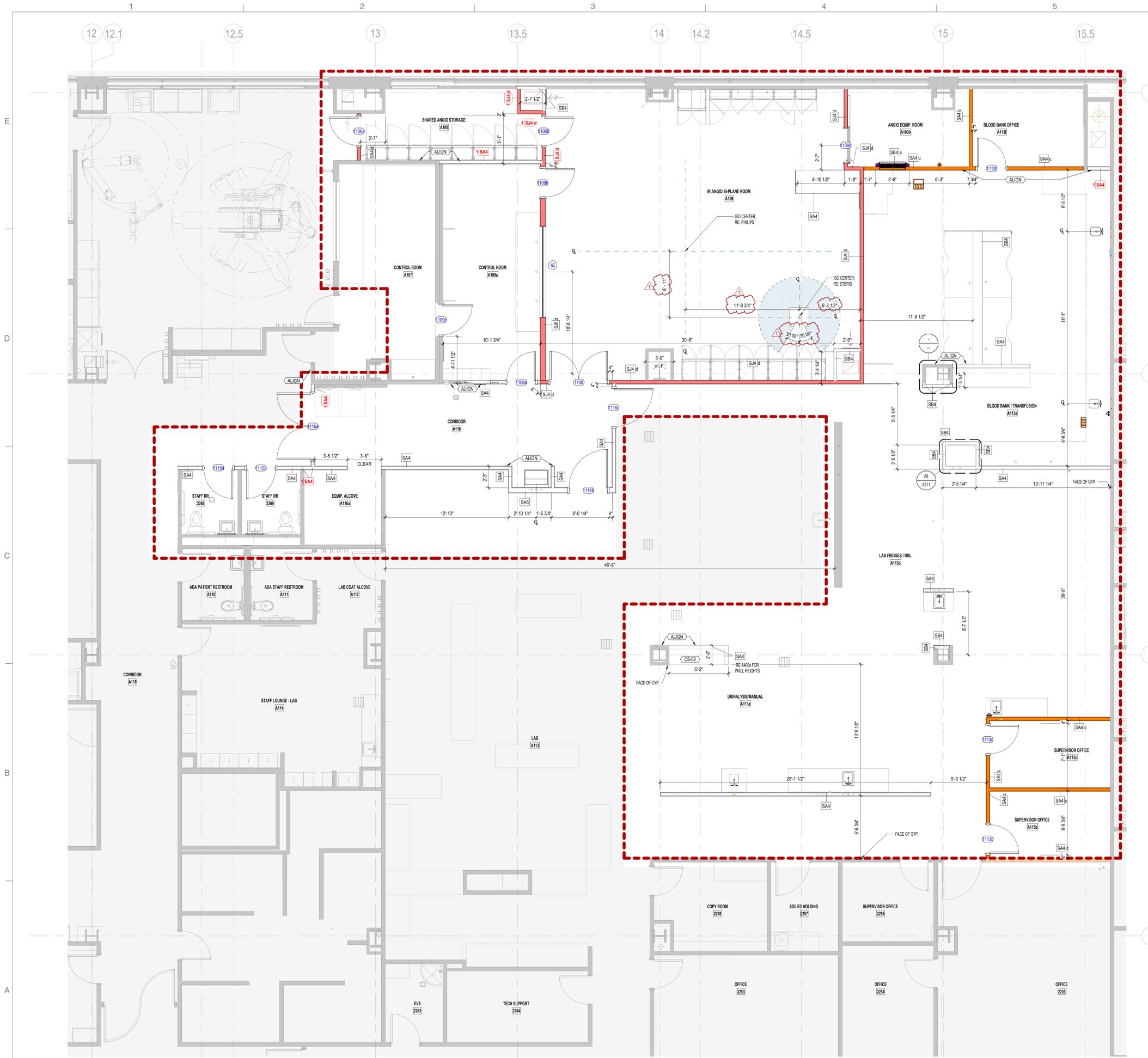
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Dee IR  
Expansion**  
  
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revisions:  
1 Add 1 2/27/2026

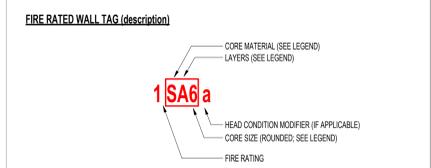
title:  
**LEVEL 01 -  
ENLARGED  
FLOOR PLAN  
- RECOVERY  
BAYS**

sheet:  
**A101b**  
CONSTRUCTION DOCUMENT  
SET



**GENERAL NOTES - DIMENSION PLAN**

- GENERAL CONTRACTOR SHALL FIELD VERIFY ALL CONDITIONS AND SHALL REPORT TO THE ARCHITECT ANY UNKNOWN CONDITIONS, ERRORS, OR CONFLICTS IN THE DRAWINGS BEFORE BEGINNING WORK. THIS INCLUDES, BUT ARE NOT LIMITED TO, RATED VERTICAL AND HORIZONTAL ASSEMBLIES AND EXISTING SLAB CONDITIONS AND PENETRATIONS.
- DO NOT SCALE THE DRAWINGS.
- ALL EXPOSED INTERIOR COLUMNS TO BE PAINTED, UNLESS NOTED OTHERWISE.
- SEE G200 SHEET SERIES FOR TYPICAL MOUNTING HEIGHTS. PROVIDE SOLID BLOCKING IN WALLS FOR ALL WALL-MOUNTED ITEMS INCLUDING OWNER EQUIPMENT AND ACCESSORIES. WHETHER BLOCKING IS DEPICTED IN DRAWINGS OR NOT.
- COORDINATE ALL EQUIPMENT AND ACCESSORIES, INCLUDING ITEMS THAT ARE OWNER FURNISHED, OWNER INSTALLED.
- SEE SHEET SERIES A400 FOR WALL HEIGHTS BELOW COUNTERTOPS.
- SEE SHEET SERIES A500 FOR WALL AND ASSEMBLY TYPES.
- SEE SHEET SERIES A600 FOR DOOR AND WINDOW TYPES.
- SEE SHEET SERIES A100 FOR OWNER EQUIPMENT.
- SEE SHEET SERIES G200 FOR LEAD SHIELDING REPORT FOR THE ANGIO ROOM WALL CONSTRUCTIONS.
- SEE ELEVATIONS AND FINISH SCHEDULES FOR SURFACE TREATMENTS AT WALLS.
- SEE ELEVATIONS, SECTIONS, AND DETAILS FOR ADDITIONAL WALL CONSTRUCTION INFORMATION.
- ALL DIMENSIONS IN FRAME CONSTRUCTION WITH NO SPECIFIED DIMENSION ARE LOCATED 4" FROM THE FACE OF ADJACENT STUD. ASSUME CENTERED IN FACE OF JAMB UNLESS NOTED OTHERWISE.
- DOOR OPENINGS IN FRAME CONSTRUCTION WITH NO SPECIFIED DIMENSION ARE LOCATED 4" FROM THE FACE OF ADJACENT STUD. ASSUME CENTERED IN FACE OF JAMB UNLESS NOTED OTHERWISE.
- ALL CORRIDORS WITH SEED AND GURNEY ACCESS REQUIRE MINIMUM 8'-0" CLEAR PER FC2 2010. GENERAL CONTRACTOR TO FIELD VERIFY PRIOR TO FRAMING AND NOTIFY ARCHITECT FOR INCONSISTENCIES.



- LAYERS LEGEND**
- NOTE: DO NOT USE THE FOLLOWING LETTERS: L, I, and o. a through e are Method Studio's Standard, f and above are user defined.
- SA = GYPSUM BOARD BOTH SIDES OF CORE
  - SB = GYPSUM BOARD ONE SIDE OF CORE
  - SC = GYPSUM BOARD, 2 LAYERS BOTH SIDES OF CORE
  - SI = TYPE "X" GYPSUM BOARD OUTSIDE OF X-RAY IMAGING, LEAD-LEADED GYPSUM BOARD INSIDE OF X-RAY IMAGING

- WALL TYPE HEAD CONDITION LEGEND**
- IF NULL = TYPICAL PARTITION FLOOR TO FLOOR/CEILING/ROOF
- a = PARTITION EXTEND FROM FLOOR TO 6" ABOVE CEILING
  - b = ACOUSTIC PARTITION TO FLOOR/CEILING/ROOF - STC 35
  - c = ACOUSTIC PARTITION TO FLOOR/CEILING/ROOF - STC 45
  - d = ACOUSTIC PARTITION TO FLOOR/CEILING/ROOF - STC 50

**CORE MATERIAL LEGEND**

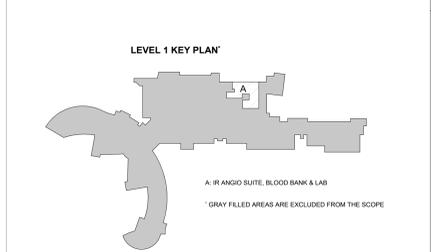
- C = CONCRETE WALLS, MASONRY
- S = STEEL STUDS
- W = WOOD STUDS
- G = GLAZING

**CORE SIZE LEGEND**

STEEL STUDS	WOOD STUDS	MASONRY (WIDTH)	CONCRETE (WIDTH)
1 = 7/8"			
2 = 1 5/8"	1 1/2"		
3 = 2 1/2"	2 1/2"		
4 = 3 5/8"	3 1/2"	MASONRY SIZE 4"	
5 =			
6 = 6"	5 1/2"	MASONRY SIZE 6"	CONCRETE 6"
8 = 8"	7 1/4"	MASONRY SIZE 8"	CONCRETE 8"
10 =	9 1/4"	MASONRY SIZE 10"	CONCRETE 10"
12 =	11 1/4"	MASONRY SIZE 12"	CONCRETE 12"
14 =			
16 =		MASONRY SIZE 16"	

- LEGEND: INT. PARTITION**
- TYPICAL PARTITION FLOOR TO UNDERSIDE OF STRUCTURE / DECK
  - EXISTING WALL / PARTITION FLOOR TO FLOOR / CEILING / DECK
  - PARTITION EXTENDS FROM FLOOR TO 6" ABOVE CEILING
  - PARTITION: STC 35
  - PARTITION STC 45
  - PARTITION STC 50
- FIELD VERIFY IF LISTED STC RATING IS ACHIEVABLE WITH EXISTING CONDITION; CONTRACTOR TO REACH OUT BEFORE THE CONSTRUCTION

- KEYED NOTES**
- ALIGN = ALIGN TO EXISTING FINISH
  - CS-02 = COUNTERTOP, SOLID COMPOSITE SURFACE, RE: INTERIOR FINISH SCHEDULE



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**IHC McKay  
Dee IR  
Expansion**

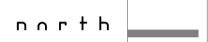
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OGDEN, UTAH 84403

project #: 25.0200  
date: 02 FEB 2026  
revisions:  
1 Add 1 2/27/2026

title:  
**LEVEL 01  
ENLARGED  
DIMENSION  
PLAN - IR  
ANGIO  
SUITE,  
BLOOD  
BANK, LAB**

sheet:  
**A121a**  
CONSTRUCTION DOCUMENT  
SET

**B1** LEVEL 1 IR ANGIO SUITE, BLOOD BANK, LAB DIMENSION PLAN  
1/4" = 1'-0"

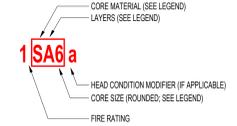




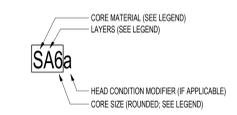
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- DO NOT SCALE THE DRAWINGS
- ALL EXPOSED INTERIOR COLUMNS TO BE PAINTED, UNLESS NOTED OTHERWISE
- SEE G200 SHEET SERIES FOR TYPICAL MOUNTING HEIGHTS. PROVIDE SOLID BLOCKING IN WALLS FOR ALL WALL-MOUNTED ITEMS INCLUDING OWNER EQUIPMENT AND ACCESSORIES WHETHER BLOCKING IS DEPICTED IN DRAWINGS OR NOT
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- SEE SHEET SERIES A600 FOR DOOR AND WINDOW TYPES
- SEE SHEET SERIES A100 FOR OWNER EQUIPMENT
- SEE SHEET SERIES G200 FOR LEAD SHIELDING REPORT FOR THE RADIO ROOM WALL CONSTRUCTIONS
- SEE ELEVATIONS AND FINISH SCHEDULES FOR SURFACE TREATMENTS AT WALLS
- SEE ELEVATIONS, SECTIONS, AND DETAILS FOR ADDITIONAL WALL CONSTRUCTION INFORMATION
- ALL DIMENSIONS TO EXISTING WALL ARE TO FACE OF GYP, UNLESS NOTED OTHERWISE
- DOOR OPENINGS IN FRAME CONSTRUCTION WITH NO SPECIFIED DIMENSION ARE LOCATED 4" FROM THE FACE OF ADJACENT STUD. ASSUME CENTERED IN FACE OF JAMB UNLESS NOTED OTHERWISE

**FIRE RATED WALL TAG (description)**  
 ACCESS REQUIRE MINIMUM 8" CLEAR PER FGJ 2010. GENERAL CONTRACTOR TO FIELD VERIFY PRIOR TO FRAMING AND NOTIFY ARCHITECT FOR INCONSISTENCIES



**NON-FIRE RATED WALL TAG (description)**



**LAYERS LEGEND**

**NOTE:** DO NOT USE THE FOLLOWING LETTERS: L, and a through e are Method Studio's Standard, f and above are user defined.

- SA = GYPSUM BOARD BOTH SIDES OF CORE
- SB = GYPSUM BOARD ONE SIDE OF CORE
- SC = GYPSUM BOARD, 2 LAYERS BOTH SIDES OF CORE
- SJ = TYPE "X" GYPSUM BOARD OUTSIDE OF X-RAY IMAGING, LEAD-LINED GYPSUM BOARD INSIDE OF X-RAY IMAGING

**WALL TYPE HEAD CONDITION LEGEND**

- F NULL = TYPICAL PARTITION FLOOR TO FLOOR/CEILING/ROOF
- # = PARTITION EXTEND FROM FLOOR TO 6" ABOVE CEILING
- b = ACOUSTIC PARTITION TO FLOOR/CEILING/ROOF - STC 35
- c = ACOUSTIC PARTITION TO FLOOR/CEILING/ROOF - STC 45
- d = ACOUSTIC PARTITION TO FLOOR/CEILING/ROOF - STC 50

**CORE MATERIAL LEGEND**

- C = CONCRETE WALLS, MASONRY
- S = STEEL STUDS
- W = WOOD STUDS
- G = GLAZING

**CORE SIZE LEGEND**

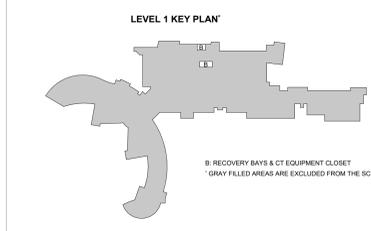
	STEEL STUDS	WOOD STUDS	MASONRY (WIDTH)	*CONCRETE (WIDTH)
1 =	7/8"			
2 =	1 5/8"	1 1/2"		
3 =	2 1/2"	2 1/2"		
4 =	3 5/8"	3 1/2"	MASONRY SIZE 4"	
5 =				
6 =	6"	5 1/2"	MASONRY SIZE 6"	CONCRETE 6"
8 =	8"	7 1/4"	MASONRY SIZE 8"	CONCRETE 8"
10 =		9 1/4"	MASONRY SIZE 10"	CONCRETE 10"
12 =		11 1/4"	MASONRY SIZE 12"	CONCRETE 12"
14 =			MASONRY SIZE 14"	CONCRETE 14"
16 =			MASONRY SIZE 16"	

**SUPERSCRIPT NOTES:**  
 A - HAT CHANNEL FURRING IN LIEU OF METAL STUD  
 B - IF WALL IS STRUCTURAL, DO NOT TAG WALL OR INCLUDE IN WALL TYPES

**LEGEND: INT. PARTITION**

- TYPICAL PARTITION FLOOR TO UNDERSIDE OF STRUCTURE / DECK
- EXISTING WALL / PARTITION FLOOR TO FLOOR / CEILING / DECK
- PARTITION EXTENDS FROM FLOOR TO 6" ABOVE CEILING
- PARTITION: STC 35
- PARTITION STC 45
- PARTITION STC 50

FIELD VERIFY IF LISTED STC RATING IS ACHIEVABLE WITH EXISTING CONDITION; CONTRACTOR TO REACH OUT BEFORE THE CONSTRUCTION



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title:  
**LEVEL 01  
 ENLARGED  
 DIMENSION  
 PLAN -  
 RECOVERY  
 BAYS**

sheet:  
**A121b**  
 CONSTRUCTION DOCUMENT  
 SET





### GENERAL NOTES - CEILING PLAN

- VERIFY AND COORDINATE ALL MECHANICAL DUCT, GRILL, OFFUSER & LOCATIONS, VENTS, AND QUANTITY WITH MECHANICAL PLANS
- CEILING GRID SHOWN IS ONLY A GRAPHIC REPRESENTATION OF CEILING. CEILING PATTERN IS TO BE CENTERED IN THE ROOM, UNLESS NOTED OTHERWISE. CONTRACTOR SHALL VERIFY ACTUAL GRID LAYOUT/LOCATION
- VERIFY ALL LIGHTS, SMOKE DETECTORS, AND EXIT DEVICE LOCATIONS AND QUANTITIES WITH ELECTRICAL DRAWINGS. SEE ARCHITECTURE FOR LIGHT LAYOUT LOCATION. LIGHT FIXTURES TO BE CENTERED AND SYMMETRICALLY LOCATED IN UNITS AND SHARED SPACES UNLESS NOTED OTHERWISE
- MAKE FACTORY EDGE WHERE TILE IS CUT TYPICAL FOR ALL LAY-IN ACOUSTICAL TILE WITH REGULAR EDGE
- SEE SHEET SERIES A700 FOR FINISH MATERIAL SPECIFICATIONS
- ELECTRICIAN SHALL NOT SET ANY CEILING JACOBS THAT ARE FOR LIGHTS BEFORE THE FINAL LOCATION OF THE DROPPED SOFFITS HAVE BEEN DETERMINED. THIS WILL ENSURE THAT THE LIGHTS THAT NEED TO BE CENTERED ARE CORRECTLY CENTERED BETWEEN THE SOFFITS

### CEILING LEGEND

NOTE THAT ALL DROPS NEED TO BE NON-COMBUSTIBLE METAL FRAMING OR LIGHT GAUGE METAL FRAMING AND MEET U/90 STANDARD FOR ALLOWABLE DEFLECTION.

TYPE A1	(ACT-01) 24" X 24" SQUARE LAY-IN ACOUSTICAL TILE AND SUSPENSION SYSTEM, RE: FINISH SCHEDULE
TYPE A2	(ACT-02) 24" X 24" SQUARE LAY-IN ACOUSTICAL TILE AND SUSPENSION SYSTEM, RE: FINISH SCHEDULE
TYPE B1	5/8" GYPSUM BOARD (PAINTED PNT-02 UNLESS NOTED ON PLAN) ON METAL STUD
TYPE B2	5/8" GYPSUM BOARD (PAINTED PNT-02 UNLESS NOTED ON PLAN) ON METAL SUSPENSION SYSTEM
TYPE C1	5/8" GYPSUM BOARD (PAINTED PNT-02 UNLESS NOTED ON PLAN) ON UNDERSIDE OF FLOOR PLATE STRUCTURE, PROVIDE BRACING AS NECESSARY
TYPE E1	EXPOSED STRUCTURE (PAINTED PNT-02 UNLESS NOTED ON PLAN)
	SUPPLY DIFFUSER, RE: MECHANICAL
	RETURN GRILLE, RE: MECHANICAL
	LIGHT FIXTURE, RE: ELECTRICAL
	RECESSED LIGHT FIXTURE, RE: ELECTRICAL
	24" X 24" GFRG DRAFTSTOP ACCESS PANEL
	OVERHEAD SPEAKERS, RE: ELECTRICAL
	EXIT SIGN, RE: ELECTRICAL
	LINEAR AIR TERMINAL, RE: MECHANICAL

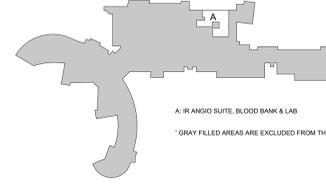
### KEYED NOTES

11.01	STERIS ANESTHESIA ROOM, RE: STERIS DRAWINGS
RS-01	ROLLER SHADES, SINGLE MANUAL, RE: INTERIOR FINISH SCHEDULE

### PROJECT SCOPE LEGEND - NEW CONSTRUCTION

- EXISTING TO REMAIN
- PROJECTED SCOPE OF WORK FROM LEVEL ABOVE
- SCOPE OF WORK
- PROJECTED SCOPE OF WORK FROM LEVEL BELOW

### LEVEL 1 KEY PLAN



**A1** LEVEL 01 - IR ANGIO SUITE, BLOOD BANK, LAB - ENLARGED RCP  
1/4" = 1'-0"



360 west aspen avenue  
salt lake city, utah 84101  
801 532 4422



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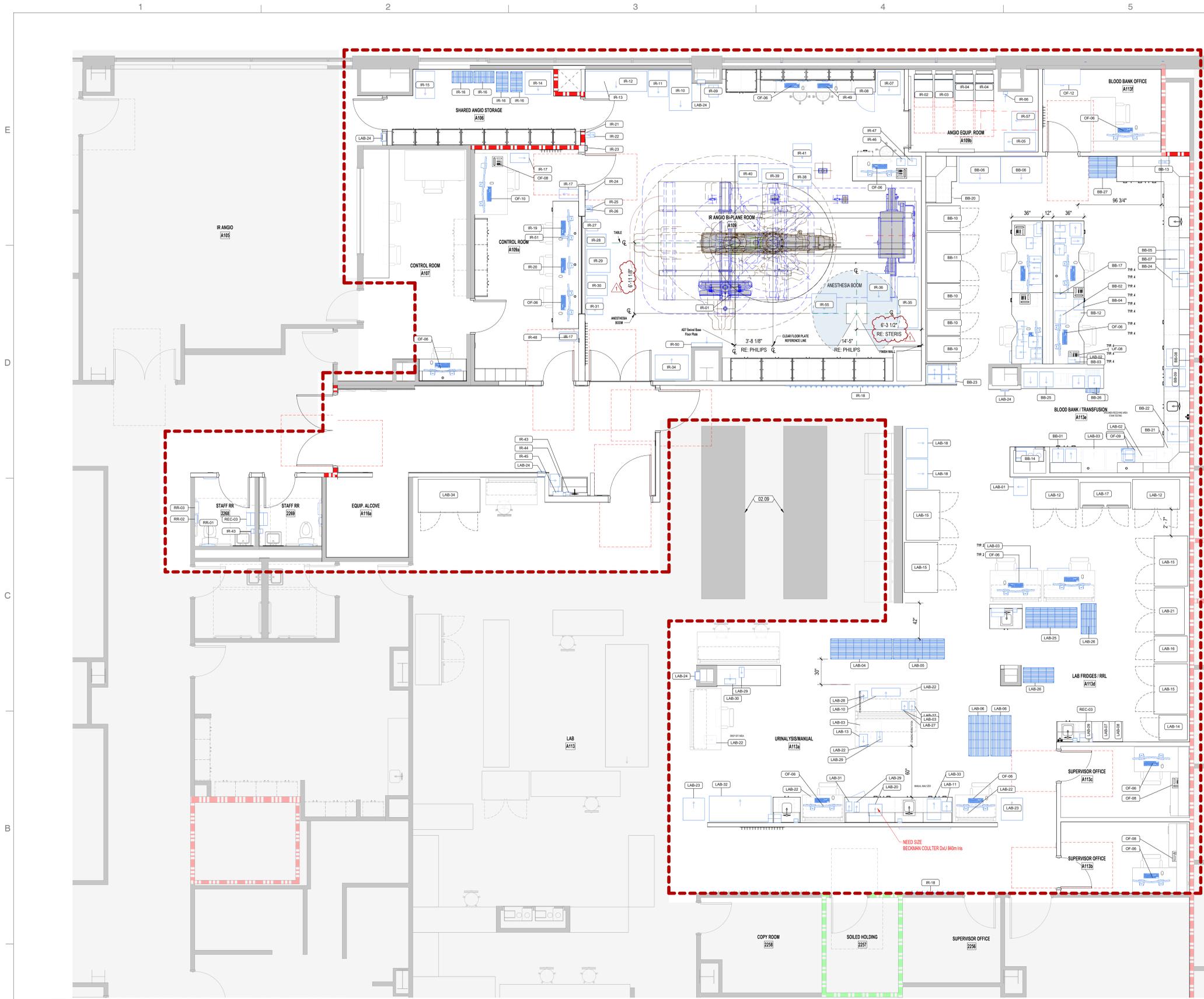
project:  
**IHC McKay  
Dee IR  
Expansion**

MCKAY DEE HOSPITAL  
4401 HARRISON BLVD  
OGDEN, UTAH 84403

project #: 25.0200  
date: 02 FEB 2026  
revisions:  
1 Add 1 2/27/2026

title:  
**LEVEL 01 -  
ENLARGED  
RCP - IR  
ANGIO  
SUITE,  
BLOOD  
BANK & LAB**

sheet:  
**A131a**



**A1** LEVEL 01 IR ANGIO SUITE, BLOOD BANK, LAB EQUIPMENT PLAN  
1/4" = 1'-0"

**KEYED NOTES**

02.09 EXISTING OWNER EQUIPMENT/FURNITURE TO REMAIN, PROTECT DURING CONSTRUCTION

**GENERAL NOTES - EQUIPMENT**

- GENERAL CONTRACTOR SHALL FIELD VERIFY ALL CONDITIONS AND SHALL REPORT TO THE ARCHITECT ANY UNKNOWN CONDITIONS, ERRORS, OR CONFLICTS IN DRAWINGS BEFORE BEGINNING WORK.
- CONTRACTOR TO COORDINATE OWNER-FURNISHED EQUIPMENT WITH OWNER FOR EQUIPMENT NOT NOTED IN DRAWINGS. CONTRACTOR TO NOTIFY ARCHITECT OF ANY MISSING EQUIPMENT NOTED BY OWNER.
- OWNER TO PROVIDE FURNISHINGS UNDER SEPARATE CONTRACT.
- CONTRACTOR TO ACCOMMODATE AND COORDINATE DELIVERY AND INSTALLATION OF THIRD PARTY FURNISHINGS, FIXTURES, EQUIPMENT, AND SYSTEMS TO BE PROVIDED AND INSTALLED BY OTHER CONTRACTED PARTIES.
- CONTRACTOR TO COORDINATE WITH OWNER FOR OWNER-PROVIDED EQUIPMENT.
- REFER TO MANUFACTURER'S EQUIPMENT PLANS FOR IMAGING EQUIPMENT AND OTHER MISCELLANEOUS EQUIPMENT.
- CONTRACTOR TO COORDINATE WITH OWNER FOR EQUIPMENT NOT NOTED IN PHILIPS OR STERIS EQUIPMENT PLANS.
- REFER TO MANUFACTURER'S REQUIREMENTS FOR EQUIPMENT REMOVAL.

