ANN ARBOR

ELECTION FACILITY RENOVATION

3021 MILLER RD.
ANN ARBOR, MI 48103

DICLEMENTE SIEGEL DESIGN INC.

ENGINEERING AND ARCHITECTURE

28105 GREENFIELD ROAD
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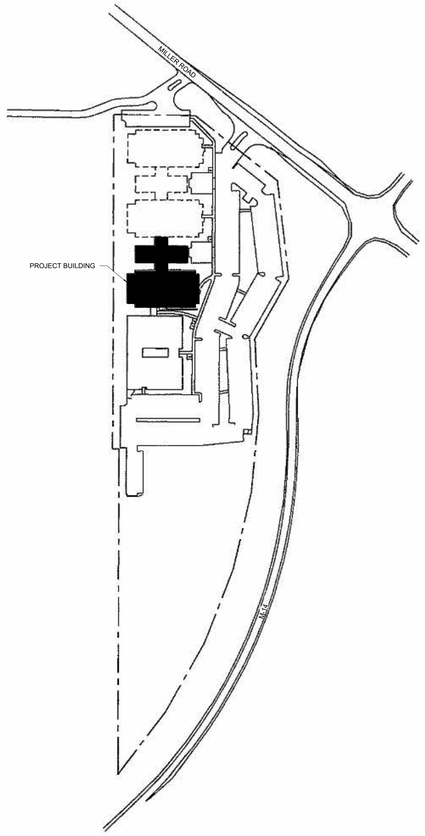
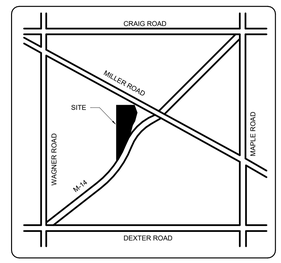


KEY PLAN
NOT TO SCALE
NORTH



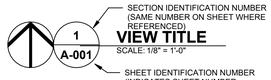
LOCATION MAP
NOT TO SCALE

DSD PROJECT No.:	24-1301
SHEET:	G-001
ACADFILE:	24-3017-BPRC-A-R22.rvt
ISSUED FOR:	IFC
DATE:	05/01/2025

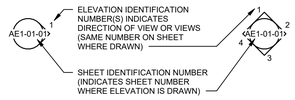
REFERENCE SYMBOLS

PLAN IDENTIFICATION

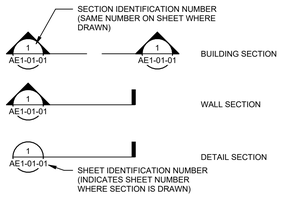
TITLE IDENTIFICATION



ELEVATION LOCATION IDENTIFICATION



SECTION LOCATION IDENTIFICATION



ELEVATION INDICATION - (FLOORS, ETC...)

FINISHED FLOOR
0'-0" (0000)

SPOT ELEVATION

0'-0" (0000)

DETAIL LOCATION IDENTIFICATION

GRAPHIC SCALE

1"=1'-0" 0 1 2"

PARTITION TYPE INDICATION

WALL TAG

MATERIAL OR WORK DIVISION INDICATION

EXISTING NEW

MATCH LINE INDICATION

MATCH LINE - SEE SHEET AE1-01-01

COLUMN INDICATION

A — COLUMN IDENTIFICATION LETTER OR NUMBER FOR EXISTING CONSTRUCTION

3.1 — COLUMN IDENTIFICATION LETTER OR NUMBER FOR NEW CONSTRUCTION

ROOM NAME AND NUMBER INDICATION

ROOM IDENTIFICATION NUMBER

DOOR NUMBER INDICATION

WINDOW NUMBER INDICATION

W101A W101A

LOUVER NUMBER INDICATION

L101A L101A

CEILING TAG

HEIGHT A.F.F.
CEILING TYPE

ROOF OR RAMP PITCH INDICATION

12
6

ROOF OR RAMP SLOPE INDICATION

SLOPE

KEYED NOTE SYMBOLS

1 GENERAL NOTE

1 DEMOLITION WORK

1 NEW WORK

1 FUTURE WORK

LIFE SAFETY SYMBOLS

OCCUPANCY TAG OPTION 1

Rm. No.	Room Name
101	NAME
Occ Group	Area / Occupancy
TYPE	150 SF / LOAD

OCCUPANCY TAG OPTION 2

150 SF / ## = # P

OCCUPANCY DOOR EXIT

MAX

AREA NAME AND NUMBER INDICATION

AREA NAME
150 SF

FLOOR FINISH TAG

CT-1

CASEWORK TAG

CW-01 CW-01

PLUMBING ACCESSORY TAG

TA-01 TA-01

PLUMBING FIXTURE TAG

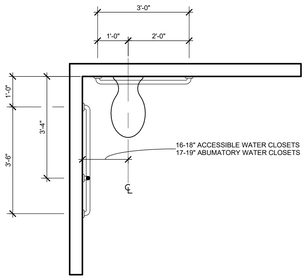
PF-01 PF-01

REVISION INDICATION

1

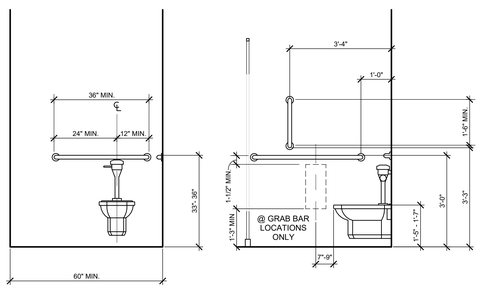
ABBREVIATIONS

&	AND
@	AT
A	ANGLE
A/C	AIR CONDITIONER / CONDITIONING
ABV	ABOVE
ACCS	ACCESSORIES
ACSDR	ACCESS DOOR
ACSFLR	ACCESS FLOOR
ACST / ACOUS	ACOUSTICAL
ACT	ACOUSTICAL CEILING TILE
AD	AREA DRAIN
ADA	AMERICANS WITH DISABILITIES ACT
ADDL	ADDITIONAL
ADDM	ADDENDUM
ADJ	ADJUSTABLE / ADJACENT
ADMIN	ADMINISTRATION
AFC	ABOVE FINISHED COUNTER
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AFS	ABOVE FINISHED SLAB
AGGR	AGGREGATE
AHR	ANCHOR
AHU	AIR HANDLING UNIT
AL / ALUM	ALUMINUM
ALNMT	ALIGNMENT
ALT	ALTERNATE
ANOD	ANODIZED
AP	ACCESS PANEL
APC	ACOUSTICAL PANEL CEILING
APPROX	APPROXIMATELY
APPVD	APPROVED
ARCH	ARCHITECT(URAL)
ASPH	ASPHALT
ASTM	AMERICAN SOCIETY FOR TESTING MATERIALS
AUTO	AUTOMATIC
AVG	AVERAGE
BD	BOARD
BET	BETWEEN
BG	BUMPER GUARD
BITUM	BITUMINOUS
BL	BLACK
BLDG	BUILDING
BLK	BLOCK
BLKG	BLOCKING
BM	BEAM
BMS	BALANCE MAGNETIC SWITCH
BOS	BOTTOM OF STEEL
BOT	BOTTOM
BS	BOTH SIDES
CAB	CABINET
CAS	CASEWORK
CB	CATCH BASIN
CEM	CEMENT
CER	CERAMIC
CF	CUBIC FOOT
CG	CORNER GUARD
CH	CEILING HEIGHT
CHAM	CHAMFER
CHBD	CHALKBOARD
CI	CAST IRON
CI	CONTRACTOR INSTALLED
CIP	CAST IN PLACE
CJ	CONTROL JOINT
CL	CENTER LINE
CLG	CEILING
CLO	CLOSET
CLR	CLEAR
CMU	CONCRETE MASONRY UNIT
CO	CLEAN/CLEAR OUT
COL	COLUMN
CONC	CONCRETE
CONST	CONSTRUCTION
CONT	CONTINUOUS
CORR	CORRIDOR
CPR	COPPER
CPT	CARPET(ED)(ING)
CT	CERAMIC TILE
CTR	COUNTER
DBL	DOUBLE
DEFS	DIRECT APPLIED EXTERIOR FINISH SYSTEM
DEG	DEGREE
DEMO	DEMOLISH
DEP	DEPRESSION
DET	DETAIL
DF	DRINKING FOUNTAIN
DIA	DIAMETER
DIAG	DIAGONAL
DIM	DIMENSION
DISP	DISPENSER
DIV	DIVISION
DN	DOWN
DR	DOOR
DS	DOWNSPOUT
DWG	DRAWING
E	EAST
EA	EACH
EF	EACH FREE
EIFS	EXTERIOR INSULATION AND FINISH SYSTEM
EJ	EXPANSION JOINT
EL	ELEVATION
ELEC	ELECTRICAL
ELEV	ELEVATOR
EMER	EMERGENCY
ENCL	ENCLOSED / ENCLOSURE
ENG	ENGINEER
EOD	EDGE OF DECK
EOS	EDGE OF SLAB
EQ	EQUAL(LY)
EQPT	EQUIPMENT
EST	ESTIMATE
EWC	ELECTRIC WATER COOLER
EXIST	EXISTING
EXP	EXPANSION
EXT	EXTERIOR
FA	FIRE ALARM
FAST	FASTEN(ER)
FCO	FLOOR CLEAN OUT
FD	FLOOR DRAIN
FDN	FOUNDATION
FE	FIRE EXTINGUISHER
FEC	FIRE EXTINGUISHER CABINET
FEC (R)	FIRE EXTINGUISHER CABINET, RECESSED
FEC (SR)	FIRE EXTINGUISHER CABINET, SEMI-RECESSED
FEW	FIRE EXTINGUISHER, WALL MOUNTED
FF	FINISHED FLOOR
FGL	FIBERGLASS
FIN	FINISH(ED)
FIXT	FIXTURE
FL	FLOOR
FLASH	FLASH(ING)
FLUOR	FLUORESCENT
FOC	FACE OF CONCRETE
FOF	FACE OF FINISH
FOM	FACE OF MASONRY
FOS	FACE OF STUDS
FOW	FACE OF WALL
FP	FIREPROOF
FPL	FIREPLACE
FR	FRAME
FRC	FIBER REINFORCED CONCRETE
FRGP	FIBER REINFORCED GYPSUM PLASTER
FRT	FIRE RETARDANT TREATED
FS	FLOOR SINK
FTG	FOOTING
FURR	FURRING
FUT	FUTURE
GA	GAUGE
GALV	GALVANIZE(D)
GB	GRAB BAR
GC	GENERAL CONTRACTOR
GL	GLASS / GLAZING
GND	GROUND
GR	GRADE
GRV	GRAVEL
GT	GLASS TILE
GYP	GYPSUM
GYP BD	GYPSUM BOARD
HB	HOSE BIB
HC	HOLLOW CORE
HCP	HANDICAPPED
HD	HEAVY DUTY
HD	HARD
HDR	HEADER
HDWR	HARDWARE
HI	HIGH
HM	HOLLOW METAL
HMI	HOLLOW METAL INSULATED
HOR / HORIZ	HORIZONTAL
HP	HIGH POINT
HR	HANDRAIL
HR	HOUR
HT	HEIGHT
HVAC	HEATING / VENTILATION / AIR CONDITIONING
HW	HARDWARE
HYD	HYDRANT
ID	INSIDE DIAMETER
IN	INCH / INCHES
INCL	INCLUDE(D) / INCLUDING
INSUL	INSULATE / INSULATION
INT	INTERIOR
JAN	JANITOR
JT	JOINT
KIT	KITCHEN
LAB	LABORATORY
LAM	LAMINATE(D)
LAV	LAVATORY
LB(S)	POUND(S)
LF	LINEAR FOOT (FEET)
LH	LEFT HAND
LIB	LIBRARY
LKR	LOCKER
LNS	LINOLEUM SHEET
LNT	LINOLEUM TILE
LP	LOW POINT
LT	LIGHT
LVR	LOUVER
LWT	LIGHT WEIGHT
MACH	MACHINE
MAINT	MAINTENANCE
MATL	MATERIAL
MAX	MAXIMUM
MC	MEDICINE CABINET
ME	MECHANICAL EQUIPMENT
MECH	MECHANICAL
MEZZ	MEZZANINE
MFR	MANUFACTURE(R)
MH	MANHOLE
MIN	MINIMUM
MIR	MIRROR
MISC	MISCELLANEOUS
MLD / MLDG	MOULDING
MO	MASONRY OPENING
MR	MOISTURE RESISTANT
MTD	MOUNTED
MTL	METAL
MUL	MULLION
N	NORTH
NA OR N/A	NOT AVAILABLE / APPLICABLE
NFPA	NATIONAL FIRE PROTECTION ASSOCIATION
NIC	NOT IN CONTRACT
NO / #	NUMBER
NOM	NOMINAL
NTS	NOT TO SCALE
OA	OVERALL
OBS	OBSCURE
OC	ON CENTER
OD	OUTSIDE DIAMETER
OFCI	OWNER FURNISHED CONTRACTOR INSTALLED
OFF	OFFICE
OPG / OPNG	OPENING
OPP	OPPOSITE
OZ	OUNCE
PART	PARTIAL
PAT	PATTERN
PBD	PARTICLE BOARD
PC / PCC	PRECAST CONCRETE
PED	PEDESTAL
PER	PERIMETER
PERF	PERFORATED
PERP	PERPENDICULAR
PF	PRE-FINISHED
PIP	POURED-IN-PLACE
PL	PROPERTY LINE
PL	PLATE
PLAM	PLASTIC LAMINATE
PLAS	PLASTER
PLYWD	PLYWOOD
PMF	PRESSED METAL FRAMES
POP	POINT OF PRESENCE
PR	PAIR
PRCST	PRE-CAST
PREFAB	PREFABRICATED
PROP	PROPERTY
PRT	PORCELAIN TILE
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PT	POINT
PTD	PAPER TOWEL DISPENSER
PTD/WR	PAPER TOWEL DISPENSER & WASTE RECEPTACLE
PTDF	PRESSURE TREATED DOUGLAS FIR
PTN	PARTITION
PTR	PAPER TOWEL RECEPTACLE
PVC	POLYVINYL CHLORIDE
Q	QUARTZ
QT	QUARRY TILE
QTY	QUANTITY
R	RISER
RAD	RADIUS
RB	RUBBER BASE
RCP	REFLECTED CEILING PLAN
RD	ROOF DRAIN
REF	REFERENCE
REFR	REFRIGERATOR
REG	REGISTER
REINF	REINFORCE(D)
REQ	REQUIRED
RESIL	RESILIENT
RESS	RESILIENT SHEET
REST	RESILIENT TILE
RET	RETAINING
REV	REVISE / REVISION
RFG	ROOFING
RFL	REFLECTED
RH	RIGHT HAND
RM	ROOM
RO	ROUGH OPENING
RS	RUBBER SHEET FLOORING
RST	RUBBER STAIR TREADS
RSTR	RUBBER STAIR TREADS & RISERS
RT	RUBBER TILE
RWD	REDWOOD
RWL	RAIN WATER LEADER
S	SOUTH
SC	SOLID CORE
SCD	SEAT COVER DISPENSER
SCHED	SCHEDULE
SCN	SCREEN
SCR	SCREEN
SD	SOAP DISPENSER / STORM DRAIN
SDC	SEALED CONCRETE
SECT	SECTION
SF	SQUARE FEET
SHT	SHEET
SHTG	SHEATHING
SHWR	SHOWER
SIM	SIMILAR
SND	SANITARY NAPKIN DISPENSER
SNR	SANITARY NAPKIN RECEPTACLE
SOG	SLAB ON GRADE
SPEC	SPECIFY / SPECIFICATION
SPK	SPEAKER
SQ	SQUARE
SQFT	SQUARE FEET
SQIN	SQUARE INCH(ES)
SS	STAINLESS STEEL
ST	STONE
STA	STATION
STC	STAINED CONCRETE
STD	STANDARD
STDS	STUDS
STIFF	STIFFENER
STL	STEEL
STN	STAINED
STOR	STORAGE
STRUCT	STRUCTURE / STRUCTURAL
SUSP	SUSPENDED
SW	SWITCH
SYM	SYMMETRICAL
SYN	SYNTHETIC
SYS	SYSTEM
T&B	TOP AND BOTTOM
T&G	TONGUE AND GROOVE
TB	TOWEL BAR
TBD	TO BE DETERMINED
TC	TOP OF CURB
TEL	TELEPHONE
TEMP	TEMPORARY / TEMPERATURE
TER	TERRAZZO
THK	THICK
THRU	THROUGH
TOC	TOP OF CONCRETE
TOS	TOP OF SLAB
TOW	TOP OF WALL
TPD	TOILET PAPER DISPENSER
TPTN	TOILET PARTITION
TV	TELEVISION
TYP	TYPICAL
UC	UNDERCUT
UG	UNDERGROUND
UL	UNDERWRITER'S LABORATORY
UNF / UNFIN	UNFINISHED
UON	UNLESS OTHERWISE NOTED
UPS	UNINTERRUPTIBLE POWER SUPPLY
UR	URINAL
V	VOLT
VAC	VACUUM
VB	VAPOR BARRIER
VCT	VINYL COMPOSITION TILE
VENT	VENTILATE
VERT	VERTICAL
VEST	VESTIBULE
VIF	VERIFY IN FIELD
VNR	VENEER
VOL	VOLUME
VST	VINYL STAIR TREADS
VSTR	VINTYL STAIR TREADS & RISERS
VT	VINYL TILE
VTR	VENT THRU ROOF
VWC	VINYL WALLCOVERING
W	WEST
W/	WITH
W/O	WITHOUT
WC	WATER CLOSET
WCV	WALLCOVERING
WD	WOOD
WF	WIDE FLANGE
WG	WIRE GLASS
WH	WALL HOSE / HYDRANT
WI	WROUGHT IRON
WIN	WINDOW
WK	WORK
WNSCT	WAINSCOT
WP	WATERPROOF(ING)
WPT	WORK POINT
WR	WATER RESISTANT
WRR	WOOD RISER
WT	WEIGHT
YD	YARD



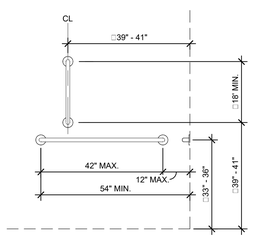
TYPICAL GRAB BAR LOCATION PLAN

SCALE: 1/2" = 1'-0"

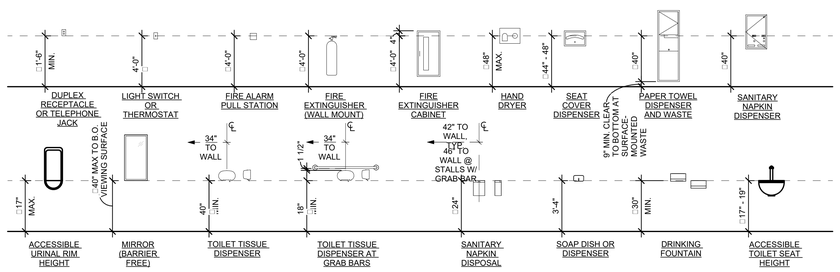


TYPICAL GRAB BAR MOUNTING HEIGHT

SCALE: 1/2" = 1'-0"



NOTE: ALL FIXTURE AND ACCESSORY MOUNTING LOCATIONS ARE BASED ON THE AMERICAN NATIONAL STANDARD ACCESSIBLE AND USABLE BUILDINGS AND FACILITIES ICC/ANSI A-117.1-2009.



TYPICAL BARRIER FREE TOILET ROOM MOUNTING HEIGHTS

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

ARCHITECTURAL SHEET INDEX

SHEET	DESCRIPTION
A-001	GENERAL PROJECT INFORMATION
A-002	CODE SUMMARY
AD101	COMPOSITE ARCHITECTURAL DEMOLITION PLANS
AD102	COMPOSITE FIRST FLOOR CEILING DEMOLITION PLAN
A-100	COMPOSITE PROGRAMING PLANS
A-101	COMPOSITE ARCHITECTURAL PLANS
A-102	COMPOSITE FIRST FLOOR REFLECTED CEILING PLAN
A-103	COMPOSITE FLOOR FINISH PLANS
A-301	MILLWORK SECTIONS
A-401	ENLARGED PLANS AND SECTIONS
A-410	INTERIOR ELEVATIONS
A-411	INTERIOR ELEVATIONS
A-601	DOOR AND FRAME SCHEDULE
A-602	FINISH SCHEDULES

OVERVIEW OF ARCHITECTURAL SCOPE

THIS OVERVIEW OF SCOPE IS INCLUDED TO GIVE THE CONTRACTOR A GENERAL OVERVIEW OF THE PROJECT REQUIREMENTS. THE OVERVIEW IS NOT ALL INCLUSIVE AND IS NOT INTENDED TO, AND SHOULD NOT BE USED TO, ESTABLISH CONTRACT LIMITS OR PRICING INCLUSIONS. THE CONTRACT DOCUMENTS SHALL BE USED TO ESTABLISH CONSTRUCTION CONTRACT SCOPE.

THIS OVERVIEW OF SCOPE INCLUDES, BUT IS NOT LIMITED TO THE FOLLOWING:

ARCHITECTURAL:

1 DEMOLISH WALLS, DOORS, WINDOWS, FINISH MATERIALS AND OTHER MISCELLANEOUS ARCHITECTURAL ITEMS AS INDICATED.

2 PATCH AND REPAIR EXISTING CONSTRUCTION AS INDICATED.

3 PROVIDE INTERIOR WALL SYSTEMS AS INDICATED.

4 PROVIDE DOORS, HARDWARE, AND FRAMES AS INDICATED.

5 PROVIDE MILLWORK AND EQUIPMENT AS INDICATED.

6 PROVIDE SPECIAL SYSTEMS AS INDICATED.

7 PROVIDE INTERIOR FINISHES AS INDICATED.

PROJECT REQUIREMENTS

PROVIDE ALL NECESSARY PERMITS. ALL WORK SHALL BE INSTALLED TO COMPLY WITH THE OWNER'S STANDARDS, STATE AND LOCAL CODES INCLUDING, BUT NOT LIMITED TO, THE FOLLOWING CODES AND THEIR RELATED REFERENCES.

2015 MICHIGAN BUILDING CODE

2021 MICHIGAN MECHANICAL CODE

2021 MICHIGAN PLUMBING CODE

2015 INTERNATIONAL FIRE CODE (AS REFERENCED)

2015 INTERNATIONAL FUEL GAS CODE

NFPA 101 LIFE SAFETY CODE 2012 (AS REFERENCED)

2015 MICHIGAN ENERGY CODE

2023 NATIONAL ELECTRICAL CODE AS AMENDED BY THE MICHIGAN CONSTRUCTION CODE PART 8, ELECTRICAL CODE RULES.

2013 NFPA 110 AND NFPA 111

MANUFACTURER AND MODEL NUMBER LISTED REPRESENTS THE BASIS OF DESIGN FOR THIS PROJECT. THE CONTRACTOR SHALL BEAR ALL ADDITIONAL COSTS ASSOCIATED WITH USING EQUIPMENT AND/OR SYSTEMS BY OTHER APPROVED MANUFACTURERS INCLUDING ADDITIONAL COSTS BY OTHER TRADES.

ALL EQUIPMENT AND/OR SYSTEMS INSTALLED SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS. WHERE FIELD OR PROJECT CONDITIONS DO NOT ALLOW ALL MANUFACTURER'S RECOMMENDATIONS TO BE MET, THE INSTALLING CONTRACTOR SHALL SUBMIT IN WRITING TO THE ARCHITECT THE PROPOSED DEVIATION, IN A SKETCH FORM, ACCOMPANIED BY THE MANUFACTURER'S CONCURRENCE.

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Since 1969

DiClemente Siegel Design Inc.
ARCHITECTURE & ENGINEERING

28105 Greenfield Rd Southfield, MI 48076-3046
248.569.1430 Fax: 248.569.0096
Website: www.dsdonline.com

A/E SEAL

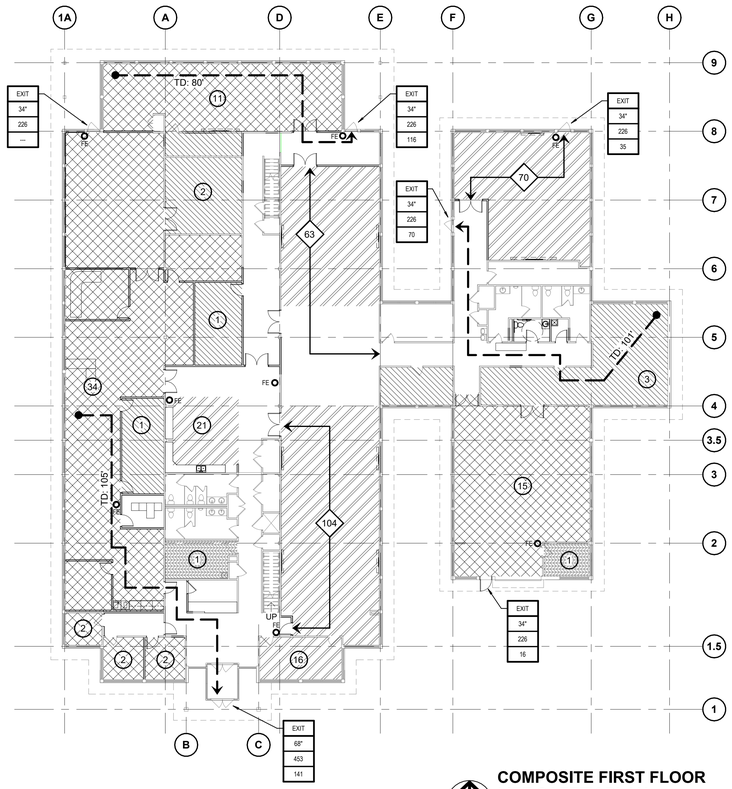
CITY OF ANN ARBOR

ELECTION FACILITY RENOVATION

3021 MILLER RD.
ANN ARBOR, MI 48103

DATE	ISSUED FOR:
11/08/2024	SCHEMATIC DESIGN
01/24/2025	DESIGN DEVELOPMENT
02/21/2025	REVISION
03/03/2025	FINAL OWNER REVIEW
05/01/2025	IFC

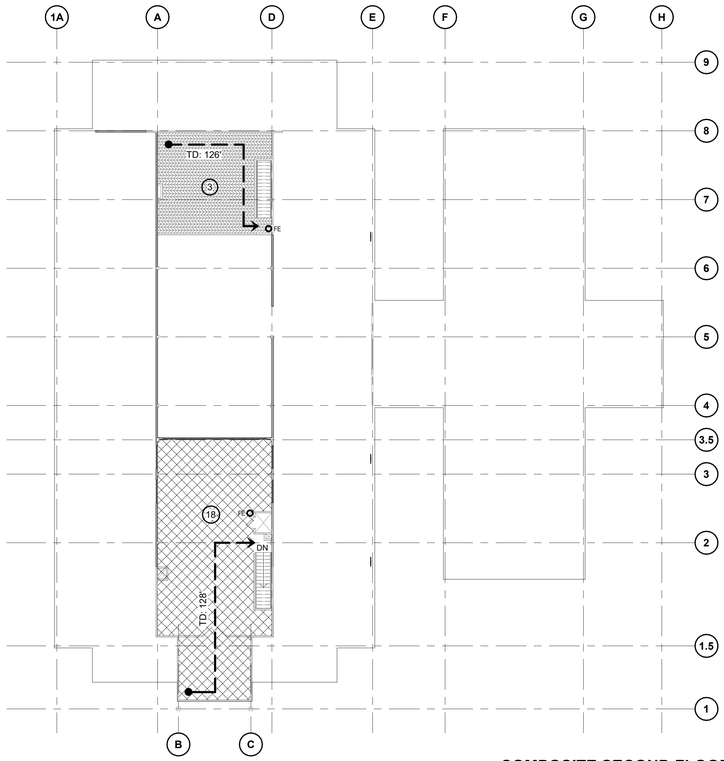
Designer:	P. HENDERSON
Modeler:	P. HENDERSON
PM:	B. REED
PIC:	B. REED
ACADFILE:	24-1301-ANN ARBOR ELECTION FACILITY-A-R22
Project No.	24-1301
Sheet Title	GENERAL PROJECT INFORMATION
Sheet Number	A-001



COMPOSITE FIRST FLOOR LIFE SAFETY PLAN

SCALE: 1/16" = 1'-0"

NORTH



COMPOSITE SECOND FLOOR LIFE SAFETY PLAN

SCALE: 1/16" = 1'-0"

NORTH

CODE LEGEND:

EXIT
X"
XXX
XXX

EXIT WIDTH (INCHES - ACTUAL)

CAPACITY OF EXIT WIDTH PROVIDED (OCCUPANTS)

OCCUPANTS PER CODE CALCULATIONS (OCCUPANTS - ACTUAL)

1 HOUR FIRE RATED ASSEMBLY (ASSUMED)

2 HOUR FIRE RATED ASSEMBLY (ASSUMED)

TD: 000'
CPT: 000'

TRAVEL DISTANCE TO EXIT LOCATION.

CPT: XXX'

COMMON PATH OF TRAVEL
PER MBC 2015, TABLE 1006.2.1
MAX.LENGTH 100 FT..

TD: XXX'

TRAVEL DISTANCE
PER MBC 2015, TABLE 1017.2
MAX. LENGTH 300 FT. (B)
MAX. LENGTH 400 FT. (S-2)

FE

CLASS 2A 10LB. FIRE EXTINGUISHER.
TOP OF EXTINGUISHER 60" A.F.F. MAX.

OCCUPANT START POINT

EXIT DISCHARGE POINT

EGRESS PATH OF TRAVEL

BUSINESS

ASSEMBLY

MECHANICAL

OF OCCUPANTS IN SPACE

OF OCCUPANTS MERGING/SPLITTING

BUILDING CODE SUMMARY

PROJECT	ANN ARBOR ELECTION FACILITY AND CTN OFFICE RENOVATION
LOCATION	ANN ARBOR, MI
DESCRIPTION	ALTERATIONS TO EXISTING BUILDING TO ACCOMODATE ADMINISTRATIVE SERVICES AND OFFICE SPACE. - BUSINESS OCCUPANCY - AN AUTOMATIC SPRINKLER SYSTEM IS MAINTAINED - NO INCREASE TO BUILDING AREA

APPLICABLE CODES

BUILDING	2015 MICHIGAN BUILDING CODE
ACCESSIBILITY	ANSI A117.1 - 2009
MECHANICAL	2021 MICHIGAN MECHANICAL CODE
PLUMBING	2021 MICHIGAN PLUMBING CODE
ELECTRICAL	2023 MICHIGAN ELECTRICAL CODE
ENERGY	2015 MICHIGAN ENERGY CODE 2015 INTERNATIONAL FUEL GAS CODE
OTHER	2015 INTERNATIONAL FIRE CODE (AS REFERENCED) NFPA 101 LIFE SAFETY CODE 2012 (AS REFERENCED) 2015 MICHIGAN REHABILITATION CODE FOR EXISTING BUILDINGS

USE AND OCCUPANCY CLASSIFICATION

B BUISNESS	304.1: ADMINISTRATIVE OFFICES

BUILDING LIMITATION

ACCESSORY OCCUPANCIES	508.2
B	20,434 SF (NO CHANGE)
BUILDING HEIGHT AND NUMBER OF STORIES	2 ST (NO CHANGE) 504
BUILDING AREA	18,651 SF (NO CHANGE) 506
INCIDENTAL USES	509: TABLE 509 AUTOMATIC SPRINKLER SYSTEM IN LIEU OF SEPARATION

TYPE OF CONSTRUCTION

CONSTRUCTION TYPE	TYPE V B CONSTRUCTION - UNPROTECTED (NO CHANGE)

MEANS OF EGRESS

OCCUPANT LOAD	1004 (SEE CODE SHEETS FOR DATA)
EGRESS SIZING	1005 STAIRWAY FACTOR 0.2 OTHER FACTORS 0.15
COMMON PATH OF EGRESS TRAVEL DISTANCE	1006.2 100 FEET (SEE CODE SHEETS FOR EGRESS PLANS)
EXIT ACCESS TRAVEL DISTANCE	1017.2 300 FEET (SEE CODE SHEETS FOR EGRESS PLANS)
SINGLE EXITS	1006.3.2 CONDITION 1 TABLE 1006.3.2 (2) FIRST STORY ABOVE OR BELOW GRADE BUSINESS - MAX 49 OCCUPANTS - 100(b) FEET MAX CPT
STAIRWAY WIDTH	1011.2 EXCEPTION 1 - 36 INCHES
EXIT ACCESS STAIRWAY	1019.3 CONDITION 1 - SERVING ONLY TWO STORIES
CORRIDORS	1020, TABLE 1020.1 GROUP B - OVER 30 OCCUPANTS- REQUIRES 0-HR FIRE-RESISTANCE RATING IF SPRINKLED

NET AREA	
LEVEL 1	18,611 SQ FT
LEVEL 2	1,823 SQ FT

PLUMBING FIXTURES SUMMARY

OCCUPANCY CALCULATIONS

BUSINESS (1/100) : 21,173 SF = 212 OCCUPANTS *

FIXTURE CALCULATIONS

	REQUIRED	EXISTING	PROVIDED
MWC	4	5	5
FWC	4	5	5
LAV	3 EACH	3 EACH	3 EACH
DF	2	2	2
SS	1 PER AREA	1	1
SINGLE USE	0	0	1
SHOWER	0	0	0

* NO CHANGE IN OCCUPANCY

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CITY OF ANN ARBOR

ELECTION FACILITY RENOVATION

3021 MILLER RD.
ANN ARBOR, MI 48103

DATE	ISSUED FOR:
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02/21/2025	REVISION
03/03/2025	FINAL OWNER REVIEW
05/01/2025	IFC

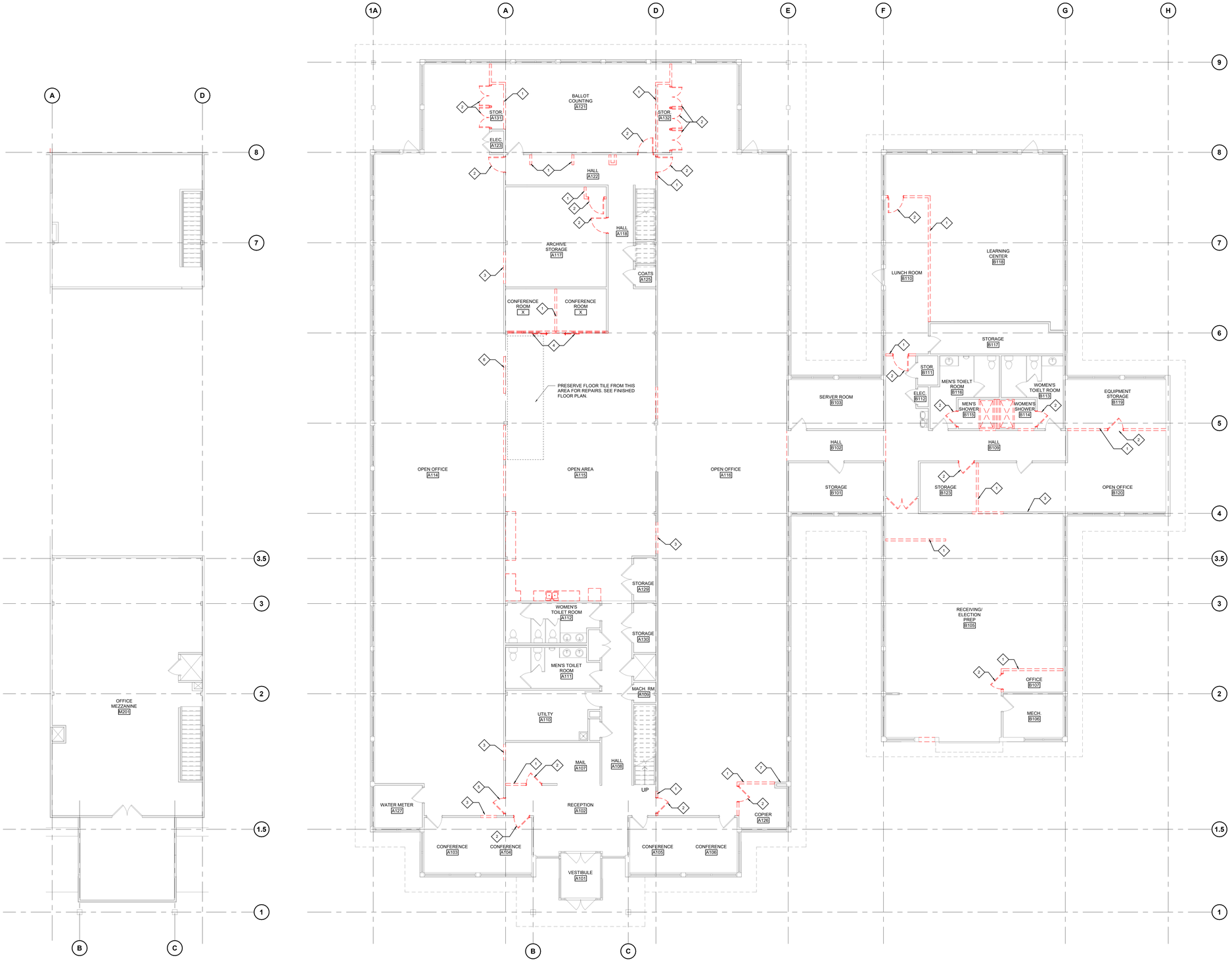
Designer:	P. HENDERSON
Modeler:	M. ALSHADOOD
PM:	B. REED
PIC:	B. REED
ACADFILE:	24-1301-ANN ARBOR ELECTION FACILITY-A-R22
Project No.	24-1301

Sheet Title

CODE SUMMARY

Sheet Number

A-002



PARTIAL MEZZANINE DEMOLITION PLAN

2 / AD101

SCALE: 1/8" = 1'-0"

1/8"=1'-0" 0 8' 16'

COMPOSITE FIRST FLOOR DEMOLITION PLAN

1 / AD101

SCALE: 1/8" = 1'-0"

1/8"=1'-0" 0 8' 16'

GENERAL NOTES

NO.	DESCRIPTION
1	FIELD VERIFY ALL EXISTING CONDITIONS PRIOR TO START OF ANY WORK.
2	COORDINATE ALL MECHANICAL AND ELECTRICAL WORK. REFER TO MECHANICAL AND ELECTRICAL DOCUMENTS.
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8	CONTRACTOR TO PROVIDE TEMPORARY BARRICADES AND OTHER FORMS OF PROTECTION IN ACCORDANCE WITH ALL OSHA REGULATIONS, AS REQUIRED TO PROTECT OWNERS PERSONNEL, GENERAL PUBLIC AND ALL EGRESS ROUTES.
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13	MAINTAIN ALL NECESSSARY EGRESS ROUTES AND SITE ACCESS ROUTES THROUGHOUT THE DURATION OF CONSTRUCTION.
14	RESTRIPE PARKING LOT TO ACCOMMODATE EV CHARGER INSTALL.
15	REPAIR LANDSCAPING, SIDEWALK, AND PAVEMENT TO ACCOMMODATE INSTALL OF EV CHARGER AND CONNECTION TO EV CHARGER.

KEYNOTES

NO.	DESCRIPTION
1	EXISTING WALL TO BE REMOVED IN ITS ENTIRETY AS INDICATED
2	EXISTING DOOR, FRAME, HARDWARE, AND THRESHOLD TO BE REMOVED IN ITS ENTIRETY
3	EXISTING WALL TO BE REMOVED TO ACCOMMODATE INSTALL OF NEW DOOR.
4	EXISTING STOREFRONT WITH SLIDING DOOR, FRAME, HARDWARE, AND THRESHOLD TO BE REMOVED WITH CARE. PRESERVE AND TURN OVER TO OWNER.
5	EXISTING DOOR, HARDWARE TO BE REMOVED AND FLIPPED.
6	EXISTING WALL TO BE REMOVED WITH CARE IN ITS ENTIRETY AS INDICATED. PROTECT EXISTING WOOD BRACE.
7	EXISTING CHASE TO REMAIN MODIFY AND REPAIR TO ACCOMMODATE INSTALL OF NEW PIPING.

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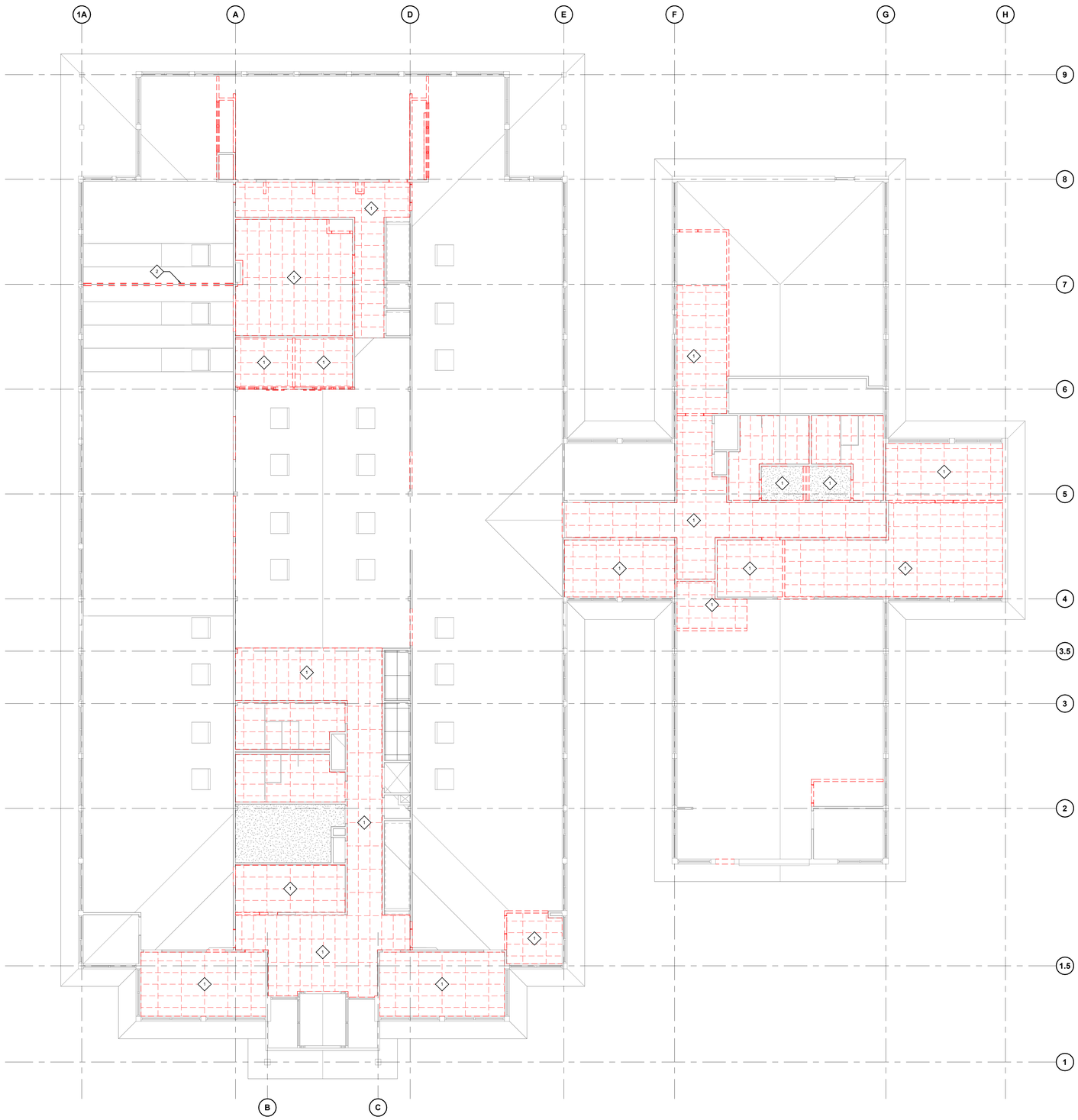
Designer:	P. HENDERSON
Modeler:	P. HENDERSON
PM:	B. REED
PIC:	B.REED
ACADFILE:	24-1301-ANN ARBOR ELECTION FACILITY-A-R22
Project No.	24-1301

Sheet Title

COMPOSITE ARCHITECTURAL DEMOLITION PLANS

Sheet Number

AD101



COMPOSITE FIRST FLOOR CEILING DEMOLITION PLAN

1 / AD102

SCALE: 1/8" = 1'-0"

1/8"=1'-0" 0 4' 8' 16'

GENERAL NOTES

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KEYNOTES

NO.	DESCRIPTION
1	EXISTING CEILING TO BE REMOVED IN ITS ENTIRETY, REFER TO MECH. & ELECT. FOR EXISTING LIGHTING, DIFFUSER, GRILLE, SPEAKER, SPRINKLER HEAD, ETC. REMOVAL
2	REMOVE DECORATIVE WOOD TRUSS WITH CARE.

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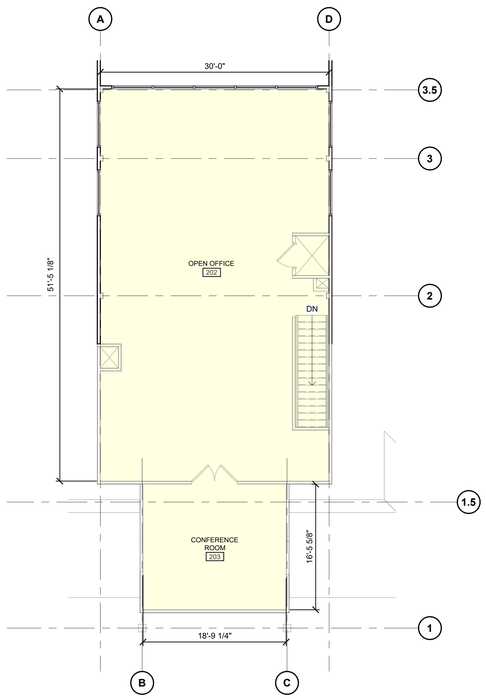
Designer:	P. HENDERSON
Modeler:	P. HENDERSON
PM:	B. REED
PIC:	B. REED
ACADFILE:	24-1301-ANN ARBOR ELECTION FACILITY-A.RZT
Project No.	24-1301

Sheet Title

COMPOSITE FIRST FLOOR CEILING DEMOLITION PLAN

Sheet Number

AD102



2 A-100

PARTIAL MEZZANINE ARCHITECTURAL PLAN

SCALE: 1/8" = 1'-0"

1/8"=1'-0" 0 8" 16"

1 A-100

COMPOSITE FIRST FLOOR ARCHITECTURAL PROGRAMING PLAN

SCALE: 1/8" = 1'-0"

1/8"=1'-0" 0 8" 16"

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- CITY CLERK GROUP
- CTN GROUP
- ECONOMICS GROUP
- SHARED SPACE
- BUILDING SUPPORT

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Designer:	P. HENDERSON
Modeler:	P. HENDERSON
PM:	B. REED
PIC:	B. REED
ACADFILE:	24-1301-ANN ARBOR ELECTION FACILITY-A-R23
Project No.	24-1301

Sheet Title

COMPOSITE PROGRAMING PLANS

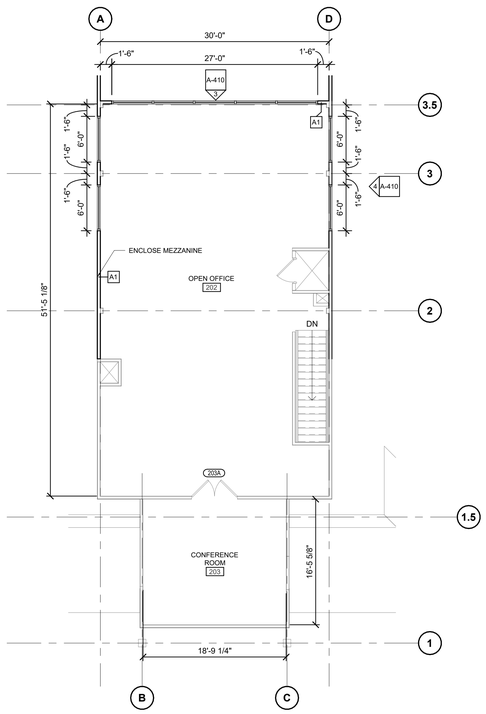
Sheet Number

A-100

WALL LEGEND

- **A1** 3 5/8" METAL STUD WITH 5/8" GYP ON BOTH SIDES. WITH BAT INSULATION. EXTEND TO TOP OF EXISTING DECORATIVE WOOD TRUSS. OR TO UNDERSIDE OF EXISTING WOOD TRUSS OF ALIGNED WITH TRUSS. SEE SECTION DRAWINGS.
- **B1** 3 5/8" METAL STUD WITH 5/8" GYP ON BOTH SIDES. WITH BAT INSULATION. EXTEND TO EXISTING MEZZANINE LEVEL. SEE SECTION DRAWINGS.
- **C1** 3 5/8" METAL STUD WITH 5/8" GYP ON BOTH SIDES. WITH BAT INSULATION. EXTEND TO UNDERSIDE OF EXISTING DECK. SEE SECTION DRAWINGS.
- **D1** 3 5/8" METAL STUD WITH 5/8" GYP ON ONE SIDE. WITH BAT INSULATION. AROUND EXISTING WALL AS SHOWN.
- **D2** 2 1/2" METAL STUD WITH 5/8" GYP ON ONE SIDE. WITH BAT INSULATION. AROUND EXISTING WALL AS SHOWN.
- **E1** 3 5/8" METAL STUDS BACK TO BACK WITH 1" AIR SPACE BETWEEN. WITH 5/8" GYP ON ONE SIDE. WITH BAT INSULATION. EXTEND TO UNDERSIDE OF EXISTING DECK.

PROVIDE ACOUSTIC SEALANT AT ALL WALLS AND PENETRATIONS.