EQUIPMENT LIST	
MARK	DESCRIPTION
9-270	BLOOD BANK BECKMAN CENTRIFUGE
BB-01	BLOOD BANK CELL WASHER
BB-02	BLOOD BANK DRY BLOOD HEATER
BB-03	BLOOD BANK HELMEX CENTRIFUGE
BB-04	BLOOD BANK ICE MACHINE
BB-05	BLOOD BANK DRUG VISION ANALYZER WITH TABLE
BB-06	BLOOD BANK PLASMA TREATING SYSTEM
BB-07	BLOOD BANK PLATELET PC1000 PRO INCUBATOR
BB-08	BLOOD BANK PLATELET PC1000 INCUBATOR
BB-09	BLOOD BANK REFRIGERATOR 1 DOOR
BB-10	BLOOD BANK REFRIGERATOR 2 DOOR
BB-11	BLOOD BANK SHARPS FLOOR CART
BB-12	BLOOD BANK TUBE SEALER
BB-13	PNEUMATIC TUBE SYSTEM
BB-14	18 X 27 X 32 CART ON CASTERS
BB-15	BLOOD BANK MEDIUM GLASS TUBE BIN
BB-16	BLOOD BANK PYRETTLE STORAGE
BB-17	BLOOD BANK AGGLUTINATION VIEWER
BB-18	BLOOD BANK SMALL GLASS TUBE BIN
BB-19	BLOOD BANK SALINE CUBE
BB-20	BLOOD BANK DRY ICE CART
BB-21	BLOOD BANK LARGE PRINTER
BB-22	BLOOD BANK COOLER
BB-23	BLOOD BANK ICE MACHINE FILTER
BB-24	BLOOD BANK PLATELET SHIPPING BOX
BB-25	BLOOD BANK BLOOD SHIPPING BOX
BB-26	32 X 17 X 17 WIRE SHELF
BB-27	BLOOD BANK RBC SHIPPING BOX
BB-28	WHITE BOARD 36" X 60"
BB-29	Philips Angio Bi Plane
BB-30	Philips Angio Bi Plane
BB-31	Philips Azurion Max 40E Cabinet
BB-32	Philips Azurion Image 40E Cabinet
BB-33	Philips Azurion Cerebra X Generator 40E Cabinet
BB-34	PHILIPS AZURION LIPS
BB-35	PHILIPS SERVICE HUB
BB-36	ANGIO CANNEL
BB-37	ANGIO - UC HELMEX FRIDGE
BB-38	STEP STOOL W/ HANDRAIL
BB-39	ANGIO-MOBILE INJECTOR
BB-40	ANGIO-MULTIPURPOSE PORTABLE ULTRASOUND
BB-41	MOBILE TABLE - 72 inch
BB-42	STEP STOOL
BB-43	ANGIO WARMING CABINET
BB-44	ANGIO PROCEDURE CART
BB-45	WIRE SHELF 72" X 14"
BB-46	ANGIO 32 GAL GALLON WASTE
BB-47	WALL MOUNT HEAVY DUTY COAT AND APRON HOOK
BB-48	Philips Azurion Control Room Junction Box
BB-49	Philips Azurion Interventional Hardware
BB-50	ANGIO WALL MOUNT EMERGENCY BAG
BB-51	ANGIO WALL MOUNT WIRE RESPRESSOR
BB-52	AS105 - Dispenser, Hand Sanitizer, Free Standing
BB-53	4 Glove Box
BB-54	ANGIO - PUMP INFUSION - MODULAR CONTROLLER
BB-55	ANGIO - PUMP INFUSION - SINGLE
BB-56	RED SHARP DISPOSAL CART
BB-57	BLUE SHARP DISPOSAL CART
BB-58	ANGIO - 3255 GALLON BIO-H WASTE
BB-59	ANGIO - 4455 GALLON WASTE
BB-60	ANGIO-HAMPER
BB-61	ANGIO-ENTRANCE CART W/ ROLL-TOP DOOR
BB-62	MOBILE TABLE - 55-60 inch
BB-63	ANGIO-ANESTHESIA CART
BB-64	ANGIO-REDIGO IV POLE PLACERHOLDER
BB-65	MOBILE LEAD - ANGIO MEDICAL
BB-66	MOBILE LEAD - ANGIO MEDICAL
BB-67	ANGIO-PRIVOR IV POLE PLACERHOLDER
BB-68	SOAP DISPENSER
BB-69	41 QT GRAY WASTE CAN
BB-70	SURFACE MOUNT PAPER TOWEL
BB-71	ANGIO LABEL PRINTER
BB-72	ANGIO I/STAT
BB-73	ANGIO IVUS WALL MOUNTED
BB-74	Philips Additional Flex Spot
BB-75	ANGIO-14 PEGS
BB-76	ANGIO-THERMOMETER
BB-77	MAVIG RADIATION SHIELD
BB-78	STERIS INTEGRATION RACK
BB-79	32 GALLON SHRED IT BIN
BB-80	26 QT GRAY WASTE CAN
BB-81	29 GALLON RED BIO WASTE CAN
BB-82	24 X 72 X 78 WIRE SHELF ON CASTERS
BB-83	24 X 80 X 78 WIRE SHELF ON CASTERS
BB-84	24 X 48 X 78 WIRE SHELF ON CASTERS
BB-85	15 GAL BEIGE WASTE CAN
BB-86	23 GAL GREEN WASTE CAN W/ LID
BB-87	32 GAL BLUE WASTE CAN W/ LID
BB-88	LAB AUTOMATED SEMEN ANALYZER
BB-89	LAB CLAY ADAMS CENTRIFUGE
BB-90	LAB MCR LAKE GLASS DOOR FREEZER 2 DOOR
BB-91	LAB COOKTOP
BB-92	LAB PHARMACEUTICAL REFRIGERATOR 1 DOOR
BB-93	LAB PHARMACEUTICAL REFRIGERATOR 2 DOOR
BB-94	LAB PLASMA HELMEX FREEZER 1 DOOR
BB-95	LAB THERMO FISHER FREEZER 2 DOOR
BB-96	LAB WATER TREATMENT SYSTEM
BB-97	LAB UNDERCOUNTER REFRIGERATOR 1 DOOR
BB-98	LAB URINE CHEMISTRY ANALYZER SEMI AUTO
BB-99	LAB MCR LAKE GLASS DOOR REFRIGERATOR 2 DOOR
BB-100	26 QT BLACK WASTE CAN
BB-101	29 GALLON RED BIO WASTE CAN W/ STEP ON ROLLING BASE
BB-102	12 X 6 X 24" SEMI RECESSED REC
BB-103	24 X 80 X 72 WIRE SHELF ON CASTERS
BB-104	18 X 36 X 72 WIRE SHELF ON CASTERS
BB-105	LAB HEMOSTASIS MANAGEMENT
BB-106	LAB FRY
BB-107	LAB MICROSCOPE
BB-108	LAB EXCYTE M ESR ANALYZER
BB-109	LAB CLINTEX STATUS URINALYSIS ANALYZER
BB-110	LAB ROLLING METAL FRAME COUNTERTOP
BB-111	LAB CITOSSYN 4 CENTRIFUGE
BB-112	LAB PHARMACEUTICAL REFRIGERATOR 2 DOOR - 6" WIDE
BB-113	INTERMOUNTAIN 2 MONITOR COMPUTER
BB-114	A1015 - Telephone, Desk Phone, Multiple Line 12 x 12
BB-115	PRINTER
BB-116	Intermountain 3 Monitor Computer
BB-117	15" x 42"
BB-118	PAPER TOWEL DISP - MOTION
BB-119	Toilet Seat Cover Dispenser
BB-120	Sanitary Disposal
BB-121	9-3088



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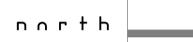
project:  
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Dee IR  
Expansion**

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4401 HARRISON BLVD  
OGDEN, UTAH 84403

project #: 25.0200  
date: 02 FEB 2026  
revisions :  
1 Add 1 2/27/2026

title:  
**LEVEL 01 -  
EQUIPMENT  
PLAN - IR  
ANGIO  
SUITE,  
BLOOD  
BANK & LAB**

sheet:  
**A141a**  
CONSTRUCTION DOCUMENT  
SET





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**EQUIPMENT LIST**

MARK	DESCRIPTION
BR-02	INTERMOUNTAIN 1 MONITOR & COMPUTER
BR-06	WHITE BOARD 36" X 60"
BR-07	50" TV
CT-01	CT GE EQUIPMENT 1
CT-03	CT GE EQUIPMENT CPU 2
CT-04	CT GE EQUIPMENT 4
CT-05	CT GE EQUIPMENT 5
CT-06	CT GE EQUIPMENT CPU3
CT-07	CT GE EQUIPMENT MAIN DISCONNECT PANEL 1
CT-08	CT GE EQUIPMENT MAIN DISCONNECT PANEL 2
OF-06	INTERMOUNTAIN 2 MONITOR COMPUTER
OF-11	INTERMOUNTAIN 1 MONITOR COMPUTER
REC-01	GENRELLA SMART RED - 4" SIDE CLEARANCE
REC-02	SOAP DISPENSER RC
REC-03	PAPER TOWEL DISP - MOTION
REC-04	ANGIO-WALLMOUNT HAND SANITIZER RC
REC-05	ANGIO-WALLMOUNT EMESIS BAG RC
REC-06	GLOVE DISPENSER RC



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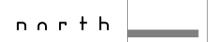
project #: 25.0200  
date: 02 FEB 2026  
revisions :  
1 Add 1 2/27/2026

title:  
**LEVEL 01 -  
EQUIPMENT  
PLAN -  
RECOVERY  
BAYS & CT  
EQUIPMENT  
CLOSET**

sheet:  
**A141b**

CONSTRUCTION DOCUMENT  
SET

**A1** LEVEL 01 IR DEPARTMENT EQUIP. PLAN - PRE/POST RECOVERY BAYS  
1/4" = 1'-0"





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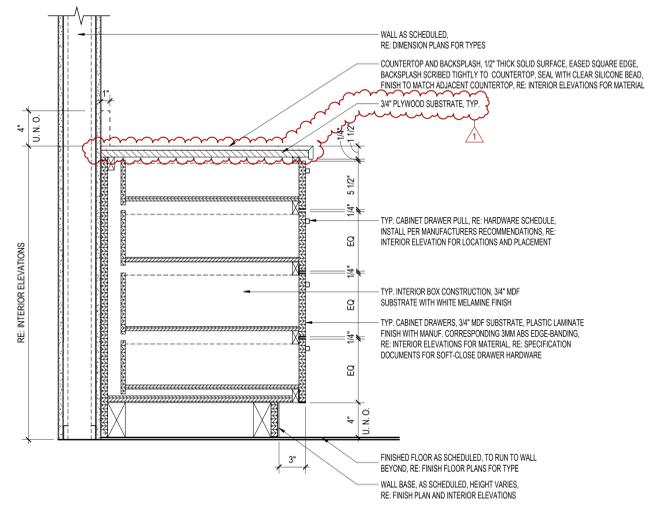


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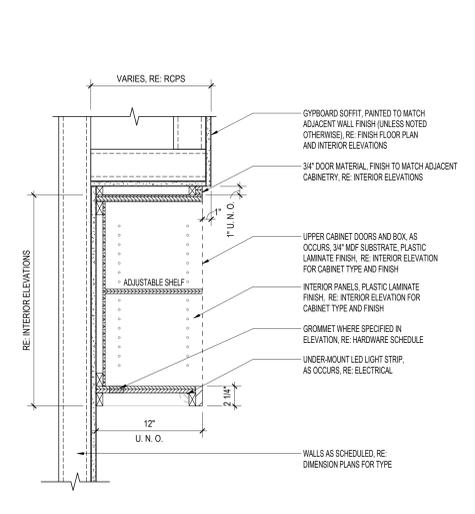
### HARDWARE SCHEDULE

SCHEDULED ACCESSORIES SHALL BE USED FOR BASIS OF DESIGN, U.N.O.

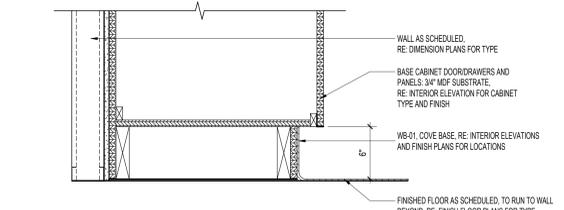
KEYNOTE	PRODUCT TYPE	MANUFACTURER	MODEL NUMBER	SIZE	COLOR	FINISH	COMMENTS
-	CONCEALED COUNTERTOP BRACKET	AAM HARDWARE	C-21 (2.0) CONCEALED BRACKET	2 1/2" DEPTH	WHITE	-	@ 3/4" D OR DEEPER FLOATING COUNTERTOPS, RE: DETAILS, INSTALL PER MANUFACTURERS RECOMMENDATIONS
-	CONCEALED COUNTERTOP BRACKET	AAM HARDWARE	C-24 (2.0) CONCEALED BRACKET	2 1/2" DEPTH	WHITE	-	@ 3/4" D OR DEEPER FLOATING COUNTERTOPS, UNLESS NOTED OTHERWISE, RE: DETAILS, INSTALL PER MANUFACTURERS RECOMMENDATIONS
05.01	CABINET PULL	BERENSON	9401-2BPNP	5-3/8" LENGTH	-	BRUSHED NICKEL	RE: INTERIOR ELEVATIONS FOR LOCATIONS AND QUANTITY
05.02	DIGITAL LOCK	KITLOCK	LKL1000-G3	5-3/8" X 1 1/8" X 15/16"	SILVER	CHROME	RE: INTERIOR ELEVATIONS FOR LOCATIONS AND QUANTITY
05.03	WORKSURFACE GROMMET	MOCKETT	MM, SOLID BRASS DESK GROMMET, CAP AND LINER SET	2-3/8" DIAMETER	POLISHED CHROME (26)	SATIN	RE: FLOOR PLANS FOR LOCATIONS, INSTALL PER MANUFACTURERS RECOMMENDATIONS
05.04	CAM LOCK, CABINET DOORS	RICHELIEU	192CR	-	-	CHROME	INSTALL AT CABINET DOORS, RE: INTERIOR ELEVATIONS FOR LOCATIONS AND QUANTITY
05.05	CAM LOCK, CABINET DRAWERS	RICHELIEU	190CR	-	-	CHROME	INSTALL AT CABINET DOORS, RE: INTERIOR ELEVATIONS FOR LOCATIONS AND QUANTITY



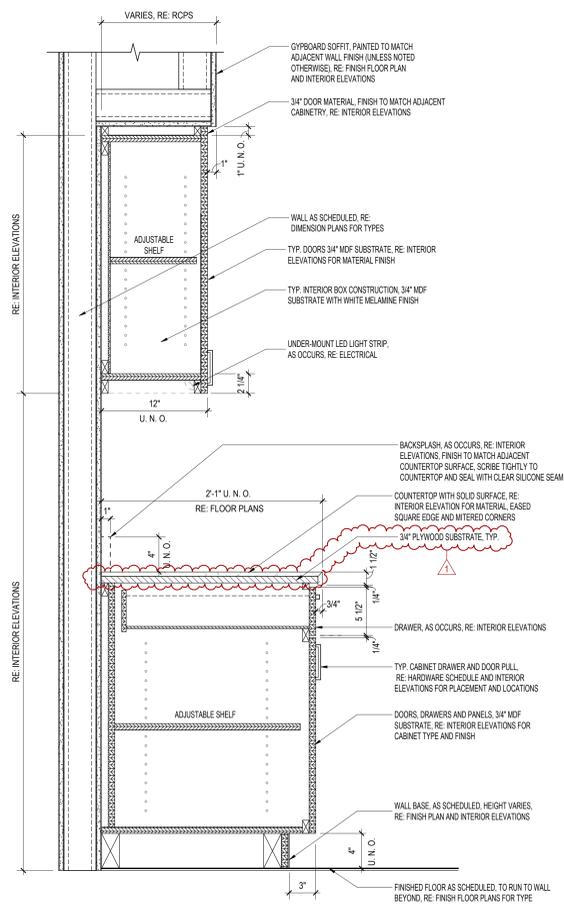
**D1** TYP. BASE CABINET, 4 DRAWER  
1 1/2" = 1'-0"



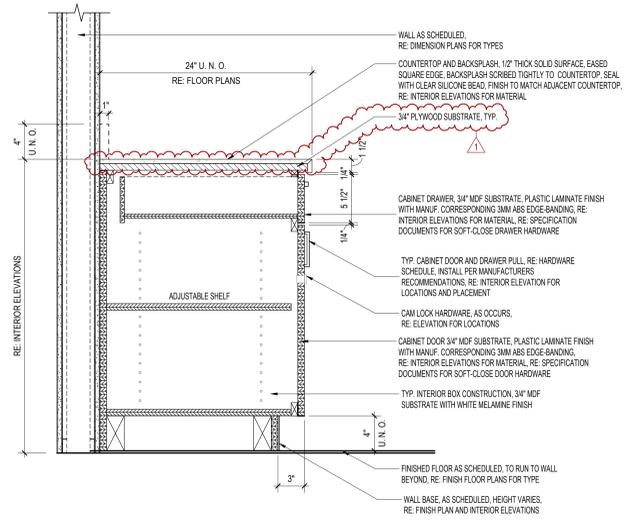
**D2** OPEN SHELVING WITH UNDERMOUNT LIGHT  
1 1/2" = 1'-0"



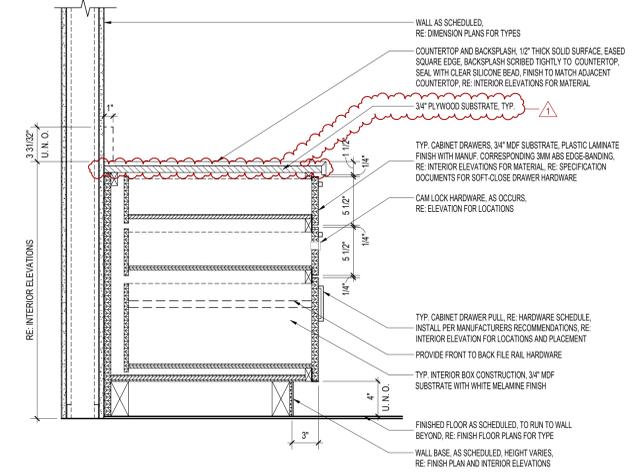
**C1** COVE BASE @ CASEWORK  
1 1/2" = 1'-0"



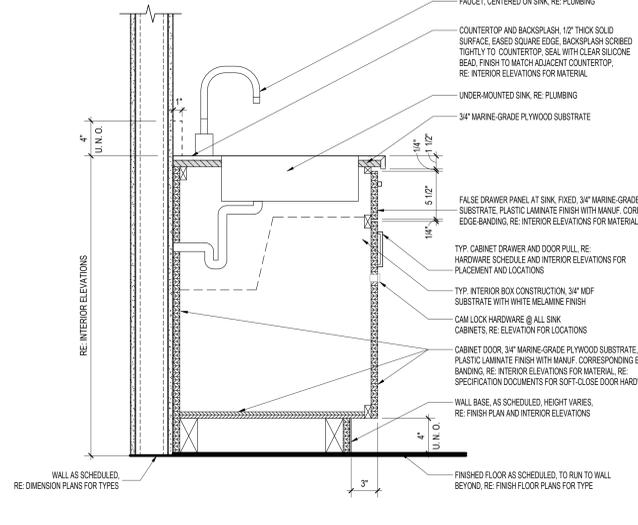
**A1** TYP. UPPER & BASE CASEWORK CONSTRUCTION - SECTION DETAIL  
1 1/2" = 1'-0"



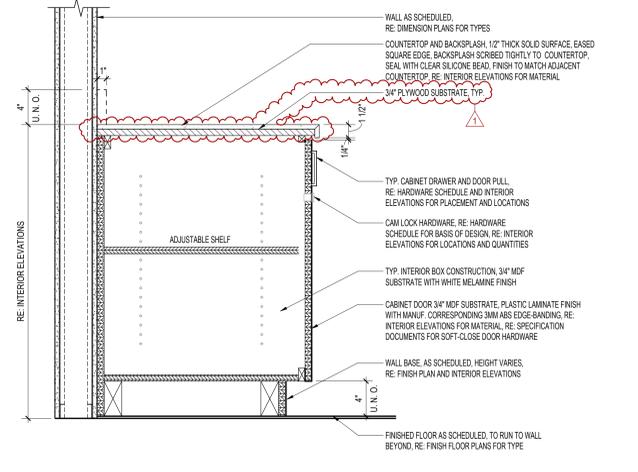
**B2** TYP. BASE CABINET, DRAWER & DOOR  
1 1/2" = 1'-0"



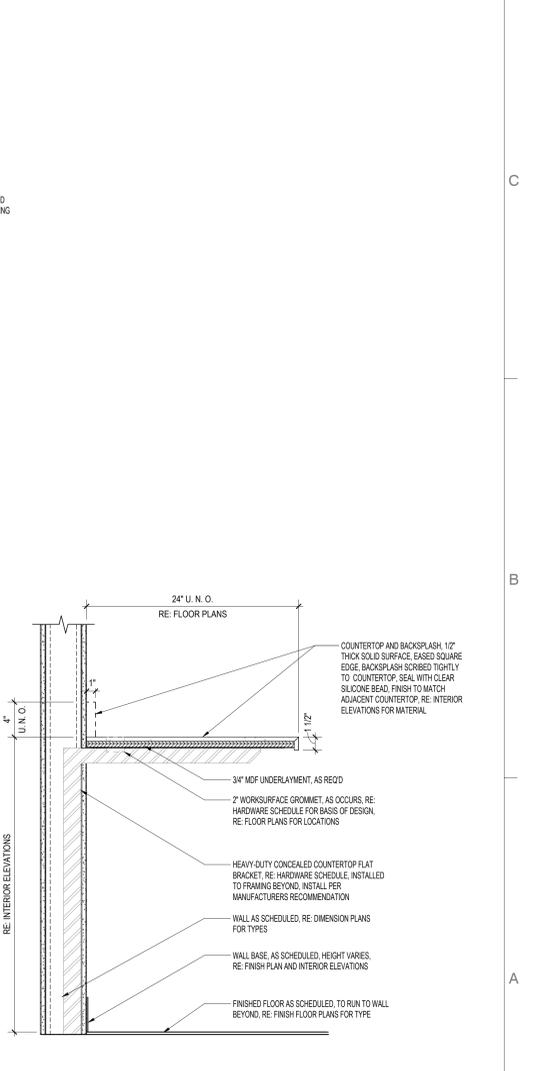
**A2** BOX FILE, BASE CABINET  
1 1/2" = 1'-0"



**B3** TYP. BASE CABINET WITH UNDERMOUNT SINK  
1 1/2" = 1'-0"



**A3** TYP. BASE CABINET WITH DOOR  
1 1/2" = 1'-0"



**A4** FLOATING COUNTERTOP DETAIL  
1 1/2" = 1'-0"

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project #: 25.0200  
date: 02 FEB 2026  
revisions :  
1 Add 1 2/27/2026

title:  
**CASEWORK  
& MILLWORK  
DETAILS**

sheet:

**A581**

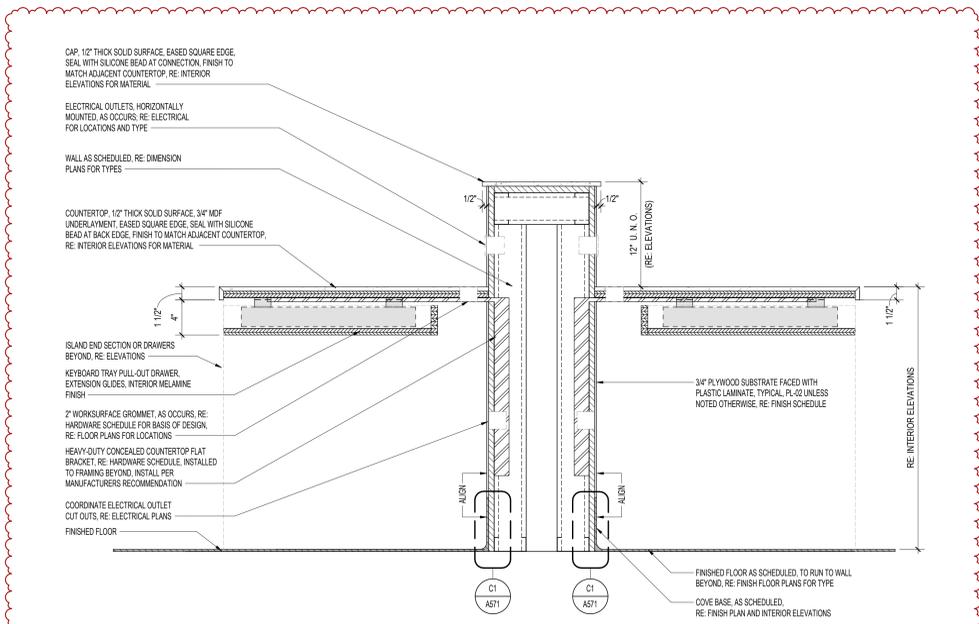
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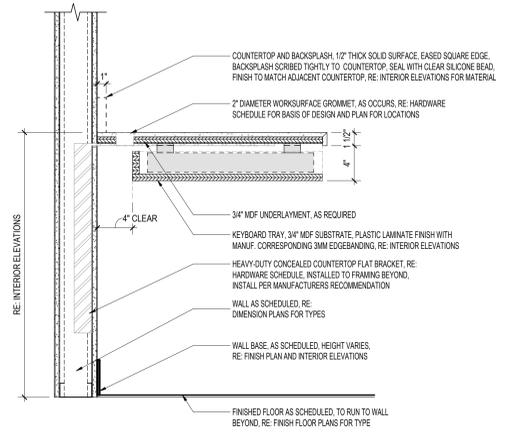
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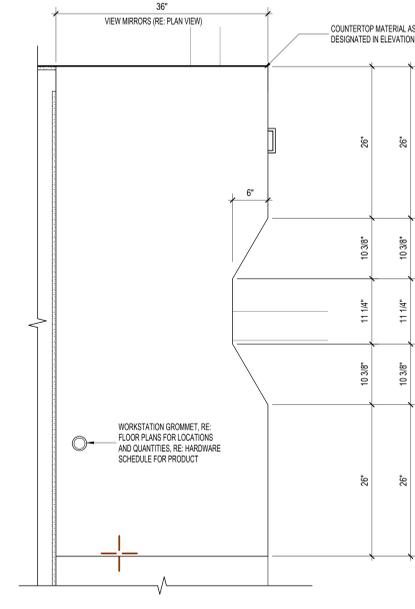
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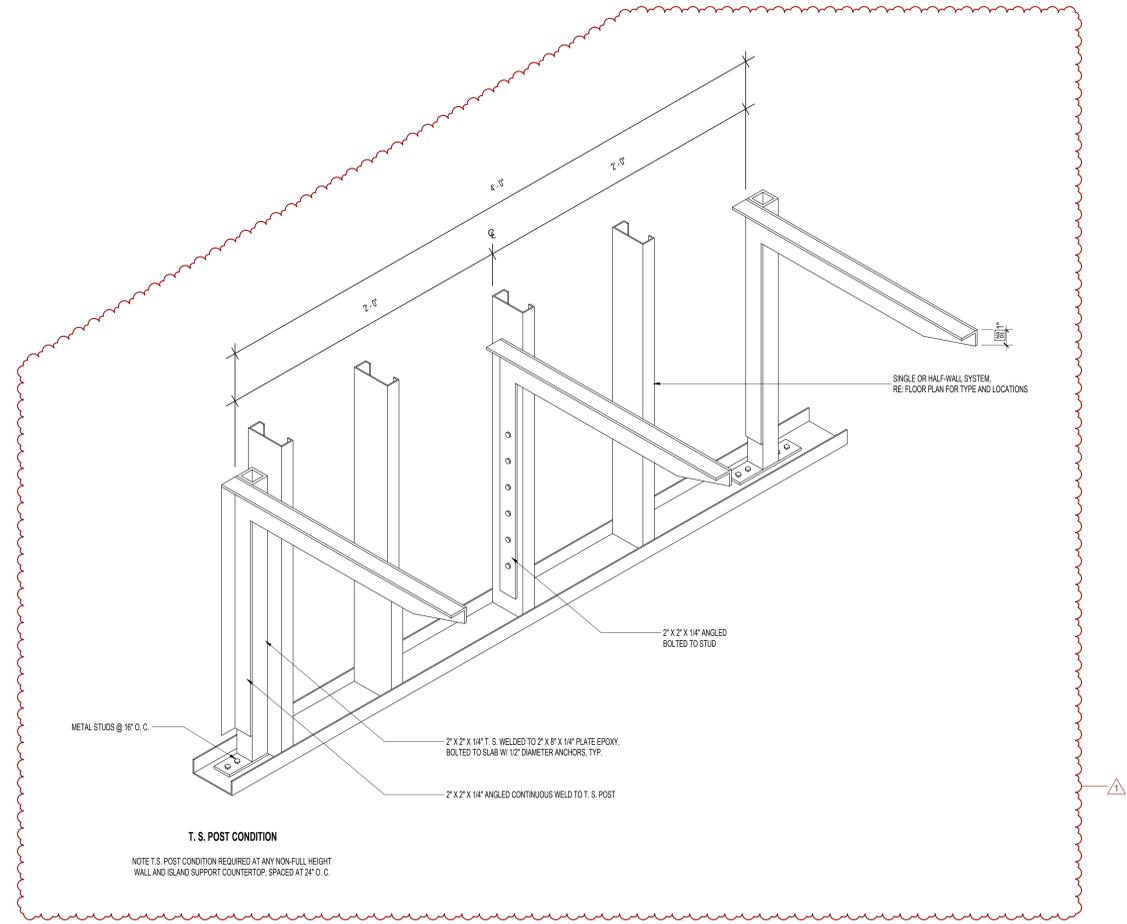
**D1** ISLAND, TYP. - SECTION DETAIL  
1 1/2" = 1'-0"



**D3** WORKSTATION WITH KEYBOARD TRAY  
1 1/2" = 1'-0"



**D4** TYP. BLOODBANK / TRANSFUSION DESKTOP - PLAN VIEW DETAIL  
1" = 1'-0"



**A1** HIDDEN COUNTER SUPPORT BRACKET  
1 1/2" = 1'-0"

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date: 02 FEB 2026

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1 Add 1 2/27/2026

title:  
**CASEWORK  
& MILLWORK  
DETAILS**

sheet:

**A582**

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IR Expansion**

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project #: 25.0200 DS#: 5441025  
date: 02 FEB 2026

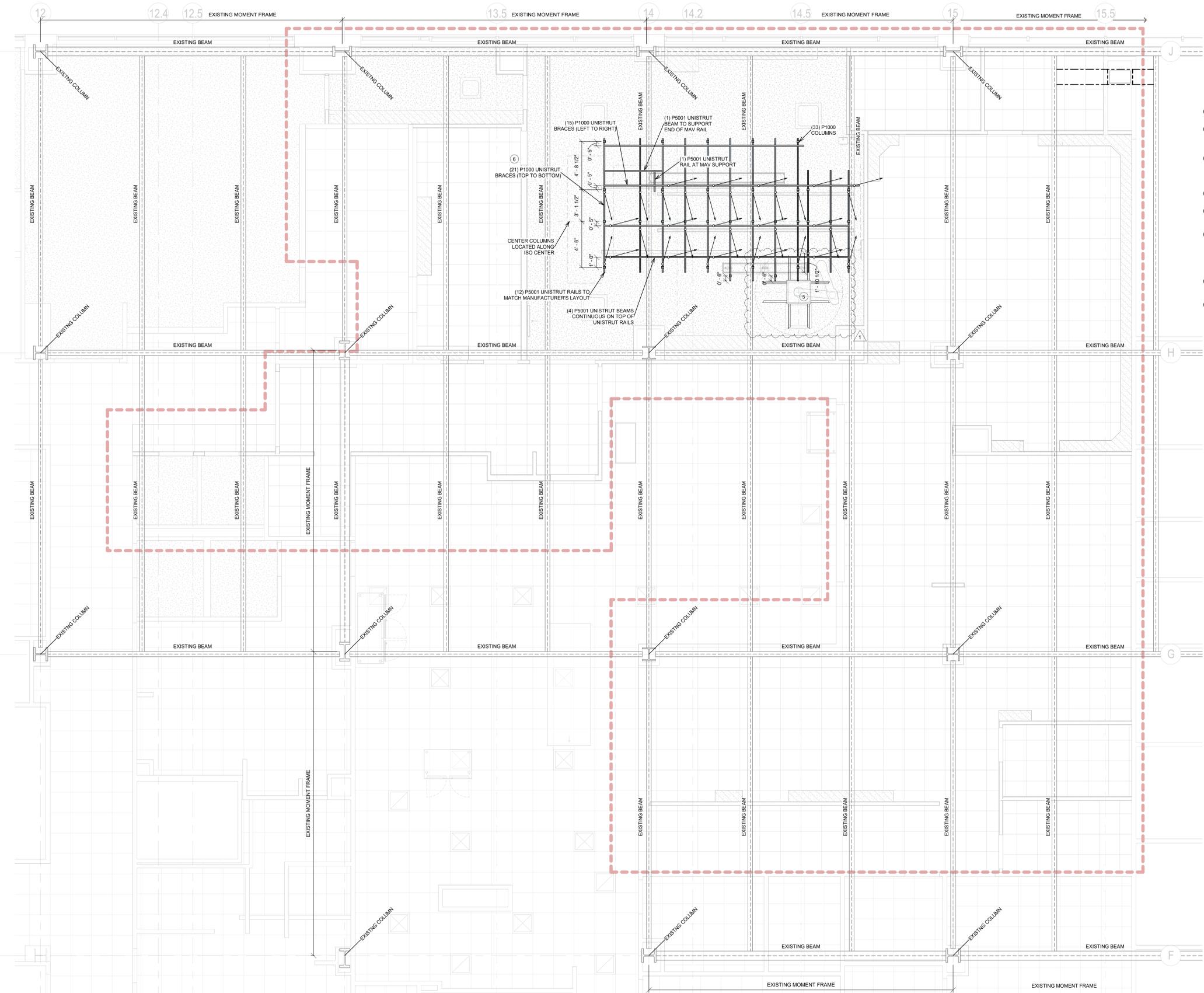
revisions:  
1 Addendum 1 26 FEB 2026

title:  
**LEVEL 02  
FRAMING PLAN  
AREA 'B' -  
CEILING PLAN -  
IR ANGIO  
SUITE, BLOOD  
BANK, LAB**

sheet:

**S131a**

CONSTRUCTION DOCUMENT  
SET



- STRUCTURAL NOTES**
- CONTRACTOR SHALL PROVIDE SHOP DRAWINGS FOR UNISTRUT PRIOR TO CONSTRUCTION
  - SYMBOL REPRESENTS COLUMN LOCATION CONNECTION TO DECK: 10/S310 CONNECTION TO P5001 RAIL: 11/S310 CONNECTION TO STEEL BEAM: 9/S311
  - ARROW HEAD INDICATES TOP OF BRACE ATTACHES TO EXISTING DECK CONNECTION TO DECK: 1/S311 CONNECTION TO P5001 BEAM: 2/S311 CONNECTION TO STEEL BEAM: 10/S311
  - EACH UNISTRUT RAIL SHALL ATTACH TO UNISTRUT BEAM PER 3/S311
  - BOOM SUPPORT PER DETAIL 9/S310, CONTRACTOR TO VERIFY IF THE ANGLE SUPPORTS NEED TO BE MOVED TO ACCOMMODATE MECHANICAL EQUIPMENT
  - INSTALL NEW CFS WALLS PER ARCHITECTURAL PLANS, WHERE TYPICAL JAMB LOCATION CANNOT EXTEND TO DECK DUE TO MECHANICAL DUCTS OR OTHERWISE, EXTEND HEADER TO LOCATION WHERE JAMB CAN EXTEND TO DECK, SEE DETAIL 8/S311, DO NOT SUPPORT JAMB STUDS OFF BEAM WITHOUT PRIOR APPROVAL
  - REFER TO UNISTRUT MANUFACTURER FOR RECOMMENDED TORQUE REQUIREMENTS ON FASTENERS AND FITTINGS
  - FOR NON-TYPICAL FRAMING THAT MAY BE NEEDED DUE TO EXISTING AND/OR NEW MECHANICAL, PLUMBING OR ELECTRICAL OBSTACLES IN THE CEILING SEE DETAILS 1-3/S312



1 LEVEL 02 FRAMING PLAN AREA 'B' - CEILING PLAN - IR ANGIO SUITE, BLOOD BANK, LAB  
1/4" = 1'-0"

2/26/2026 2:32:17 PM Autodesk Docs/IHC McKay Dee IR Expansion/IHC McKay Dee IR Expansion - Structural

### MEDICAL VALVE BOX SCHEDULE

ACCEPTABLE MANUFACTURERS: AMICO, BEACONMEDAES, OHIO MEDICAL

REMARKS:  
 (1) STEEL WALL BOX, 18 GAUGE STEEL, WHITE EPOXY FINISH, SLIDING OPAQUE DOOR, ANODIZED ALUMINUM TRIP, COLOR CODE GAS INDICATION LABELS.  
 (2) FULL PORT BALL VALVE, DOUBLE SEAL, 3-PIECE BRONZE/BRASS, CHROME PLATED BALL, 600 WOG (29" HG) MAXIMUM WORKING PRESSURE, TEFLON SEAT, GAUGE PORT.  
 (3) 0 - 30" HG PRESSURE GAUGE FOR MEDICAL VACUUM.  
 (4) 0 - 100 PSIG PRESSURE GAUGE FOR OXYGEN.

LABEL	SERVES	PIPE SIZE (IN)					MANUFACTURER	MODEL	REMARKS
		OXYGEN	MEDICAL AIR	NITROUS OXIDE	MEDICAL VACUUM	WASTE ANEST.			
ZVB-1	IR ANGIO ROOM	1/2"	1/2"	1/2"	1"	3/4"	AMICO	VBU-M0707051007	ALL
ZVB-2	PRE POST OP	1/2"	1/2"	0"	1"	0"	AMICO	VBU-M0707051007	ALL

### MEDICAL GAS OUTLET SCHEDULE

ACCEPTABLE MANUFACTURERS: AMICO, BEACONMEDAES, OHIO MEDICAL

REMARKS:  
 (1) MED GAS OUTLETS TO BE INSTALLED WITHIN HEADWALL SYSTEM. COORDINATE INSTALLATION WITH HEADWALL SUPPLIER.  
 (2) QUICK CONNECT WALL OUTLET WITH GEOMETRIC QUICK CONNECT ADAPTER.  
 (3) UL LISTED.  
 (4) DIE CAST FACE PLATE.  
 (5) PROVIDE WITH 1" WALL THICKNESS ADJUSTMENT.

LABEL	OUTLET TYPE	PIPE SIZE (IN)	DESCRIPTION	MANUFACTURER	MODEL T	REMARKS
O2	OXYGEN	1/2"	QUICK CONNECT WALL OUTLET, GAS SPECIFIC FOR MED GAS, UL LISTED, NFPA 99 COMPLIANT, DIE CAST FACE PLATE.	AMICO CHEMTROM	O-CHWAL-U-OXYS	ALL
VAC	VACUUM	3/4"	QUICK CONNECT WALL OUTLET, GAS SPECIFIC FOR MED GAS, UL LISTED, NFPA 99 COMPLIANT, DIE CAST FACE PLATE.	AMICO CHEMTROM	O-CHWAL-U-VACS	ALL

### PLUMBING FIXTURE SCHEDULE

REFER TO PLUMBING SPECIFICATIONS FOR COMPLETE FIXTURE COMPONENTS

LABEL	DESCRIPTION	WASTE	VENT	CW	HW	MANUFACTURER	MODEL	REMARKS
DH	WALL MOUNTED DRENCH HOSE	0"	0"	3/4"	3/4"	FIXTURE: GUARDIAN	FIXTURE: G5025-FSH	PROVIDE THERMOSTATIC MIXING VALVE (GUARDIAN G6020)
FD	FLOOR DRAIN	2"	2"	0"	0"	FIXTURE: ZURN TRAP SEAL: RECTORSEAL	FIXTURE: Z415-B21 TRAP SEAL: SURESEAL	TRAP SEAL TO MATCH FD SIZE
FS	FLOOR SINK	3"	2"	0"	0"	FIXTURE: ZURN	FIXTURE: Z1900-2	PROVIDE HALF GRATE
ICE	ICE BOX	0"	0"	1/2"	0"	FIXTURE: IPS	FIXTURE: WATER-TITE (ICE BOX)	WITH WATER HAMMER ARRESTOR
LAV	WALL MOUNTED LAVATORY	1 1/4"	1 1/2"	1/2"	1/2"	FIXTURE: AMERICAN STANDARD FAUCET: CHICAGO FAUCETS INSULATION: TRUEBRO	FIXTURE: 0355-027 FAUCET: 895-3170N2B3MAB INSULATION: LAV GUARD 2	MOUNT AT ADA HEIGHT POWER REQUIREMENT: 120V 144 WATTS
SCRUB	SCRUB SINK	1 1/2"	1 1/2"	1/2"	1/2"	FIXTURE: STERIS	FIXTURE: SNK-0042F	
SS-1	SINK	1 1/2"	1 1/2"	1/2"	1/2"	FIXTURE: JUST MANUFACTURING FAUCET: CHICAGO FAUCETS	FIXTURE: SLXD2019A-J FAUCET: LWM1-823-B	
SS-2	BREAK SINK	1 1/2"	1 1/2"	1/2"	1/2"	FIXTURE: JUST MANUFACTURING FAUCET: KOHLER	FIXTURE: US1821A-J FAUCET: K-22065	
WB	WASHING MACHINE OUTLET BOX	2"	0"	1/2"	0"	FIXTURE: WATER-TITE	FIXTURE: W4700 HA SERIES	PROVIDE WATER HAMMER ARRESTORS ENSURE 1" MIN. AIR GAP IS PROVIDED FOR WASTE
WC	FLOOR MOUNT FLUSH VALVE WATER CLOSET	3"	2"	1 1/2"	0"	FIXTURE: AMERICAN STANDARD FLUSH VALVE: SLOAN SEAT: BEMIS	FIXTURE: 3461.001 FLUSH VALVE: REGAL 111-1.6 SEAT: 1965SSCT	

### IECC TABLE C403.11.1 MINIMUM PIPE INSULATION THICKNESS (in inches)

FLUID OPERATING TEMPERATURE RANGE AND USAGE (F)	INSULATION CONDUCTIVITY		NOMINAL PIPE SIZE (inches)				
	CONDUCTIVITY (BTU / IN. F)	MEAN RATING TEMPERATURE (F)	PIPE SIZE				
			< 1	1 to < 1 1/2	1 1/2 to < 4	4 to < 8	> 8
251 - 350	0.29 - 0.32	200	3.0	4.0	4.5	4.5	4.5
201 - 250	0.27 - 0.30	150	2.5	2.5	2.5	3.0	3.0
141 - 200	0.25 - 0.29	125	1.5	1.5	2.0	2.0	2.0
105 - 140	0.21 - 0.28	100	1.0	1.0	1.5	1.5	1.5
40 - 60	0.21 - 0.27	75	0.5	0.5	1.0	1.0	1.0
< 40	0.20 - 0.26	50	0.5	1.0	1.0	1.0	1.5

NOTES:  
 1. FOR PIPING SMALLER THAN 1 1/2" INCHES AND LOCATED IN PARTITIONS WITHIN CONDITIONED SPACES, REDUCTION OF THESE THICKNESS BY 1" SHALL BE PERMITTED, BUT NOT TO A THICKNESS LESS THAN 1 INCH.  
 2. FOR DIRECT-BURIED HEATING AND HOT WATER PIPING, REDUCTION OF THICKNESSES BY 1 1/2" SHALL BE PERMITTED, BUT NOT LESS THAN 1 INCH



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project:  
**IHC McKay  
Dee IR  
Expansion**

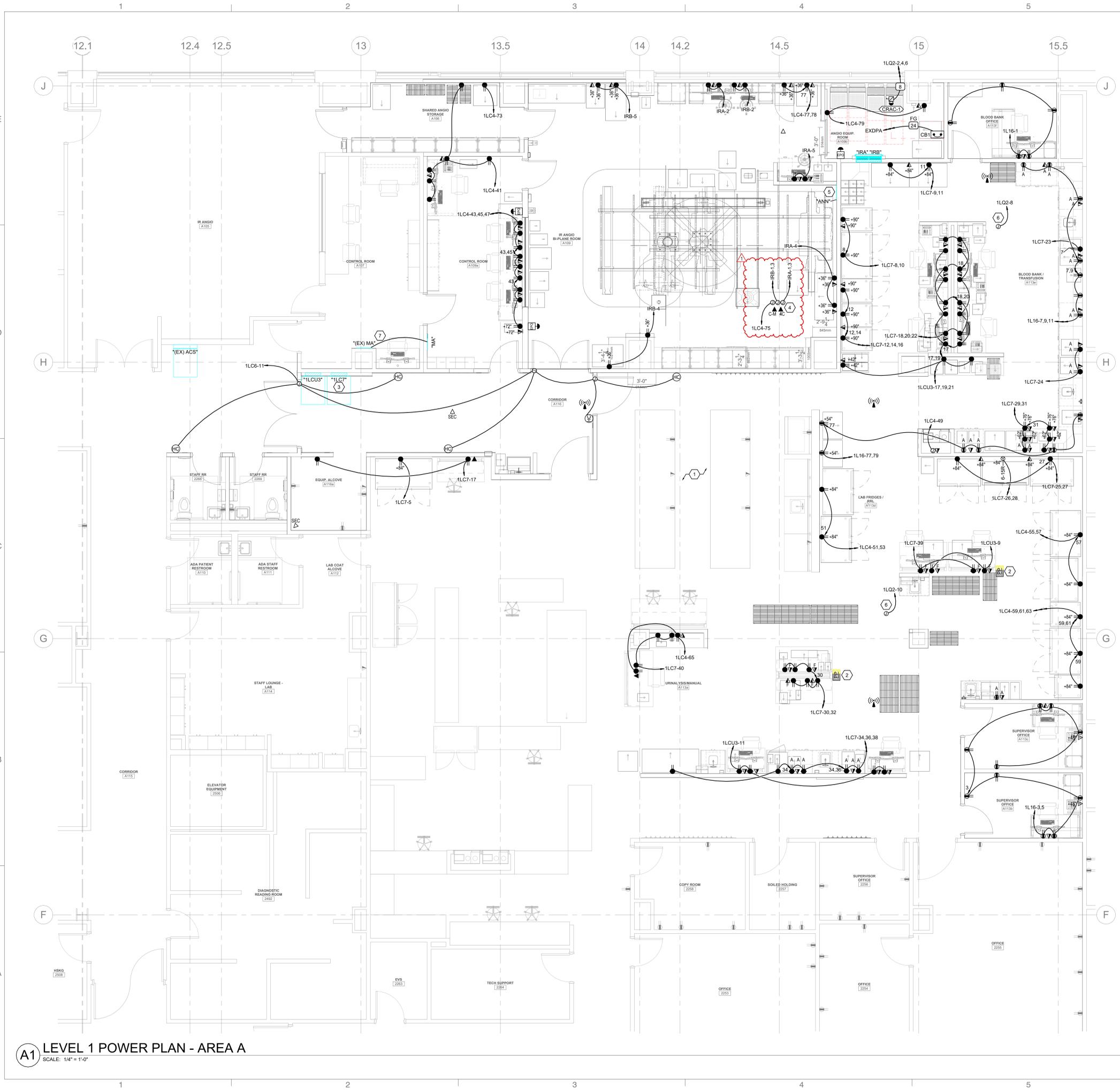
MCKAY DEE HOSPITAL  
4401 HARRISON BLVD  
OGDEN, UTAH 84403

project #: 25.0200  
date: 02 FEB 2026  
revisions:  
1 ADDENDUM #1 02/27/2026

title:  
**PLUMBING  
SCHEDULES**

sheet:  
**P601**

CONSTRUCTION DOCUMENT  
SET



**GENERAL SHEET NOTES**

- 1 PROVIDE TYPED AND UPDATED PANEL SCHEDULES FOR ALL PANELS AFFECTED BY PROJECT SCOPE.
- 2 ALL WIRING IN PATIENT CARE AREAS SHALL ADHERE TO THE REQUIREMENTS OF NEC 517.13.
- 3 ALL POWER RECEPTACLES WITHIN 6' OF THE EDGE OF A SINK SHALL BE GFCI PROTECTED.
- 4 CONTRACTOR TO REFER TO VENDOR DRAWINGS FROM GE, PHILLIPS, AND STERIS FOR ADDITIONAL CONTRACTOR RESPONSIBILITIES.
- 5 PROVIDE DEDICATED NEUTRALS FOR ALL BRANCH CIRCUITS.