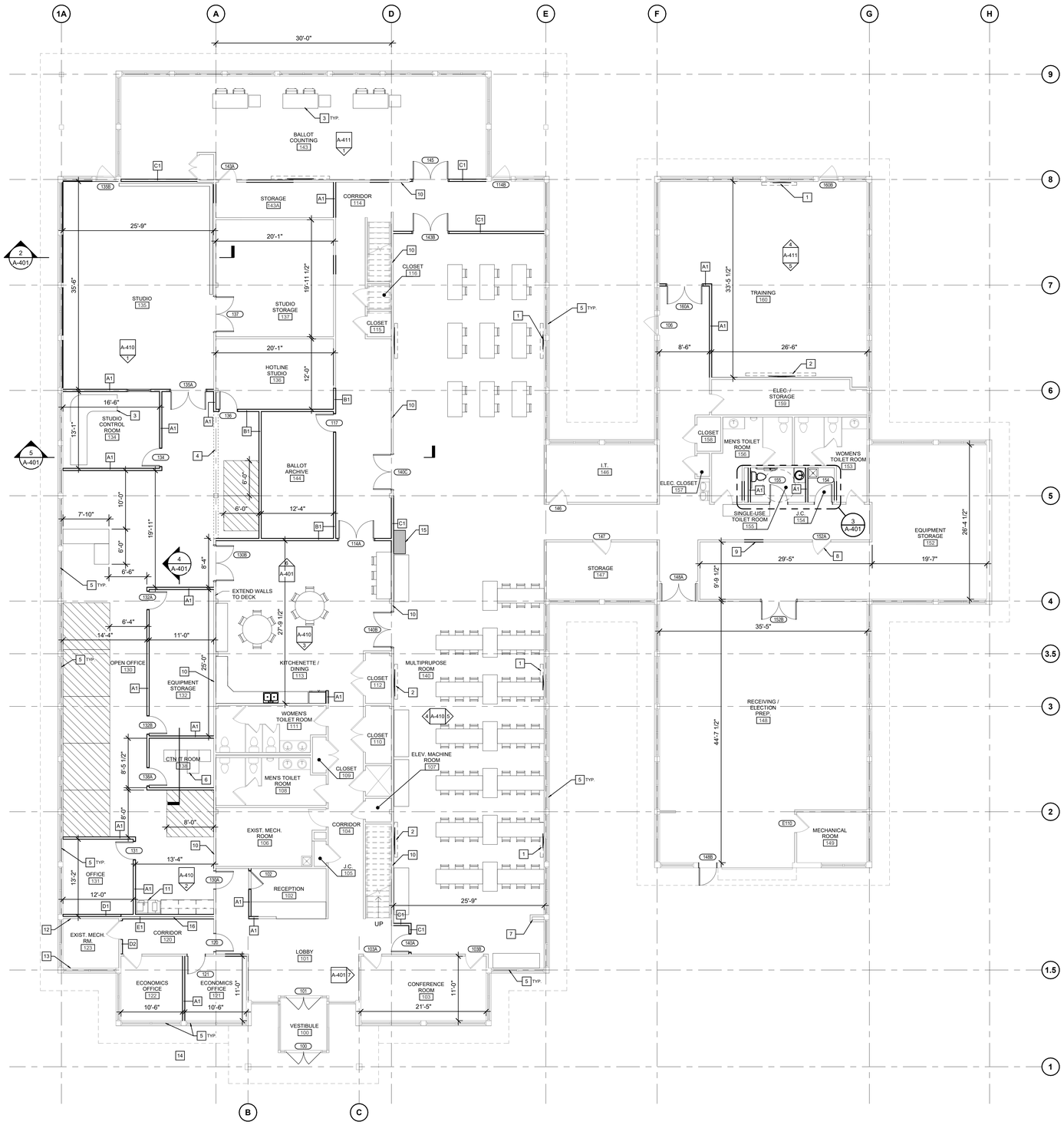


PARTIAL MEZZANINE ARCHITECTURAL PLAN

2 / A-101

SCALE: 1/8" = 1'-0"

1/8"=1'-0" 0 8" 16"



COMPOSITE FIRST FLOOR ARCHITECTURAL PLAN

1 / A-101

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1/8"=1'-0" 0 8" 16"

GENERAL NOTES

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KEYNOTES

NO.	DESCRIPTION
1	PRESENTER SCREEN. MONITOR TO BE MOUNTED ON GYP WALL ABOVE WINDOWS. PROVIDE BLOCKING CONCEALED IN EXISTING WALL. REFER TO ELECTRICAL DRAWINGS FOR POWER AND DATA CONNECTIONS. REPAIR GYP WALL AND PAINT TO MATCH EXISTING. MONITOR PROVIDED BY OWNER.
2	DISPLAY MONITOR. PROVIDE BLOCKING CONCEALED IN EXISTING WALL. REFER TO ELECTRICAL DRAWINGS FOR POWER AND DATA CONNECTIONS. REPAIR GYP WALL AND PAINT TO MATCH EXISTING. MONITOR PROVIDED BY OWNER.
3	FURNITURE BY OWNER.
4	WOOD BRACE TO REMAIN. REPAIR ANY DAMAGE CAUSED BY REMOVAL OF WALL BELOW.
5	PROVIDE NEW MANUAL SHADES AT EXISTING WINDOWS. BASIS OF DESIGN: DRAPER CLUTCH-OPERATED FLEXSHADE, DUAL ROLLER. REFER TO FINISH SCHEDULE.
6	IT EQUIPMENT BY OWNER.
7	EXISTING CHASE TO REMAIN MODIFY AND REPAIR TO ACCOMMODATE INSTALL OF NEW PIPING.
8	PROVIDE NEW HARDWARE ON EXISTING DOOR. REFER TO DOOR SCHEDULE.
9	INFILL OPENING WHERE EXISTING DOOR WAS REMOVED, MATCH EXISITNG ADJACENT WALL CONSTRUCTION.
10	EXTEND EXISTING WALL TO DECK, MATCH EXISTING CONSTRUCTION.
11	EXISTING PRINTER RELOCATED FROM EXISTING FACILITY.
12	RE-SEAL ALL PENETRATIONS THROUGH ROOM. INFILL ALL HOLES. IN EFFORT TO DECREASE TRANSFER OF EQUIPMENT SOUND TO OTHER SPACES.
13	PROVIDE 1 INCH ACOUSTIC PANELING ON Z-CLIPS FOR ENTIRE ROOM UP TO 8 FEET, INCLUDING DOOR. PROVIDE 1 INCH SPRAY APPLIED ACOUSTIC INSULATION "SONASPRAY" ON CEILING AND WALLS ABOVE 8 FEET.
14	RESTORE LANDSCAPING TO ORIGINAL CONDITION AFTER INSTALLATION OF NEW ELECTRICAL VEHICLE CHARGERS. REFER TO ELEC. DRAWINGS FOR SCOPE OF SITE WORK.
15	PROVIDE WALL MOUNTED ROOM DIVIDER, BASIS OF DESIGN: VERSARE, THE ROOM DIVIDER 360 FOLDING PARTITION, WALL-MOUNTED.
16	

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Project No.	24-1301

Sheet Title

COMPOSITE ARCHITECTURAL PLANS

Sheet Number

A-101

COMPOSITE FIRST FLOOR REFLECTED CEILING PLAN

1 / A-102

SCALE: 1/8" = 1'-0"

1/8"=1'-0" 0 8" 16"

GENERAL NOTES

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KEYNOTES

NO.	DESCRIPTION
1	REPAIR CEILING AND WALLS AFTER REMOVAL OF DECORATIVE WOOD TRUSS.
2	INSTALL NEW 2'X2' ACT CEILING.
3	INSTALL NEW GYP. BOARD CEILING.
4	WOOD BRACE TO REMAIN. REPAIR ANY DAMAGE CAUSED BY REMOVAL OF WALL BELOW.

LEGEND:

LAY-IN ACT CEILING

GYP. BOARD CEILING

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CITY OF ANN ARBOR

ELECTION FACILITY RENOVATION

3021 MILLER RD.
ANN ARBOR, MI 48103

DATE	ISSUED FOR:
11/08/2024	SCHEMATIC DESIGN
12/05/2024	REVISION
12/13/2024	REVISION
01/06/2025	REVISION
01/24/2025	DESIGN DEVELOPMENT
02/21/2025	REVISION
03/03/2025	FINAL OWNER REVIEW
05/01/2025	IFC

Designer:	P. HENDERSON
Modeler:	P. HENDERSON
PM:	B. REED
PIC:	B. REED
ACADFILE:	24-1301-ANN ARBOR ELECTION FACILITY-A-R22
Project No.	24-1301

Sheet Title

COMPOSITE FIRST FLOOR REFLECTED CEILING PLAN

Sheet Number

A-102

PARTIAL MEZZANINE FLOOR FINISH PLAN

2 / A-103

SCALE: 1/8" = 1'-0"

1/8"=1'-0" 0 8' 16'

COMPOSITE FIRST FLOOR ARCHITECTURAL PLAN

1 / A-103

SCALE: 1/8" = 1'-0"

1/8"=1'-0" 0 8' 16'

GENERAL NOTES

NO.	DESCRIPTION
1	FIELD VERIFY ALL EXISTING CONDITIONS PRIOR TO START OF ANY WORK.
2	COORDINATE ALL MECHANICAL AND ELECTRICAL WORK, REFER TO MECHANICAL AND ELECTRICAL DOCUMENTS.
3	ALL EXISTING REMAINING CONSTRUCTION SHALL BE PROTECTED DURING DEMOLITION AND CONSTRUCTION. REPAIR OF DAMAGED EXISTING FINISHES WILL BE AT CONTRACTORS EXPENSE.
4	CONTRACTORS LOGISTICS AND STAGING PLAN SHALL INCLUDE SPECIFIC DETAIL ON HOW THE WORK AREA WILL BE SECURE AND ADJACENT FINISHED AREA PROTECTED.
5	REFER TO SPECIFICATIONS FOR ITEMS TO BE RECYCLED AND/OR REUSED. COORDINATE WITH OWNER.
6	ALL SPACES ARE TO BE CLEANED AND ANY DAMAGE CAUSED BY THE CONTRACTORS TO BE PATCHED, REPAIRED, AND/OR PAINTED/REPLACE TO MATCH ORIGINAL CONDITION ONCE WORK IS COMPLETED.
7	OWNER SHALL OCCUPY ADJACENT AREA DURING CONSTRUCTION. ALL CONSTRUCTION WORK SHALL NOT DISTURB OWNER OPERATION. ANY WORK WHICH MAY DISTURB OWNER OPERATION IS TO BE COORDINATED PRIOR TO COMMENCEMENT OF WORK. MAINTAIN ALL REQUIRED EGRESS ROUTES FOR DURATION OF CONSTRUCTION.
8	CONTRACTOR TO PROVIDE TEMPORARY BARRICADES AND OTHER FORMS OF PROTECTION IN ACCORDANCE WITH ALL OSHA REGULATIONS, AS REQUIRED TO PROTECT OWNERS PERSONNEL, GENERAL PUBLIC AND ALL EGRESS ROUTES.
9	PROVIDE TEMPORARY SHORING.BRACING AS REQUIRED PRIOR TO ANY CONSTRUCTION. TEMPORARY SHORING/BRACING SHALL REMAIN IN PLACE UNTIL PERMANENT CONSTRUCTION IS COMPLETE.
10	CONTRACTOR TO COORDINATE WITH OWNER ALL STAGING AND LAY DOWN AREAS FOR CONSTRUCTION MATERIALS, CONTRACTOR PARKING, AND DEMOLITION REMOVAL.
11	CONTRACTOR IS TO MAINTAIN SECURED WORK AREA AND FACILITY AT ALL TIMES DURING THE COURSE OF DEMOLITION AND CONSTRUCTION.
12	CONFIRM TEST REPORTS WITH OWNER PRIOR TO DEMOLITION WORK IF ASBESTOS, LEAD OR OTHER HAZARDOUS MATERIALS HAVE BEEN FOUND WITHIN AREA OF SCOPE. HAZARDOUS MATERIALS WILL BE REMOVED BY OWNER.
13	MAINTAIN ALL NECESSSARY EGRESS ROUTES AND SITE ACCESS ROUTES THROUGHOUT THE DURATION OF CONSTRUCTION.
14	RESTRIPE PARKING LOT TO ACCOMMODATE EV CHARGER INSTALL.
15	REPAIR LANDSCAPING, SIDEWALK, AND PAVEMENT TO ACCOMMODATE INSTALL OF EV CHARGER AND CONNECTION TO EV CHARGER.

LEGEND:

- CONCRETE
- CARPET
- LVT
- TILE

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Modeler:	P. HENDERSON
PM:	B. REED
PIC:	B. REED
ACADFILE:	24-1301-ANN ARBOR ELECTION FACILITY-A-R23
Project No.	24-1301

Sheet Title

COMPOSITE FLOOR FINISH PLANS

Sheet Number

A-103

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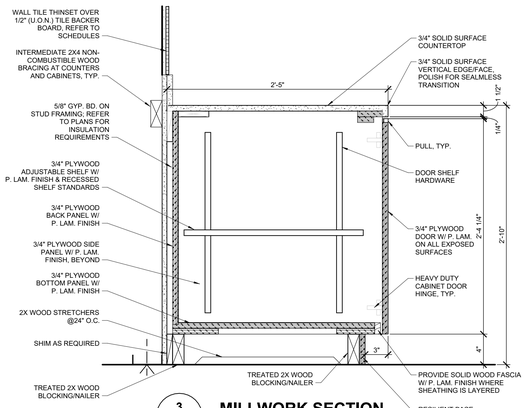
ACADFILE:	24-1301-ANN ARBOR ELECTION FACILITY-A-R22
Project No.	24-1301

Sheet Title

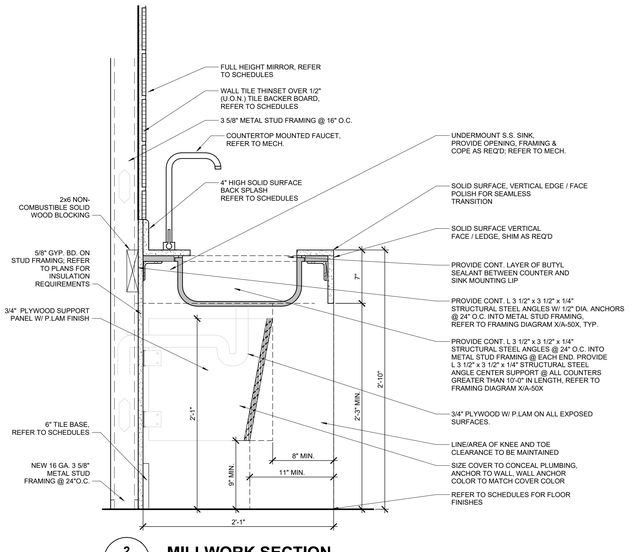
MILLWORK SECTIONS

Sheet Number

A-301



3 A-301 **MILLWORK SECTION**
SCALE: 1 1/2" = 1'-0"



2 A-301 **MILLWORK SECTION**
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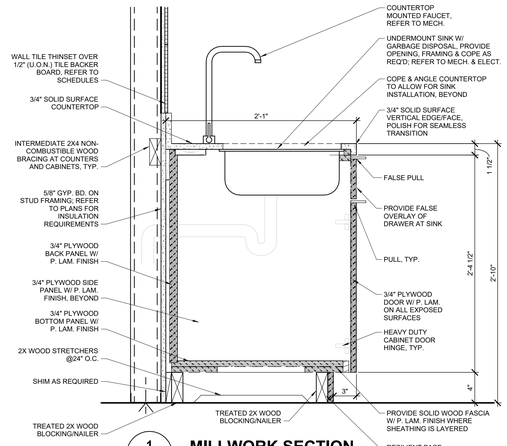

1 A-301 **MILLWORK SECTION**
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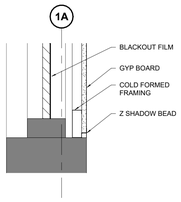
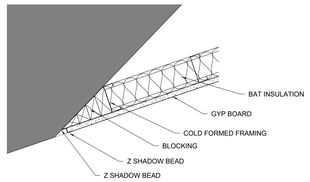
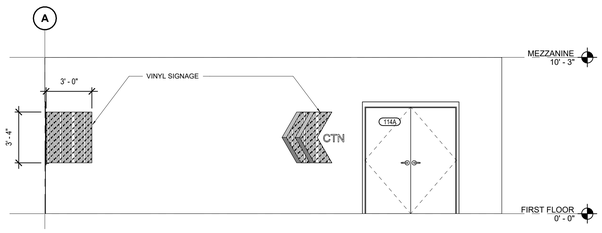


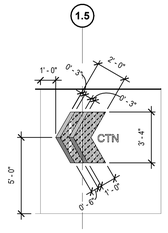
8 A-401 **STUDIO WINDOW INFILL DETAIL**
SCALE: 1 1/2" = 1'-0"



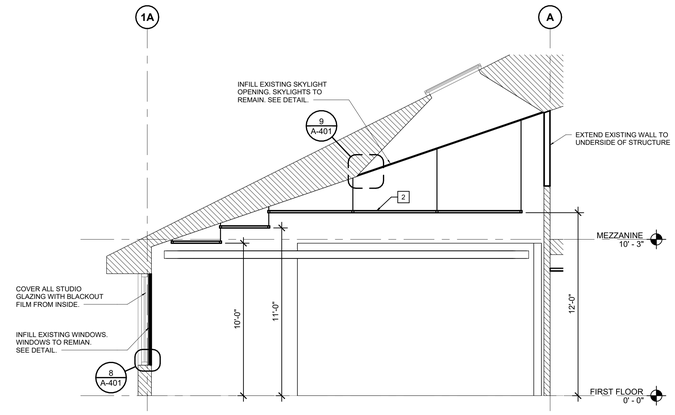
9 A-401 **STUDIO CEILING INFILL DETAIL**
SCALE: 1 1/2" = 1'-0"



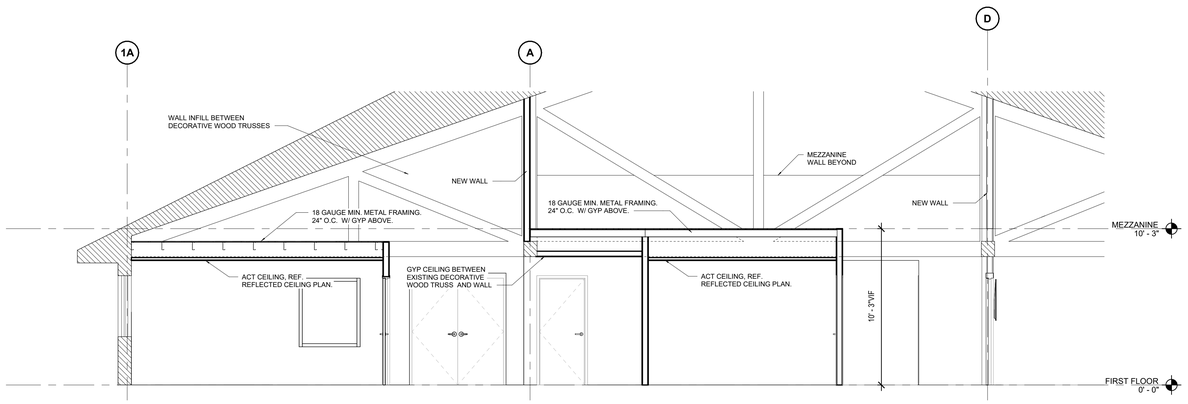
6 A-100 **SIGNAGE ELEVATION 2**
SCALE: 1/4" = 1'-0"



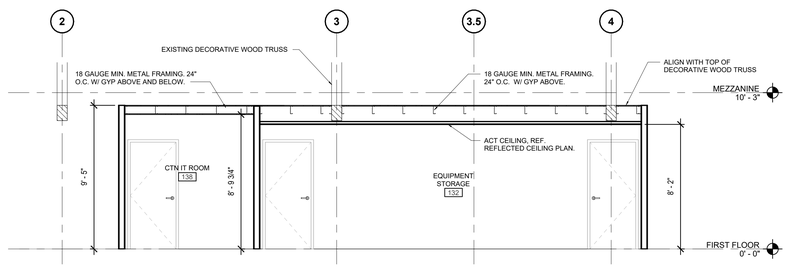
7 A-100 **SIGNAGE ELEVATION 1**
SCALE: 1/4" = 1'-0"



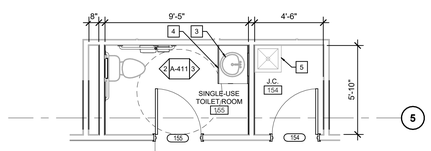
2 A-101 **SECTION THROUGH STUDIO**
SCALE: 1/4" = 1'-0"
1/4"=1'-0" 0 4" 8"



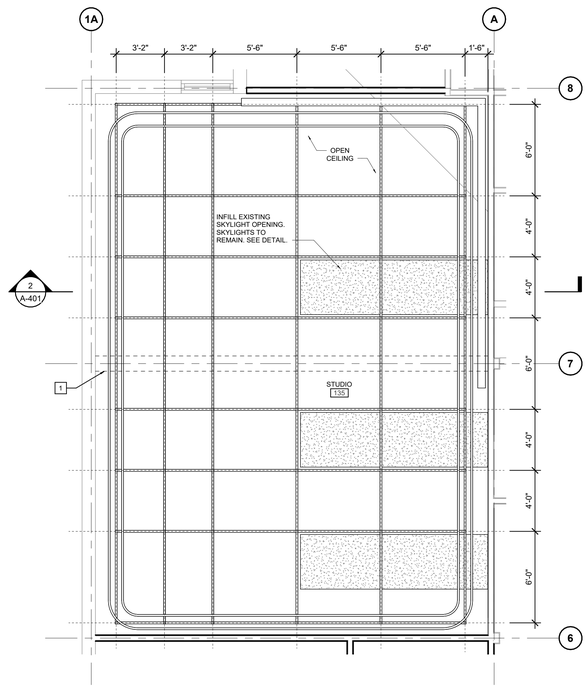
5 A-101 **CTN OPEN AREA SECTION**
SCALE: 1/4" = 1'-0"



4 A-101 **CTN IT - STORAGE ROOM SECTION**
SCALE: 1/4" = 1'-0"



3 A-401 **ENLARGED FIRST FLOOR ARCHITECTURAL PLAN**
SCALE: 1/4" = 1'-0"



1 A-401 **ENLARGED FIRST FLOOR REFLECTED CEILING PLAN**
SCALE: 1/4" = 1'-0"
1/4"=1'-0" 0 4" 8"

GENERAL NOTES

NO.	DESCRIPTION
1	FIELD VERIFY ALL EXISTING CONDITIONS PRIOR TO START OF ANY WORK.
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13	MAINTAIN ALL NECESSSARY EGRESS ROUTES AND SITE ACCESS ROUTES THROUGHOUT THE DURATION OF CONSTRUCTION.
14	RESTRIPE PARKING LOT TO ACCOMMODATE EV CHARGER INSTALL.
15	REPAIR LANDSCAPING, SIDEWALK, AND PAVEMENT TO ACCOMMODATE INSTALL OF EV CHARGER AND CONNECTION TO EV CHARGER.

KEYNOTES

NO.	DESCRIPTION
1	REPAIR CEILING AND WALLS AFTER REMOVAL OF DECORATIVE WOOD TRUSS.
2	1 5/8" UNISTRUT SUPPORT SYSTEM. CONNECT TO EXISTING STRUCTURE.
3	DROP-IN LAVATORY, REFER TO PLUMB.
4	SOLID SURFACE COUNTERTOP, REFER TO SCHEDULES.
5	INSTALL NEW JANITORIAL SINK, REFER TO PLUMB.

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PM:	B. REED
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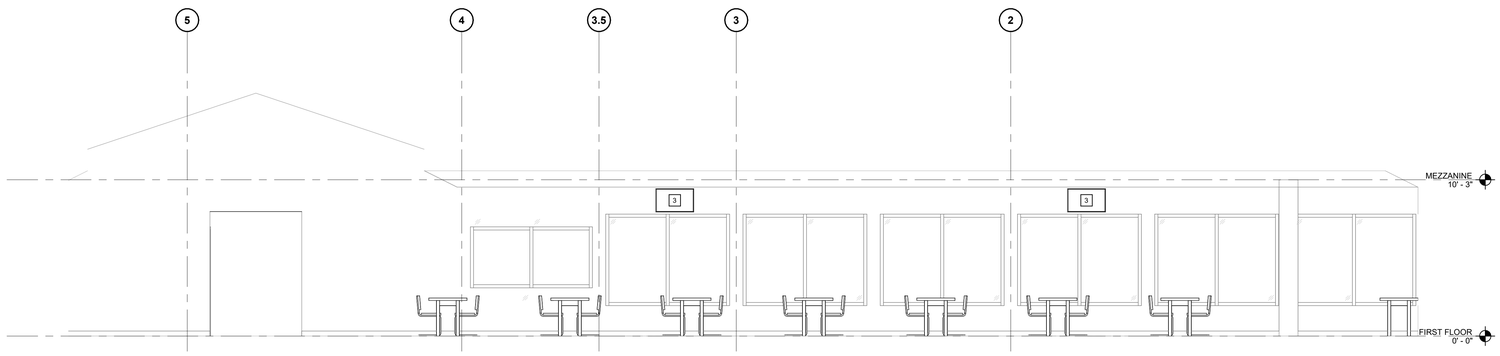
ACADFILE:	24-1301-ANN ARBOR ELECTION FACILITY-A-R23
Project No.	24-1301

Sheet Title

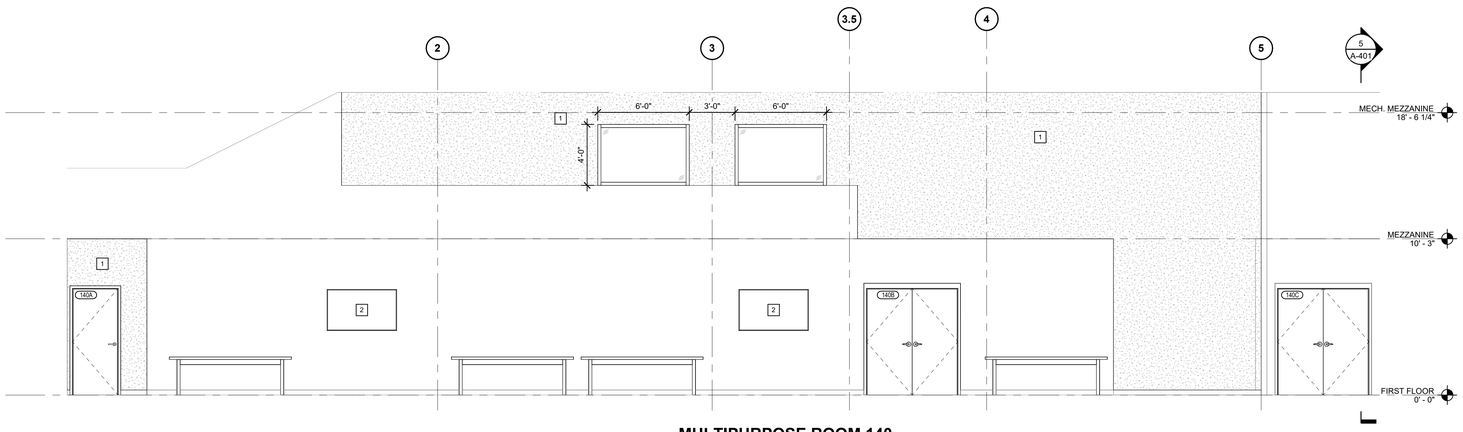
ENLARGED PLANS AND SECTIONS

Sheet Number

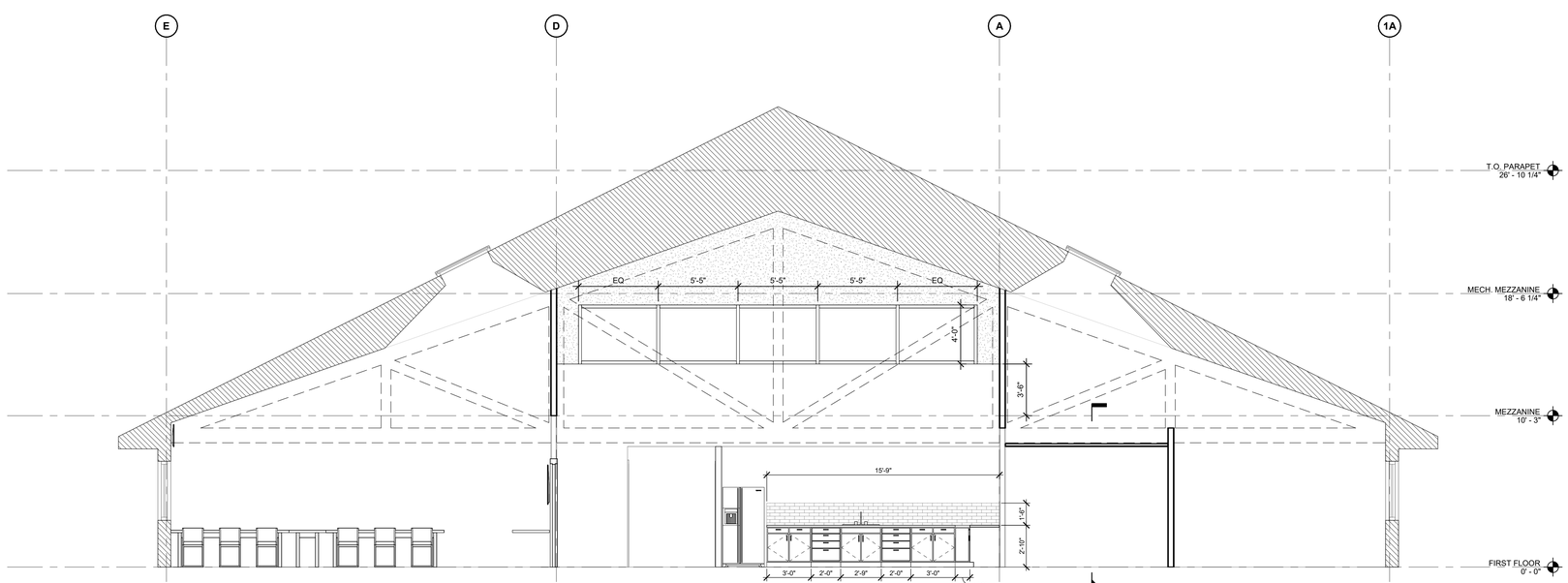
A-401



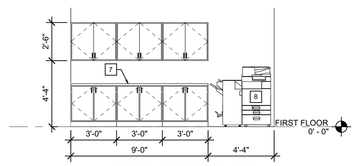
5 A-101 **MULTIPURPOSE ROOM 140 INTERIOR ELEVATION**
SCALE: 1/4" = 1'-0"



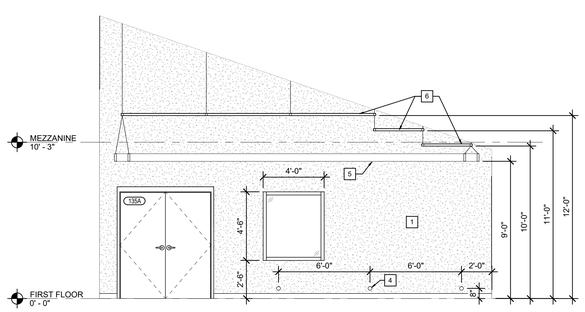
4 A-101 **MULTIPURPOSE ROOM 140 INTERIOR ELEVATION**
SCALE: 1/4" = 1'-0"



3 A-101 **KITCHEN/DINING 113 INTERIOR ELEVATION-SECTION**
SCALE: 1/4" = 1'-0"



2 A-101 **OPEN OFFICE 130 INTERIOT ELEVATION**
SCALE: 1/4" = 1'-0"



1 A-101 **STUDIO 135 INTERIOR ELEVATION**
SCALE: 1/4" = 1'-0"

GENERAL NOTES

NO.	DESCRIPTION
1	FIELD VERIFY ALL EXISTING CONDITIONS PRIOR TO START OF ANY WORK.
2	COORDINATE ALL MECHANICAL AND ELECTRICAL WORK. REFER TO MECHANICAL AND ELECTRICAL DOCUMENTS.
3	ALL EXISTING REMAINING CONSTRUCTION SHALL BE PROTECTED DURING DEMOLITION AND CONSTRUCTION. REPAIR OF DAMAGED EXISTING FINISHES WILL BE AT CONTRACTORS EXPENSE.
4	CONTRACTORS LOGISTICS AND STAGING PLAN SHALL INCLUDE SPECIFIC DETAIL ON HOW THE WORK AREA WILL BE SECURE AND ADJACENT FINISHED AREA PROTECTED.
5	REFER TO SPECIFICATIONS FOR ITEMS TO BE RECYCLED AND/OR REUSED. COORDINATE WITH OWNER.
6	ALL SPACES ARE TO BE CLEANED AND ANY DAMAGE CAUSED BY THE CONTRACTORS TO BE PATCHED, REPAIRED, AND/OR PAINTED/REPLACE TO MATCH ORIGINAL CONDITION ONCE WORK IS COMPLETED.
7	OWNER SHALL OCCUPY ADJACENT AREA DURING CONSTRUCTION. ALL CONSTRUCTION WORK SHALL NOT DISTURB OWNER OPERATION. ANY WORK WHICH MAY DISTURB OWNER OPERATION IS TO BE COORDINATED PRIOR TO COMMENCEMENT OF WORK. MAINTAIN ALL REQUIRED EGRESS ROUTES FOR DURATION OF CONSTRUCTION.
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13	MAINTAIN ALL NECESSSARY EGRESS ROUTES AND SITE ACCESS ROUTES THROUGHOUT THE DURATION OF CONSTRUCTION.
14	RESTRIPE PARKING LOT TO ACCOMMODATE EV CHARGER INSTALL.
15	REPAIR LANDSCAPING, SIDEWALK, AND PAVEMENT TO ACCOMMODATE INSTALL OF EV CHARGER AND CONNECTION TO EV CHARGER.

KEYNOTES

NO.	DESCRIPTION
1	PAINTED GYPSUM BOARD, REFER TO ROOM FINISH SCHEDULE.
2	DISPLAY MONITOR. PROVIDE BLOCKING CONCEALED IN EXISTING WALL. REFER TO ELECTRICAL DRAWINGS FOR POWER AND DATA CONNECTIONS. REPAIR GYP WALL AND PAINT TO MATCH EXISTING. MONITOR PROVIDED BY OWNER.
3	PRESENTER SCREEN. MONITOR TO BE MOUNTED ON GYP WALL ABOVE WINDOWS. PROVIDE BLOCKING CONCEALED IN EXISTING WALL. REFER TO ELECTRICAL DRAWINGS FOR POWER AND DATA CONNECTIONS. REPAIR GYP WALL AND PAINT TO MATCH EXISTING. MONITOR PROVIDED BY OWNER.
4	PROVIDE 3 INCH SLEEVE AND GROMMET IN NEW WALL FOR CABLES.
5	EXISTING CURTAIN TRACK RELOCATED FROM EXISTING STUDIO SPACE. MODIFY AS REQUIRED TO FIT NEW SPACE. MOUNT TO NEW SUSPENDED UNISTRUT SYSTEM AT 9'-0" AFF.
6	1 5/8" UNISTRUT SUPPORT SYSTEM. CONNECT TO EXISTING STRUCTURE.
7	LAMINATE COUNTERTOP, REFER TO FINISH SCHEDULES.
8	EXISTING PRINTER RELOCATED FROM EXISTING FACILITY.

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PM:	B. REED
PIC:	B. REED
ACADFILE:	24-1301-ANN ARBOR ELECTION FACILITY-A-R23
Project No.	24-1301

Sheet Title

INTERIOR ELEVATIONS

Sheet Number

A-410

GENERAL NOTES	
NO.	DESCRIPTION
1	FIELD VERIFY ALL EXISTING CONDITIONS PRIOR TO START OF ANY WORK.
2	COORDINATE ALL MECHANICAL AND ELECTRICAL WORK. REFER TO MECHANICAL AND ELECTRICAL DOCUMENTS.
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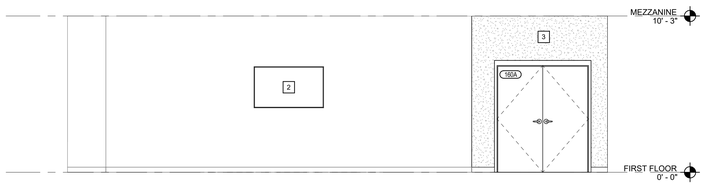
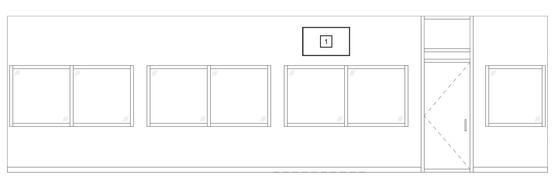
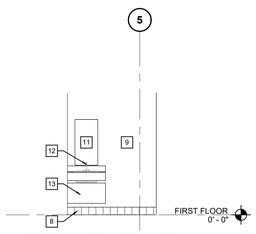
KEYNOTES	
NO.	DESCRIPTION
1	PRESENTER SCREEN. MONITOR TO BE MOUNTED ON GYP WALL ABOVE WINDOWS. PROVIDE BLOCKING CONCEALED IN EXISTING WALL. REFER TO ELECTRICAL DRAWINGS FOR POWER AND DATA CONNECTIONS. REPAIR GYP WALL AND PAINT TO MATCH EXISTING. MONITOR PROVIDED BY OWNER.
2	DISPLAY MONITOR. PROVIDE BLOCKING CONCEALED IN EXISTING WALL. REFER TO ELECTRICAL DRAWINGS FOR POWER AND DATA CONNECTIONS. REPAIR GYP WALL AND PAINT TO MATCH EXISTING. MONITOR PROVIDED BY OWNER.
3	PAINTED GYPSUM BOARD, REFER TO ROOM FINISH SCHEDULE.
4	WALL / PARTITION MOUNTED GRAB BAR (VERTICAL)
5	WALL / PARTITION MOUNTED GRAB BAR (HORIZONTAL)
6	WALL / PARTITION MOUNTED TOILET PAPER DISPENSER
7	WALL MOUNTED SANITARY NAPKIN DISPOSAL
8	TILE BASE, REFER TO FINISH SCHEDULE.
9	TILE ON WET WALLS, REFER TO FINISH SCHEDULE.
10	WALL MOUNTED TOILET SEAT COVER DISPENSER
11	WALL MOUNTED MIRROR
12	DROP-IN LAVATORY, REFER TO PLUMB.
13	WALL-MOUNTED PLUMBING COVER, REFER TO MILLWORK SECTIONS.



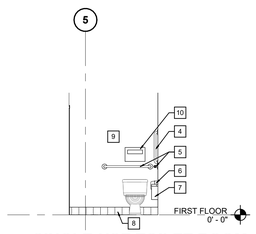
5 / A-101 TRAINING 160 INTERIOR ELEVATION
SCALE: 1/4" = 1'-0"



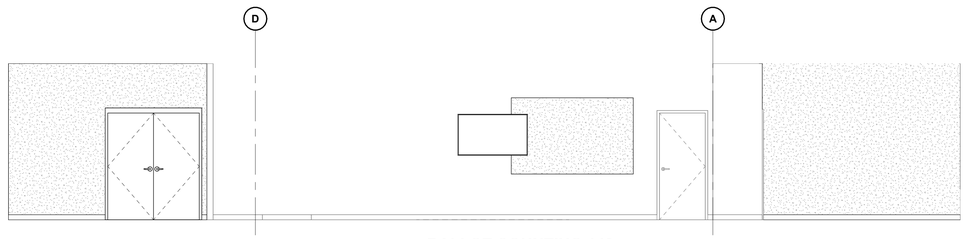
4 / A-101 TRAINING 160 INTERIOR ELEVATION
SCALE: 1/4" = 1'-0"



3 / A-401 SINGLE-USE TOILET ROOM 155 INTERIOR ELEVATION
SCALE: 1/4" = 1'-0"



2 / A-401 SINGLE-USE TOILET ROOM 155 INTERIOR ELEVATION
SCALE: 1/4" = 1'-0"



1 / A-101 BALLOT COUNTING 143 INTERIOR ELEVATION
SCALE: 1/4" = 1'-0"

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A/E SEAL

CITY OF ANN ARBOR

ELECTION FACILITY RENOVATION

3021 MILLER RD.
ANN ARBOR, MI 48103

DATE	ISSUED FOR:
02/21/2025	REVISION
03/03/2025	FINAL OWNER REVIEW
05/01/2025	IFC

Designer:	P. HENDERSON
Modeler:	P. HENDERSON
PM:	B. REED
PIC:	B. REED
ACADFILE:	24-1301-ANN ARBOR ELECTION FACILITY-A.RZT
Project No.	24-1301

Sheet Title

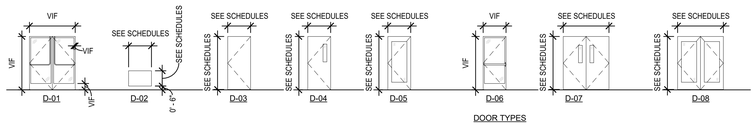
INTERIOR ELEVATIONS

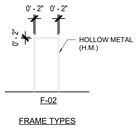
Sheet Number

A-411

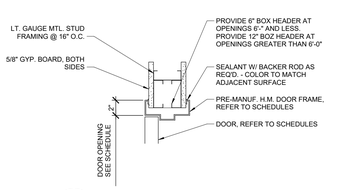
FORD LAND DOOR AND FRAME SCHEDULE

DOOR NO.	DOOR PANEL WIDTH	HEIGHT	TYPE	MATERIAL	FINISH	GLAZING TYPE	DOOR FRAME MATERIAL	FINISH	TYPE	GLAZING TYPE	DETAILS JAMB	HEAD	THRESHOLD	HARDWARE SET	CARD READER	FIRE RATING	REMARKS
FIRST FLOOR																	
100	6' - 0"	7' - 8 1/4"	D-01	ALUMINUM	MATCH EXIST - BLK	CLEAR	EXISTING	EXISTING	EXISTING	EXISTING	-	-	EXISTING	1.0	YES	-	REPLACE DOOR IN EXISTING FRAME. UNLOCK BUZZER AT CTN RECEPTION DESK AND GNERAL RECEPTION 102. AUTOMATIC DOOR OPERATOR.
101	6' - 0"	7' - 8 1/4"	D-01	ALUMINUM	MATCH EXIST - BLK	CLEAR	EXISTING	EXISTING	EXISTING	EXISTING	-	-	EXISTING	5.0	YES	-	REPLACE DOOR IN EXISTING FRAME. UNLOCK BUZZER AT CTN RECEPTION DESK AND GNERAL RECEPTION 102. AUTOMATIC DOOR OPERATOR.
102	3' - 0"	2' - 0"	D-02	HM	PNT-XX	-	HM	PNT-XX	F-02	-	-	-	-	23.0	-	-	SALOON DOOR WITH DOUBLE ACTING SPRING HINGE
106	3' - 0"	7' - 0"	D-03	HM	PNT-XX	-	EXISTING	PNT-XX	EXISTING	-	EXISTING	EXISTING	EXISTING	4.0	-	-	REPLACE HARDWARE ON EXISTING DOOR IN EXISTING FRAME. REPAINT DOOR AND FRAME ON INTERIOR SIDE.
114A	6' - 0"	7' - 0"	D-07	HM	PNT-XX	CLEAR	HM	PNT-XX	F-02	-	1/A-601	2/A-601	-	6.0	YES	-	CARD READER DEACTIVATES WHEN ALARM IS TRIGGERED.
114B	3' - 0"	7' - 0"	D-06-EXIST	ALUMINUM	EXISTING	EXISTING	ALUMINUM	EXISTING	EXISTING	-	EXISTING	EXISTING	EXISTING	2.0	-	-	REPLACE HARDWARE ON EXISTING DOOR. REMOVE MAGLOCK AND MAGLOCK BUTTON.
117	3' - 0"	7' - 0"	D-04	HM	PNT-XX	CLEAR	HM	PNT-XX	F-02	-	1/A-601	2/A-601	-	15.0	YES	-	
120	3' - 0"	7' - 0"	D-04	HM	PNT-XX	CLEAR	HM	PNT-XX	F-02	-	1/A-601	2/A-601		16.0	YES	-	
121	3' - 0"	7' - 0"	D-04	HM	PNT-XX	CLEAR	HM	PNT-XX	F-02	-	1/A-601	2/A-601	-	19.0	-	-	
130A	3' - 0"	7' - 0"	D-05	HM	PNT-XX	CLEAR	HM	PNT-XX	F-02	-	1/A-601	2/A-601		9.0	YES	-	
130B	6' - 0"	7' - 0"	D-08	HM	PNT-XX	CLEAR	HM	PNT-XX	F-02	-	1/A-601	2/A-601		8.1	YES	-	
131	3' - 0"	7' - 0"	D-04	HM	PNT-XX	CLEAR	HM	PNT-XX	F-02	-	1/A-601	2/A-601	-	19.0	-	-	
132A	3' - 0"	7' - 0"	D-04	HM	PNT-XX	CLEAR	HM	PNT-XX	F-02	-	1/A-601	2/A-601	-	15.0	YES	-	
132B	3' - 0"	7' - 0"	D-04	HM	PNT-XX	CLEAR	HM	PNT-XX	F-02	-	1/A-601	2/A-601	-	15.0	YES	-	
134	3' - 0"	7' - 0"	D-04	HM	PNT-XX	CLEAR	HM	PNT-XX	F-02	-	1/A-601	2/A-601	-	21.0	-	-	
135A	6' - 0"	7' - 0"	D-07	HM	PNT-XX	CLEAR	HM	PNT-XX	F-02	-	1/A-601	2/A-601	-	20.0	-	-	
135B	3' - 0"	7' - 0"	D-06-EXIST	ALUMINUM	EXISTING	EXISTING	ALUMINUM	EXISTING	EXISTING	-	EXISTING	EXISTING	EXISTING	2.0	-	-	REPLACE HARDWARE ON EXISTING DOOR. REMOVE MAGLOCK AND MAGLOCK BUTTON.
136	3' - 0"	7' - 0"	D-04	HM	PNT-XX	CLEAR	HM	PNT-XX	F-02	-	1/A-601	2/A-601	-	15.0	YES	-	
137	6' - 0"	7' - 0"	D-07	HM	PNT-XX	CLEAR	HM	PNT-XX	F-02	-	1/A-601	2/A-601	-	17.0	-	-	
138A	3' - 0"	7' - 0"	D-04	HM	PNT-XX	CLEAR	HM	PNT-XX	F-02	-	1/A-601	2/A-601		15.0	YES	-	
140A	3' - 0"	7' - 0"	D-05	HM	PNT-XX	CLEAR	HM	PNT-XX	F-02	-	1/A-601	2/A-601		9.0	YES	-	
140B	6' - 0"	7' - 0"	D-07	HM	PNT-XX	CLEAR	HM	PNT-XX	F-02	-	1/A-601	2/A-601		8.0	YES	-	
140C	6' - 0"	7' - 0"	D-07	HM	PNT-XX	CLEAR	HM	PNT-XX	F-02	-	1/A-601	2/A-601		8.1	YES	-	
143A	3' - 0"	7' - 0"	D-04-EXIST	HM-EXIST	PNT-XX	EXISTING	HM-EXIST	PNT-XX	EXISTING	-	EXISTING	EXISTING	-	25.0	-	-	REMOVE CARD READER AND ALTER HARDWARE TO STORAGE FUNCTION
143B	6' - 0"	7' - 0"	D-07	HM	PNT-XX	CLEAR	HM	PNT-XX	F-02	-	1/A-601	2/A-601		7.0	YES	-	
145	6' - 0"	7' - 0"	D-07	HM	PNT-XX	CLEAR	HM	PNT-XX	F-02	-	1/A-601	2/A-601		12.0	YES	-	
146	3' - 0"	7' - 0"	D-04-EXIST	HM-EXIST	PNT-XX	EXISTING	HM-EXIST	PNT-XX	EXISTING	-	-	-		26.0	YES	-	EXISTING DOOR. REPAINT DOOR AND FRAME.
147	3' - 0"	7' - 0"	D-04-EXIST	HM-EXIST	PNT-XX	EXISTING	HM-EXIST	PNT-XX	EXISTING	-	-	-		26.0	-	-	EXISTING DOOR. REPAINT DOOR AND FRAME.
148A	6' - 0"	7' - 0"	D-07	HM	PNT-XX	CLEAR	HM-EXIST	PNT-XX	EXISTING	-	EXISTING	EXISTING		13.0	YES	-	REPLACE DOOR IN EXISTING FRAME.
148B	3' - 0"	7' - 0"	D-04	HM	PNT-XX	CLEAR	HM	PNT-XX	F-02	-	EXISTING	EXISTING	REPLACE EXIST	3.0	YES	-	REPLACE DOOR AND FRAME IN EXISTING LOCATION.
152A	3' - 0"	7' - 0"	D-04-EXIST	HM-EXIST	PNT-XX	EXISTING	HM-EXIST	PNT-XX	EXISTING	-	-	-	-	24	YES	-	PROVIDE NEW CLOSER.
152B	6' - 0"	7' - 0"	D-07	HM	PNT-XX	CLEAR	HM	PNT-XX	F-02	-	1/A-601	2/A-601		14.0	YES	-	
154	3' - 0"	7' - 0"	D-03	HM	PNT-XX	-	HM	PNT-XX	F-02	-	1/A-601	2/A-601		18.0	-	-	
155	3' - 0"	7' - 0"	D-03	HM	PNT-XX	-	HM	PNT-XX	F-02	-	1/A-601	2/A-601		22.0	-	-	
160A	6' - 0"	7' - 0"	D-07	HM	PNT-XX	CLEAR	HM	PNT-XX	F-02	-	1/A-601	2/A-601		11.0	-	-	
160B	3' - 0"	7' - 0"	D-06-EXIST	ALUMINUM	EXISTING	EXISTING	ALUMINUM	EXISTING	EXISTING	-	EXISTING	EXISTING	EXISTING	2.0	-	-	REPLACE HARDWARE ON EXISTING DOOR. REMOVE MAGLOCK AND MAGLOCK BUTTON.

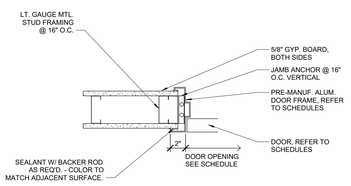




NOTES:
1. ALL INTERIOR DOOR GLAZING IS TO BE 3/8" CLEAR TEMPERED GLAZING.