**SHEET KEYNOTES**

- 1 EQUIPMENT IN THIS AREA SHALL REMAIN ENERGIZED AT ALL TIMES. CONSTRUCTION ACTIVITIES SHALL NOT INTERRUPT POWER OR COMMUNICATION CABLING. COORDINATE ALL WORK ACCORDINGLY.
- 2 PROVIDE A LEGRAND AMDT-P-4 SERIES TELE-POWER POLE OR EQUIVALENT FOR PONY WALL WIREWAY. PROVIDE SEPARATED WIREWAYS FOR EM POWER, UPS POWER AND TELECOM CABLING.
- 3 PANEL TO BE RENAMED FROM 1L63 TO 1LC7. AFTER DEMOLITION THERE SHOULD BE ROUGHLY NINE CIRCUITS REMAINING. TRACE AND UPDATED ALL LABELS FOR CIRCUITS FED FROM 1LC7. PROVIDE A NEW 20A/2P BREAKER IN EXISTING SQUARE D PANEL 1LC7.
- 4 ANESTHESIA BOOM RECEPTACLES TO BE FED FROM ISOLATION PANEL CIRCUITS. CIRCUIT THE BOOM BREAK TO CRITICAL BRANCH PANEL 1LC4. PROVIDE FOUR DATA RECEPTACLES AND THREE CLINICAL ENGINEERING PORTS AT THE BOOM VIDEO LOCATIONS.
- 5 PROVIDE A REMOTE ANNUNCIATOR ALARM/MONITOR FOR THE ISOLATION PANEL. COORDINATE EXACT LOCATION WITH OWNER GROUP.
- 6 PROVIDE 120V POWER IN CEILING FOR VAVS.
- 7 CONNECT TO THE EXISTING LIFE SAFETY CIRCUIT FEEDING THE MED GAS ALARM PANELS.



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project:  
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Expansion**

MCKAY DEE HOSPITAL 4401  
HARRISON BLVD OGDEN, UTAH  
84403

project #: 25.0200  
date: 04 FEB 2026  
revisions:  
1 Add #01 02/27/26

title:  
**LEVEL 1  
POWER  
PLAN - AREA  
A**

sheet:  
**EP103A**  
CONSTRUCTION  
DOCUMENTS

2/26/2026 3:50:27 PM Autodesk Docs: \\IHC McKay D:\R Expansion\0250450-Elec\Comb\A1.dwg

**A1 LEVEL 1 POWER PLAN - AREA A**  
SCALE: 1/4" = 1'-0"



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02/04/2026

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project:  
**IHC McKay  
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Expansion**

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HARRISON BLVD OGDEN, UTAH  
84403

project #: 25.0200  
date: 04 FEB 2026

revisions:  
1 Add #01 02/27/26

title:  
**PHILIPS  
VENDOR  
DRAWINGS**

sheet:  
**EP501**  
CONSTRUCTION  
DOCUMENTS

**Point to Point Run Lengths**

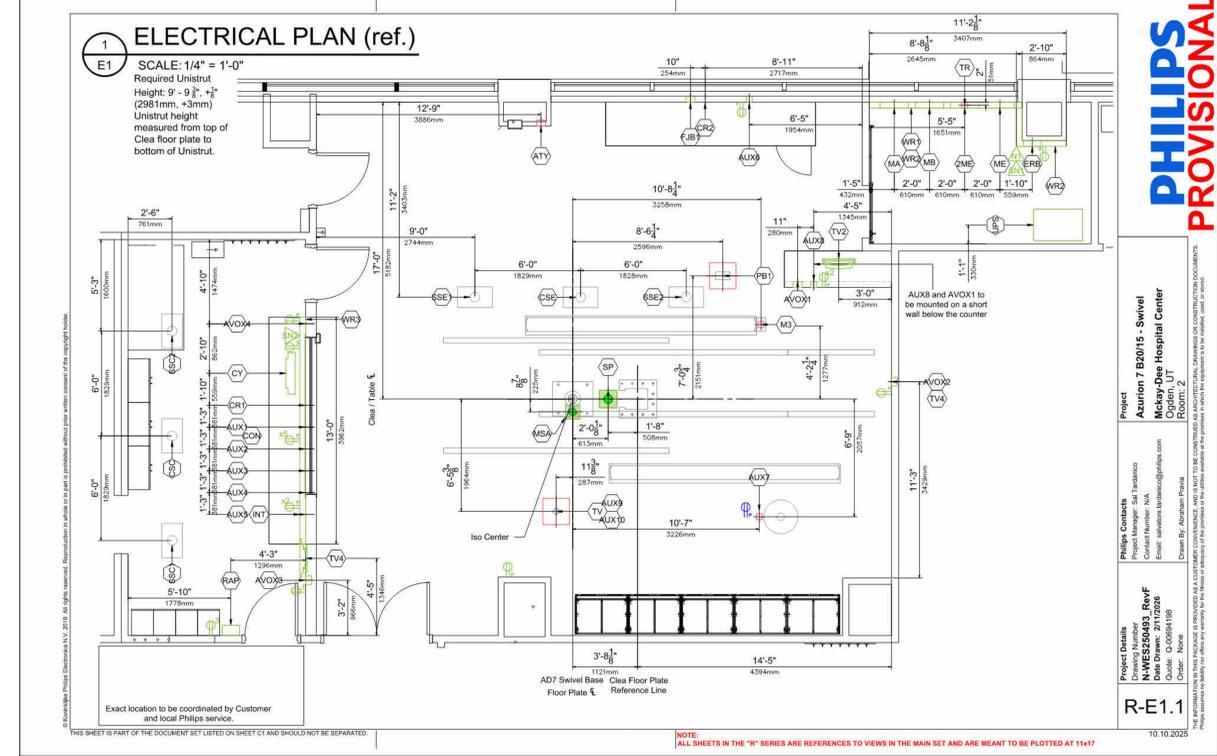
Electrician Requirements and Notes

- A Greenlee measuring tape (part no. 435) must be provided with raceway (conduit) runs
- All raceway (conduit) runs must take most direct route point to point
- All conduits shall be labeled and identified at each end by run number/destination.
- For conduit use the minimum bending radius specific to the conduit diameter. All conduit and raceway shall be sweeps.

Run No.	From	To	Raceway (Conduit) Quantity	Cable Type (*)	Minimum Raceway (Conduit) Size	Maximum Point to Point Run Length	Special Requirements	REQUIREMENTS Reference to document point to point measurements
A	ERB	Third Party Room	1	G	2"	-	For Injector, Auxiliary Box, Patient Monitoring, Video Networking, etc.	
C	2	ERB	1	G	2"	-	See Sheet "2-ED" for details.	
A	3	SP	ME	1	C	2 1/2"	61'	Tube Cooling Hoses.
A	4	SP	ME	1	H	2 1/2"	56'	X-Ray high-voltage cables, the use of 90 deg. elbows is not acceptable.
A	5	SP	MA	1	PIG	1 1/2"	50'	
A	6	SP	MA	1	PIG	1 1/2"	57'	
A	7	SP	MA	1	S	2"	57'	
A	8	SP	ME	1	S	1"	57'	
A	9	MSA	MA	1	PIG	2"	44'	
A	10	MSA	MA	1	S	3"	44'	
A	11	MSA	MB	1	S	1"	44'	
A	12	PB1	2ME	1	C	2 1/2"	60'	Tube Cooling Hoses.
A	13	PB1	2ME	1	H	2"	54'	X-Ray high-voltage cables, the use of 90 deg. elbows is not acceptable.
A	14	PB1	MA	1	PIG	1 1/2"	51'	
A	15	PB1	2ME	1	PIG	1 1/2"	57'	
A	16	PB1	MA	1	S	2"	51'	
A	17	PB1	2ME	1	S	1"	57'	
A	18	TV	(MA)	1	P	1 1/2"	60'	
A	19	TV	(MB)	1	PIG	1 1/2"	60'	For FlexVision XL.
A	20	TV	(MB)	1	S	1 1/2"	60'	
A	21	TV	(CY)	1	S	1"	60'	
A	22	ATY	(TV)	1	S	1"	60'	
A	23	CY	MA	1	S	3"	60'	Conduits to land on wall raceway adjacent to CY.
A	24	CY	MB	1	S	1 1/2"	60'	Conduits to land on wall raceway adjacent to CY.
A	25	CY	MA	1	PIG	2"	60'	Conduits to land on wall raceway adjacent to CY.
A	26	CY	MB	1	S	2"	66'	Conduits to land on wall raceway adjacent to CY. For Philips Workstations.
A	27	ATY	MA	1	S	2"	47'	
C	28	SN1	SN2	1	S	1"	-	For Service Hub. Dedicated conduit and CAT 6 network connection terminated at each end and labeled with run number/coding.
C	29	WL	MA	1	P	PER NEC	PER NEC	X-ray Warning Light Refer to Detail 3-ED
C	30	RL	MA	1	P	PER NEC	PER NEC	Exam Room Light Refer to Detail 3-ED

**PHILIPS PROVISIONAL**

Project: Azurion 7 E2015 - Swivel McKay-Dee Hospital Center Ogden, UT Room: 2  
 Philips Contacts: Project Manager: Sam Taborico, Contact Number: N/A, Email: samtan@philips.com, Drawn By: Abraham Pineda  
 Project Details: Drawing Number: N-WES250483\_RevF, Date Drawn: 2/11/2026, Quoted: Q-00094198  
 R-EC1



**Point to Point Run Lengths**

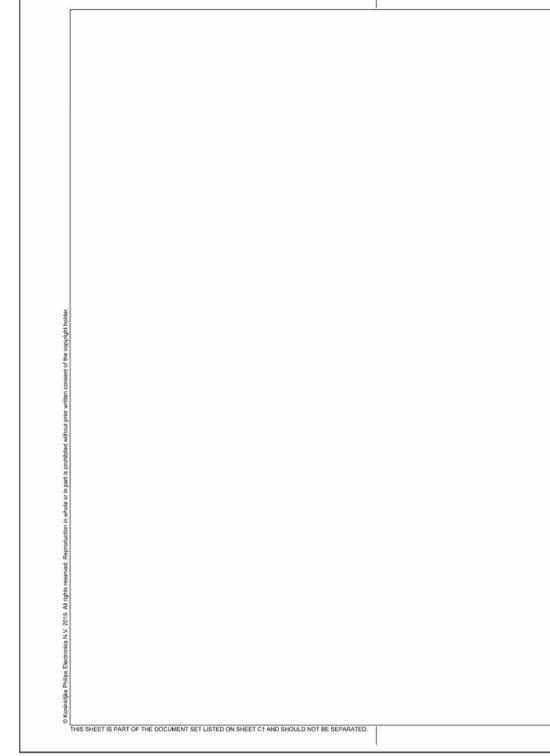
Electrician Requirements and Notes

- A Greenlee measuring tape (part no. 435) must be provided with raceway (conduit) runs
- All raceway (conduit) runs must take most direct route point to point
- All conduits shall be labeled and identified at each end by run number/destination.
- For conduit use the minimum bending radius specific to the conduit diameter. All conduit and raceway shall be sweeps.

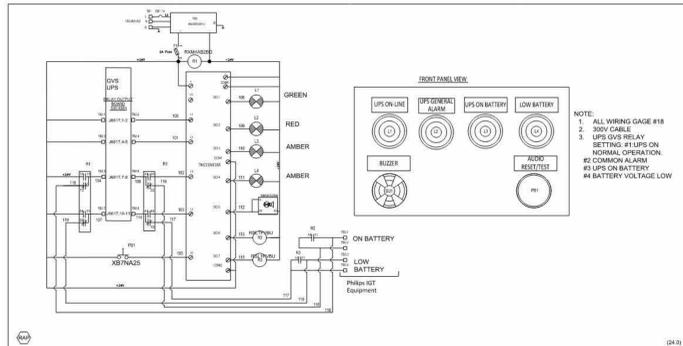
Run No.	From	To	Raceway (Conduit) Quantity	Cable Type (*)	Minimum Raceway (Conduit) Size	Maximum Point to Point Run Length	Special Requirements	REQUIREMENTS Reference to document point to point measurements
G	31	MSA	(PH)	1	S	3"	-	For future options (Patient Monitoring).
A	32	AUX	(MB)	1	S	1 1/2"	86'	
A	33	AUX	(MB)	1	S	1 1/2"	86'	
A	34	AUX	(MB)	1	S	1 1/2"	86'	
A	35	AUX	(MB)	1	S	1 1/2"	86'	
A	36	AUX	(MB)	1	S	1 1/2"	86'	
A	37	AUX	(MB)	1	S	1 1/2"	86'	
A	38	AUX	(MB)	1	S	1 1/2"	86'	
A	39	AUX	(MB)	1	S	1 1/2"	86'	
G	40	MSA	(ME) Dns	1	-	2"	-	Optional for med gas box.
C	41	Power Page	(CB)	1	PIG	Per N.E.C.	Per N.E.C.	3 AWG minimum phase/ground wire size.
C	42	(CB)	(PS)	1	PIG	Per N.E.C.	Per N.E.C.	3 AWG minimum phase/ground wire size.
C	43	(PS)	(WR)	1	PIG	Per N.E.C.	Per N.E.C.	4 AWG minimum phase/ground wire size. Final connections to terminate at MA terminal block.
C	44	RAP	(PS)	1	S	Per N.E.C.	Per N.E.C.	For Remote Alarm Panel. Cable by electrician.
B	45	MAP	(MA)	1	S	Per N.E.C.	Per N.E.C.	For Remote Alarm Panel. Cable provided by Schneider. Can be extended per N.E.C.
C	47	(PS)	(ST)	1	P	Per N.E.C.	Per N.E.C.	
A	48	AUX	(MB)	1	S	1 1/2"	86'	for TV2.
A	49	AUX	(MB)	1	S	1 1/2"	86'	for TV4.
A	50	(IB)	(MB)	1	PIG	1 1/2"	86'	
A	51	(IB)	(MB)	1	S	1 1/2"	86'	
C	52	TR	(MA)	1	P	2"	-	LED 150F Surgical Light.
G	53	(M)	(ER)	1	G	2"	-	Per local code. LED 150F Surgical Light.
A	54	(NT)	(MS)	1	P	1 1/2"	75'	Conduit opening must be covered if the IntraSight system is planned for future installation.
A	55	(NT)	(MS)	1	S	1 1/2"	75'	Conduit opening must be covered if the IntraSight system is planned for future installation.
A	56	(V)	(MA)	1	S	1 1/2"	86'	for TV3.
B	(CN)	(TV)	(S)	1	S	1"	50'	For Exam Room Microphone Coaxial cable.
B	(CN)	(SE)	(S)	1	S	1"	50'	Exam room speaker (x3) ethernet cable.
B	(CN)	(SC)	(S)	1	S	1"	50'	Control room speaker (x3) ethernet cable.

**PHILIPS PROVISIONAL**

Project: Azurion 7 E2015 - Swivel McKay-Dee Hospital Center Ogden, UT Room: 2  
 Philips Contacts: Project Manager: Sam Taborico, Contact Number: N/A, Email: samtan@philips.com, Drawn By: Abraham Pineda  
 Project Details: Drawing Number: N-WES250483\_RevF, Date Drawn: 2/11/2026, Quoted: Q-00094198  
 R-EC2



2/26/2026 3:50:30 PM Autodesk Docs: IHC McKay D:IR Expansion\250483-Elec-Cemist.dwg



**5** **DIAGRAM - REMOTE ALARM PANEL INTERCONNECTION FOR UPS (ref.)**  
SCALE: N.T.S.

**PHILIPS**  
**PROVISIONAL**

**Project Details**  
Project: **Azurion 7 B2015 - Swivel**  
McKay-Dee Hospital Center  
Opden, UT  
Room: 2

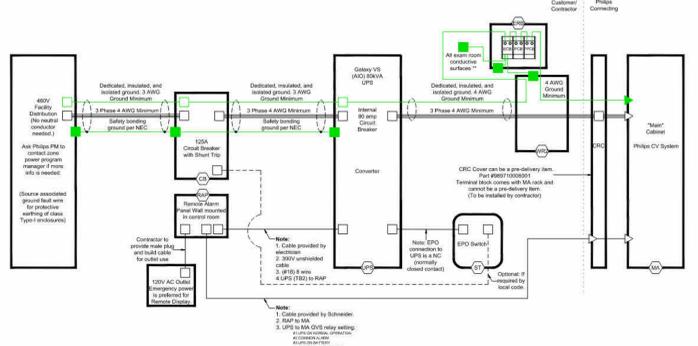
**PHILIPS CONTACTS**  
Project Manager: Sam Tardicio  
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Email: samuel.tardicio@philips.com

**PHILIPS CONTACTS**  
Project Manager: Sam Tardicio  
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**Project Details**  
Drawing Number: **N-WES250483\_RevF**  
Date Drawn: 2/11/2026  
Cable: C-00054158  
Order: None

**R-ED.5**  
10.10.2025

**NOTE:**  
ALL SHEETS IN THE "R" SERIES ARE REFERENCES TO VIEWS IN THE MAIN SET AND ARE MEANT TO BE PLOTTED AT 11x17



**6** **ELECTRICAL SCHEMATIC WITH SCHNEIDER AiO UPS DETAIL**  
SCALE: N.T.S.

**PHILIPS**  
**PROVISIONAL**

**Project Details**  
Project: **Azurion 7 B2015 - Swivel**  
McKay-Dee Hospital Center  
Opden, UT  
Room: 2

**PHILIPS CONTACTS**  
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**PHILIPS CONTACTS**  
Project Manager: Sam Tardicio  
Contact Number: N/A  
Email: samuel.tardicio@philips.com

**Project Details**  
Drawing Number: **N-WES250483\_RevF**  
Date Drawn: 2/11/2026  
Cable: C-00054158  
Order: None

**R-ED.6**  
10.10.2025

**NOTE:**  
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project:  
**IHC McKay  
Dee IR  
Expansion**

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HARRISON BLVD OGDEN, UTAH  
84403

project #: 25.0200  
date: 04 FEB 2026  
revisions:  
1 Add #01 02/27/26

title:  
**PHILIPS  
VENDOR  
DRAWINGS**

sheet:  
**EP502**  
CONSTRUCTION  
DOCUMENTS

**ELECTRICAL NOTES**

- Aluminum or solid wires are not allowed.
- Wire sizes given are for use of equipment. Larger sizes may be required by local codes.
- It is recommended that all wires be color coded, as required in accordance with national and local electrical codes.
- Conduit sizes shall be verified by the architect, electrical engineer or contractor, in accordance with local or national codes.
- Convenience outlets are not illustrated. Their number and location are to be specified by others. Locate at least one convenience outlet close to the system control, the power distribution unit and one on each wall of the procedure room. Use hospital approved outlet or equivalent.
- General room illumination is not illustrated. Caution should be taken to avoid excessive heat from overhead spotlights. Damage can occur to ceiling mounting components and wiring if high wattage bulbs are used. Recommend low wattage bulbs no higher than 75 watts and use dimmer controls (except MR). Do not mount lights directly above areas where ceiling mounted accessories will be parked.
- Routing of cable ductwork, conduits, etc., must run direct as possible otherwise may result in the need for greater than standard cable lengths (refer to the interconnection diagram for maximum usable lengths point to point).
- Conduit turns to have large, sweeping bends with minimum radius in accordance with national and local electrical codes.
- In some cases GEHC will specify ground wires to be sized larger than code. In these situations, the GEHC specification must be followed.
- A special grounding system is required in all procedure rooms by some national and local codes. It is recommended in areas where patients might be examined or treated under present, future, or emergency conditions. Consult the governing electrical code and confer with appropriate customer administrative personnel to determine the areas requiring this type of grounding system.
- The maximum point to point distances illustrated on this drawing must not be exceeded.
- Physical connection of primary power to GEHC equipment is to be made by customers electrical contractor with the supervision of a GEHC representative. The GEHC representative would be required to identify the physical connection location, and insure proper handling of GEHC equipment.
- GEHC conducts power audits to verify quality of power being delivered to the system. The customer's electrical contractor is required to be available to support this activity.
- Every installation is unique. The electrical contractor will be required to support the installation of the GEHC equipment by providing knockouts, grommeted openings, bushings, etc. as required. All power connections to be performed by the electrician.

- All junction boxes, conduit, duct, duct dividers, switches, circuit breakers, cable tray, etc., are to be supplied and installed by customers electrical contractor. All junction boxes shall be provided with covers.
- Conduit and duct runs shall have gradual sweep radius bends.
- Conduits and duct above ceiling or below finished floor must be installed as near to ceiling or floor as possible to reduce run length.
- Ceiling mounted junction boxes illustrated on this plan must be installed flush with finished ceiling.
- All ductwork must meet the following requirements:
  - Ductwork shall be metal with dividers and have removable, accessible covers.
  - Ductwork shall be certified/rated for electrical power purposes.
  - Ductwork shall be electrically and mechanically bonded together in an approved manner.
  - PVC as a substitute must be used in accordance with all local and national codes.
- All openings in raceway and access flooring are to be cut out and finished off with grommet material by the customers contractor.
- Electrical contractor to provide measured pull strings in all conduit and raceway runs.
- Provide 10 foot pigtail at all junction points.
- Grounding is critical to equipment function and patient safety. Site must conform to wiring specifications shown on this plan.

**CONNECTIVITY REQUIREMENTS**

Your new GE Healthcare imaging modality will require local and remote connectivity to enable our full range of digital support:

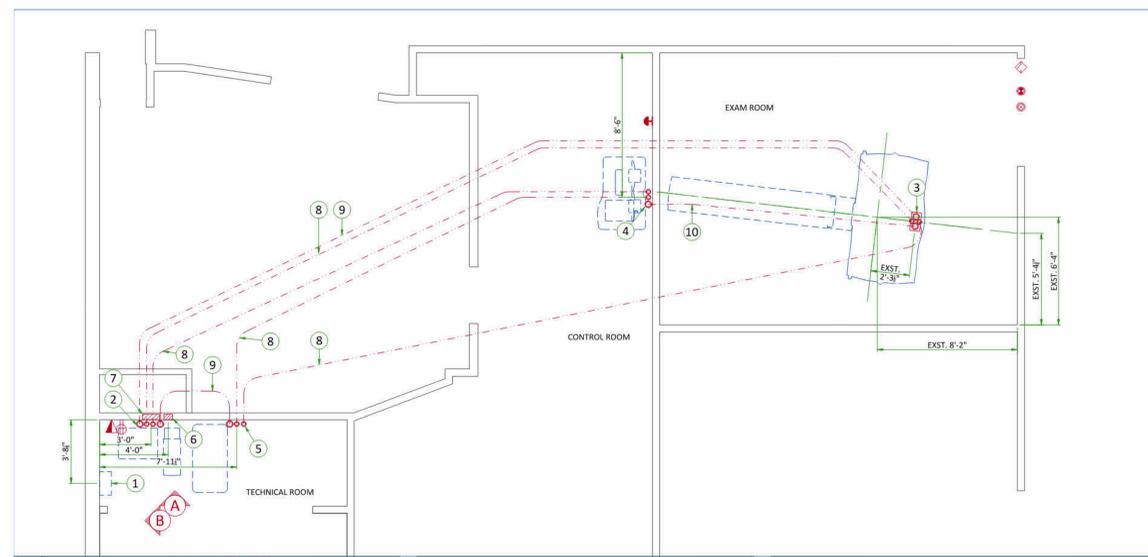
- Local connectivity - This allows your system to connect to local devices such as PACS and modality worklist. We will require network information to configure the system(s), and a live ethernet port(s) prior to the delivery of the system(s).
- Remote connectivity - Your GE Healthcare service warranty includes InSite™ (applicable to InSite capable products), a powerful broadband-based service which enables digital tools that can help guard your hospital against equipment downtime and revenue loss by quickly connecting you to a GE Healthcare expert.

Depending on product family and software version, imaging systems can be connected in one of the following methods:

- TLS over TCP Port 443 (Preferred method for new products) via:
  - DNS resolution
  - Customer-provided Proxy or
  - GE Proxy (Available in some regions)
- Site-to-Site IPsec VPN tunnel

Please provide the GE project manager with the contact information for the resource that can provide information required to set up these connections. GEHC will send out communication to these contacts, which will include the project's Connectivity requirements, and a Connectivity form. This form will need to be completed and returned to GEHC prior to delivery of the system to ensure the system is tested and connectivity is enabled prior to the completion of the installation.

McKay Dee Hospital Center | REVOLUTION CT ES | CT-M486983-FIN-00-A.DWG | Rev A | Date 23/Feb/2026 | E1 - Electrical Notes | 13/17



Item	Electrical Layout Item List
1	Main disconnect panel (MDP)
2	Suitable bushings & lock nuts (Power Distribution Unit)
3	Suitable bushings & lock nuts (Gantry)
4	Suitable bushings & lock nuts (Operator's console)
5	Suitable bushings & lock nuts (System Cabinet)
6	6" x 6" x 4" [150 x 150 x 100] box (Partial UPS)
7	12" x 16" x 4" [300 x 400 x 100] box (Power Distribution Unit)
8	2 1/2" [64] conduit below floor
9	3 1/2" [89] conduit below floor
10	[EXISTING] 3 1/2" [89] conduit below floor

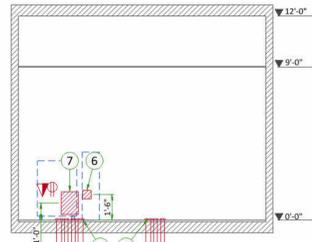
**Room Move Cables Note:**  
Cable lengths listed may differ from what is included with reinstalled system. Contact the local field engineer for actual lengths to be delivered. Run all conduits straight as possible.

**Existing Electrical Note:**  
Use existing duct/conduits where possible. Additional duct/conduit runs may be necessary if existing system is inadequate in size and/or location for this installation. Verify existing size and location.

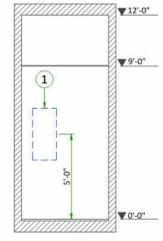
ITEM	Electrical Outlet Legend
	Customer/contractor supplied and installed items unless otherwise specified. Height above floor determined by local codes unless otherwise specified.
Ⓜ	Duplex hospital grade, dedicated wall outlet 120-v, single phase power
Ⓝ	Network outlet
Ⓢ	System emergency off (SEO), (recommended height 1.2m [48"] above floor)
Ⓡ	X-Ray room warning light control panel
Ⓡ	X-Ray ON lamp [11]-24V
Ⓢ	Door interlock switch (needed only if required by state/local codes)

Additional Conduit Runs (Contractor Supplied and Installed)				
From (Bubble # / Item)	To (Bubble # / Item)	Qty	in.	mm
3 Phase Power	1 Main Disconnect Panel	1	As req'd	As req'd
	Emergency Off	1	1/2"	13
1 Main Disconnect Panel	7 Power Distribution Unit	1	As req'd	As req'd
	Door Switch	1	1/2"	13
7 Power Distribution Unit		1	1/2"	13
Warning Light	Warning Light Control	1	1/2"	13
1 Phase Power		1	1/2"	13
1 Main Disconnect Panel	6 Partial UPS	1	1 1/4"	30
	7 Power Distribution Unit	1	2"	50
Operator's Console	6 Partial UPS	1	1"	25

McKay Dee Hospital Center | REVOLUTION CT ES | CT-M486983-FIN-00-A.DWG | 1/4"=1'-0" Rev A | Date 23/Feb/2026 | E2 - Electrical Layout | 14/17



**\*\*\* EXISTING ROOM \*\*\***  
NOTE: ALL OTHER JUNCTION POINTS IN ELEVATIONS ARE EXISTING, AND THUS ARE NOT SHOWN.



McKay Dee Hospital Center | REVOLUTION CT ES | CT-M486983-FIN-00-A.DWG | 1/4"=1'-0" Rev A | Date 23/Feb/2026 | E3 - Electrical Elevations | 15/17



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project:  
**IHC McKay Dee IR Expansion**

MCKAY DEE HOSPITAL 4401  
HARRISON BLVD OGDEN, UTAH  
84403

project #: 25.0200  
date: 04 FEB 2026  
revisions:  
1 Add #01 02/27/26

title:  
**CT #1 DRAWINGS**

sheet:  
**EP503**  
CONSTRUCTION DOCUMENTS

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**POWER REQUIREMENTS**

POWER SUPPLY	3 PHASES+G (4-Wire Wye system, neutral not used)
FREQUENCIES	380/400/420/440/460/480 V ± 10%
MAXIMUM POWER DEMAND	50/60 Hz ± 3 Hz
AVERAGE (CONTINUOUS) POWER DEMAND	150 kVA
POWER FACTOR	11 kVA
	0.85

- Power supply should come into a main disconnect panel (MDP) containing the protective units and controls.
- Governing electrical codes may require a neutral wire. If present, neutral must be terminated in MDP.
- The section of the supply cable should be calculated in accordance with its length and the maximum permissible voltage drops.
- There must be discrimination between supply cable protective device at the beginning of the installation (main low-voltage transformer side) and the protective devices in the MDP.
- Potential future upgrade may require a Maximum Power Demand of 200 kVA to be compatible.

**SUPPLY CHARACTERISTICS**

- Power input must be separate from any others which may generate transients (elevators, air conditioning, radiology rooms equipped with high speed film changers...).
- All equipment (lighting, power outlets, etc...) installed with GE system components must be powered separately.
- The minimum recommended size for a dedicated distribution transformer is: 225 kVA, rated 2.4% regulation at unity power factor. Resultant maximum allowable feeder regulation is 3.6%.
- Phase imbalance 2% maximum.
- Transients must be less than 1500V peak. (on a 400V line)
- Maximum source regulation allowable is 6%. The combination of daily voltage variation (no load) and source regulation under full load shall not exceed + 10/-13% of nominal.

**GROUND SYSTEM**

- System of equipotential grounding.
- Equipotential: The equipotential link will be by means of an equipotential bar. This equipotential bar should be connected to the protective earth conductors in the ducts of the non GE cableways and to additional equipotential connections linking up all the conducting units in the rooms where GE system units are located.

**CABLES**

- Power and cable installation must comply with the distribution diagram.
- All cables must be isolated and flexible, cable color codes must comply with standards for electrical installation.
- The cables from signaling and remote control (Y, SEO, L...) will go to MDP with a pigtail length of 1.5m (4.9 ft), and will be connected during installation. Each conductor will be identified and isolated (screw connector).

**CABLEWAYS**

- The general rules for laying cableways should meet the conditions laid down in current standards and regulations, with regard to:
  - Protecting cables against water (cableways should be waterproof).
  - Protecting cables against abnormal temperatures (proximity to heating pipes or ducts).
  - Protecting cables against temperature shocks.
  - Replacing cables (cableways should be large enough for cables to be replaced).
  - Metal cableways should be grounded.

**POWER DISTRIBUTION**

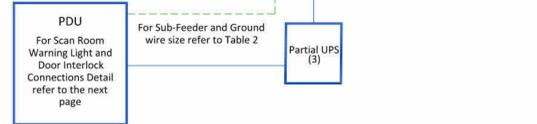
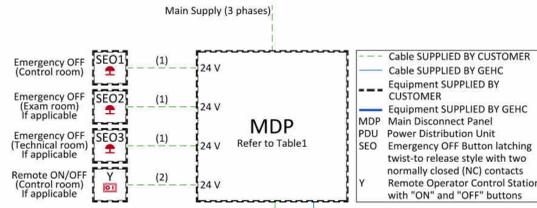


Table1: Recommended minimum customer supplied Main Disconnect Panel (MDP) rating

Power/Voltage	150 kVA
380, 400, 420 V	150 A
440, 460, 480 V	125 A

Table2: Feeder Table

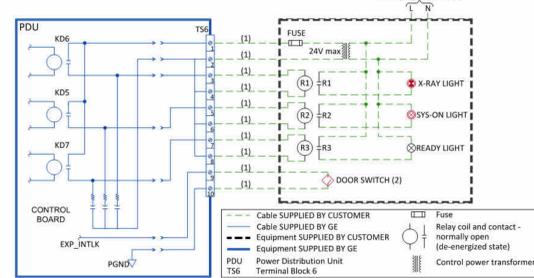
The information below assumes the use of copper wire, rated 75 C and run in steel conduit. All ampacity is determined in accordance with the National Electrical Code (NFPA 70), Table 310-16 (2002). The ampacity of the circuit protection device listed above determines the minimum feeder size, except where total source regulation limits require a larger size. If the wire size does not match the list below, please select the nearest wire size as per local standards.

Sub-Feeder length from MDP to PDU - Ft (m)	Minimum Wire Size, AWG or MCM (mm <sup>2</sup> )/VAC					
	380 VAC	400 VAC	420 VAC	440 VAC	460 VAC	480 VAC
50 (15)	3/0 (95)	3/0 (95)	3/0 (95)	2/0 (70)	2/0 (70)	2/0 (70)

Grounding

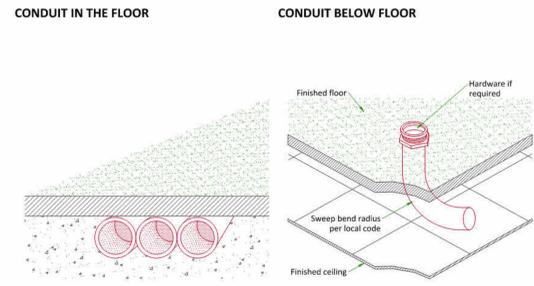
- Notes :
- Wire size: 4x2mm<sup>2</sup> [14AWG] and 1x2mm<sup>2</sup> [14AWG] GND
  - Wire size: 6x2mm<sup>2</sup> [14AWG] and 1x2mm<sup>2</sup> [14AWG] GND
  - Optional for Revolution CT systems

**SCAN ROOM WARNING LIGHT AND DOOR INTERLOCK**



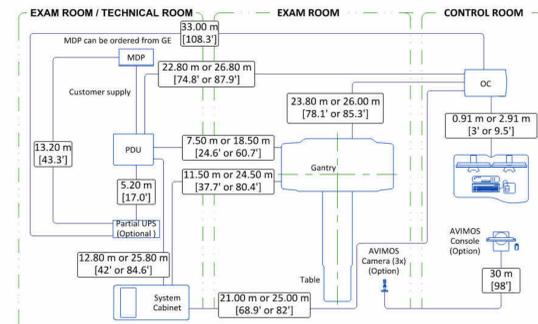
- Notes :
- Wire size: 2mm<sup>2</sup> [14 AWG] at 24V
  - Door interlock circuit is jumpered out if a door switch is not provided.
  - Grounding not shown on the detail, but must comply with local codes.

**TYPICAL CABLE MANAGEMENT**



NOT TO SCALE

**INTERCONNECTIONS**



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project:  
**IHC McKay  
Dee IR  
Expansion**

MCKAY DEE HOSPITAL 4401  
HARRISON BLVD OGDEN, UTAH  
84403

project #: 25.0200  
date: 04 FEB 2026  
revisions :  
1 Add #01 02/27/26

title:  
**CT #1  
DRAWINGS**

sheet:  
**EP504**  
CONSTRUCTION  
DOCUMENTS

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**ELECTRICAL NOTES**

- Aluminum or solid wires are not allowed.
- Wire sizes given are for use of equipment. Larger sizes may be required by local codes.
- It is recommended that all wires be color coded, as required in accordance with national and local electrical codes.
- Conduit sizes shall be verified by the architect, electrical engineer or contractor, in accordance with local or national codes.
- Convenience outlets are not illustrated. Their number and location are to be specified by others. Locate at least one convenience outlet close to the system control, the power distribution unit and one on each wall of the procedure room. Use hospital approved outlet or equivalent.
- General room illumination is not illustrated. Caution should be taken to avoid excessive heat from overhead spotlights. Damage can occur to ceiling mounting components and wiring if high wattage bulbs are used. Recommend low wattage bulbs no higher than 75 watts and use dimmer controls (except MR). Do not mount lights directly above areas where ceiling mounted accessories will be parked.
- Routing of cable ductwork, conduits, etc., must run direct as possible otherwise may result in the need for greater than standard cable lengths (refer to the interconnection diagram for maximum usable lengths point to point).
- Conduit turns to have large, sweeping bends with minimum radius in accordance with national and local electrical codes.
- In some cases GE will specify ground wires to be sized larger than code. In these situations, the GE specification must be followed.
- A special grounding system is required in all procedure rooms by some national and local codes. It is recommended in areas where patients might be examined or treated under present, future, or emergency conditions. Consult the governing electrical code and confer with appropriate customer administrative personnel to determine the areas requiring this type of grounding system.
- The maximum point to point distances illustrated on this drawing must not be exceeded.
- Physical connection of primary power to GE equipment is to be made by customers electrical contractor with the supervision of a GE representative. The GE representative would be required to identify the physical connection location, and insure proper handling of GE equipment.
- GEHC conducts power audits to verify quality of power being delivered to the system. The customer's electrical contractor is required to be available to support this activity.
- Every installation is unique. The electrical contractor will be required to support the installation of the GE equipment by providing knockouts, grommeted openings, bushings, etc. as required. All power connections to be performed by the electrician.

- All junction boxes, conduit, duct, duct dividers, switches, circuit breakers, cable tray, etc., are to be supplied and installed by customers electrical contractor. All junction boxes shall be provided with covers.
- Conduit and duct runs shall have sweep radius bends.
- Conduits and duct above ceiling or below finished floor must be installed as near to ceiling or floor as possible to reduce run length.
- Ceiling mounted junction boxes illustrated on this plan must be installed flush with finished ceiling.
- All ductwork must meet the following requirements:
  - Ductwork shall be metal with dividers and have removable, accessible covers.
  - Ductwork shall be certified/rated for electrical power purposes.
  - Ductwork shall be electrically and mechanically bonded together in an approved manner.
  - PVC as a substitute must be used in accordance with all local and national codes.
- All openings in raceway and access flooring are to be cut out and finished off with grommet material by the customers contractor.
- Electrical contractor to insert pull cords for all cable run conduits.
- Provide 10 foot pigtail at all junction points.
- Grounding is critical to equipment function and patient safety. Site must conform to wiring specifications shown on this plan.

McKay Dee Hospital Center | DISCOVERY CT750 HD | CT-M486982-FIN-00-A.DWG | Rev A | Date 23/Feb/2026 | E1 - Electrical Notes | 14/18

**CONNECTIVITY REQUIREMENTS**

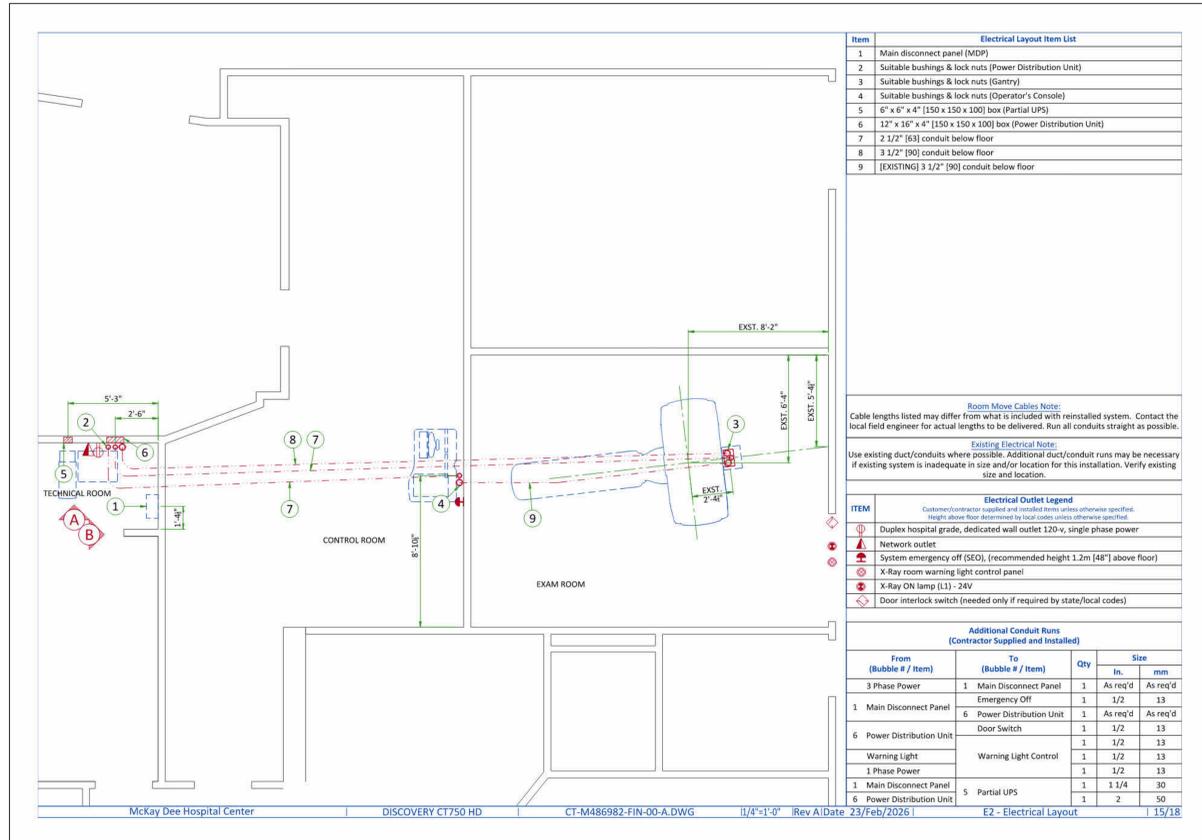
Your new GE Healthcare imaging modality will require local and remote connectivity to enable our full range of digital support:

- Local connectivity - This allows your system to connect to local devices such as PACS and modality worklist. We will require network information to configure the system(s), and a live ethernet port(s) prior to the delivery of the system(s).
- Remote connectivity - Your GE Healthcare service warranty includes InSite™ (applicable to InSite capable products), a powerful broadband-based service which enables digital tools that can help guard your hospital against equipment downtime and revenue loss by quickly connecting you to a GE Healthcare expert.

Depending on product family and software version, imaging systems can be connected in one of the following methods:

- TLS over TCP Port 443 (Preferred method for new products) via:
  - DNS resolution
  - Customer-provided Proxy or
  - GE Proxy (Available in some regions)
- Site-to-Site IPsec VPN tunnel

Please provide the GE project manager with the contact information for the resource that can provide information required to set up these connections. GEHC will send out communication to these contacts, which will include the project's Connectivity requirements, and a Connectivity form. This form will need to be completed and returned to GEHC prior to delivery of the system to ensure the system is tested and connectivity is enabled prior to the completion of the installation.



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project:  
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Dee IR  
Expansion**

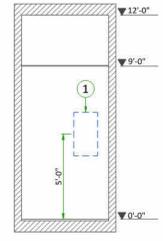
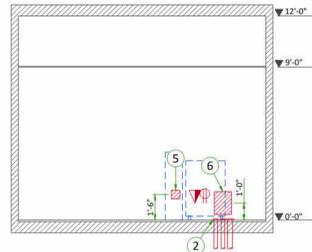
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project #: 25.0200  
date: 04 FEB 2026  
revisions:  
1 Add #01 02/27/26

title:  
**CT #2  
DRAWINGS**

sheet:  
**EP505**  
CONSTRUCTION DOCUMENTS

**\*\*\* EXISTING ROOM \*\*\***  
NOTE: ALL OTHER JUNCTION POINTS IN ELEVATIONS ARE EXISTING, AND  
THUS ARE NOT SHOWN.



McKay Dee Hospital Center | DISCOVERY CT750 HD | CT-M486982-FIN-00-A.DWG | 1/4"=1'-0" Rev A | Date 23/Feb/2026 | E3 - Electrical Elevations | 16/18

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**POWER REQUIREMENTS**

POWER SUPPLY	3 PHASES+G 380/400/420/440/460/480 V ± 10%
FREQUENCIES	50/60 Hz ± 3 Hz
MAXIMUM POWER DEMAND	150 kVA
AVERAGE (CONTINUOUS) POWER DEMAND	11 kVA
POWER FACTOR	0.85

- Power supply should come into a main disconnect panel (MDP) containing the protective units and controls.
- The section of the supply cable should be calculated in accordance with its length and the maximum permissible voltage drops.
- There must be discrimination between supply cable protective device at the beginning of the installation (main low-voltage transformer side) and the protective devices in the MDP.

**SUPPLY CHARACTERISTICS**

- Power input must be separate from any others which may generate transients (elevators, air conditioning, radiology rooms equipped with high speed film changers...).
- All equipment (lighting, power outlets, etc...) installed with GE system components must be powered separately.
- Phase imbalance 2% maximum.
- Transients must be less than 1500V peak. (on a 400V line)

**GROUND SYSTEM**

- System of equipotential grounding.
- Equipotential: The equipotential link will be by means of an equipotential bar. This equipotential bar should be connected to the protective earth conductors in the ducts of the non GE cableways and to additional equipotential connections linking up all the conducting units in the rooms where GE system units are located.

**CABLES**

- Power and cable installation must comply with the distribution diagram.
- All cables must be isolated and flexible, cable color codes must comply with standards for electrical installation.
- The cables from signaling and remote control (Y, SEO, L...) will go to MDP with a pigtail length of 1.5m, and will be connected during installation. Each conductor will be identified and isolated (screw connector).

**CABLEWAYS**

The general rules for laying cableways should meet the conditions laid down in current standards and regulations, with regard to:

- Protecting cables against water (cableways should be waterproof).
- Protecting cables against abnormal temperatures (proximity to heating pipes or ducts).
- Protecting cables against temperature shocks.
- Replacing cables (cableways should be large enough for cables to be replaced).
- Metal cableways should be grounded.

**POWER DISTRIBUTION**

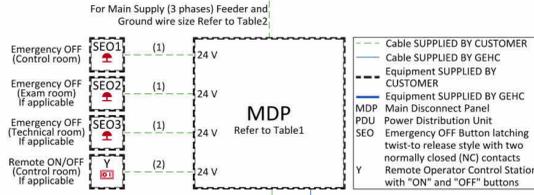


Table1:

Power/Voltage	Recommended minimum customer supplied Main Disconnect Panel (MDP) rating
380, 400, 420 V	150 kVA
440, 460, 480 V	125 A

Table2:

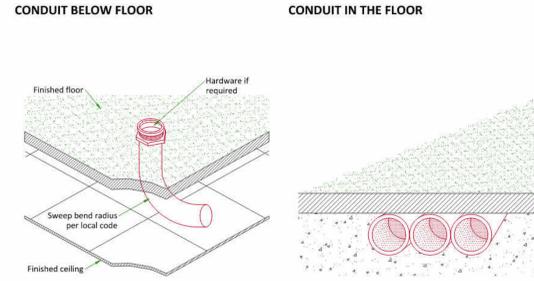
Feeder length from Power Substation to MDP - ft (m)	Minimum Wire Size, AWG or MCM (mm²)/VAC					
	380 VAC	400 VAC	420 VAC	440 VAC	460 VAC	480 VAC
50 (15)	1/0 (50)	1/0 (50)	1/0 (50)	1 (35)	1 (35)	1 (35)
100 (30)	1/0 (50)	1/0 (50)	1/0 (50)	1 (35)	1 (35)	1 (35)
150 (46)	1/0 (50)	1/0 (50)	1/0 (50)	1 (35)	1 (35)	1 (35)
200 (61)	1/0 (50)	1/0 (50)	1/0 (50)	1 (35)	1 (35)	1 (35)
250 (76)	2/0 (70)	2/0 (70)	1/0 (50)	1 (35)	1 (35)	1 (35)
300 (91)	3/0 (95)	3/0 (95)	2/0 (70)	2/0 (70)	1/0 (50)	1/0 (50)
350 (107)	4/0 (120)	3/0 (95)	3/0 (95)	2/0 (70)	2/0 (70)	1/0 (50)
400 (122)	250 (120)	4/0 (100)	3/0 (95)	3/0 (95)	3/0 (95)	2/0 (70)
Sub-Feeder length from MDP to PDU - ft (m)	1/0 (50)	1/0 (50)	1/0 (50)	1 (35)	1 (35)	1 (35)

Grounding

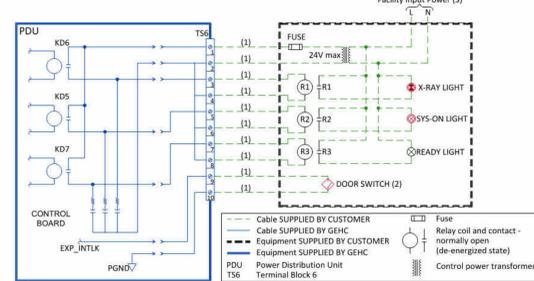
Run a dedicated 1/0 [50 mm²] or larger insulated copper ground wire from the power source to the MDP and from MDP to the PDU. Run the ground wire in the same raceway with the three-phase wires.

- Notes:
- Wire size: 4x2.5mm² [14AWG] and 1x2.5mm² [14AWG] GND
  - Wire size: 6x2.5mm² [14AWG] and 1x2.5mm² [14AWG] GND

**TYPICAL CABLE MANAGEMENT**

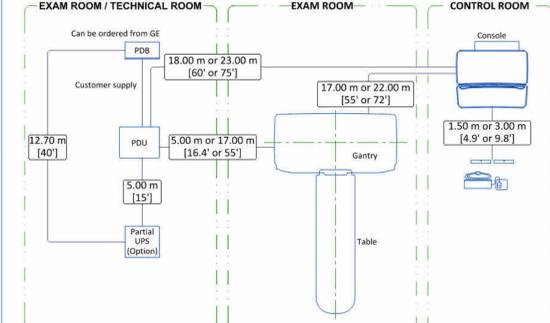


**SCAN ROOM WARNING LIGHT AND DOOR INTERLOCK**



- Notes:
- Wire size: 2.5 mm² [14 AWG] at 24V
  - Door interlock circuit is jumpered out if a door switch is not provided.
  - Grounding not shown on the detail, but must comply with local codes.

**INTERCONNECTIONS**



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project:  
**IHC McKay  
Dee IR  
Expansion**

MCKAY DEE HOSPITAL 4401  
HARRISON BLVD OGDEN, UTAH  
84403

project #: 25.0200  
date: 04 FEB 2026  
revisions:  
1 Add #01 02/27/26

title:  
**CT #2  
DRAWINGS**

sheet:  
**EP506**  
CONSTRUCTION DOCUMENTS

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**GENERAL SHEET NOTES**

- CONNECT ALL NEW EXIT SIGNS TO THE EXISTING LIFE SAFETY CIRCUIT CURRENTLY FEEDING THE EXISTING EXIT SIGNS.

**SHEET KEYNOTES**

- CONNECT TO THE EXISTING UNSWITCHED LIGHTING CIRCUIT THAT PREVIOUSLY FED THIS SPACE.
- CONNECT TO THE EXISTING LIGHTING CIRCUIT AND CONTROLS FEEDING THE EXISTING LIGHTING IN THE LAB SPACE.
- CONNECT TO THE EXISTING LIGHTING CIRCUIT AND CONTROLS FEEDING THE EXISTING EGRESS LIGHTING IN THE LAB SPACE.
- CONNECT TO THE EXISTING LIGHTING CIRCUIT AND CONTROLS FEEDING THE EXISTING EGRESS LIGHTING IN THE CORRIDOR.
- CONNECT TO THE EXISTING LIGHTING CIRCUIT AND CONTROLS FEEDING THE EXISTING LIGHTING IN THE CORRIDOR.
- PROVIDE A KEYED SWITCH AT +2" AFF FOR TESTING BATTERY PACKS.
- PROVIDE A BATTERY PACK IN TWO FIXTURES. EACH F14-EOR FIXTURE SHOULD HAVE AN EMERGENCY BATTERY PACK. ALSO PROVIDE A KEYED SWITCH OUTSIDE OF THE IR SUITE FOR TESTING.
- PROVIDE NEW WALL STATION FOR LIGHTING CONTROLS.