2 / A-601 **DOOR HEAD DETAIL**
SCALE: 1 1/2" = 1'-0"



1 / A-601 **DOOR JAMB DETAIL**
SCALE: 1 1/2" = 1'-0"

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A/E SEAL

CITY OF ANN ARBOR
ELECTION FACILITY RENOVATION
3021 MILLER RD.
ANN ARBOR, MI 48103

DATE	ISSUED FOR:
03/03/2025	FINAL OWNER REVIEW
05/01/2025	IFC

Designer:	P. HENDERSON
Modeler:	P. HENDERSON
PM:	B. REED
PIC:	B. REED
ACADFILE:	24-1301-ANN ARBOR ELECTION FACILITY-A-R22
Project No.	24-1301

Sheet Title
DOOR AND FRAME SCHEDULE

Sheet Number
A-601

ARCHITECTURAL - MECHANICAL - ELECTRICAL COORDINATION SCHEDULE

MARK	LOCATION	HP	KW	FLA	ELECTRICAL			DISCONNECT		STARTER		REMARKS
					VOLTAGE	PHASE	SCCR	FURN.	INST.	FURN.	INST.	
HVAC-1A (RTU)	WEST ROOF	-	-	-	-	-	-	Ex	Ex	Ex	Ex	EXISTING TO REMAIN 7.5 TON DX/GAS, CONSTANT VOLUME
HVAC-2A (RTU)	WEST ROOF			59MCA 60MFS	208	3	-	S	S	S	S	REPLACE EXISTING 3 TON DX GAS RTU CONSTANT VOLUME WITH NEW 4 TON HEAT PUMP WITH ELECTRIC HEAT
HVAC-3A (RTU)	WEST ROOF							Ex	Ex	Ex	Ex	EXISTING TO REMAIN 6 TON DX/GAS, CONSTANT VOLUME
HVAC-4A (RTU)	WEST ROOF			172MCA 225MFS	208	3	-	S	S	S	S	REPLACE EXISTING 12.5 TON DX/GAS, CONSTANT VOLUME WITH NEW 12.5 TON HEAT PUMP, UNIT TO HAVE CO2 MONITORING/DEMAND CONTROL VENTILATION.
HVAC-5A (RTU)	WEST ROOF			66MCA 70MFS	208	3	-	S	S	S	S	REPLACE EXISTING 6.25 TON DX/GAS, CONSTANT VOLUME WITH NEW 6.25 TON HEAT PUMP, UNIT TO HAVE CO2 MONITORING/DEMAND CONTROL VENTILATION.
HVAC-6A (RTU)	EAST ROOF											DELETE UNIT 6.25 TON DX/GAS, CONSTANT VOLUME WITH
HVAC-1B (RTU)	EAST ROOF							Ex	Ex	Ex	Ex	EXISTING TO REMAIN 7.5 TON DX/GAS, CONSTANT VOLUME
HVAC-2B (RTU)	EAST ROOF			61MCA 70MFS	208	3	-	S	S	S	S	REPLACE EXISTING 5 TON DX/GAS, CONSTANT VOLUME WITH NEW 5 TON HEAT PUMP, UNIT TO HAVE CO2 MONITORING/DEMAND CONTROL VENTILATION.
HP-CTN1 EVAP-CTN1	WEST ROOF CTN OPEN OFFICE			20MFS 2.63A	208 24	1	-	S	S	S	S	OUTDOOR LOW AMBIENT HEAT PUMP ON ROOF. INDOOR DUCTED EVAPORATOR WITH POWER FROM OUTDOOR UNIT(#14 WIRE)
HP-CTN2 EVAP-CTN2	WEST ROOF CTN OPEN OFFICE			20MFS 2.63A	208 24	1	-	S	S	S	S	OUTDOOR LOW AMBIENT HEAT PUMP ON ROOF. INDOOR DUCTED EVAPORATOR WITH POWER FROM OUTDOOR UNIT(#14 WIRE)
HP-1 EVAP-F1	GRADE MEZ. OPEN OFFICE			29MCA 35MOP 0.36A	208 208	1 1	-	S	S	S	S	3.5 TON AIR COOLED HEAT PUMP OUTDOORS AND INDOOR VERTICAL EVAPORATOR UNIT. POWER TO OUTDOOR UNIT. INDOOR UNIT POWERED SEPARATELY
HP-3 EVAP-F3	GRADE FURNACE MECHANICAL ROOM			37A 5.63 A	208 208	1 1	-	S	S	S	S	3.5 TON AIR COOLED HEAT PUMP OUTDOORS AND INDOOR VERTICAL EVAPORATOR UNIT, POWER TO OUTDOOR UNIT. INDOOR UNIT POWERED BY OUTDOOR UNIT
ERH-1	RECEIVING ELECTION PREPARATION		1,5		120	1	-	S	S	S	S	1500 WATT, QUARTZ TUBE RADIANT HEATER CONTROLLED IN PARALLEL WITH ERH-2
ERH-2	RECEIVING ELECTION PREPARATION		1,5		120	1	-	S	S	S	S	1500 WATT, QUARTZ TUBE RADIANT HEATER CONTROLLED IN PARALLEL WITH ERH-1
CUH-2	FIRE SUPPRESSION ROOM		1,5		120	1	-	S	S	S	S	1500 WATT, ELECTRIC SURFACE MOUNTED SPACE HEATER WITH THERMOSTAT
EF-1	RECEIVING ELECTION PREPARATION	1/6HP			120	1	-	S	S	S	S	ROOF MOUNTED EXHAUST FAN ON EXISTING PITCHED CURB WITH CURB ADAPTOR AND BACKDRAFT DAMPER
EF-3	FIRE SUPPRESSION ROOM	1/6HP			120	1	-	S	S	S	S	ROOF MOUNTED EXHAUST FAN ON EXISTING PITCHED CURB WITH CURB ADAPTOR AND BACKDRAFT DAMPER
HP-CTN3 EVAP-CTN3	GRADE IT ROOM			20MFS 2.63A	208 24	1 1	-	S	S	S	S	2 TON AIR COOLED HEAT PUMP OUTDOORS AND INDOOR WALL MOUNTED EVAPORATOR UNIT. EVAPORATOR POWERED BY HEAT PUMP

LEGEND

S	=	SUPPLIER (MANUFACTURER)*	HP	=	HEAT PUMP	* - ITEMS INDICATED AS SUPPLIER SHALL BE PROVIDED WITH THE ITEM/ EQUIPMENT OR BY THE CONTRACTOR PURCHASING THE ITEM/EQUIPMENT
M	=	MECHANICAL CONTRACTOR	EVAP	=	EVAPORATOR UNIT	
E	=	ELECTRICAL CONTRACTOR	ERH	=	ELECTRIC RADIANT HEAT	
Ex	=	EXISTING DEVICE/ITEM	HVAC	=	HEATING, VENTILATING AND AIR CONDITIONING UNIT	
VFD	=	VARIABLE FREQUENCY DRIVE	RTU	=	ROOF TOP UNIT	

TRANE 4 TON HEAT PUMP WITH SUPPLEMENTAL ELECTRIC HEAT WHK048A3 WITH FAIEHWB312 ELECTRIC HEAT, 12KW, SCR CONTROLS ECONOMIZER, ADAPTOR CURB, CO2 DEMAND CONTROL MONITORING, BACNET CONTROL INTERFACE.

TRANE 5 TON HEAT PUMP WITH SUPPLEMENTAL ELECTRIC HEAT WSHK060A3 WITH FAIEHWB309 ELECTRIC HEAT, SCR CONTROLS ECONOMIZER, ADAPTOR CURB, CO2 DEMAND CONTROL MONITORING, BACNET CONTROL INTERFACE.

TRANE 6 TON HEAT PUMP WITH SUPPLEMENTAL ELECTRIC HEAT WS/HK07A3 WITH FIAEWB309, 9KW ELECTRIC HEAT, SCR CONTROLS, AND OVERSIZED EVAPORATOR FAN MOTOR. ECONOMIZER, ADAPTOR CURB, CO2 DEMAND CONTROL MONITORING, BACNET CONTROL INTERFACE.

TRANE 5 TON HEAT PUMP WITH SUPPLEMENTAL ELECTRIC HEAT WSK060A3 WITH FIAEHTA312, 12KW ELECTRIC HEAT, SCR CONTROLS AND ECONOMIZER, ADAPTOR CURB, CO2 DEMAND CONTROL MONITORING, BACNET CONTROL INTERFACE.

TRANE MITSUBISHI TPEADA0241AA70A AND NTXSKS24A112AA DUCTED 3 SPEED EVAPORATOR FAN, 700 CFM LOCAL CONTROLS

TRANE MITSUBISHI TPEADA0241AA70A AND NTXSKS24A112AA DUCTED 3 SPEED EVAPORATOR FAN, 700 CFM LOCAL CONTROLS

TRANE MITSUBISHIPVA-A54 INDOOR, PUZ-HA54NKA OUTDOOR LOW AMBIENT CONTROLS, 0.8"MAX ESP, 1,800CFM, 54MBH COOLING, 48MBH HEATING @17F, 9.8EER, 15.3SEER, M-NET ADAPTOR, WIRED

TRANE MITSUBISHI 4.5 TON HEAT PUMP - HORIZONTAL DUCTED UNIT STAND ALONE CONTROLS, 0.8"MAX ESP, 1,000CFM, 42MBH COOLING, 48MBH HEATING @17F, 9.8EER, 15.3SEER, M-NET ADAPTOR, WIRED

FOSTERIA QUARTZ ELECTRIC BEAM RADIANT HEATER MODEL OCH-46-120V-SEE, 120VOLTS, 1500 WATTS, 48" LONG, UL LISTED

FOSTERIA QUARTZ ELECTRIC BEAM RADIANT HEATER MODEL OCH-46-120V-SEE, 120VOLTS, 1500 WATTS, 48" LONG, UL LISTED

DAYTON ELECTRIC WALL MOUNTED HEATER MODEL 5XK68 WITH SURFACE MOUNTING ENCLOSURE KIT. 1500 WATTS, WHITE FINISH, UL LISTED.

GREENHECK GB098, 1/6HP, 120VOLT, 1PHASE EXHAUST FAN, 500 CFM, 0.5" ESP, WITH CURB ADAPTOR TO GO ON EXISTING PITCHED ROOF CURB, BACK DRAFT DAMPER AND DISCONNECT SWITCH.

GREENHECK GB098, 1/6HP, 120VOLT, 1PHASE EXHAUST FAN. 450CFM, 0.5"ESP, WITH CURB ADAPTOR TO GO ON EXISTING PITCHED ROOF CURB, BACK DRAFT DAMPER AND DISCONNECT SWITCH.

TRANE MITSUBISHI 2 TON HEAT PUMP - WALL MOUNT AC/OUTDOOR HEAT PUMP, 600CFM, 24MBH COOLING, 20MBH HEATING @17F, 9.8EER, 15.3SEER, M-NET ADAPTOR, WIRED, LOW AMBIENT CONTROLS

GRILLE, REGISTER, AND DIFFUSER SCHEDULE

MARK	CFM RANGE		TYPE	CONST.	MOUNTING TYPE	FINISH	CONNECTION SIZE (IN.)	FACE SIZE (IN.)	BASIS OF DESIGN MODEL NUMBER	REMARKS
	MIN.	MAX.								
CD-1	0	200	FULLY ADJUSTABLE LOUVER STYLE	STEEL	LAY-IN	WHITE	8"	24x24	TITUS TMSA	FOUR INDIVIDUAL ADJUSTABLE SIDES
	201	350	FULLY ADJUSTABLE LOUVER STYLE	STEEL	LAY-IN	WHITE	10"	24x24	TITUS TMSA	FOUR INDIVIDUAL ADJUSTABLE SIDES
	351	600	FULLY ADJUSTABLE LOUVER STYLE	STEEL	LAY-IN	WHITE	12"	24x24	TITUS TMSA	FOUR INDIVIDUAL ADJUSTABLE SIDES
CD ROUND	0	200	ADJUSTABLE CORE/ DEFLECTION ROUND LOUVER STYLE	STEEL	DUCT OR SURFACE	WHITE	8"	24x24	TITUS TMRA	ADJUSTABLE CORE FOR HORIZONTAL / VERTICAL FLOW
	201	350	ADJUSTABLE CORE/ DEFLECTION ROUND LOUVER STYLE	STEEL	DUCT OR SURFACE	WHITE	10"	24x24	TITUS TMRA	ADJUSTABLE CORE FOR HORIZONTAL / VERTICAL FLOW
	351	600	ADJUSTABLE CORE/ DEFLECTION ROUND LOUVER STYLE	STEEL	DUCT OR SURFACE	WHITE	12"	24x24	TITUS TMRA	ADJUSTABLE CORE FOR HORIZONTAL / VERTICAL FLOW
SR-1		275	DOUBLE DEFLECTION INDIVID. ADJ BLADE GRILLE	STEEL	DUCT OR SURFACE	WHITE	10x6		TITUS 300RL	FRONT/REAR INDIVIDUALLY ADJUSTABLE BLADES
SR-2		300	DOUBLE DEFLECTION INDIVID. ADJ BLADE GRILLE	STEEL	DUCT OR SURFACE	WHITE	12x6		TITUS 300RL	FRONT/REAR INDIVIDUALLY ADJUSTABLE BLADES
SR-3		350	DOUBLE DEFLECTION INDIVID. ADJ BLADE GRILLE	STEEL	DUCT OR SURFACE	WHITE	14x6		TITUS 300RL	FRONT/REAR INDIVIDUALLY ADJUSTABLE BLADES
SR-4		200	DOUBLE DEFLECTION INDIVID. ADJ BLADE GRILLE	STEEL	DUCT OR SURFACE	WHITE	8x6		TITUS 300RL	FRONT/REAR INDIVIDUALLY ADJUSTABLE BLADES
RR-1	0	1000	FIXED BLADE	STEEL	LAY-IN OR SURFACE	WHITE	20x10	24x12 (WHERE SHOWN)	TITUS 350RL	WITH DAMPER
RR-1	0	2000	FIXED BLADE	STEEL	LAY-IN OR SURFACE	WHITE	20x20	24x24	TITUS 350RL	WITH DAMPER

EQUIPMENT SCHEDULES AND REQUIREMENTS.

MECHANICAL SHEET INDEX

SHEET	DESCRIPTION
M-001	MECHANICAL GENERAL INFORMATION
F-101	FIRST FLOOR AND MEZZANINE – FIRE PROTECTION PLANS
P-101	PARTIAL FIRST FLOOR AND MEZZANINE – PLUMBING PLANS
MD101	FIRST FLOOR AND MEZZANINE – MECHANICAL DEMOLITION PLANS
MD102	ROOF – MECHANICAL DEMOLITION PLAN
M-101	FIRST FLOOR AND MEZZANINE PLANS – MECHANICAL PLANS
M-102	ROOF – MECHANICAL PLAN
M-601	MECHANICAL DETAILS AND SCHEDULES

OVERVIEW OF MECHANICAL SCOPE

THIS OVERVIEW OF SCOPE IS INCLUDED TO GIVE THE CONTRACTOR A GENERAL OVERVIEW OF THE PROJECT REQUIREMENTS. THE OVERVIEW IS NOT ALL INCLUSIVE AND IS NOT INTENDED TO, AND SHOULD NOT BE USED TO, ESTABLISH CONTRACT LIMITS OR PRICING INCLUSIONS. THE CONTRACT DOCUMENTS SHALL BE USED TO ESTABLISH CONSTRUCTION CONTRACT SCOPE.

THIS OVERVIEW OF SCOPE INCLUDES, BUT IS NOT LIMITED TO THE FOLLOWING:

MECHANICAL:

1. DEMOLISH AND REMOVE EXISTING PLUMBING, HVAC AND OTHER MECHANICAL SYSTEMS/EQUIPMENT ITEMS AS INDICATED.
2. PROVIDE NEW/MODIFIED PLUMBING SYSTEMS AS INDICATED AND EXTEND/CONNECT TO EXISTING BUILDING SERVICES.
3. PROVIDE NEW/MODIFIED FIRE PROTECTION SYSTEMS AS INDICATED. PROVIDE FULL CERTIFICATION OF THE NEW/MODIFIED SYSTEM.
4. PROVIDE NEW/MODIFIED HVAC AND EXHAUST SYSTEMS TO THE BUILDING AREAS INCLUDING EXTENSION, MODIFICATIONS AND NEW SYSTEMS.
5. PROVIDE NEW/MODIFIED TEMPERATURE CONTROL SYSTEM AND/OR COMPONENTS AS INDICATED.

PROJECT REQUIREMENTS

PROVIDE ALL NECESSARY PERMITS. ALL WORK SHALL BE INSTALLED TO COMPLY WITH THE OWNER'S STANDARDS, STATE AND LOCAL CODES INCLUDING, BUT NOT LIMITED TO, THE FOLLOWING CODES AND THEIR RELATED REFERENCES.

2021 MICHIGAN MECHANICAL CODE

2021 MICHIGAN PLUMBING CODE

2015 INTERNATIONAL FIRE CODE (AS REFERENCED)

2015 INTERNATIONAL FUEL GAS CODE

NFPA 101 LIFE SAFETY CODE 2012 (AS REFERENCED)

2015 MICHIGAN ENERGY CODE

2023 NATIONAL ELECTRICAL CODE AS AMENDED BY THE MICHIGAN CONSTRUCTION CODE PART 8, ELECTRICAL CODE RULES.

2015 MICHIGAN BUILDING CODE

MANUFACTURER AND MODEL NUMBER LISTED REPRESENTS THE BASIS OF DESIGN FOR THIS PROJECT. THE MECHANICAL CONTRACTOR SHALL BEAR ALL ADDITIONAL COST ASSOCIATED WITH USING EQUIPMENT BY OTHER APPROVED MANUFACTURERS INCLUDING ADDITIONAL COSTS BY OTHER TRADES.

ALL EQUIPMENT INSTALLED SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS. WHERE FIELD OR PROJECT CONDITIONS DO NOT ALLOW ALL MANUFACTURER'S RECOMMENDATIONS TO BE MET, THE INSTALLING CONTRACTOR SHALL SUBMIT IN WRITING TO THE ENGINEER THE PROPOSED DEVIATION, IN A SKETCH FORM, ACCOMPANIED BY THE MANUFACTURER'S CONCURRENCE.

GENERAL START UP, CONTROL AND BALANCE NOTES

1. START UP - EACH NEW AND MODIFIED PIECE OF MECHANICAL EQUIPMENT SHALL RECEIVE A START UP. PACKAGED EQUIPMENT WITH MOTORS SHALL INCLUDE A FACTORY REPRESENTATIVE START UP. OTHER EQUIPMENT SHALL RECEIVE A MECHANICAL CONTRACTOR OR PLUMBING CONTRACTOR START UP (BASED ON WHO PURCHASED THE EQUIPMENT OR WHO IT WAS ASSIGNED TO). START UP REPORTS SHALL INCLUDE A FUNCTIONAL TEST OF ALL MODES OF OPERATION AND A WITNESSED REPORT OF THE VALIDATION (BY THE CONTRACTOR, WHERE PERFORMED BY THE SUPPLIER OR THE OWNER'S REPRESENTATIVE WHERE PERFORMED BY THE CONTRACTOR).
2. TEMPERATURE CONTROL CONTRACTOR (TCC) OR TEMPERATURE CONTROL WIRING CONTRACTOR SHALL PERFORM A DOCUMENTED STARTUP ON THE MECHANICAL CONTROLS. THIS SHALL VALIDATE THE START UP REPORT.
3. EACH SYSTEM SHALL BE TESTED IN EACH MODE OF OPERATION.
4. DISCHARGE AIR TEMPERATURE, PRESSURE AND OTHER SYSTEM PARAMETERS ARE TO BE RECORDED DURING TESTING.
5. TEST IS TO SIMULATE VARYING SPACE DEMAND TO PROVE THE SYSTEM CONTROLS ARE AUTOMATICALLY FUNCTIONING.
6. SYSTEM SAFETY FEATURES (FREEZE THERMOSTATS, HIGH PRESSURE, ETC.) ARE TO BE TESTED TO PROVE OPERATION.
7. TCC SHALL PROVIDE A WRITTEN REPORT FOR EACH CONTROLLED COMPONENT SHOWING TESTING AND PROPER OPERATION.
8. TEST AND BALANCE - EACH NEW OR MODIFIED SYSTEM SHALL RECEIVE A HYDRONIC AND/OR AIR TEST AND BALANCE AT THE CONCLUSION OF THE INSTALLATION (AND AS DESIGNATED OTHERWISE). THE MINIMUM BALANCE SHALL INCLUDE THE SYSTEM TOTALS OF THE MAIN EQUIPMENT DELIVERING THE AIR OR WATER (INCLUDING THE HP, BHP, MOTOR AMPS, RPM AND FLOW RATES) AS WELL AS INDIVIDUAL BALANCES OF EACH ITEM MODIFIED AS A PART OF THE PROJECT, (EACH DIFFUSER, COIL, ETC.). WHERE NEW SYSTEMS ARE PROVIDED, A FULL TEST AND BALANCE SHALL BE PROVIDED IN ACCORDANCE WITH ASHRAE HVAC APPLICATIONS HANDBOOK.

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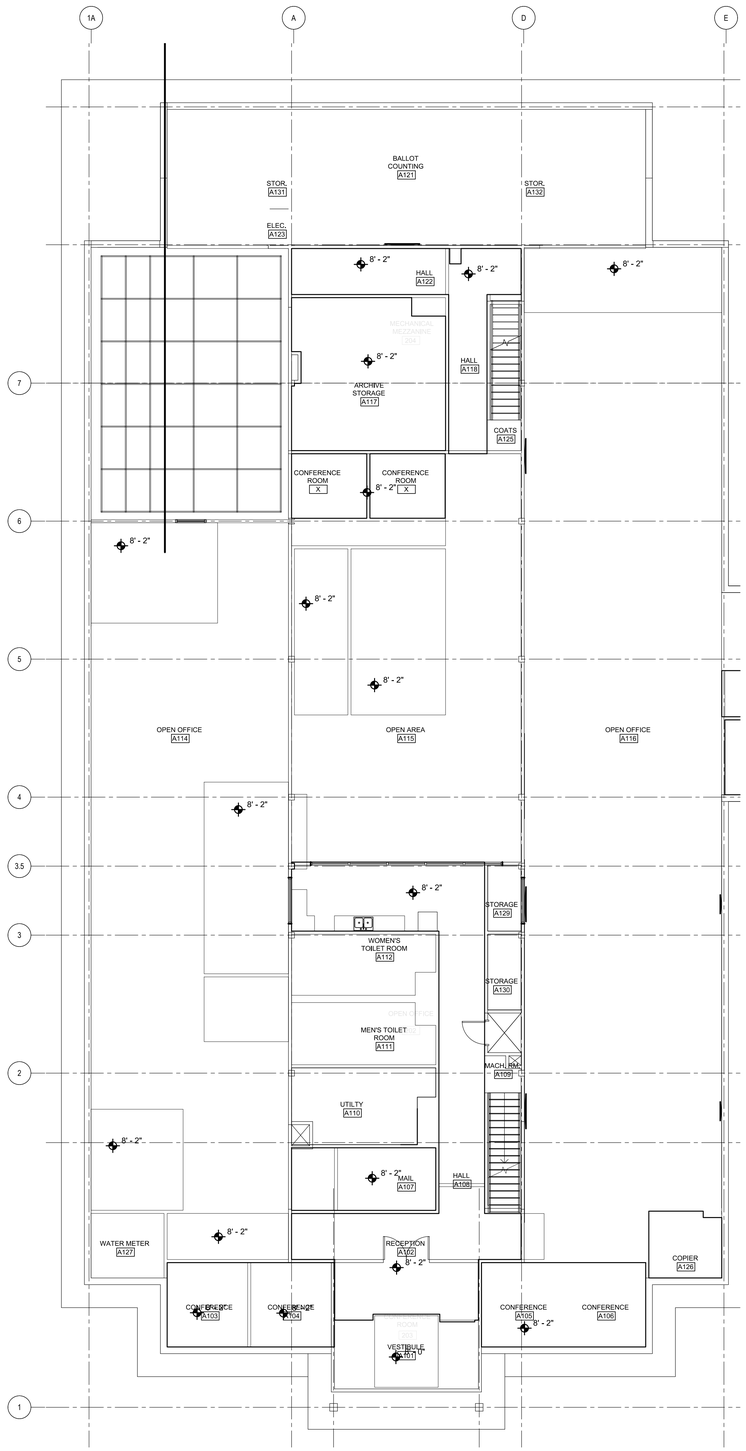
PM:	B. REED
PIC:	B. REED
ACADFILE:	24-1301-M-1.dwg
Project No.	24-1301

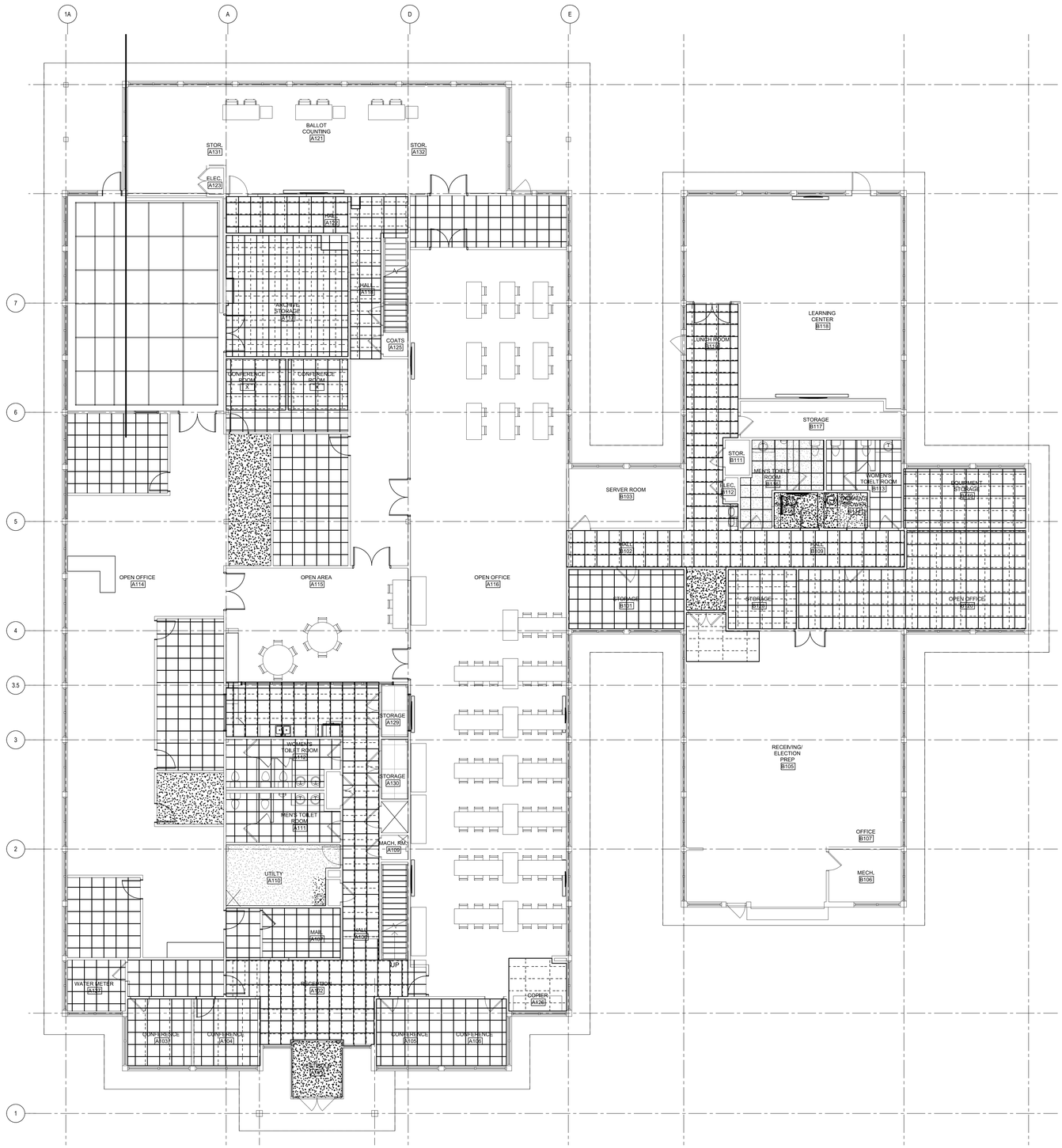
Sheet Title

MECHANICAL GENERAL INFORMATION

Sheet Number

M-001





NORTH

MEZZANINE FIRE PROTECTION PLAN

SCALE: 1/8"=1'-0"

0 4 8 16 Feet — 1/8" = 1'-0"

NORTH

FIRST FLOOR FIRE PROTECTION PLAN

SCALE: 1/8"=1'-0"

0 4 8 16 Feet — 1/8" = 1'-0"

FIRE PROTECTION COVERAGE NOTES

THE FIRE PROTECTION CONTRACTOR SHALL PROVIDE AND INSTALL A TOTAL COVERAGE SPRINKLER SYSTEM FOR THE ENTIRE BUILDING. THE SYSTEM SHALL BE HYDRAULICALLY DESIGNED AND CALCULATED IN STRICT ACCORDANCE WITH NFPA CHAPTER 13 AND FORD FIRE PROTECTION ENGINEERING BULLETIN NO. 8 AND NO. 8.1. (LATEST EDITION) AND ALL OTHER CODES HAVING JURISDICTION.

MECHANICAL ROOM SPRINKLER HEAD COVERAGE SHALL BE BASED ON ORDINARY HAZARD. MECHANICAL ROOM CONTAINS LITTLE OR NO FLAMMABLE MATERIALS 0.2 GPM DENSITY IN THE 3000 SQUARE FEET PLUS 8 FEET MIN DISTANCE PLUS 12 FEET MAX DISTANCE BETWEEN SPRINKLER HEADS.
AREAS SHALL BE ORDINARY HAZARD WITH 0.2 GPM DENSITY IN THE LAST 2000 SQUARE FEET PLUS 8 FEET MIN DISTANCE PLUS 12 FEET MAX DISTANCE BETWEEN HEADS.

ALL ROOMS WITHOUT CEILINGS SHALL HAVE UPRIGHT SPRINKLER HEADS WITH ROUGH BRASS FINISH AND SPRINKLER BRANCH PIPING ROUTED THRU JOIST WEBS AND AS CLOSE TO THE DECK AS POSSIBLE. FURNISHED AREAS WITH LAY-IN CEILINGS SHALL HAVE WHITE SEMI-RECESSED SPRINKLER HEADS WITH SET SCREW ESCUTCHEON. SPRINKLER HEADS SHALL BE RATED AT 165°F EXCEPT IN MECHANICAL ROOMS WHICH SHALL BE RATED AT 225°F.

THE FIRE PROTECTION CONTRACTOR SHALL PREPARE AND SUBMIT A COMPLETE SET OF DRAWINGS AND CALCULATIONS ILLUSTRATING SPRINKLER HEAD LOCATIONS. SPRINKLER HEAD LOCATIONS SHALL BE COORDINATED WITH THE ARCHITECTURAL REFLECTED CEILING PLANS AND ALL OTHER TRADES. SPRINKLER HEADS SHALL BE LOCATED IN THE CENTER OF LAY-IN CEILING TILES, AS FAR AS POSSIBLE.

THE FIRE PROTECTION CONTRACTOR SHALL SUBMIT A COMPLETE SET(S) OF DRAWINGS AND CALCULATIONS TO THE AUTHORITIES HAVING JURISDICTION AND TO THE OWNER'S INSURANCE UNDERWRITER. ALL PLANS AND DRAWINGS TO BE FULLY APPROVED AND STAMPED PRIOR TO STARTING CONSTRUCTION.

FIRE PROTECTION PIPING SHALL NOT VIOLATE THE NEC REQUIREMENTS FOR ELECTRICAL EQUIPMENT AND THEIR ASSOCIATED CLEARANCES.

FIRE PROTECTION NOTES:

1. EXISTING WET PIPE FIRE PROTECTION SYSTEM REQUIRES ALL OF THE VICTAULIC JOINT GASKETS TO BE REPLACED THROUGHOUT THE ENTIRE BUILDING.
2. AREAS WHERE WALLS ARE ALTERED - PROVIDE NEW FIRE PROTECTION SPRINKLER HEADS IN AREAS WHERE WALLS ARE RELOCATED.
3. CEILING REPLACEMENT - PROTECT SPRINKLERS AND ESCUTCHEONS IN AREAS WHERE CEILING TILES ARE REPLACED (SEE ARCHITECTURAL PLANS).
4. CEILING ALTERATION - IN AREAS WHERE CEILING IS REPLACED AND SHIFTED OR NEW CEILINGS ARE ADDED, PROVIDE NEW SPRINKLER HEADS CENTERED IN 2 DIRECTIONS IN NEW TILES.
5. DRY PIPE FIRE PROTECTION SPRINKLER SYSTEM - NO ALTERATION INTENDED.
6. NO FIRE PROTECTION AS BUILT DRAWINGS EXIST. FIRE PROTECTION CONTRACTOR WILL BE REQUIRED TO MODEL AND DOCUMENT THE SPRINKLER SYSTEM AS PART OF THEIR CONTRACT. ALL AREAS OF THE BUILDING ARE SPRINKLED (INCLUDING THE ATTIC USING THE EXISTING DRY PIPE SYSTEM)
7. LIGHTING TAKES PRIORITY OVER SPRINKLER LOCATIONS. DIFFUSERS AND GRILLES TAKE SECOND PRIORITY EXCEPT AS NEGOTIATED WITH MECHANICAL TRADES.

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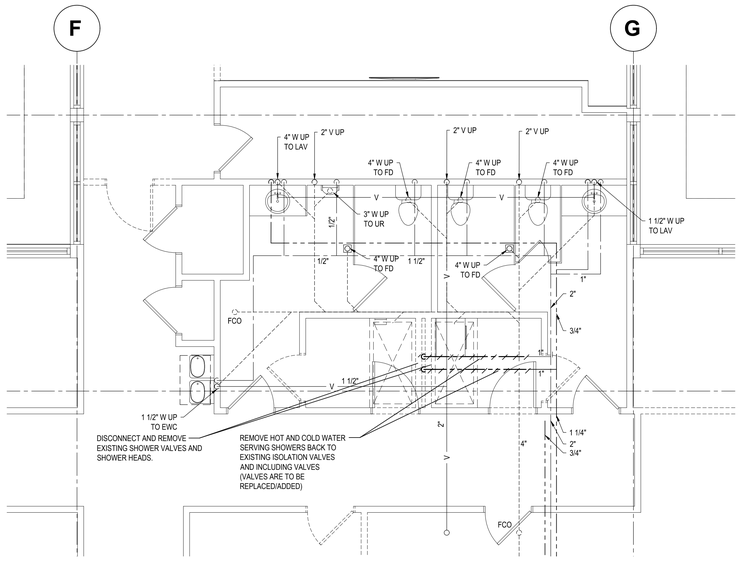
Modeler:	R. SEPULVEDA
PM:	B. REED
PIC:	B. REED
ACADFILE:	24-1301-E-101.DWG
Project No.	24-1301

Sheet Title
1ST FLOOR AND MEZ. FIRE PROTECTION PLANS

Sheet Number
F-101

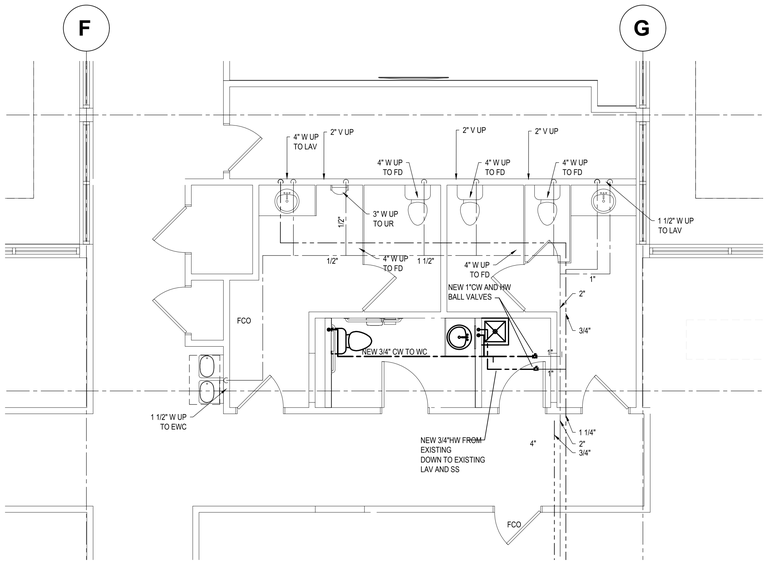


NORTH

PARTIAL FIRST FLOOR PLUMBING DEMOLITION PLAN

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

0 2 4 8 1/4" = 1'-0" Feet



NORTH

PARTIAL FIRST FLOOR PLUMBING PLAN

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

0 2 4 8 1/4" = 1'-0" Feet

PLUMBING FIXTURE CONNECTION SCHEDULE

DESIGNATION	DESCRIPTION	WATER		DRAIN		REMARKS
		COLD	HOT	WASTE	VENT	
SINK	COFFEE STATION SINK	1/2"	1/2"	1-1/2"	1-1/2"	COUNTER MOUNTED W/IN-SINK-ERATOR MODEL LC-50 GARBAGE DISPOSER
EWC	ELECTRIC WATER COOLER	1/2"	-	1-1/4"	1-1/4"	WALL MOUNTED
KS	KITCHEN SINK	3/4"	3/4"	1-1/2"	1-1/2"	COUNTER MOUNTED W/GARBABE DISPOSER AND 1/2" CW SUPPLY STOP VALVE WITH BFP-3, CONNECT TO ICE MACHINE AND/OR COFFEE MAKER AS REQUIRED.
LAV	LAVATORY	1/2"	1/2"	1-1/4"	1-1/2"	WALL MOUNTED - PROVIDE WATTS MODEL "MMV" MIXING VALVE (TEMPERED WATER @ 105°F). PROVIDE UNDERSINK PROTECTION BY "TRUEBRO" OR "PLUMBEREX"
SS	SERVICE SINK	3/4" & 1-1/2"	3/4"	3"	1-1/2"	MOUNTED ON CONCRETE PEDESTAL W/BEDPAN WASHER
WC (FLUSH TANK)	WATER CLOSET	3/4"	-	4"	2"	FLOOR OR WALL MOUNTED, (INSTALL WITH WATER HAMMER ARRESTOR)
WC (FLUSH VALVE)	WATER CLOSET	1-1/2"	-	4"	2"	FLOOR OR WALL MOUNTED, (INSTALL WITH WATER HAMMER ARRESTOR)
WHA-1	WATER HAMMER ARRESTOR	3/4"	-	-	-	"WATTS" SERIES 15 (OR PRESENT MODEL)

* PROVIDE VANDAL PROOF UNDERSINK PROTECTION BY "PLUMBEREX" OR "TRUEBRO" FOR ADA REQUIREMENTS.

PLUMBING FIXTURE SCHEDULE

WC-1 - FLOOR MOUNT FLUSH TANK
AMERICAN STANDARD YORKVILLE VORMAX
VITREOUS CHINA WATER CLOSET WITH FLOOR MOUNT AND WALL MOUNT ANCHORING.
17" HIGH RIM
1.28 GALLONS PER FLUSH, RH ELONGATED BOWL
WHITE FINISH

SEAT: OLSONITE 95 COMFORT CURVE SEAT
(OR ABOVE MFG. EQUIVALENT)

LAV-1 -AMERICAN STANDARD OVALYN UNDER COUNTER MOUNT
WHITE FINISH, VITREOUS CHINA
COORDINATE MOUNTING AND OPENING WITH MILLWORK CONTRACTOR
ALTERNATIVE: KOHLER

BARRIER FREE:

FAUCET - SLOAN SF2350 BATTERY OPERATED CHROME FAUCET
4" CENTERS, 6VDC, FILTERED SOLENOID WITH SERVICEABLE STRAINER
WITH 4 AA BATTERIES (TO BE INCLUDED)

KS-1 - KITCHENETTE COFFEE SINK - COUNTER MOUNTED STAINLESS STEEL
ELKAY DAYTON GE1252/1L ADA COMPLIANT 21x15x5" BOWL
ALTERNATIVES:
KOLHER
AMERICAN STANDARD

FAUCET:
ELKAY LK5000 PULL OUT SPRAY LEVER HANDLE FAUCET WITH
ESCUTCHEON. 3 HOLE INSTALLATION.
ALTERNATIVES:
DELTA
MOEN
AMERICAN STANDARD
KOHLER

THERMOSTATIC MIXING VALVES:
LEONARD MODEL 320

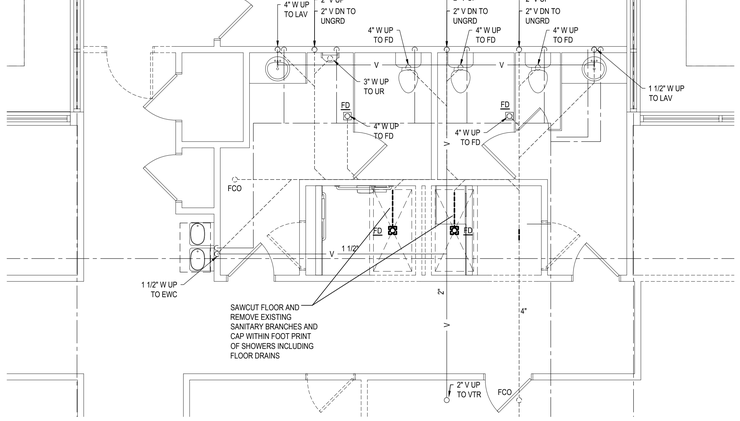
SS-FLOOR: FLOOR MOUNTED STAINLESS STEEL MOP SINK
ELKAY EFS2523C, STAINLESS STEEL FLOOR MOUNTED MOP SINK.
GRID STRAINER.

WITH PALE HOOK,
SUPPORT AND VACUUM BREAKER WITH THREADED FITTING.
PROVIDE WITH THREE MOP WALL HANGER

ALTERNATIVES:
ELGER
KOLHER
AMERICAN STANDARD

FAUCET:
LK945BP0T4S WALL MOUNTED CHROME FAUCET ELKAY 8" CENTERS
WITH VACUUM BREAKER AND HOSE FITTING, HOSE AND 3-MOP WALL HANGER
ALTERNATIVES:
BRADLEY
CHICAGO
DELTA
MOEN
T&S BRASS

WHERE MANUFACTURER HAS CHANGED MODEL NUMBERS OR FEATURES, MATCH CURRENT FIXTURE EQUIVALENT.

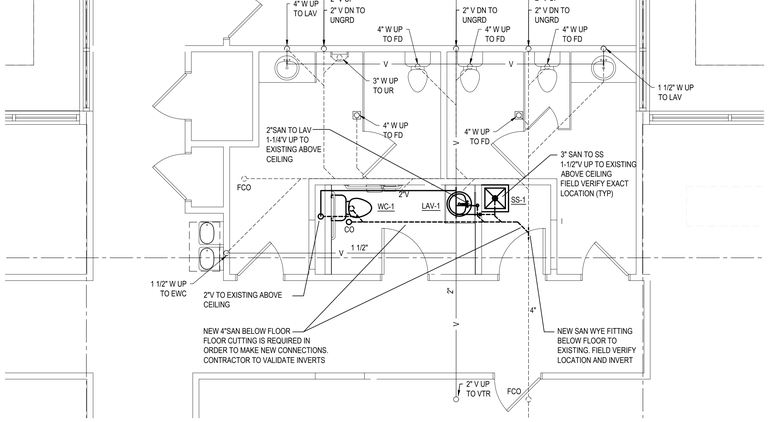


NORTH

TOILET ROOMS PARTIAL FIRST FLOOR WASTE AND VENT PLUMBING DEMOLITION PLAN

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

0 2 4 8 1/4" = 1'-0" Feet



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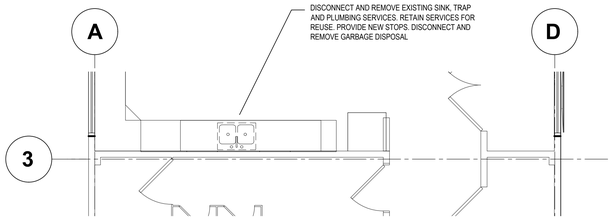

NORTH

KITCHENETTE PARTIAL FIRST FLOOR PLUMBING DEMOLITION PLAN

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

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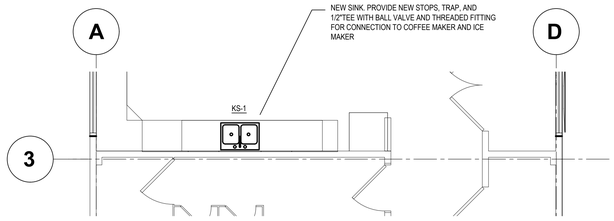

NORTH

KITCHENETTE PARTIAL FIRST FLOOR PLUMBING PLAN

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

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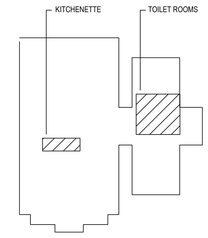

KEY PLAN

NO SCALE

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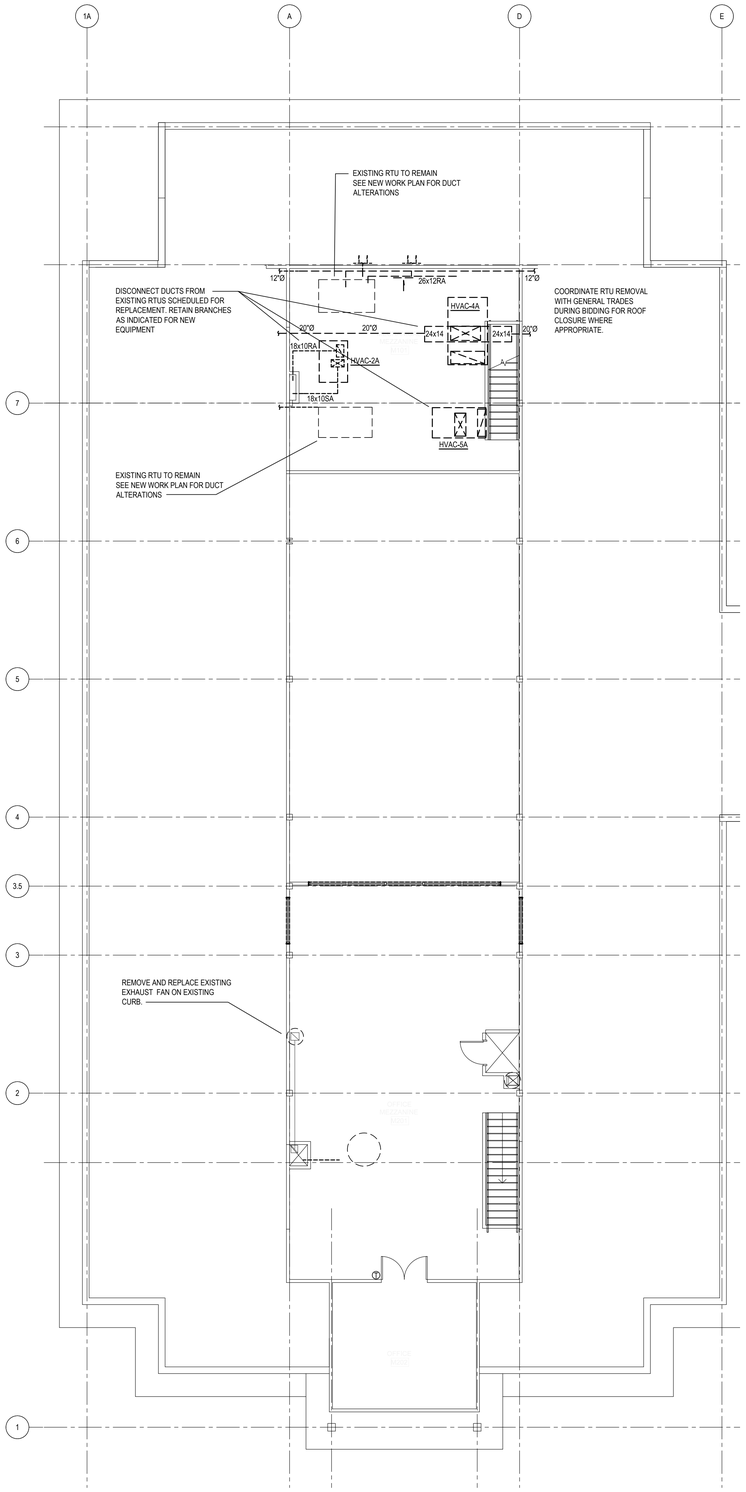
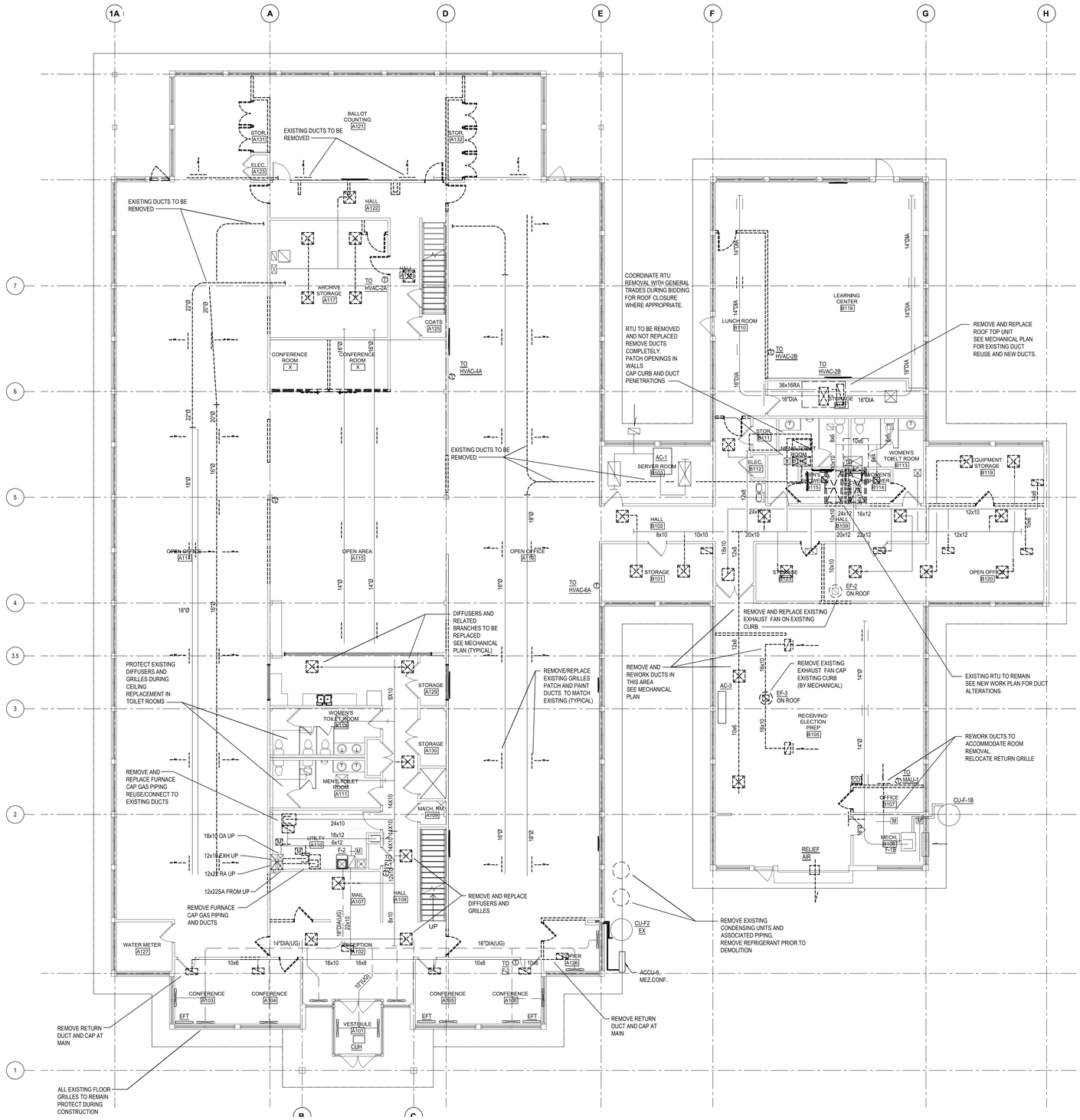
PARTIAL 1ST FLOOR AND MEZ. PLUMBING PLANS

Sheet Number
M-101





NORTH

MEZZANINE MECHANICAL DEMOLITION PLAN

SCALE: 1/8"=1'-0"

0 4 8 16 1/8" = 1'-0" Feet

NORTH

FIRST FLOOR MECHANICAL DEMOLITION PLAN

SCALE: 1/8"=1'-0"

0 4 8 16 1/8" = 1'-0" Feet

NOTES:

REMOVE ALL EXISTING THERMOSTATS AND REPLACE WITH NEW PROGRAMMABLE THERMOSTATS.