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salt lake city, utah 84101  
801 532 4422



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project:  
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project#: 25.0200  
date: 04 FEB 2026  
revisions:  
1 Add #01 02/27/26

title:  
**LEVEL 1  
LIGHTING  
PLAN - AREA  
A**

sheet:  
**EL101A**  
CONSTRUCTION  
DOCUMENTS

**A1 LEVEL 1 LIGHTING PLAN - AREA A**  
SCALE: 1/4" = 1'-0"

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## SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient support.
9. Resilient pipe guides.
10. Air-spring isolators.
11. Restrained-air-spring isolators.
12. Elastomeric hangers.
13. Spring hangers.
14. Snubbers.
15. Restraints - rigid type.
16. Restraints - cable type.
17. Restraint accessories.
18. Post-installed concrete anchors.
19. Concrete inserts.
20. Vibration isolation equipment bases.

B. Related Requirements:

1. Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
2. Section 230548 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

#### 1.3 DEFINITIONS

- A. Designated Seismic System: A plumbing component that requires design in accordance with ASCE/SEI 7, Ch. 13 and for which the Component Importance Factor is greater than 1.0.

- B. IBC: International Building Code.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Include load rating for each wind-force-restraint fitting and assembly.
3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component.
4. Annotate types and sizes of seismic restraints and accessories, complete with listing markings or report numbers and load rating in tension and compression as evaluated by ICC-ES product listing.
5. Annotate to indicate application of each product submitted and compliance with requirements.
6. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

- B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

- C. Delegated-Design Submittal:

1. For each seismic-restraint device, including seismic-restrained mounting, snubber, seismic restraint, seismic-restraint accessory, and concrete anchor and insert, that is required by this Section or is indicated on Drawings, submit the following:
  - a. Seismicrestraint, and vibration isolator, and isolation base selection: Select vibration isolators, seismicrestraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data.
  - b. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification by professional engineer that riser system was examined for excessive stress and that none exists.
  - c. Concrete Anchors and Inserts: Include calculations showing anticipated seismic and wind loads. Include certification that device is approved by an NRTL for seismic reinforcement use.
  - d. Seismic Design Calculations: Submit all input data and loading calculations prepared in "Performance Requirements" Article in "Seismic Design Calculations" Paragraph.
  - e. Wind-Load Design Calculations: Submit all static and dynamic loading calculations prepared in "Wind-Load Design Calculations" Paragraph in "Performance Requirements" Article.

- f. Qualified Professional Engineer: All designated-design submittals for seismic calculations are to be signed and sealed by qualified professional engineer responsible for their preparation.
- 2. Seismic-Restraint Detail Drawing:
  - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
  - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
  - c. Coordinate seismic restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply also with requirements in other Sections for equipment mounted outdoors.
- 3. Product Listing, Preapproval, and Evaluation Documentation: By an evaluation service member of ICC-ES an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- 4. All delegated-design submittals for seismic- and wind-restraint detail Drawings are to be signed and sealed by qualified professional engineer responsible for their preparation.
- 5. Design Calculations for Vibration Isolation Devices: Calculate static and dynamic loading due to equipment weight and operating forces required to select proper vibration isolators, and to design vibration isolation bases.
- 6. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification that riser system was examined for excessive stress and that none exists.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For professional engineer.
- C. Welding certificates.
- D. Air-Spring Mounting System Performance Certification: Include natural frequency, load, and damping test data.
- E. Field quality-control reports:
- F. Seismic Qualification Data: Provide special certification for designated seismic systems as indicated in ASCE/SEI 7-05, Paragraph 13.2.2, "Special Certification Requirements for Designated Seismic Systems" for all Designated Seismic Systems identified as such on Drawings or in the Specifications.

1. Provide equipment manufacturer's written certification for each designated active plumbing seismic device and system, stating that it will remain operable following the design earthquake. Certification must be based on requirements of ASCE/SEI 7 and AHRI 1270, including shake table testing per ICC-ES AC156 or a similar nationally recognized testing standard procedure acceptable to authorities having jurisdiction.
  2. Provide equipment manufacturer's written certification that components with hazardous contents maintain containment following the design earthquake by methods required in ASCE/SEI 7-05.
  3. Submit evidence demonstrating compliance with these requirements for approval to authorities having jurisdiction after review and acceptance by a licensed professional engineer.
  4. The following plumbing systems and components are Designated Seismic Systems and require written special certification of seismic qualification by manufacturer:
- G. Wind-Force Performance Certification: Provide special certification for plumbing components subject to high wind exposure and impact damage and designated on Drawings or in the Specifications to require wind-force performance certification.
1. Provide equipment manufacturer's written certification for each designated plumbing device, stating that it will remain in place and operable following the design wind event and comply with all requirements of authorities having jurisdiction.
  2. Certification must be based on ICC-ES or similar nationally recognized testing standard procedures acceptable to authorities having jurisdiction.
  3. The following plumbing systems and components require special certification for high wind performance. Written special certification of resistance to the effects of high wind force and impact damage must be provided by manufacturer:

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-spring isolators and restrained-air-spring isolators to include in operation and maintenance manuals.

## 1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, be an NRTL as defined by OSHA in 29 CFR 1910.7, and be acceptable to authorities having jurisdiction.
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-Restraint Device Load Ratings: Devices to be tested and rated in accordance with applicable code requirements and authorities having jurisdiction. Devices to be listed by a nationally recognized third party that requires periodic follow-up inspections and has a listing directory available to the public. Provide third-party listing by one or more of the following: ICC-ES product listing.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic control system.
1. Seismic Performance: Equipment shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7-05.
- B. Seismic Design Calculations:
1. Perform calculations to obtain force information necessary to properly select seismic-restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in ASCE/SEI 7-05. Where "ASCE/SEI 7" is used throughout this Section, it is to be understood that the edition referred to in this subparagraph is the edition intended as reference throughout the section text.
    - a. Data indicated below to be determined by Delegated-Design Contractor must be obtained by Contractor and must be included in individual component submittal packages.
    - b. Coordinate seismic design calculations with wind-load calculations for equipment mounted outdoors. Comply with requirements in other Sections in addition to those in this Section for equipment mounted outdoors.
    - c. Building Occupancy Category: Per the structural drawings and specifications.
    - d. Building Risk Category: Per the structural drawings and specifications..
    - e. Building Site Classification: Per the structural drawings and specifications.
  2. Calculation Factors, ASCE/SEI 7-16, Ch. 13 - Seismic Design Requirements for Nonstructural Components: All section, paragraph, equation, and table numbers refer to ASCE/SEI 7-16 unless otherwise noted.
    - a. Horizontal Seismic Design Force  $F_p$ : Value is to be calculated by Delegated-Design Contractor using Equation 13.3-1. Factors below must be obtained for this calculation.
      - 1)  $S_{DS}$  = Spectral Acceleration: Per the structural drawings and specifications. Value applies to all components on Project.
      - 2)  $a_p$  = Component Amplification Factor: See Drawing Schedule for each component.
      - 3)  $I_p$  = Component Importance Factor: See Drawing Schedule for each component.
      - 4)  $W_p$  = Component Operating Weight: For each component. Obtain by Delegated-Design Contractor from each component submittal.
      - 5)  $R_p$  = Component Response Modification Factor: See Drawing Schedule for each component.
      - 6)  $z$  = Height in Structure of Point of Attachment of Component for Base: Determine from Project Drawings for each component by Delegated-Design Contractor. For items at or below the base, "z" shall be taken as zero.
      - 7)  $h$  = Average Roof Height of Structure for Base: Determine from Project Drawings by Delegated-Design Contractor.

- b. Vertical Seismic Design Force: Calculated by Delegated-Design Contractor using method explained in ASCE/SEI 7-16, Paragraph 13.3.1.2.
  - c. Seismic Relative Displacement  $D_p$ : Calculated by Delegated-Design Contractor using methods explained in ASCE/SEI 7-16, Paragraph 13.3.2. Factors below must be obtained for this calculation:
    - 1)  $D_p$  = Relative Seismic Displacement that Each Component Must Be Designed to Accommodate: Calculated by Delegated-Design Contractor in accordance with ASCE/SEI 7-16, Paragraph 13.3.2.
    - 2)  $I_e$  = Structure Importance Factor: Per the structural drawings and specifications. Value applies to all components on Project.
    - 3)  $\delta_{xA}$  = Deflection at Building Level x of Structure A: See Drawing Schedule for each component.
    - 4)  $\delta_{yA}$  = Deflection at Building Level y of Structure A: See Drawing Schedule for each component.
    - 5)  $\delta_{yB}$  = Deflection at Building Level y of Structure B: See Drawing Schedule for each component.
    - 6)  $h_x$  = Height of Level x to which Upper Connection Point Is Attached: Determine for each component by Delegated-Design Contractor from Project Drawings and manufacturer's data.
    - 7)  $h_y$  = Height of Level y to which Upper Connection Point Is Attached: Determine for each component by Delegated-Design Contractor from Project Drawings and manufacturer's data.
    - 8)  $\Delta_{aA}$  = Allowable Story Drift for Structure A: See Drawing Schedules for each component.
    - 9)  $\Delta_{aB}$  = Allowable Story Drift for Structure B: See Drawing Schedules for each component.
    - 10)  $h_{sx}$  = Story Height Used in the Definition of Allowable Drift  $\Delta_a$ : See Drawings Schedules for each component.
  - d. Component Fundamental Period  $T_p$ : Calculated by Delegated-Design Contractor using methods explained in ASCE/SEI 7-16, Paragraph 13.3.3. Factors below must be obtained for this calculation:
    - 1)  $W_p$  = Component Operating Weight: Determined by Contractor from Project Drawings and manufacturer's data.
    - 2)  $g$  = Gravitational Acceleration: 32.17 fps<sup>2</sup>.
    - 3)  $K_p$  = Combined Stiffness of the Component, Supports, and Attachments: Determined by delegated-design seismic engineer.
3. Calculation Factors, ASCE/SEI 7-10, Ch. 13 - Seismic Design Requirements for Nonstructural Components: All section, paragraph, equation, and table numbers refer to ASCE/SEI 7-10 unless otherwise noted.
- a. Horizontal Seismic Design Force  $F_p$ : Calculated by Delegated-Design Contractor by ASCE/SEI 7-10, Equation 13.3-1. Factors below must be obtained for this calculation:
    - 1)  $S_{DS}$  = Spectral Acceleration: Per the structural drawings and specifications. Value applies to all components on Project.
    - 2)  $a_p$  = Component Amplification Factor: See Drawing Schedule for each component.

- 3)  $I_p$  = Component Importance Factor: See Drawing Schedule for each component.
  - 4)  $W_p$  = Component Operating Weight: For each component. Obtain by Delegated-Design Contractor from equipment submittal.
  - 5)  $R_p$  = Component Response Modification Factor: See Drawing Schedule for each component.
  - 6)  $z$  = Height in Structure of Point of Attachment of Component for Base: Determined from Project Drawings for each component by Contractor. For items at or below the base, "z" shall be taken as zero.
  - 7)  $h$  = Average Roof Height of Structure for Base: Determine from Project Drawings by Delegated-Design Contractor.
- b. Vertical Seismic Design Force: Calculate by Delegated- Design Contractor using method explained in ASCE/SEI 7-10, Paragraph 13.3.1.
- c. Seismic Relative Displacement  $D_{pl}$ : Calculate by Delegated-Design Contractor using methods explained in ASCE/SEI 7-10, Paragraph 13.3.2. Factors below must be obtained for this calculation:
- 1)  $D_p$  = Relative Seismic Displacement that Each Component Must Be Designed to Accommodate: Calculate by Delegated-Design Contractor in accordance with ASCE/SEI 7-10, Paragraph 13.3.2.
  - 2)  $I_e$  = Structure Importance Factor: Per the structural drawings and specifications. Value applies to all components on Project.
  - 3)  $\delta_{xA}$  = Deflection at Building Level x of Structure A: See Drawing Schedule for each component.
  - 4)  $\delta_{yA}$  = Deflection at Building Level y of Structure A: See Drawing Schedule for each component.
  - 5)  $\delta_{yB}$  = Deflection at Building Level y of Structure B: See Drawing Schedule for each component.
  - 6)  $h_x$  = Height of Level x to which Upper Connection Point Is Attached: Determine for each component by Delegated-Design Contractor from Project Drawings and manufacturer's data;
  - 7)  $h_y$  = Height of Level y to which Upper Connection Point Is Attached: Determine for each component by Delegated-Design Contractor from Project Drawings and manufacturer's data.
  - 8)  $\Delta_{aA}$  = Allowable Story Drift for Structure A: See Drawing Schedule for each component.
  - 9)  $\Delta_{aB}$  = Allowable Story Drift for Structure B: See Drawing Schedule for each component.
  - 10)  $h_{sx}$  = Story Height Used in the Definition of the Allowable Drift  $\Delta_a$ : See Schedule for each component.
4. Calculation Factors, ASCE/SEI 7-05, Ch. 13 - Seismic Design Requirements for Nonstructural Components: All section, paragraph, equation, and table numbers refer to ASCE/SEI 7-05 unless otherwise noted.
- a. Horizontal Seismic Design Force  $F_p$ : Calculated by Delegated-Design Contractor by ASCE/SEI 7-05, Equation 13.3-1. Factors below must be obtained for this calculation.

- 1)  $S_{DS}$  = Spectral Acceleration: Per the structural drawings and specifications. Value applies to all components on the project.
  - 2)  $a_p$  = Component Amplification Factor: See Drawing Schedule for each component.
  - 3)  $I_p$  = Component Importance Factor: See Drawing Schedule for each component.
  - 4)  $W_p$  = Component Operating Weight: Obtain by Delegated-Design Contractor for each component from component submittal.
  - 5)  $R_p$  = Component Response Modification Factor: See Drawing Schedule for each component.
  - 6)  $z$  = Height in Structure of Point of Attachment of Component for the Base: Determine by Delegated-Design Contractor for each component from Project Drawings. For items at or below the base, "z" shall be taken as zero.
  - 7)  $h$  = Average Roof Height of Structure for the Base: Determine by Delegated-Design Contractor from Project Drawings.
- b. Vertical Seismic Design Force: Calculated by Delegated-Design Contractor using method explained in ASCE/SEI 7-05, Paragraph 13.3.1.
- c. Seismic Relative Displacement  $D_p$ : Calculated by Delegated-Design Contractor using methods explained in ASCE/SEI 7-05, Paragraph 13.3.2. Factors below must be obtained for this calculation:
- 1)  $\delta_{xA}$  = Deflection at Building Level x of Structure A: See Drawing Schedule for each component.
  - 2)  $\delta_{yA}$  = Deflection at Building Level y of Structure A: See Drawing Schedule for each component.
  - 3)  $\delta_{yB}$  = Deflection at Building Level y of Structure B: See Drawing Schedule for each component.
  - 4)  $h_x$  = Height of Level x to which Upper Connection Point Is Attached: Determine for each component by Delegated-Design Contractor from Project Drawings and manufacturer's data.
  - 5)  $h_y$  = Height of Level y to which Upper Connection Point Is Attached: Determine for each component by Delegated-Design Contractor from Project Drawings and manufacturer's data.
  - 6)  $\Delta_{aA}$  = Allowable Story Drift for Structure A: See Drawing Schedule for each component.
  - 7)  $\Delta_{aB}$  = Allowable Story Drift for Structure B: See Drawing Schedule for each component.
  - 8)  $h_{sx}$  = Story Height Used in the Definition of the Allowable Drift  $\Delta_a$ : See Drawing Schedule for each component.

## 2.2 ELASTOMERIC ISOLATION PADS

### A. Elastomeric Isolation Pads:

1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
2. Size: Factory or field cut to match requirements of supported equipment.
3. Pad Material: Oil and water resistant with elastomeric properties. Neoprene rubber, silicone rubber, or other elastomeric material.

4. Surface Pattern: Smooth, ribbed, or waffle pattern.
5. Infused nonwoven cotton or synthetic fibers.
6. Load-bearing metal plates adhered to pads.
7. Sandwich-Core Material: Resilient and elastomeric.
  - a. Surface Pattern: Smooth, ribbed, or waffle pattern.
  - b. Infused nonwoven cotton or synthetic fibers.

## 2.3 ELASTOMERIC ISOLATION MOUNTS

### A. Double-Deflection, Elastomeric Isolation Mounts: .

1. Mounting Plates:
  - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
  - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
2. Elastomeric Material: Molded, oil- and water-resistant neoprene rubber, silicone rubber, or other elastomeric material.

## 2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

### A. Restrained Elastomeric Isolation Mounts: .

1. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
  - a. Housing: Cast-ductile iron or welded steel.
  - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

## 2.5 OPEN-SPRING ISOLATORS

### A. Freestanding, Laterally Stable, Open-Spring Isolators: .

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

## 2.6 HOUSED-SPRING ISOLATORS

### A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing: .

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
  - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
  - b. Top housing with attachment and leveling bolt threaded mounting holes and internal leveling device elastomeric pad.

## 2.7 RESTRAINED-SPRING ISOLATORS

### A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint: .

1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
  - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
  - b. Top plate with threaded mounting holes.
  - c. Internal leveling bolt that acts as blocking during installation.
2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## 2.8 HOUSED-RESTRAINED-SPRING ISOLATORS

### A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing: .

1. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
  - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.

- b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## 2.9 PIPE-RISER RESILIENT SUPPORT

- A. All-Directional, Acoustical Pipe Anchor Consisting of Two Steel Tubes Separated by a Minimum 1/2-inch-Thick Neoprene: .
  1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
  2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

## 2.10 RESILIENT PIPE GUIDES

- A. Telescopic Arrangement of Two Steel Tubes or Post and Sleeve Arrangement Separated by a Minimum 1/2-inch-Thick Neoprene: .
  1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

## 2.11 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: .
  1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
  2. Damping Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel-to-steel contact.

## 2.12 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression: .
  1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
  2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

## 2.13 SNUBBERS

- A. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
  1. Post-installed Concrete Anchor Bolts: Secure to concrete surface with post-installed concrete anchors. Anchors to be seismically prequalified in accordance with ACI 355.2 testing and designated in accordance with ACI 318-08 Appendix D for 2009 IBC. Preset concrete inserts: Seismically prequalified in accordance with ICC-ES AC446 testing.
  2. Anchors in Masonry: Design in accordance with TMS 402.
  3. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
  4. Resilient Cushion: Maximum 1/4-inch air gap, and minimum 1/4 inch thick.

## 2.14 RESTRAINTS - RIGID TYPE

- A. Description: Shop- or field-fabricated bracing assembly made of ANSI/AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe as per NFPA 13, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

## 2.15 RESTRAINTS - CABLE TYPE

- A. Seismic-Restraint Cables: ASTM A1023/A1023M galvanized or ASTM A603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for seismic restraining cable service; with fittings attached by means of poured socket, swaged socket or mechanical (Flemish eye) loop.
- B. Restraint cable assembly and cable fittings must comply with ASCE/SEI 19. All cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge type end fittings do not comply and are unacceptable.

## 2.16 RESTRAINT ACCESSORIES

- A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Non-metallic stiffeners are unacceptable.

- B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

## 2.17 POST-INSTALLED CONCRETE ANCHORS

- A. Mechanical Anchor Bolts:
  - 1. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.
- B. Adhesive Anchor Bolts:
  - 1. Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.
- C. Provide post-installed concrete anchors that have been prequalified for use in seismic applications. Post-installed concrete anchors must comply with all requirements of ASCE/SEI 7-05, Ch. 13.
  - 1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
  - 2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.
- D. Expansion-type anchor bolts are not permitted for equipment in excess of 10 hp, which is not vibration isolated.
  - 1. Undercut expansion anchors are permitted.

## 2.18 CONCRETE INSERTS

- A. Provide preset concrete inserts, which are seismically prequalified in accordance with ICC-ES AC466 testing.
- B. Comply with ANSI/MSS 58.

## 2.19 VIBRATION ISOLATION EQUIPMENT BASES

- A. Steel Rails: Factory-fabricated, welded, structural-steel rails.
  - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.
    - a. Include supports for suction and discharge elbows for pumps.
  - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Rails shall have shape to accommodate supported equipment.
  - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- B. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.
  - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
    - a. Include supports for suction and discharge elbows for pumps.
  - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
  - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. Concrete Inertia Base: Factory-fabricated or field-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
  - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
    - a. Include supports for suction and discharge elbows for pumps.
  - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
  - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
  - 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation, wind-load control, and seismic control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength is adequate to carry static[, **load,**] and seismic load within specified loading limits.

### 3.3 INSTALLATION OF VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICES

- A. Provide vibration-control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Device Schedules, where indicated on Drawings, or where the Specifications indicate they are to be installed on specific equipment and systems.
- B. Provide seismic-restraint devices for systems and equipment where indicated in Equipment Schedules or Seismic-Restraint Devices Schedules, where indicated on Drawings, where the Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.
- C. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- D. Installation of vibration isolators and seismic restraints must not cause any stresses, misalignment, or change of position of equipment or piping.
- E. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- F. Equipment Restraints:
  - 1. Install snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
  - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
  - 3. Install seismic-restraint devices using methods approved by that provides required submittals for component.
- G. Piping Restraints:
  - 1. Comply with requirements in MSS SP-127.

2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
  3. Brace a change of direction longer than 12 feet.
- H. Install seismic-restraint cables so they do not bend across edges of adjacent equipment or building structure.
- I. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES that provides required submittals for component.
- J. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- K. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- L. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- M. Post-Installed Concrete Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify Project structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
  2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
  3. Mechanical-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
  4. Adhesive-Type Anchor Bolts: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
  5. Set anchors to manufacturer's recommended torque, using a torque wrench.
  6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

### 3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Provide flexible connections in piping systems where they cross structural seismic joints and other point where differential movement may occur. Provide adequate flexibility to accommodate differential movement as determined in accordance with ASCE/SEI 7. Comply with requirements in Section 221116 "Domestic Water Piping" and Section 221119 "Domestic Water Piping Specialties" for piping flexible connections.

### 3.5 INSTALLATION OF VIBRATION ISOLATION EQUIPMENT BASES

- A. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate dimensions of steel equipment rails, bases, and concrete inertia bases, with requirements of isolated equipment specified in this and other Sections. Where dimensions of bases are indicated on Drawings, they may require adjustment to accommodate actual isolated equipment.

### 3.6 ADJUSTING

- A. Adjust isolators after system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

### 3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Tests and Inspections:
  - 1. Perform tests and inspections.
  - 2. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
  - 3. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
  - 4. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
  - 5. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
  - 6. Test to 90 percent of rated proof load of device.
  - 7. Measure isolator restraint clearance.
  - 8. Measure isolator deflection.
  - 9. Verify snubber minimum clearances.
  - 10. Test and adjust restrained-air-spring isolator controls and safeties.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Units will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 220548

## SECTION 220719 - PLUMBING PIPING INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
  - 1. Domestic cold-water piping.
  - 2. Domestic hot-water piping.
  - 3. Domestic recirculating hot-water piping.
  - 4. Supplies and drains for handicap-accessible lavatories and sinks.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail attachment and covering of heat tracing inside insulation.
  - 3. Detail insulation application at pipe expansion joints for each type of insulation.
  - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
  - 6. Detail application of field-applied jackets.
  - 7. Detail application at linkages of control devices.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of the manufacturer, fabricator, type, description, and size, as well as ASTM standard designation and maximum use temperature.

#### 1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

#### 1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
  - 1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

## 2.2 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials are applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.
  - 1. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ.
  - 2. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
  - 3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

## 2.3 INSULATING CEMENTS

- A. Glass-Fiber and Mineral Wool Insulating Cement: Comply with ASTM C195.
- B. Glass-Fiber and Mineral Wool Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

## 2.4 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- C. PVC Jacket Adhesive: Compatible with PVC jacket.

## 2.5 MASTICS AND COATINGS

- A. Materials are compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
  - 1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  - 2. Service Temperature Range: 0 to plus 180 deg F.
  - 3. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
  - 4. Color: White.
- C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  2. Service Temperature Range: 0 to 180 deg F.
  3. Color: White.
- D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
  2. Service Temperature Range: 0 to plus 180 deg F.
  3. Color: White.

## 2.6 LAGGING ADHESIVES

- A. Adhesives comply with MIL-A-3316C, Class I, Grade A, and are compatible with insulation materials, jackets, and substrates.
1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
  2. Service Temperature Range: 20 to plus 180 deg F.
  3. Color: White.

## 2.7 SEALANTS

- A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
1. Permanently flexible, elastomeric sealant.
  2. Service Temperature Range: Minus 58 to plus 176 deg F.
  3. Color: White or gray.

## 2.8 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
  4. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136 Types I, II, III, IV, and VII.
  5. PSK Jacket: Aluminum foil fiberglass reinforced scrim with polyethylene backing, complying with ASTM C1136, Type II.