PROVIDE SS. COVER PLATE WHERE WALL NOT UNDERGOING ALTERATION.

CLEAN ALL EXISTING DUCTS PRIOR TO RESTARTING OF SYSTEMS INCLUDING UNDER FLOOR DUCTS.

COORDINATE DEMOLITION WITH OTHER TRADES.

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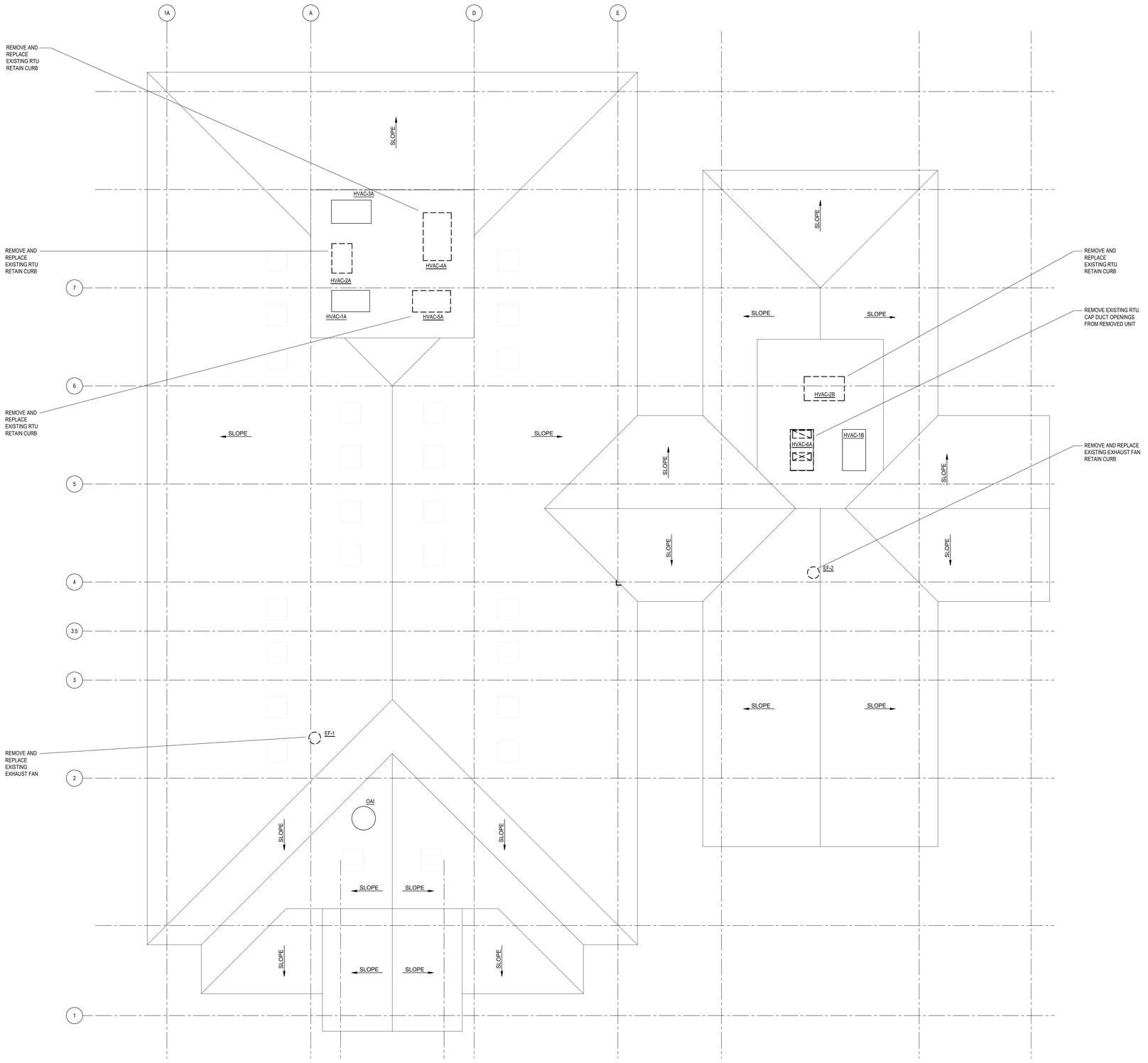
1ST FLOOR AND MEZ. MECHANICAL DEMOLITION PLANS

Sheet Number

MD101



NORTH

ROOF MECHANICAL DEMOLITION PLAN

SCALE: 1/8"=1'-0"

0 4 8 16 Feet — 1/8" = 1'-0"

COORDINATE DEMOLITION WITH GENERAL CONTRACTOR DURING BIDDING. SEAL ALL OPENINGS WEATHER TIGHT.

SEE NEW WORK MECHANICAL PLANS FOR INTERACTION BETWEEN NEW, EXISTING AND DEMOLISHED ITEMS.

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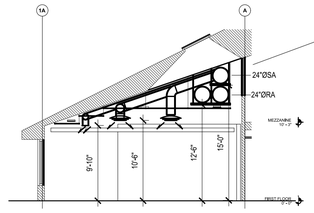
Sheet Title

ROOF MECHANICAL DEMOLITION PLAN

Sheet Number

MD102

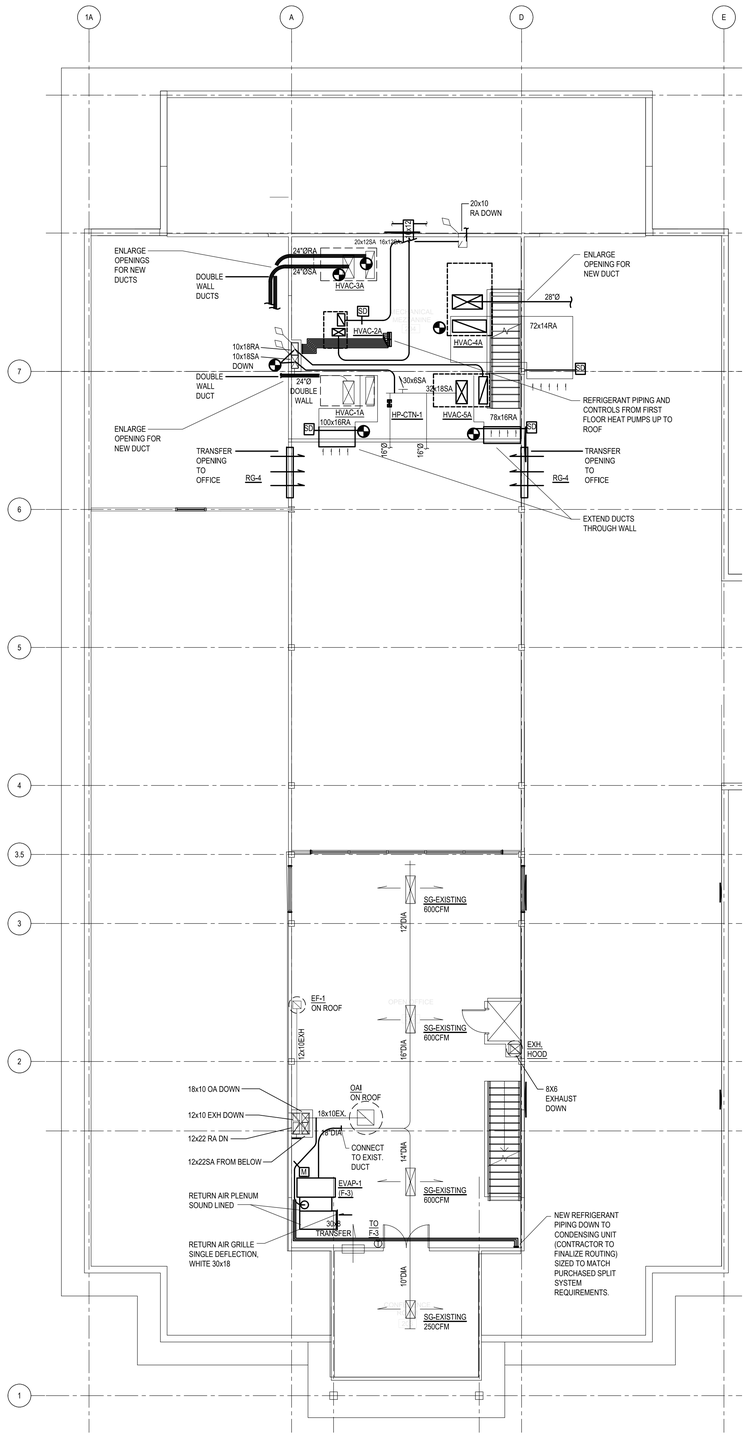


STUDIO ELEVATION/SECTION

SCALE: 1/8"=1'-0"

1/8" = 1'-0"

0 4 8 16 Feet



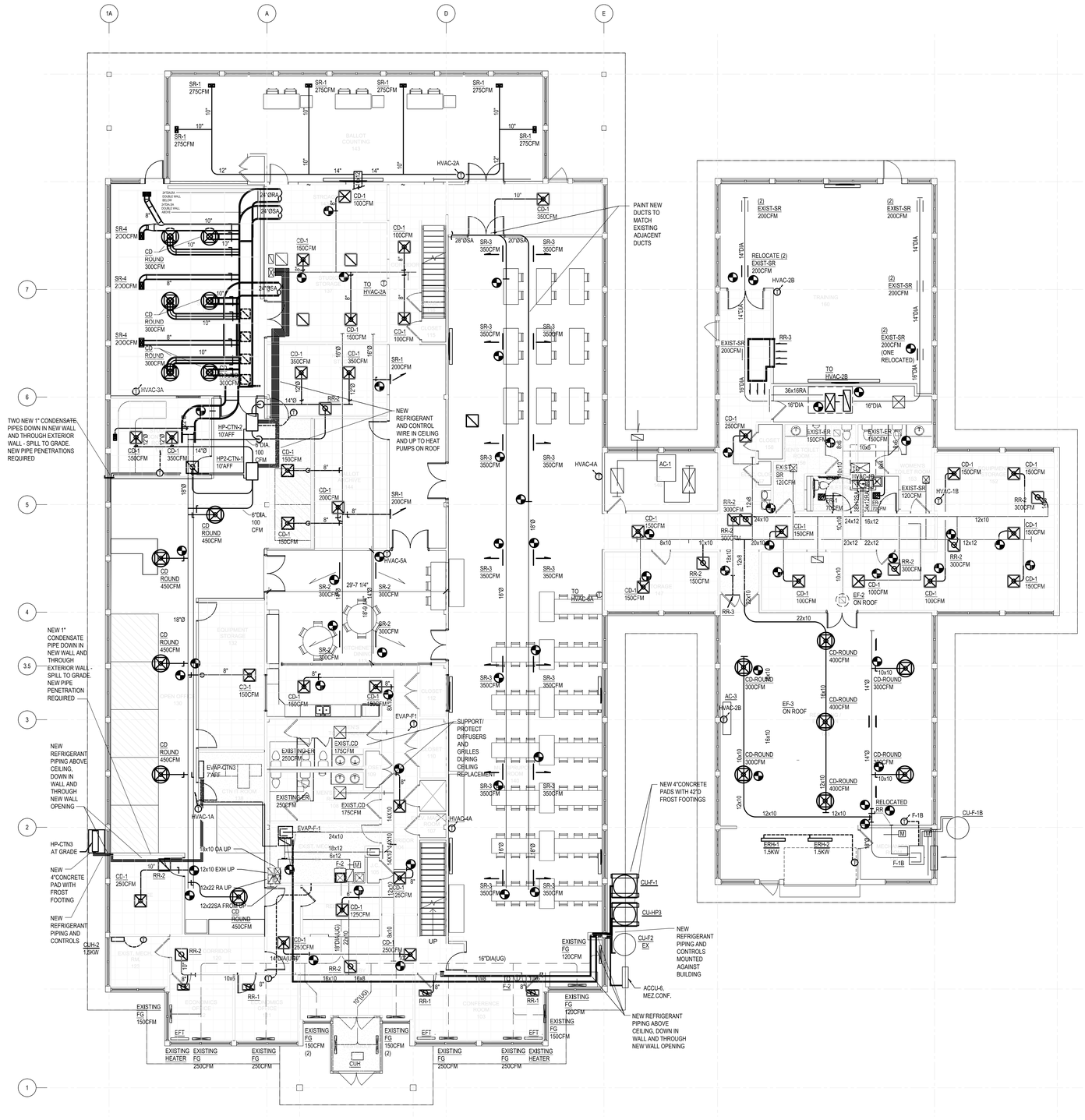
MEZZANINE MECHANICAL PLAN

NORTH

SCALE: 1/8"=1'-0"

1/8" = 1'-0"

0 4 8 16 Feet



FIRST FLOOR MECHANICAL PLAN

NORTH

SCALE: 1/8"=1'-0"

1/8" = 1'-0"

0 4 8 16 Feet

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ARCHITECTURE & ENGINEERING

28105 Greenfield Rd. Southfield, MI 48076-3046
248.569.1430 Fax: 248.569.0096
Website: www.dsdonline.com

A/E SEAL

CITY OF ANN ARBOR

ANN ARBOR ELECTION FACILITY

3021 MILLER RD.
ANN ARBOR, MI 48103

DATE	ISSUED FOR:
3/3/25	FINAL OWNER REVIEW
05/01/2025	IFC

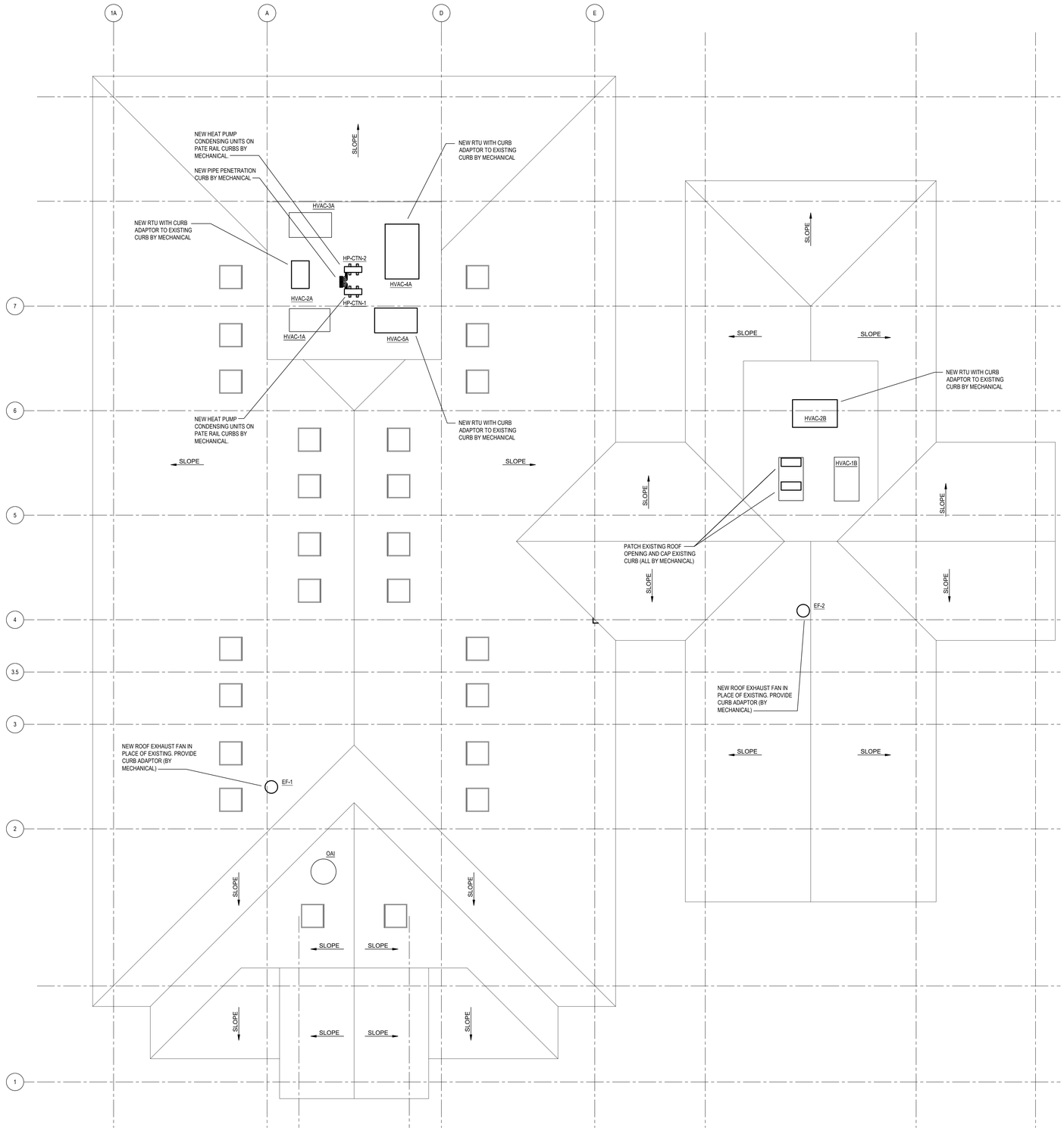
Designer	B.REED
Modeler:	R. SEPULVEDA
PM:	B. REED
PIC:	B. REED
ACADFILE:	24-1301-E-101.DWG
Project No.	24-1301

Sheet Title

1ST FLOOR AND MEZ. MECHANICAL PLANS

Sheet Number

M-101



NORTH

ROOF MECHANICAL PLAN

SCALE: 1/8"=1'-0"

0 4 8 16 1/8" = 1'-0" Feet

COORDINATE WORK WITH OTHER TRADES INCLUDING GENERAL CONTRACTOR DURING BIDDING FOR ROOF CURB FLASHING, ROOF ADAPTOR ADJUSTMENTS.

CAP ALL UNUSED GAS PIPING AT MAINS

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CITY OF ANN ARBOR

ANN ARBOR ELECTION FACILITY

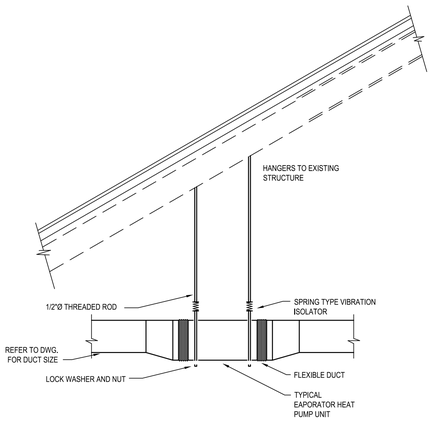
3021 MILLER RD.
ANN ARBOR, MI 48103

Sheet Title

ROOF MECHANICAL PLAN

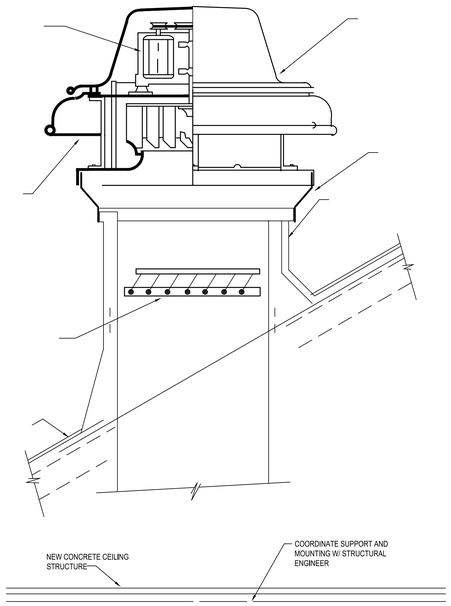
Sheet Number

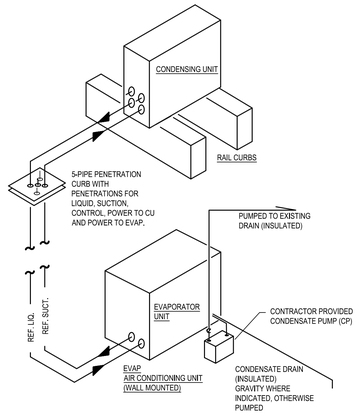
M-102



DUCTED HEAT PUMP EVAPORATOR

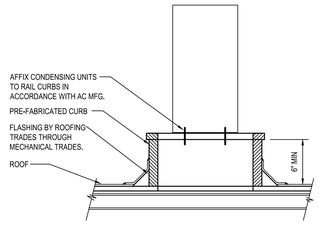
NO SCALE





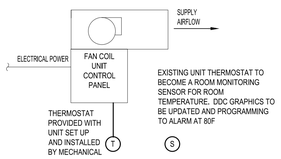
HEAT PUMP PIPING DIAGRAM

NO SCALE

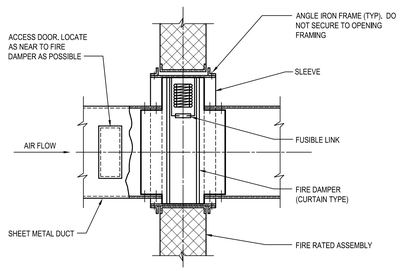


RAIL CURB DETAIL

NO SCALE

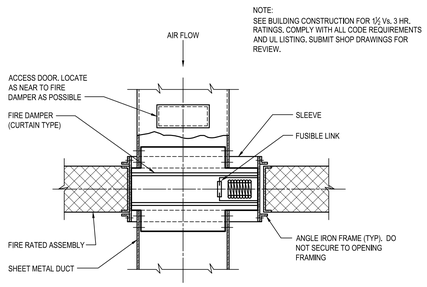


HEAT PUMP AC UNIT CONTROLS



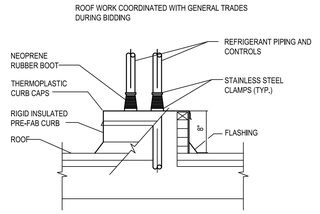
HORIZONTAL FIRE DAMPER DETAIL

NO SCALE



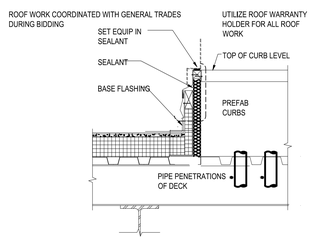
VERTICAL FIRE DAMPER DETAIL

NO SCALE



PRE-FAB PIPE PENETRATIONCURB DETAIL

NO SCALE



CURB DETAIL

NO SCALE

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PM:	B. REED
PIC:	B. REED
ACADFILE:	24-1301-M-601.dwg
Project No.	24-1301

Sheet Title

MECHANICAL DIAGRAMS

Sheet Number

M-601

GENERAL ELECTRICAL NOTES

1. The term "Contractor" as used in these specifications shall mean the "Electrical Subcontractor".

2. Include all electrical work required for a complete new installation as indicated on the plans and specified herein.

3. All equipment shall be new and shall conform in all respects to the latest approved standards of the IEEE, ANSI and the UL label or listing.

4. All electrical work shall comply with the latest edition of NEC, Local and State Codes, Ordinances, Regulations, including the Occupational Safety and Health Act (OSHA), the Americans with Disabilities Act (ADS), and The National Energy Act (NEA).

5. The Contractor shall obtain all permits, pay all fees, and arrange for all inspections for his work. At the completion of electrical work, the Contractor shall furnish the Owner with all certificates of final inspection and approvals.

6. The Contractor shall visit the site and verify the conditions under which his work must be conducted before submitting their proposal. The submitting of a proposal implies that the Contractor has visited the site, is conversant with all site conditions, including existing services and equipment, obstructions and all conditions, which will be encountered in the removal and/or relocation of present materials and equipment, installation of new materials and cutting and patching, etc., for a complete electrical installation. If any interferences or violations appear and departure from the design intent of the bid documents is required, the Contractor shall notify the Architect in writing prior to entering into contract with the Owner. Failure to provide the Architect with the aforementioned notification will result in the Contractor being held responsible to complete all work to meet the design intent of the bid documents with no additional expenses ("EXTRAS") being incurred by the Owner, Architect, or Engineer.

7. Forty-eight hours before any excavation work is started, relative to electrical work, the Contractor shall contact MISS DIG (Toll Free), at (800) 482-7171.

8. Should any structural difficulties prevent setting of cabinets, running conductors, etc., at points shown on plans, the necessary minor deviations therefrom, as determined by the Architect, may be permitted and must be made without additional cost.

9. Cooperation With Other Contractors:

   A. The Contractor shall arrange all parts of his work in proper relation to the work of others and to the architectural finish. Where interferences occur, the Contractor shall, before installing the work involved, consult with the Architect as to the exact location and level of his work. The Architect's decision shall be final.

   B. The Contractor shall be responsible for the arrangement of his work, and equipment and maintenance of proper headroom under this work. Should work installed by the Contractor require modification to avoid interference with other work, as determined by the Architect, such changes shall be made without additional cost.

   C. The Contractor shall coordinate with General Contractor to determine if the work and/or requirements of other trades affect this contractor.

   D. In General, all control wiring, conduit, and related items for all architectural and mechanical systems will be furnished and installed by those respective trades, unless specifically noted otherwise.