## 2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  - 1. Adhesive: As recommended by jacket material manufacturer.
  - 2. Color: White.
  - 3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

## 2.10 TAPES

- A. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
  - 1. Width: 2 inches.
  - 2. Thickness: 6 mils.
  - 3. Adhesion: 64 ounces force/inch in width.
  - 4. Elongation: 500 percent.
  - 5. Tensile Strength: 18 lbf/inch in width.

## 2.11 SECUREMENTS

- A. Bands:
  - 1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  - 1. Verify that systems to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  - 2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
  2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
  3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
  2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
  3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least [4 inches] <Insert value> beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Cleanouts.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.

- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  2. Insulate pipe elbows using preformed fitting insulation or mitered or routed fittings made from same material and density as that of adjacent pipe insulation. Each piece is butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation conforms to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

#### A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

#### B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

#### C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

2. When preformed sections of insulation are not available, install mitered or routed sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

### 3.7 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

4. Install insulation to flanges as specified for flange insulation application.

### 3.8 INSTALLATION OF FIELD-APPLIED JACKETS

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
  1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
  1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

### 3.9 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
  1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

### 3.10 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections.
- B. Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
- E. All insulation applications will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

### 3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawl spaces.
  - 2. Underground piping.
  - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
  - 1. NPS 1 and Smaller: Insulation is the following:
    - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
  - 2. NPS 1-1/4 and Larger: Insulation is one of the following:
    - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
  - 1. NPS 1-1/4 and Smaller: Insulation is the following:
    - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - 2. NPS 1-1/2 and Larger: Insulation is the following:
    - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.

### 3.13 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, Concealed:
  - 1. None.
- D. Piping, Exposed:
  - 1. None.
  - 2. PVC: 30 mils thick.

END OF SECTION 220719

## SECTION 224300 - HEALTHCARE PLUMBING FIXTURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Healthcare water closets.
2. Flushometer valves.
3. Toilet seats.
4. Scrub sinks.
5. Patient care units.
6. Sink faucets.
7. Supports.
8. Supply fittings.
9. Waste fittings.
10. Grout.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For each type of product.

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fixtures.
2. Rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

##### B. Shop Drawings: Diagrams for power, signal, and control wiring.

#### 1.3 CLOSEOUT SUBMITTALS

##### A. Operation and Maintenance Data: For plumbing fixtures and faucets.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - a. Servicing and adjustments of flushometer valves

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

##### A. Extra Stock Material: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.

2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
3. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than six of each type.
4. Toilet Seats: Equal to 5 percent of amount of each type installed.

## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Obtain each product type from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A112.19.2/CSA B45.1 for vitreous-china plumbing fixtures.
- B. Comply with ASME A112.19.3/CSA B45.4 for stainless steel plumbing fixtures.
- C. Comply with ASSE 1037/ASME A112.1037/CSA B125.37 for flush valves.
- D. Comply with ASME A112.19.5/CSA B45.15 for flush valves and spuds for water closets.
- E. Comply with ASME A112.18.1/CSA B125.1 for plumbing supply fittings.
- F. Comply with ASME A112.18.2/CSA B125.2 for plumbing waste fittings.
- G. Comply with IAPMO Z124.5 for water-closet (toilet) seats.
- H. Comply with ASME A112.6.1M for plumbing fixture supports.
- I. Comply with ICC A117.1 for ADA-compliant, accessible plumbing fixtures and installation.
- J. Comply with ASTM A1045 for flexible PVC gaskets used in connection of vitreous-china water closets to sanitary drainage systems.
- K. Comply with ASME A112.4.3 for plastic fittings used in connection of vitreous-china water closets to sanitary drainage systems.
- L. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- M. Faucets and bubblers intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61/NSF 372 or are certified in compliance with NSF 61/NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

## 2.3 HEALTHCARE WATER CLOSETS

### A. Healthcare Water Closets, Floor Mounted - Vitreous China: Basis of design **American Standard 3461.001**

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. American Standard
  - b. Crane Plumbing, LLC; a division of American Standard
  - c. Kohler Co
  - d. Sloan Valve Company
  - e. TOTO USA, INC
  
2. Bowl:
  - a. Material: Vitreous china.
  - b. Type: Siphon jet.
  - c. Style: Flushometer valve
  - d. Height: Accessible in accordance with ICC A117.1.
  - e. Rim Contour: Elongated.
  - f. Water Consumption: 1.6 gal per flush.
  - g. Outlet: **Bottom**.
  - h. Spud: NPS 1-1/2, top.

## 2.4 FLUSHOMETER VALVES

### A. Lever-Handle, Diaphragm Flushometer Valves: Basis of design **SLOAN REGAL 111-1.6**.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
  - a. American Standard
  - b. Delany Products
  - c. Sloan Valve Company
  - d. Wolverine Brass, Inc
  - e. Zurn Industries, LLC
  
2. Minimum Pressure Rating: 125 psig.
3. Features: Integral check stop, backflow-prevention device, and outlet-tube-mounted bedpan washer.
4. Material: Brass body with corrosion-resistant components.
5. Exposed Flushometer-Valve Finish: Chrome plated.
6. Style: Exposed.
7. Consumption: 1.6 gal per flush.
8. Minimum Inlet: NPS 1.
9. Minimum Outlet: NPS 1-1/4, extended length.

## 2.5 TOILET SEATS

### A. Toilet Seats: Basis of design Bemis 1955CTJ.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard
  - b. Bemis Manufacturing Company
  - c. Centoco Manufacturing Corporation
  - d. Church Seats; Bemis Manufacturing Company
  - e. Kohler Co
  - f. Olsonite; Bemis Manufacturing Company
  - g. TOTO USA, INC
  - h. Zurn Industries, LLC
2. **Material:** Plastic with antimicrobial agent.
3. **Type:** Commercial heavy duty.
4. **Shape:** Elongated rim, open front.
5. **Hinge:** Check.
6. **Hinge Material:** Noncorroding metal.
7. **Color:** White.

## 2.6 LAVATORIES

### A. Sinks LAV: Vitreous China, wall mounted, ADA compliant. **AMERICAN STANDARD 0355.027** or equal by below manufacturers.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Advance Tabco.
  - b. Elkay Manufacturing Co.
  - c. Just Manufacturing.
  - d. Sloan
  - e. **American Standard**
2. **Fixture:**
  - a. **Standard:** ASME A112.19.3/CSA B45.4.
  - b. **Type:** Ledge back
  - c. **Number of Compartments:** One
  - d. **Overall Dimensions:** 21 ¼ x18 ¼.
  - e. **Material:** Vitreous China
  - f. **Holes:** Three, Centered.
  - g. **Mounting Type:** Wall mounted

## 2.7 SINKS

A. Sinks HS: Stainless steel, under mounted. **JUST MANUFACTURING SLXD2019A-J** or equal by below manufacturers.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Advance Tabco.
- b. Elkay Manufacturing Co.
- c. Just Manufacturing.
- d. Kohler

2. Fixture:

- a. Standard: ASME A112.19.3/CSA B45.4.
- b. Type: **Drop In.**
- c. Number of Compartments: One
- d. Overall Dimensions: **19 ½" x 19"**.
- e. Material: 304, 18-8 Stainless Steel, 18 Gauge
- f. Holes: **Single hole.**
- g. Mounting Type: **Drop In**

B. Sinks BS: Stainless steel, under mounted. **JUST MANUFACTURING K- US1821A-J** or equal by below manufacturers.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Advance Tabco.
- b. Elkay Manufacturing Co.
- c. Just Manufacturing.
- d. Sloan

2. Fixture:

- a. Standard: ASME A112.19.3/CSA B45.4.
- b. Type: **Undermount**
- c. Number of Compartments: One
- d. Overall Dimensions: **21 ½" x 18 ½"**.
- e. Material: 304, 18-8 Stainless Steel, 18 Gauge
- f. Holes: No holes
- g. Mounting Type: Undermount

## C. SCRUB SINKS

1. **Scrub Sinks, Stainless Steel, Wall Mounted: STERIS SNK-D042F** or equal by below manufacturers.

- a. **CSI Industries Inc.**

- b. Elkay
- c. Franke
- d. Sloan Valve Company
- e. Whitehall Manufacturing; a division of Morris Group International
- f. Willoughby Industries, Inc.
- g. STERIS

2. Fixture:

- a. Nominal Size: Single Station 32" x 27.28" with back and faucet hole.
  - b. Drain: Grid, NPS 1-1/2.
- 3. Valve: Adjustable thermostatic controlled pressure mixing valve, one per station.
  - 4. Faucet: Gooseneck-spout, knee-action water and soap dispenser; laminar-flow spout outlet.
  - 5. Waste Fittings: Comply with requirements in "Waste Fittings" Article.
  - 6. Support: Type I sink carrier.
  - 7. Sink Mounting Height: ADA compliant.

2.8 SINK FAUCETS

A. LAV, Manual-Operation Mixing Valve: Basis of design Chicago faucets 895-317GN2BE3MAB

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard
  - b. Bradley Corporation
  - c. Chicago Faucets; Geberit Group
  - d. Delta Faucet Company
  - e. Elkay
  - f. Fisher Manufacturing Co
  - g. GROHE America, Inc
  - h. Kohler Co
  - i. Krowne
  - j. Moen Incorporated
  - k. Speakman Company
  - l. T&S Brass and Bronze Works, Inc.
  - m. Zurn Industries, LLC
- 2. Configuration: Hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
- 3. Body Type: Centerset
- 4. Body Material: Solid brass.
- 5. Finish: Chrome plated Polished chrome plate.
- 6. Maximum Flow Rate: 2.2 gpm
- 7. Control: Wrist-blade, 4-inch handle(s).

8. Mounting Type: Deck, concealed
9. Spout Type: gooseneck
10. Spout Outlet: Plain end

B. **SS-2** Faucets, Manual-Operation Mixing Valve: Basis of design Kohler K-22065

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard
  - b. Bradley Corporation
  - c. Chicago Faucets; Geberit Group
  - d. Delta Faucet Company
  - e. Elkay
  - f. Fisher Manufacturing Co
  - g. GROHE America, Inc
  - h. Kohler Co
  - i. Krowne
  - j. Moen Incorporated
  - k. Speakman Company
  - l. T&S Brass and Bronze Works, Inc.
  - m. Zurn Industries, LLC
2. Configuration: Hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
3. Body Type: Single hole
4. Body Material: Solid brass.
5. Finish: By architect
6. Maximum Flow Rate: 1.5 gpm
7. Control: Lever handle(s).
8. Mounting Type: Deck, concealed
9. Spout Type: Swivel,
10. Spout Outlet: Spray

C. **SS-1** Faucet, Manual-Operation Mixing Valve: Basis of design Chicago faucets **LWM1-B23-B**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard
  - b. Bradley Corporation
  - c. Chicago Faucets; Geberit Group
  - d. Delta Faucet Company
  - e. Elkay
  - f. Fisher Manufacturing Co
  - g. GROHE America, Inc
  - h. Kohler Co
  - i. Krowne
  - j. Moen Incorporated
  - k. Speakman Company

- l. T&S Brass and Bronze Works, Inc.
  - m. Zurn Industries, LLC
2. Configuration: Hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
  3. Body Type: Centerset
  4. Body Material: Solid brass.
  5. Finish: Chrome plated Polished chrome plate.
  6. Maximum Flow Rate: 2.2 gpm
  7. Control: **Vandal Proof** wrist-blade, 4-inch handles.
  8. Mounting Type: Deck, concealed
  9. Spout Type: gooseneck
  10. Spout Outlet: Plain end

## 2.9 SUPPORTS

### A. Type I Sink Carrier:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International
  - b. Josam Company
  - c. MIFAB, Inc
  - d. Wade; a subsidiary of McWane Inc.
  - e. WATTS; A Watts Water Technologies Company
  - f. Zurn Industries, LLC
  - g.

## 2.10 SUPPLY FITTINGS

- A. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless steel wall flange.
- B. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- C. Operation: Loose key
- D. Risers: NPS 1/2 ASME A112.18.6, braided or corrugated stainless steel, flexible hose.

## 2.11 WASTE FITTINGS

- A. Drain: Grid with NPS 1-1/2 tailpiece.
- B. Trap:

1. Size: NPS 1-1/2.
2. Material:
  - a. Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- thick, brass tube to wall; and chrome-plated brass or steel wall flange.
  - b. Stainless steel, two-piece trap and swivel elbow with 0.012-inch- thick, stainless steel tube to wall; and stainless steel wall flange.

## 2.12 GROUT

- A. Characteristics: Nonshrink; recommended for interior and exterior applications.
- B. Design Mix: 5000 psi, 28-day compressive strength.
- C. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls, floors, cabinets, and counters for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF HEALTHCARE PLUMBING FIXTURES

- A. Install healthcare plumbing fixtures level and plumb in accordance with rough-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted fixtures.
  1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install floor-mounted healthcare water closets on bowl-to-drain, connecting fitting attachments to piping or building substrate.
- D. Install counter-mounted fixtures in, and attached to, casework.
- E. Install water-supply piping with stop on each supply to each fixture to be connected to water-distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
  1. Exception for use of ball or gate valve if supply stops are not specified with fixture.

Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."

- F. Install flushometer valves on healthcare water closets.
- G. Install flushometer valves for accessible healthcare water closets, with lever handle mounted on wide side of compartment.
- H. Install toilet seats on healthcare water closets.
- I. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts, if faucets are not available with required rates and patterns. Include adapters if required.
- J. Install laminar-flow, faucet-spout fittings in faucet spouts where laminar-flow fittings are specified.
- K. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- L. Install traps on fixture outlets.
  - 1. Exception for omission of trap on fixtures with integral traps.
- M. Set healthcare showers in leveling bed of cement grout.
- N. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."
- O. Seal joints between healthcare plumbing fixtures, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- P. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."

### 3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with requirements for water piping specified in Section 221116 "Domestic Water Piping."
- C. Comply with requirements for soil and waste drainage piping and vent piping specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Comply with requirements for atmospheric vent piping specified in Section 221316 "Sanitary Waste and Vent Piping."
- E. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

### 3.4 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning healthcare plumbing fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometer valves to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

### 3.5 CLEANING AND PROTECTION

- A. After installing healthcare plumbing fixtures, inspect and repair damaged finishes.
- B. Clean healthcare plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed fixtures and fittings.
- D. Do not allow use of healthcare plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224300

## SECTION 226213 - VACUUM PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Pipes, tubes, and fittings.
2. Shape-memory-metal couplings.
3. Flexible pipe connectors.
4. Joining materials.
5. Zone valve box assemblies.
6. Copper alloy ball valves
7. Check valves
8. Medical vacuum service connections.

##### B. Related Requirements:

1. Section 226400 "Medical Gas Alarms" for vacuum piping alarms.

#### 1.2 DEFINITIONS

- ##### A. Vacuum Piping Systems: Include medical vacuum, WAGD, dental vacuum, HVE, and laboratory vacuum piping systems.

#### 1.3 ACTION SUBMITTALS

- ##### A. Product Data: For each type of product.

#### 1.4 INFORMATIONAL SUBMITTALS

- ##### A. Qualification Data: For Installer and testing agency.

- ##### B. Seismic Qualification Data: Certificates, for compressed-air manifolds, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- ##### C. Material Certificates: Signed by Installer, certifying that medical vacuum piping materials comply with requirements in NFPA 99 for medical vacuum systems.

- D. Brazing certificates.
- E. Field quality-control reports.
- F. Source quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For vacuum piping specialties to include in emergency, operation, and maintenance manuals.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Quick-Coupler Service Connections: Furnish complete noninterchangeable medical vacuum suction inlets.
    - a. Medical Vacuum: Equal to 10percent of amount installed.
  - 2. D.I.S.S. Service Connections: Furnish complete medical vacuum suction inlets complying with CGA V-5.
    - a. Medical Vacuum D.I.S.S. No. 1220: Equal to 10 percent of amount installed.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Medical Vacuum Piping Systems for Healthcare Facilities: In accordance with ASSE Standard #6010 and NFPA 99 for medical-gas-system installers.
  - 2. Pressure-Seal Joining Procedure for Copper Tubing: An authorized representative who is trained and approved by manufacturer.
  - 3. Extruded-Tee Outlet Procedure: An authorized representative who is trained and approved by manufacturer.
  - 4. Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer in accordance with ASSE Standard #6040 and NFPA 99.
- B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.
  - 1. Qualify testing personnel in accordance with ASSE Standard #6020 and NFPA 99 for medical-gas-system inspectors and ASSE Standard #6030 and NFPA 99 for medical-gas-system verifiers.

- C. Brazing: Qualify processes and operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications," or AWS B2.2/B2.2M.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- A. Medical vacuum operating at 15 in. Hg.

### 2.2 PIPES, TUBES, AND FITTINGS

- A. Comply with NFPA 99 for medical vacuum piping materials.
- B. Copper Medical Gas Tube: ASTM B819, Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service or in accordance with CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in blue.
- C. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type that has been manufacturer cleaned, purged, and sealed for medical gas service or in accordance with CGA G-4.1 for oxygen service.
- D. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.
- E. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.
  - 1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, full-face type.
  - 2. Flange Bolts and Nuts: ASME B18.2.1 carbon steel.
- F. Shape-Memory-Metal Couplings:
  - 1. Description: Cryogenic compression fitting made of nickel-titanium, shape-memory alloy, and that has been manufacturer cleaned, purged, and sealed for oxygen service in accordance with CGA G-4.1.
- G. Flexible Pipe Connectors:
  - 1. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
    - a. Working-Pressure Rating: **[200 psig] [250 psig]** minimum.
    - b. End Connections: Plain-end copper tube.

### 2.3 JOINING MATERIALS

- A. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux in accordance with ASTM B813.
- B. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys.

- C. Threaded-Joint Tape: PTFE.

## 2.4 VALVES

- A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged in accordance with CGA G-4.1 for oxygen service.
- B. Zone Valve Box Assemblies: Box with medical gas valves, tube extensions, and gages.

- 1. Zone Valve Boxes:

- a. Steel Box with Aluminum Cover:

- 1) Manufacturers: Subject to compliance with requirements, provide product by one of the following:
  - a) Allied Healthcare Products, Inc.
  - b) Amico Corporation
  - c) Ohio Medical Corporation
  - d) Beacon Medaes
  - e) Patton's Medical

- b. Description: Formed-steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves. Medical air and medical vacuum tubing, valves, and gages may be incorporated in zone valve boxes for medical gases.

- 1) Interior Finish: Factory-applied white enamel.
- 2) Cover Plate: Aluminum with frangible or removable windows.
- 3) Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, in accordance with NFPA 99.

- C. Copper-Alloy Ball Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
  - a. Allied Healthcare Products, Inc.
  - b. Amico Corporation
  - c. Beacon Medaes
  - d. Conbraco Industries, Inc.
  - e. NIBCO Inc.
  - f. Ohio Medical Corporation
  - g. Patton's Medical
  - h. Tri-Tech Medical Inc.
- 2. Standard: MSS SP-110.
- 3. Description: Three-piece body, brass or bronze.
- 4. Pressure Rating: 300 psig minimum.
- 5. Ball: Full-port, chrome-plated brass.
- 6. Seats: PTFE or TFE.
- 7. Handle: Lever type with locking device.
- 8. Stem: Blowout proof with PTFE or TFE seal.
- 9. Ends: Manufacturer-installed ASTM B819, copper-tube extensions.

- D. Check Valves:
1. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
    - a. Allied Healthcare Products, Inc.
    - b. Amico Corporation
    - c. Beacon Medaes
    - d. Conbraco Industries, Inc.
    - e. Ohio Medical Corporation
    - f. Patton's Medical
    - g. Tri-Tech Medical Inc.
  2. Description: In-line pattern, bronze.
  3. Pressure Rating: 300 psig minimum.
  4. Operation: Spring loaded.
  5. Ends: Manufacturer-installed ASTM B819, copper-tube extensions.

## 2.5 MEDICAL VACUUM SERVICE CONNECTIONS

- A. General Requirements for Medical Vacuum Service Connections:
1. Suitable for specific medical vacuum service listed.
  2. Include roughing-in assemblies, finishing assemblies, and cover plates.
  3. Individual cover plates are not required if service connection is in multiple units or assembly with cover plate.
  4. Recessed-type units made for concealed piping unless otherwise indicated.
- B. Roughing-in Assembly:
1. Steel outlet box for recessed mounting and concealed piping.
  2. Brass-body inlet block.
  3. Seals that will prevent vacuum leakage.
  4. ASTM B819, NPS 3/8 copper outlet tube brazed to valve with service marking and tube-end dust cap.
- C. Finishing Assembly:
1. Brass housing with primary check valve.
  2. Seals that will prevent vacuum leakage.
  3. Cover plate with gas-service label.
- D. Quick-Coupler Suction Service Connections:
1. Inlets for medical vacuum with noninterchangeable keyed indexing to prevent interchange between services.
  2. Constructed to permit one-handed connection and removal of equipment.
  3. With positive-locking ring that retains equipment stem in valve during use.
- E. D.I.S.S. Suction Service Connections:
1. Inlets complying with CGA V-5.
  2. Threaded indexing to prevent interchange between services.

3. Constructed to permit one-handed connection and removal of equipment.
  4. Medical Vacuum: CGA V-5, D.I.S.S. No. 1220.
  5. WAGD: CGA V-5, D.I.S.S. No. 2220.
- F. Vacuum Bottle Brackets: One piece, with pattern and finish matching corresponding service cover plate.
- G. Cover Plates:
1. One piece.
  2. Aluminum or stainless steel.
  3. Permanent, color-coded, identifying label matching corresponding service.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Cleaning of Medical Vacuum Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:
1. Clean medical vacuum tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service in accordance with CGA G-4.1.
  2. Wash medical vacuum tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb of chemical to 3 gal. of water.
    - a. Scrub to ensure complete cleaning.
    - b. Rinse with clean, hot water to remove cleaning solution.

### 3.2 INSTALLATION OF PIPING

- A. General Location and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of vacuum piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, vacuum producer sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Comply with NFPA 99 for installation of vacuum piping.
- C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- F. Install piping adjacent to equipment and specialties to allow service and maintenance.
- G. Install piping with 1 percent slope downward in direction of flow.
- H. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than piping pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.
- I. Install eccentric reducers, if available, where vacuum piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- J. Provide drain leg and drain trap at end of each main and branch and at low points.
- K. Install piping to permit valve servicing.
- L. Install piping free of sags and bends.
- M. Install fittings for changes in direction and for branch connections. Extruded-tee branch outlets in copper tubing may be made where specified.
- N. Install medical vacuum piping from medical vacuum service connections specified in this Section, to equipment specified in Section 226219 "Vacuum Equipment for Laboratory and Healthcare Facilities," and to equipment specified in other Sections requiring medical vacuum service.
- O. Piping Restraint Installation: Install seismic restraints on vacuum piping. Seismic-restraint devices are specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- P. Install vacuum service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
- Q. Install vacuum bottle bracket adjacent to each wall-mounted medical vacuum service connection suction inlet.
- R. Connect vacuum piping to vacuum producers and to equipment requiring vacuum service.
- S. Install unions in copper vacuum tubing adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.
- T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."

### 3.3 INSTALLATION OF VALVES

- A. Install shutoff valve at each connection to and from vacuum equipment and specialties.
- B. Install check valves to maintain correct direction of vacuum flow to vacuum-producing equipment.
- C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
- D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.
- E. Install flexible pipe connectors in suction inlet piping to each vacuum producer.

### 3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Apply appropriate tape to external pipe threads.
- D. Brazed Joints: Join copper tube and fittings in accordance with CDA's "Copper Tube Handbook," Ch. "Brazed Joints." Do not use flux. Continuously purge joint with oil-free dry nitrogen during brazing.
- E. Soldered Joints: Apply ASTM B813, water-flushable flux to tube end. Join copper tube and fittings in accordance with ASTM B828.
- F. Extruded-Tee Outlets: Form branches in copper tube in accordance with ASTM F2014, with tools recommended by tube manufacturer.
- G. Flanged Joints:
  - 1. Copper Tubing: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts in accordance with ASME B31.9 for bolting procedure.
- H. Pressure-Sealed Joints: Join copper tube and copper and copper-alloy fittings with tools recommended by fitting manufacturer.
- I. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.

### 3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for hangers, supports, and anchor devices specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- C. Vertical Piping: MSS Type 8 or Type 42, clamps.
- D. Individual, Straight, Horizontal Piping Runs:
  - 1. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.
  - 2. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.
- E. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.
- F. Base of Vertical Piping: MSS Type 52 spring hangers.
- G. Install hangers for copper tubing with maximum horizontal spacing and minimum rod diameters to comply with MSS SP-58, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- H. Support horizontal piping within [**12 inches**] <Insert dimension> of each fitting and coupling.
- I. Support vertical runs of copper tubing to comply with MSS SP-58, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.6 IDENTIFICATION

- A. Install identifying labels and devices for laboratory vacuum piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Install identifying labels and devices for medical vacuum piping systems in accordance with NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
  - 1. Medical Vacuum: Black letters on white background.

### 3.7 FIELD QUALITY CONTROL FOR HEALTHCARE FACILITY MEDICAL VACUUM PIPING

- A. Testing Agency:
  - 1. Owner will engage a qualified testing agency to perform tests and inspections.
  - 2. Engage a qualified testing agency to perform tests and inspections.

- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Tests and Inspections:
  - 1. Medical Vacuum Testing Coordination: Perform tests, inspections, verifications, and certification of medical vacuum piping systems concurrently with tests, inspections, and certification of medical compressed-air piping and medical gas piping systems.
  - 2. Preparation: Perform the following Installer tests in accordance with requirements in NFPA 99 and ASSE Standard #6010:
    - a. Initial blowdown.
    - b. Initial pressure test.
    - c. Cross-connection test.
    - d. Piping purge test.
    - e. Standing pressure test for vacuum systems.
    - f. Repair leaks and retest until no leaks exist.
  - 3. System Verification: Perform the following tests and inspections in accordance with NFPA 99, ASSE Standard #6020, and ASSE Standard #6030:
    - a. Standing pressure test.
    - b. Individual-pressurization or pressure-differential cross-connection test.
    - c. Valve test.
    - d. Master and area alarm tests.
    - e. Piping purge test.
    - f. Final tie-in test.
    - g. Operational vacuum test.
    - h. Verify correct labeling of equipment and components.
  - 4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed, and certify report results. Include the following:
    - a. Inspections performed.
    - b. Procedures, materials, and gases used.
    - c. Test methods used.
    - d. Results of tests.
- E. Piping will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

### 3.8 FIELD QUALITY CONTROL FOR LABORATORY FACILITY VACUUM PIPING

- A. Testing Agency: Engage qualified testing agency to perform tests and inspections of vacuum piping in laboratory facilities and to prepare test and inspection reports.

- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Tests and Inspections:
  - 1. Piping Leak Tests for Vacuum Piping: Test new and modified parts of existing piping. Cap and fill vacuum piping with oil-free, dry nitrogen. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
    - a. Test Pressure for Copper Tubing: 100 psig.
  - 2. Repair leaks and retest until no leaks exist.
  - 3. Inspect filters for proper operation.
- E. Piping will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

### 3.9 PROTECTION

- A. Protect tubing from damage.
- B. Retain sealing plugs in tubing, fittings, and specialties until installation.
- C. Clean tubing not properly sealed, and where sealing is damaged, in accordance with "Preparation" Article.

### 3.10 PIPING SCHEDULE

- A. Connect new copper tubing to existing copper tubing with memory-metal couplings.
- B. Flanges may be used where connection to flanged equipment is required.
- C. Medical Vacuum Piping: Use one of the following piping materials for each size range:
  - 1. NPS 4 (DN 100) and Smaller, Wrought-Copper Fittings: Copper medical gas tube, wrought-copper fittings, and brazed joints.

### 3.11 VALVE SCHEDULE

- A. Shutoff Valves:
  - 1. Copper Tubing: Copper-alloy ball valve with manufacturer-installed ASTM B819, copper-tube extensions.

- B. Zone Valves: Copper-alloy ball valve with manufacturer-installed ASTM B819, copper-tube extensions with pressure gage on one copper-tube extension.

END OF SECTION 226213

## SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Pipe hangers and supports - metal.
2. Pipe hangers - metal, trapeze type.
3. Strut support systems - metal, rod type.
4. Thermal-hanger shield inserts.
5. Fastener systems.

##### B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230500 "Common Work Results for HVAC" for pipe guides and anchors.
3. Section 230548 "Vibration and Seismic Controls for HVAC" for vibration isolation devices.
4. Section 233113 "Metal Ducts" for duct hangers and supports.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data:

1. For each type of product.

##### B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal strut support systems.
3. Rooftop-mounted strut support systems.
4. FRP strut support systems.
5. Pipe stands.
6. Equipment supports.

##### C. Delegated Design Submittals: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication/assembly and design calculations for trapeze hangers.
2. Detail fabrication/assembly and design calculations for each type of strut support system, by the manufacturer's technical representative.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

### 1.4 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment are to withstand the effects of gravity loads and stresses within limits and under conditions indicated in accordance with ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
  - 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

### 2.2 PIPE HANGERS AND SUPPORTS - METAL

- A. Pipe Hangers and Supports - Carbon Steel:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
  - 3. Nonmetallic Coatings: Plastic coated, or epoxy powder coated.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washers made of [**carbon steel**] [**stainless steel**] <Insert material>.
- B. Pipe Hangers and Supports - Stainless Steel:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of [**stainless steel**] <Insert material>.

- C. Pipe/Tube Hangers and Supports - Copper:
  - 1. Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.
  - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of [**copper-plated steel**] [**stainless steel**] <Insert material>.

## 2.3 PIPE HANGERS - METAL, TRAPEZE TYPE

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

## 2.4 STRUT SUPPORT SYSTEMS - METAL, ROD TYPE

- A. Description: Factory-fabricated pipe-support assembly made of steel channels, vertical metal support rods, accessories, fittings, and other components for supporting multiple parallel pipes.
- B. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
- C. Struts: Continuous slotted carbon-steel.
- D. Strut Width: Selected for applicable load criteria.
- E. Strut Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
- F. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized steel.
- G. Metallic Coating: Pregalvanized G90 Hot-dip galvanized.
- H. Paint Coating: Green epoxy, acrylic, or urethane.

## 2.5 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100 psi minimum compressive strength.
- B. For Trapeze or Clamped Systems: Insert and shield are to cover entire circumference of pipe.
- C. For Clevis or Band Hangers: Insert and shield are to cover bottom 180 degrees of pipe.
- D. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.7 EQUIPMENT STANDS, OUTDOOR TYPE

- A. Description: Individual foot supports with elevated adjustable channel cross bars and clamps/fasteners/bolts for ground- or roof-supported outdoor equipment components, without roof membrane penetration, in a prefabricated system that can be modularly-assembled on site.
- B. Foot Material: Rubber or polypropylene.
- C. Rails Material: Hot dip galvanized carbon steel.

## 2.8 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.
- F. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000 psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry static loads within specified loading limits. Minimum static design load used for strength determination is to include weight of supported components plus 200 lb.

### 3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- B. Install lateral bracing with pipe hangers and supports to prevent swaying.

- C. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Coordinate location of concrete inserts before concrete is placed.
- D. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- E. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- F. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Thermal-hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields are to span an arc of 180 degrees.
    - a. Thermal-hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches long and 0.048 inch thick.
    - b. NPS 4 (DN 100): 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches long and 0.06 inch thick.
    - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches long and 0.075 inch thick.
    - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches long and 0.105 inch thick.
  - 5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- G. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- H. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  2. Field fabricate in accordance with ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel in accordance with AWS D1.1/D1.1M.
- I. FRP Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.
  - J. Strut System Installation: Metal. Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.
  - K. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
  - L. Fastener System Installation:
    1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick after concrete is placed and cured. Use installers that are licensed by powder-actuated tool manufacturer.
    2. Install mechanical-expansion anchors after concrete is placed and completely cured.
    3. Install fasteners in accordance with manufacturer's written instructions.
    4. Install lag screw wood fasteners in accordance with manufacturer's written instructions.
  - M. Pipe Stand Installation:
    1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
    2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
  - N. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
  - O. Equipment Support Installation:
    1. Fabricate from welded-structural-steel shapes.
    2. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
    3. Grouting: Place grout under supports for floor-mounted equipment, and make bearing surface smooth.
    4. Provide lateral bracing, to prevent swaying.

### 3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded.

- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.5 PAINTING

- A. Touchup:
1. Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
    - a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
  2. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

### 3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

- F. Use copper-plated pipe hangers and copper or stainless steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.

20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is unnecessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.

- b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  - 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  - 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  - 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  - 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  - 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  - 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  - 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
  - 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
  - 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
  - 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    - a. Horizontal (MSS Type 54): Mounted horizontally.
    - b. Vertical (MSS Type 55): Mounted vertically.
    - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

## SECTION 233113 - METAL DUCTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
  - a. **Per ASHRAE Standard 170 section 6.9 duct liner shall not be installed in ductwork downstream of filter bank #2 for this project.**
5. Sealants and gaskets.
6. Hangers and supports.

##### B. Related Requirements:

1. Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraint devices and installation.
2. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
3. Section 233116 "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
4. Section 233119 "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
5. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.

##### B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top and bottom of ducts.
5. Dimensions of main all duct runs from building grid lines.
6. Fittings.

7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Delegated Design Submittals:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. Welding certificates.
- C. Field quality-control reports.

### 1.4 QUALITY ASSURANCE

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports and seismic restraints are to withstand the effects of gravity[ **and seismic**] loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
- C. Airstream Surfaces: Surfaces in contact with airstream comply with requirements in ASHRAE 62.1.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- E. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

- F. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

## 2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
  - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
- B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
  - 2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
  - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
- B. Source Limitations: Obtain single-wall round ducts and fittings from single manufacturer.
- C. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- D. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
  2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- E. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.4 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials are to be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
  1. Galvanized Coating Designation: **[G60]** **[G90]**.
  2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Factory- or Shop-Applied Antimicrobial Coating:
  1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating is to be applied to the exterior surface.
  2. Antimicrobial compound is to be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  3. Coating containing the antimicrobial compound is to have a hardness of 2H, minimum, when tested in accordance with ASTM D3363.
  4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
  5. Shop-Applied Coating Color: **[Black]** **[White]**.
  6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.
- D. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- E. Tie Rods: Galvanized steel, 1/4-inch-minimum diameter for lengths 36 inches or less; 3/8-inch-minimum diameter for lengths longer than 36 inches.

## 2.5 DUCT LINER

- A. **Per ASHRAE Standard 170 section 6.9 duct liner shall not be installed in ductwork downstream of filter bank #2 for this project.**

## 2.6 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets are to be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.

- B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

- C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

- D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.

3. Solvent: Toluene and heptane.
  4. Solids Content: Minimum 60 percent.
  5. Shore A Hardness: Minimum 60.
  6. Water resistant.
  7. Mold and mildew resistant.
  8. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
  9. Service: Indoor or outdoor.
  10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- E. Flanged Joint Sealant: Comply with ASTM C920.
1. General: Single-component, acid-curing, silicone, elastomeric.
  2. Type: S.
  3. Grade: NS.
  4. Class: 25.
  5. Use: O.
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- G. Round Duct Joint O-Ring Seals:
1. Seal is to provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and is to be rated for 10-inch wg static-pressure class, positive or negative.
  2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
  3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.7 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. 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."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.
- E. Steel Cables for Stainless Steel Ducts: Stainless steel complying with ASTM A492.
- F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless Steel Ducts: Stainless steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

## PART 3 - EXECUTION

### 3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.
- B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- J. Install fire, combination fire/smoke, and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.
- K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

- M. Elbows: Use long-radius elbows wherever they fit.
  - 1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
  - 2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.
- N. Branch Connections: Use lateral or conical branch connections.

### 3.2 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 2. Outdoor, Supply-Air Ducts: Seal Class A.
  - 3. Outdoor, Exhaust Ducts: Seal Class C.
  - 4. Outdoor, Return-Air Ducts: Seal Class C.
  - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
  - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
  - 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
  - 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
  - 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
  - 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
  - 11. Conditioned Space, Exhaust Ducts: Seal Class B.
  - 12. Conditioned Space, Return-Air Ducts: Seal Class C.

### 3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

5. Do not use powder-actuated concrete fasteners for seismic restraints. Coordinate with Section 230548 "Vibration and Seismic Controls for HVAC."
- C. Hanger Spacing: 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," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.4 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. See Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraint installation requirements.

### 3.5 DUCTWORK CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
  1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
  2. Test the following systems:
    - a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
    - b. Supply Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
    - c. Return Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.

- d. Exhaust Ducts test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
  - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  - 4. Testing of each duct section is to be performed with access doors, coils, filters, dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.
  - 5. Test for leaks before applying external insulation.
  - 6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
- C. Duct System Cleanliness Tests:
- 1. Visually inspect duct system to ensure that no visible contaminants are present.
  - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness in accordance with "Description of Method 3 - NADCA Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
    - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media is to not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

### 3.7 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. For cleaning of existing ductwork, see Section 230130.52 "Existing HVAC Air Distribution System Cleaning."
- C. Use duct cleaning methodology as indicated in NADCA ACR.
- D. Use service openings for entry and inspection.
  - 1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
  - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
  - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- E. Particulate Collection and Odor Control:
  - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.

2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

F. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

G. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans in accordance with NADCA ACR. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents in accordance with manufacturer's written instructions after removal of surface deposits and debris.

### 3.8 STARTUP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

### 3.9 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
  - a. Pressure Class: Positive 2-inch wg.
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 16.
  - d. SMACNA Leakage Class for Round and Flat Oval: 8.
2. Ducts Connected to Variable-Air-Volume Air-Handling Units:
  - a. Pressure Class: Positive 4-inch wg.
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 4.
  - d. SMACNA Leakage Class for Round and Flat Oval: 2.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
  - a. Pressure Class: Positive or negative 2-inch wg.
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 16.
  - d. SMACNA Leakage Class for Round and Flat Oval: 8.
2. Ducts Connected to Air-Handling Units:
  - a. Pressure Class: Positive or negative 2-inch wg.
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 16.
  - d. SMACNA Leakage Class for Round and Flat Oval: 8.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
  - a. Pressure Class: Negative 2-inch wg.
  - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
  - c. SMACNA Leakage Class for Rectangular: 16.
  - d. SMACNA Leakage Class for Round and Flat Oval: 4.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

F. Liner:

1. **Per ASHRAE 170 section 6.9, duct liner is not allowed in any ductwork on this project.**

G. Elbow Configuration:

1. Rectangular Duct - Requirements for Different Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
  - a. Velocity 1000 fpm or Lower:
    - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
    - 2) Mitered Type RE 4 without vanes.
  - b. Velocity 1000 to 1500 fpm:
    - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
  - c. Velocity 1500 fpm or Higher:
    - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Rectangular Duct - Requirements for All Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
  - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
  - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
  - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
  - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
    - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
    - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.

- 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
  - 4) Radius-to Diameter Ratio: 1.5.
- b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
  - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

H. Branch Configuration:

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
  - a. Rectangular Main to Rectangular Branch: 45-degree entry.
  - b. Rectangular Main to Round Branch: Conical spin in.
- 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
  - a. Velocity 1000 fpm or Lower: 90-degree tap.
  - b. Velocity 1000 to 1500 fpm: Conical tap.
  - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

## SECTION 233400 - HVAC FANS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Fans, utility set – Lab Exhaust

#### ACTION SUBMITTALS

- B. Product Data:
1. For each type of product.
    - a. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
    - b. Rated capacities, furnished specialties, and accessories for each fan.
    - c. Fans:
      - 1) Certified fan performance curves with system operating conditions indicated.
      - 2) Certified fan sound-power ratings.
      - 3) Fan construction and accessories.
      - 4) Motor ratings and electrical characteristics, plus motor and electrical accessories.
      - 5) Fan speed controllers.
    - d. Material thickness and finishes, including color charts.
    - e. Dampers, including housings, linkages, and operators.
- C. Shop Drawings:
1. Include plans, elevations, sections, and attachment details.
  2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  3. Include diagrams for power, signal, and control wiring.
  4. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
  5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- D. Delegated Design Submittal: For vibration isolation, supports, and seismic restraints indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for selecting vibration isolators, supports, , seismic restraints, and for designing vibration isolation bases.

## 1.2 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans showing fan rooms and fan system layouts, reflected ceiling plans, and other drawings required to illustrate relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
- B. Seismic Qualification Data: Certificates, for fans, accessories, and components, from manufacturer.
  1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Startup service reports.
- D. Field quality-control reports.

## 1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fans and ventilators, include the following:
  1. Operation in normal and emergency modes.
  2. Operation and maintenance manuals.

## 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective coverage for storage and identified with labels describing contents.
  1. Belts: One set(s) for each belt-driven unit.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.

- C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- E. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vibration isolation, supports, and seismic restraints, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- F. Seismic Performance: Fans and ventilators are to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7. See Section 230548 "Vibration and Seismic Controls for HVAC."
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  - 2. Component Importance Factor: 1.5.

## 2.2 FANS, UTILITY SET – Lab Exhaust

- A. Manufacturers: See plans
- B. Source Limitations: Obtain fan utility sets from single manufacturers.
- C. Description:
  - 1. Unit consisting of a fan, curb cap, inlet box and high velocity nozzle shall be a single width, single inlet, backward inclined airfoil blade, belt driven centrifugal vent set laboratory exhaust blower.
- D. Housings:
  - 1. The unit shall be of bolted and welded construction utilizing stainless steel fasteners. The scroll wrapper shall be a minimum 14 gauge steel and the scroll side panels shall be a minimum 12 gauge steel. The scroll housing shall have continuously welded seams for leakproof operation. A performance cut-off shall be furnished to prevent the recirculation of air in the fan housing. The adjustable nozzle is positioned to generate the designed outlet velocity. The integral cap and inlet box is intended to be used for curb mounting with bottom intake roof duct connections. Inlet box shall include gasketed access door with quick release latches to allow wheel and inlet removal. Bearing support shall be minimum 10 gauge welded steel. Side access inspection ports shall be provided with quick release latches for access to the motor compartment without removing the weather cover. The fan housing shall have a door for wheel access and threaded drain connection. Lifting lugs shall be provided for ease of installation. Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM, static pressure, and maximum fan RPM. Unit shall be shipped in ISTA certified transit tested packaging.
- E. Wheels:

1. Wheel shall be steel centrifugal backward inclined, non-overloading airfoil blade type. Blades shall be continuously welded to the backplate and deep spun inlet shroud. Wheel hub shall be keyed and securely attached to the fan shaft. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency.
- F. Motor:
1. Motor shall be NEMA design B with class B insulation rated for continuous duty and furnished at the specified voltage, phase and enclosure.
- G. Shafts:
1. Blower shaft shall be AISI 316 stainless steel and accurately turned, ground and polished. Shafting shall be sized for a critical speed of at least 125% of maximum RPM.
- H. Bearings:
1. Bearings shall be designed and tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball or roller type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- I. Belt Drive:
1. Belts shall be oil and heat resistant, static conducting. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- J. Motor Enclosure: Totally enclosed, fan cooled.
- K. Accessories:
1. Inlet and Outlet: Flanged.
  2. Variable-Frequency Motor Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
  4. Backdraft Dampers: Gravity actuated with counterweight and interlocking aluminum blades, with felt edges in steel frame installed on fan discharge.
  5. Access Door: Gasketed door in scroll with latch-type handles.
  6. Scroll Dampers: Single-blade damper installed at fan scroll top with adjustable linkage.
  7. Inlet Screens: Removable wire mesh.
  8. Outlet Screens: Removable wire mesh.
  9. Belt Guard: OSHA-compliant, fabricated in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." Diamond mesh wire screen welded to steel angle frame or equivalent, prime coated.
  10. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
  11. Drain Connections: NPS 3/4 threaded coupling drain connection installed at lowest point of housing.
  12. Weather Hoods: Weather resistant with stamped vents over motor and drive compartment.

- 13. Discharge Dampers: Assembly with parallel opposed blades constructed of two plates formed around, and to, shaft, channel frame, and sealed ball bearings, with blades linked outside of airstream to single control lever of same material as housing.
  - L. Back-draft damper: Integral.
  - M. Grille: Painted aluminum, louvered grille with flange on intake and thumbscrew or spring retainer attachment to fan housing.
  - N. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
  - O. Housing: Removable spun aluminum; square, one-piece aluminum base with venturi inlet cone.
    - 1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.

## 2.3 SOURCE QUALITY CONTROL

- A. AMCA Certification for Fan Sound Performance Rating: Test, rate, and label in accordance with AMCA 311.
- B. Fan Operating Limits: Classify fans in accordance with AMCA 99, Section 14.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Install fans level and plumb.
- B. Disassemble and reassemble units, as required for moving to the final location, in accordance with manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.
- D. Equipment Mounting:
  - 1. Install roof-mounted fans on roof curbs or support steel. See Drawings for specific requirements.
  - 2. Unit Support: Install fans level on structural curbs. Coordinate with duct connections. Secure units to structural support with anchor bolts.
  - 3. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
  - 4. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- E. Curb Support, Prefabricated: Rail-type wood support provided by fan manufacturer.
- F. Unit Support: Install centrifugal fans level on structural curbs. Coordinate with duct connections. Secure units to structural support with anchor bolts.

- G. Isolation Curb Support: Install centrifugal fans on isolation curbs, and install flexible duct connectors and vibration-isolation and seismic-control devices.
  - 1. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
  - 2. Comply with requirements in Section 230548.13 "Vibration Controls for HVAC."
- H. Install units with adequate clearances for service and maintenance.
- I. Label fans in accordance with requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

### 3.2 DUCTWORK CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."
- B. Where installing ducts adjacent to fans, allow space for service and maintenance.

### 3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  - 1. Nameplate is to be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
  - 2. Nameplate is to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

### 3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### 3.5 STARTUP SERVICE:

#### A. Perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.
2. Verify that shipping, blocking, and bracing are removed.
3. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
4. Verify that cleaning and adjusting are complete.
5. For direct-drive fans, verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.
6. For belt-drive fans, disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
7. Adjust belt tension.
8. Adjust damper linkages for proper damper operation.
9. Verify lubrication for bearings and other moving parts.
10. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
11. Disable automatic temperature-control operators, energize motor and confirm proper motor rotation and unit operation, adjust fan to indicated rpm, and measure and record motor voltage and amperage.
12. Shut unit down and reconnect automatic temperature-control operators.
13. Remove and replace malfunctioning units and retest as specified above.

### 3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Lubricate bearings.
- D. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

### 3.7 CLEANING

- A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean fans internally to remove foreign material and construction dirt and dust.

### 3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.

- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
  - 1. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 2. Test and adjust controls and safeties.
  - 3. Fans and components will be considered defective if they do not pass tests and inspections.
  - 4. Prepare test and inspection reports.

### 3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain HVAC fans.

END OF SECTION 233400

## SECTION 233600 - AIR TERMINAL UNITS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Modulating, single-duct air terminal units.
  2. **Critical environment control valve.**

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of air terminal unit.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for air terminal units.
  2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For air terminal units.
1. Include plans, elevations, sections, and mounting details.
  2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  3. Include diagrams for power, signal, and control wiring.
  4. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, indicating the items described in this Section, and coordinated with all building trades.
- B. Seismic Qualification Data: For air terminal units, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

## 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Instructions for resetting minimum and maximum air volumes.
    - b. Instructions for adjusting software set points.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a Qualified Electrical Testing Laboratory, and marked for intended location and application.
- B. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."

### 2.2 MODULATING, SINGLE-DUCT AIR TERMINAL UNITS

- A. Description: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- B. Casing: Minimum 20-gauge- thick galvanized steel.
  - 1. Casing Liner: Comply with requirements in "Casing Liner" Article below for "Casing Liner, Fibrous Glass" Paragraph.
  - 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
  - 3. Air Outlet: S-slip and drive connections, size matching inlet size.
  - 4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
- C. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
  - 1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
- D. Velocity Sensors: Multipoint array with velocity inlet sensors.
- E. Access Door: **Access door upstream of the reheat coil.**

- F. Hydronic Heating Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch. Include manual air vent and drain valve. Provide hydronic heating coils for air terminal units scheduled on Drawings.
- G. Direct Digital Controls:
  - 1. Terminal Unit Controller, Section 230923: Controller is to be factory mounted and wired by air terminal manufacturer; unit controllers, integrated actuators, and room sensors to be furnished under Section 230923 "Direct Digital Controls (DDC) for HVAC."

### 2.3 CRITICAL ENVIRONMENT CONTROL VALVE

- A. Description: Volume-damper or venturi assembly inside a unit casing with control components inside a protective metal shroud, for general exhaust applications or for exhaust applications where pressurization control via exhaust and supply airflow control is desired and airstream corrosion and contamination may be a concern.
- B. Casing:
  - 1. Material: Type 316 stainless steel.
- C. Airflow Metering, Option: Calibrated shaft position with self-adjusting, spring-loaded cone.
- D. Sensors, Option: Multipoint, Type 316 stainless steel.
- E. Direct Digital Controls:
  - 1. Terminal Unit Controller, Section 230923: Controller is to be factory mounted and wired by air terminal manufacturer; unit controller, actuators, and room sensors are to be furnished under Section 230923 "Direct Digital Control (DDC) System for HVAC."

### 2.4 SOURCE QUALITY CONTROL

- A. AHRI 880 Certification: Test, rate, and label assembled air terminal units in accordance with AHRI 880.
- B. Water Coils: Factory pressure test to 300 psig in accordance with AHRI 410 and ASHRAE 33.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Comply with Section 230529 "Hangers and Supports for HVAC Piping and Equipment" and Section 233113 "Metal Ducts" for hangers and supports.
- B. Install air terminal units according to NFPA 90A.
- C. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

- D. Install wall-mounted thermostats.

### 3.2 PIPING CONNECTIONS

- A. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.
- B. Hot-Water Piping: Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties," and connect heating coils to supply piping with shutoff valve, strainer, control valve, and union or flange; and to return piping with balancing valve and union or flange.

### 3.3 DUCTWORK CONNECTIONS

- A. Comply with requirements in Section 233113 "Metal Ducts" for connecting ducts to air terminal units.
- B. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."

### 3.4 ELECTRICAL CONNECTIONS

- A. Install field power to each air terminal unit electrical power connection. Coordinate with air terminal unit manufacturer and installers.
- B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

### 3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

### 3.6 IDENTIFICATION

- A. Label each air terminal unit with drawing designation, nominal airflow, maximum and minimum factory-set airflows, and coil type. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

### 3.7 STARTUP SERVICE

- A. Perform startup service.
  - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
  - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
  - 3. Verify that controls and control enclosure are accessible.
  - 4. Verify that control connections are complete.
  - 5. Verify that nameplate and identification tag are visible.
  - 6. Verify that controls respond to inputs as specified.

### 3.8 ADJUSTING

- A. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air terminal unit testing, adjusting, and balancing.

### 3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections:
  - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
  - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Air terminal unit will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

### 3.10 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 233600