10. Cutting and patching of walls, floors, ceilings, roofs, etc., shall be done at the expense of the Contractor installing equipment and appurtenances, subject to the approval of the Architect. Structural members shall not be cut without obtaining written permission. Conduits passing through roofs or outside walls exposed to weather shall be carefully flashed. Fireproofing of holes shall be provided and shall be of a UL listed material and approved by authority having jurisdiction.

11. Underground Work:

   A. Coordinate all new electrical underground work with existing and new utilities prior to installation.

   B. Contractor shall be responsible for all excavation, fill, concrete pad, reinforcing bar, and forms required for installation, underground conduit, and other similar electrical work.

   C. Contractor shall install system coordinated, approved warning tapes, 12" below grade, above all underground work.

12. Any item appearing on the drawings and not in the specification or vice versa, and any items appearing in neither but necessary to accomplish the intent of these specifications, shall be furnished by the Contractor.

13. Grounding:

   A. Furnish and install a complete grounding system in accordance with the National Electrical Code and local codes and ordinances.

   B. Furnish and install a supplemental ground wire for all power and lighting circuits. Grounding path from circuits, equipment, and conductor enclosures shall be permanent and continuous; and shall have a resistance to ground of less than 5 ohms.

   C. All cabinets, motor frames, motor starters, contactors, conduit systems, panelboards, transformers, etc., shall be thoroughly grounded in accordance with the NEC Section 250.

14. All conductors shall be copper and shall be installed in conduit. All branch circuit conductors shall be minimum size #12 AWG, Type "THWN" insulated. Control wiring may be #14 AWG minimum size. All feeders and secondary service conductors shall be copper, with 600 volt insulation. Feeder insulation shall be Type "THHW" or "XHHW". Final homeruns shall be increased by one AWG size for every 70 foot length of 120V circuits, 150 foot length of 208V circuits, 250 foot length of 277V, circuits, and 400 foot length of 480V circuits.

15. All conduits shall be run concealed unless otherwise noted. Exposing of any conduit shall be only done with the approval of the Architect.

16. Fuses 0 to 600 ampere shall be current limiting dual-element type, with separate elements for overloads and short-circuits, 200,000 AIC rms symmetrical. UL Class RK1. Bussman or approved equal.

17. Duplex receptacles shall be specification grade, 120V, 20 ampere, grounding type, equal to Hubbell #5362 series, P&S, or Arrow-Hart. Color shall be chosen by Architect or Owner.

18. Ground fault receptacles shall be specification grade, 120V, 20 ampere, UL listed under 498 Receptacle Requirements and 943 Class A Requirements, shall conform to NEC Requirements, and equal to Hubbell Series #5362, P&S, or Arrow Hart. Color to be chosen by Architect or Owner.

19. Toggle wall switches shall be 20 ampere, 120/277 volt, specification grade single, double, etc., as indicated, equal to Hubbell #1221 series, P&S, or Arrow Hart. Color to be chosen by Architect or Owner.

20. Device plates shall be stainless steel Type 302. Hubbell "S" series, or as selected by the Architect or Owner.

21. Conduit installed in walls and above ceilings shall be thin-wall type electrical metallic tubing ("EMT"). Conduit installed in and below concrete slab shall be galvanized rigid steel. Conduit installed below grade for feeders and lighting circuits shall be PVC plastic type as approved by local inspection authority for the intended purpose.

   A. All fixtures and equipment mounted in lay-in ceilings shall have adequate flexible conduit to allow lowering of item to two feet below ceiling. Liquid tight flexible conduit shall be used for final connections to motors and other vibrating mechanical equipment. All conduit shall be ½" minimum size.

22. Disconnect switches shall be heavy duty type; NEMA 1, for indoor use, and NEMA 3R for outdoor use rated 250 volt or 600 volt as required. Disconnect switches serving motor loads shall be horsepower rated. Square D, Eaton or Siemens.

23. Motor Starters:

   A. Starters for single phase motors shall be manual toggle switch type with thermal overloads, surface or flush mounted as required. Square D Class 2510.

   B. Starters for three phase motors shall be electrically operated, magnetically-held type with three overloads, 120V secondary control transformer and one set of auxiliary contacts, one NO and one NC, in addition to those used for controls, with HOA selector switch and red & green pilot lights mounted in front cover. Starters shall be mounted in NEMA 1 enclosure for indoor use and NEMA Type 4X enclosure for outdoor installation. Square D Class 8536 or equal.

   C. Combination starters shall consist of a fused disconnect switch as previously specified and a three phase motor starter in one enclosure.

   D. The Contractor shall furnish and install thermal overloads based on motor nameplate data.

24. The Contractor shall submit equipment shop drawings to the Architect for review prior to installation of lighting fixtures and electrical distribution generator transfer switch, fire alarm and detection systems.

   Note: Review of Contractors shop drawings does not relieve the Contractor of his responsibility to conform to the contract documents and applicable codes.

25. Contractor shall guarantee all work installed by his workmen under this contract to be free from all defective workmanship and materials for a period of one year after the acceptance of the building by the Owner, and should defects occur within this period, repair and/or replace defective items, at no expense to the Owner.

26. Panel directories shall be neatly updated and typed showing equipment served and location for each breaker or switch.

27. All circuits and equipment shall be tested upon completion of work and final tests, when requested, shall be done in the presence of the Owner's Representative. Any circuits or equipment found to be defective shall be replaced or repaired, as necessary, and then re-tested without additional expense to the Owner.

28. Upon completion of the project, all enclosures shall be left free of refuse and the exterior free of dirt and paint splatters.

29. Demolition Work:

   A. As required to suit the intent of the new work, certain areas in the existing building shall be modified to suite the new requirements.

   B. Work in the area shall include the disconnection, removal, relocation, and reconnection complete in all respects of all items required to suit the design intent. It shall be the responsibility of the Contractor to visit the project site to correctly ascertain the scope of services and to include all pertinent costs in his bid. No extras will be allowed.

   C. All electrical work interfering with and requiring modification for the new requirements shall be disconnected, removed, and/or rerouted to suite the final installation.

   D. Relocate and reroute equipment devise and wiring as required in demolition areas.

   E. All equipment and wiring not in renovation areas but affected by work in renovation areas shall be reconnected as required for a complete working system.

   F. Abandoned and inactive conduits, wire, devices, equipment, etc., shall be removed in their entirety. In addition to these items, this Contractor shall remove all items as indicated on the plans, or as required to clean up the entire area of unused, abandoned, or inactive materials. Conduit and wiring feeding devices and equipment to be removed shall also be removed up to the next active pullbox, junction box, or panelboard. Hangers, messenger cable, brackets, etc, supporting items to be removed shall also be unfastened and removed. Open holes in ducts, boxes, panelboards, and knockouts shall be closed with suitable snap plugs or filler plates.

   G. The Contractor shall remove and deliver to a place designated by the Owner all existing electrical equipment no longer intended for use. This equipment remains the property of the Owner.

   H. Any equipment, devices, materials, etc., the Owner elects not to retain shall be legally disposed of by the Contractor off the Owner's premises.

General: Furnish and install an electrically supervised, non-coded, zoned, microprocessor based, addressable, manual and automatic fire alarm system as specified herein. The system shall include the control unit, all alarm initiating and indicating devices and outlet boxes, conduit, wire, etc. necessary for a complete operational system and meeting the following requirements. The systems shall operate from one leg of a 120/208 volt, 60 Hz electrical service and receive supervisory power from the other leg. All components of the system shall be listed by the underwriters' Laboratories, Inc. for their intended use. All components and operational sequence shall also be approved by authority having jurisdiction. System shall be as manufactured by Simplex, Pyrotronics, FCI, or approved equal.

SYMBOL LIST

SYMBOL	DESCRIPTION
⊗	EXIT LIGHT
	EMERGENCY LIGHTING UNIT
	RECESSED FIXTURE
○	RECESSED, SURFACE, OR PENDENT MOUNTED FIXTURE
	FIXTURE ON NIGHT LIGHT/EMERGENCY CIRCUIT
	SURFACE MOUNTED OR SUSPENDED FIXTURE
S	SINGLE POLE SWITCH
S_3	THREE WAY SWITCH
S_L	LIGHTING CONTROLLER
S_T	MANUAL MOTOR STARTER WITH THERMAL PROTECTION
(S)	OCCUPANCY SENSOR
	SINGLE PHASE MOTOR
	THREE PHASE MOTOR
	COMBINATION MAGNETIC STARTER / DISCONNECT SWITCH (FUSED)
	LIGHTING / RECEPTACLE / EQUIPMENT PANEL
	DISCONNECT SWITCH
J	JUNCTION BOX
T	TRANSFORMER
▽	EXISTING COMMUNICATION OUTLET
▼	NEW COMMUNICATION OUTLET WITH 1-1/4"C. TO CABLE TRAY
$▼_F$	NEW COMMUNICATION OUTLET - FLOOR MOUNTED
$▽_F$	EXISTING COMMUNICATION OUTLET - FLOOR MOUNTED
CR	CARD READER
M	MAGNETIC DOOR STRIKE
I	INTERCOM STATION
DC	DOOR CONTROL/INTERCOM STATION
⊡	PUSH BUTTON
	SPEAKER
	SPEAKER - WALL MOUNTED
C, C	CAMERA OUTLET
P	FIRE ALARM PULL STATION
F	FIRE ALARM NOTIFICATION DEVICE - AUDIO/VISUAL
S	SMOKE DETECTOR
S_{SA}	DUCT TYPE SMOKE DETECTOR (SA = SUPPLY AIR, RA = RETURN AIR)
FS	FLOW SWITCH
TS	TAMPER SWITCH
	SINGLE RECEPTACLE OUTLET
	DUPLEX RECEPTACLE OUTLET
$_F$	DUPLEX RECEPTACLE OUTLET - FLOOR MOUNTED
	DUPLEX RECEPTACLE OUTLET - (48" A.F.F. OR AS DIRECTED)
	DOUBLE DUPLEX RECEPTACLE OUTLET
(S)	OCCUPANCY SENSOR CONTROLLED DUPLEX RECEPTACLE OUTLET
Y	SPECIAL DUPLEX RECEPTACLE OUTLET
AFF	ABOVE FINISHED FLOOR
(E)	EXISTING EQUIPMENT / DEVICE
GFI	GROUND FAULT INTERRUPTER
R	RELOCATED EQUIPMENT / DEVICE
WP	WEATHERPROOF
NL	NIGHT LIGHT
————	EXISTING TO REMAIN
⁄⁄⁄⁄⁄	EXISTING TO BE REMOVED
————	NEW

FEEDER AND BRANCH CIRCUIT SIZING SCHEDULE - GENERAL PURPOSE

OVERCURRENT DEVICE RATING (AMPERES)	WIRE SIZE - 3Ø, 3W SYSTEM (AWG OR Kcmil)	WIRE SIZE - 3Ø, 4W SYSTEM (AWG OR Kcmil)
15-20	3#12+#12GND, 3/4"C.	4#12+#12GND, 3/4"C.
25-30	3#10+#10GND, 3/4"C.	4#10+#10GND, 3/4"C.
35-40-45	3#8+#10GND, 3/4"C.	4#8+#10GND, 3/4"C.
50-60	3#6+#10GND, 3/4"C.	4#6+#10GND, 1"C.
70-80	3#4+#8GND, 1"C.	4#4+#8GND, 1 1/4"C.
90-100	3#2+#8GND, 1 1/4"C.	4#2+#8GND, 1 1/4"C.
110	3#1+#6GND, 1 1/4"C.	4#1+#6GND, 1 1/2"C.
125	3#1/0+#6GND, 1 1/2"C.	4#1/0+#6GND, 2"C.
150	3#2/0+#6GND, 1 1/2"C.	4#2/0+#6GND, 2"C.
175	3#3/0+#6GND, 2"C.	4#3/0+#6GND, 2"C.
200-225	3#4/0+#4GND, 2"C.	4#4/0+#4GND, 2 1/2"C.
250	3-250Kcmil+#4GND, 2"C.	4-250Kcmil+#4GND, 2 1/2"C.
300	3-350Kcmil+#4GND, 2 1/2"C.	4-350Kcmil+#4GND, 3"C.
350	3-500Kcmil+#2GND, 3"C.	4-500Kcmil+#2GND, 3 1/2"C.
400	3-600Kcmil+#2GND, 3"C.	4-600Kcmil+#2GND, 3 1/2"C.

NOTES:

- CONTRACTOR TO SIZE FEEDERS AND BRANCH CIRCUITS BASED ON THIS SCHEDULE AND OVER CURRENT DEVICE SIZE, UNLESS NOTED OTHERWISE.
- CONDUCTORS ARE BASED ON COPPER THHN/THWN UP TO AND INCLUDING #4/0. LARGER THAN #4/0 ARE BASED ON COPPER TYPE XHHW.
- ALL CALCULATIONS FOR WIRING AND CONDUIT SIZES BASED ON THE 2023 NEC
- CONDUIT SIZES SHOWN ARE MINIMUM AND ARE APPLICABLE FOR ELECTRICAL METALLIC TUBING (EMT), RIGID METAL CONDUIT (RMC) AND PVC TYPES, ACTUAL CONDUIT SIZES TO BE INSTALLED MAY VARY.
- CONTRACTOR TO ACCOUNT FOR VOLTAGE DROP DUE TO FEEDER/BRANCH CIRCUIT LENGTHS AND INCREASE CONDUCTOR (AND RACEWAY) SIZES ACCORDINGLY. CONDUCTORS FOR BRANCH CIRCUITS SHALL BE SIZED TO PREVENT A VOLTAGE DROP EXCEEDING 3% AT FARTHEST POINT IN ANY BRANCH CIRCUIT, AND A MAXIMUM COMBINED VOLTAGE DROP FOR BOTH FEEDER AND BRANCH CIRCUITS, AT FARTHEST POINT, NOT EXCEEDING 5%.

ELECTRICAL SHEET INDEX

SHEET	DESCRIPTION
E–001	ELECTRICAL GENERAL INFORMATION
E–002	SITE PLAN – ELECTRICAL
ED101	FIRST FLOOR AND MEZZANINE PLANS – LIGHTING DEMOLITION
ED102	FIRST FLOOR AND MEZZANINE PLANS – POWER DEMOLITION
ED103	FIRST FLOOR AND MEZZANINE PLANS – COMMUNICATION DEMOLITION
ED104	PARTIAL FLOOR PLAN CTN INDUSTRIAL PARKWAY – ELECTRICAL DEMOLITION
EL101	FIRST FLOOR AND MEZZANINE PLANS – LIGHTING
EP101	FIRST FLOOR AND MEZZANINE PLANS – POWER
EC101	FIRST FLOOR AND MEZZANINE PLANS – COMMUNICATION
E–601	ELECTRICAL ONE LINE DIAGRAM
E–602	ELECTRICAL ONE LINE DIAGRAM – NEW WORK
E–603	ELECTRICAL SCHEDULES
E–604	LIGHTING SCHEDULES

OVERVIEW OF ELECTRICAL SCOPE

THIS OVERVIEW OF SCOPE IS INCLUDED TO GIVE THE CONTRACTOR A GENERAL OVERVIEW OF THE PROJECT REQUIREMENTS. THE OVERVIEW IS NOT ALL INCLUSIVE AND IS NOT INTENDED TO, AND SHOULD NOT BE USED TO, ESTABLISH CONTRACT LIMITS OR PRICING INCLUSIONS. THE CONTRACT DOCUMENTS SHALL BE USED TO ESTABLISH CONSTRUCTION CONTRACT SCOPE.

THIS OVERVIEW OF SCOPE INCLUDES, BUT IS NOT LIMITED TO THE FOLLOWING:

ELECTRICAL:

1. REMOVE AND DISPOSE OF EXISTING LIGHTING, POWER DISTRIBUTION, DATA/COMMUNICATION SYSTEMS/EQUIPMENT AS INDICATED.
2. PROVIDE LIGHTING, EMERGENCY EGRESS LIGHTING. INCLUDING CONTROLS AND EXTENSION/CONNECTION TO EXISTING BUILDING SERVICES.
3. PROVIDE POWER DISTRIBUTION SYSTEMS, EQUIPMENT PANELBOARDS, STARTERS, DISCONNECTS, RECEPTACLES AS INDICATED.
4. PROVIDE DATA/COMMUNICATION SYSTEM RACEWAYS AND CABLING AS INDICATED.
5. PROVIDE A FIRE ALARM SYSTEM INCLUDING EXTENSION/CONNECTION, PROGRAMMING/UPGRADE OF THE EXISTING BUILDING'S FIRE ALARM SYSTEM.
6. PROVIDE SECURITY AND CARD ACCESS SYSTEM AS INDICATED.
7. PROVIDE PROTECTIVE DEVICE COORDINATION, SHORT CIRCUIT AND ARC FLASH HAZARD ANALYSIS, AND ARC FLASH HAZARD LABELING COMPLIANT WITH NEC REQUIREMENTS FOR ALL EXISTING AND NEW PANELBOARDS.

PROJECT REQUIREMENTS

PROVIDE ALL NECESSARY PERMITS. ALL WORK SHALL BE INSTALLED TO COMPLY WITH THE OWNER'S STANDARDS, STATE AND LOCAL CODES INCLUDING, BUT NOT LIMITED TO, THE FOLLOWING CODES AND THEIR RELATED REFERENCES.

2023 NATIONAL ELECTRICAL CODE AS AMENDED BY THE MICHIGAN CONSTRUCTION CODE PART 8, ELECTRICAL CODE RULES.
NFPA 101 LIFE SAFETY CODE 2012 (AS REFERENCED)
2015 MICHIGAN ENERGY CODE
2015 INTERNATIONAL FIRE CODE (AS REFERENCED)
2015 MICHIGAN BUILDING CODE
2021 MICHIGAN MECHANICAL CODE
2021 MICHIGAN PLUMBING CODE
2015 INTERNATIONAL FUEL GAS CODE
2019 NFPA 110 AND NFPA 111

MANUFACTURER AND MODEL NUMBER LISTED REPRESENTS THE BASIS OF DESIGN FOR THIS PROJECT. THE ELECTRICAL CONTRACTOR SHALL BEAR ALL ADDITIONAL COST ASSOCIATED WITH USING EQUIPMENT BY OTHER APPROVED MANUFACTURERS INCLUDING ADDITIONAL COSTS BY OTHER TRADES.

ALL EQUIPMENT INSTALLED SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS. WHERE FIELD OR PROJECT CONDITIONS DO NOT ALLOW ALL MANUFACTURER'S RECOMMENDATIONS TO BE MET, THE INSTALLING CONTRACTOR SHALL SUBMIT IN WRITING TO THE ENGINEER THE PROPOSED DEVIATION, IN A SKETCH FORM, ACCOMPANIED BY THE MANUFACTURER'S CONCURRENCE.

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CITY OF ANN ARBOR
ANN ARBOR ELECTION FACILITY
3021 MILLER RD.
ANN ARBOR, MI 48103

DATE	ISSUED FOR:
5/1/25	IFC

Designer	T.RESCHKE
Modeler:	N.POLLARD
PM:	B.REED
PIC:	B.REED
ACADFILE:	24-1301-E-001.dwg
Project No.	24-1301

Sheet Title
ELECTRICAL GENERAL INFORMATION

Sheet Number
E-001

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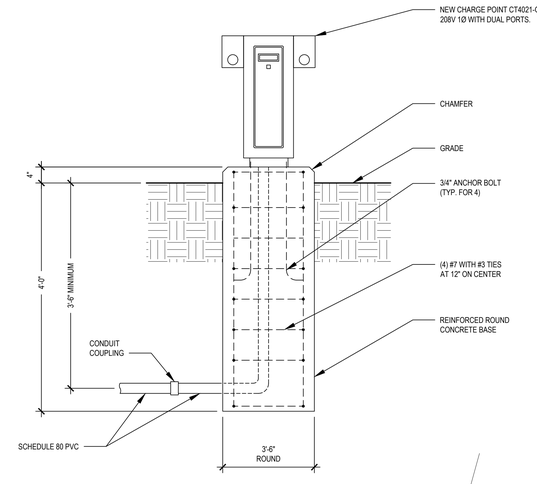
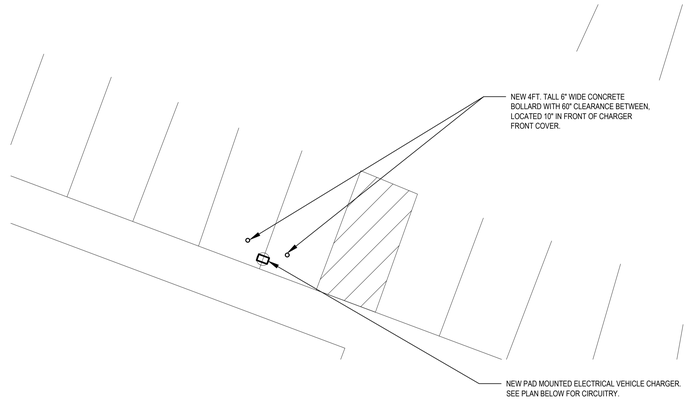


EVC PAD DETAIL

NO SCALE

NOTES:
1. COORDINATE EXACT REQUIREMENTS WITH MANUFACTURER.

2. BOND CONCRETE REINFORCEMENTS SO THAT SYSTEM IS ELECTRICALLY CONTINUOUS.

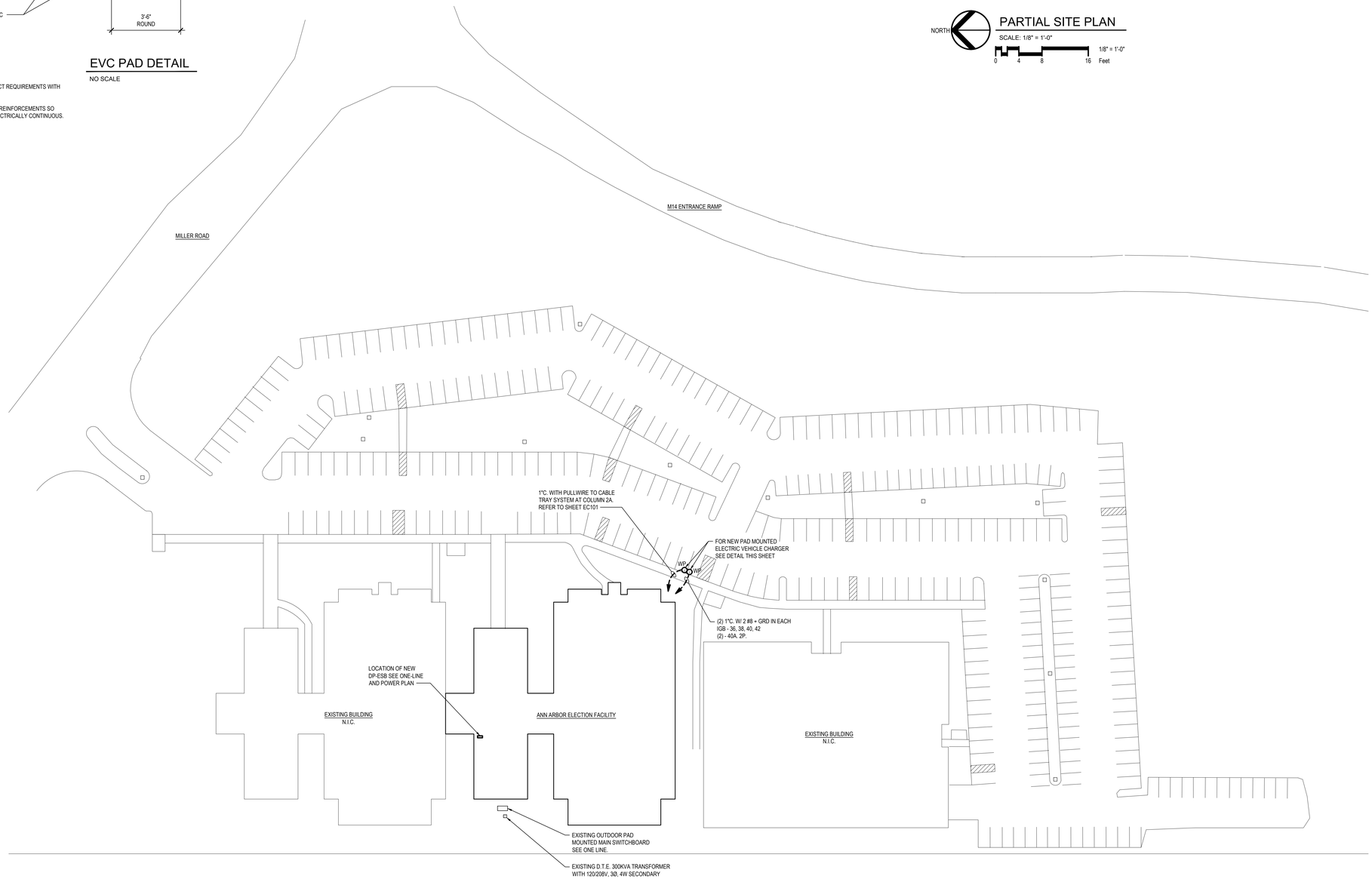


PARTIAL SITE PLAN

NORTH

SCALE: 1/8" = 1'-0"

0 4 8 16 Feet 1/8" = 1'-0"



SITE PLAN - ELECTRICAL

NORTH

SCALE: 1/32" = 1'-0"

0 16 32 64 Feet 1/32" = 1'-0"

STEP 1: CALL "MISS DIG" (SEE BELOW) TO LOCATE UNDERGROUND UTILITY LINES OWNED BY UTILITY COMPANY.

MISS DIG

4 WORKING DAYS
BEFORE YOU DIG
CALL MISS DIG
1-800-482-7171

NOTE:
UTILITY INFORMATION ON THIS DRAWING MAY BE FROM INFORMATION DISCLOSED TO THIS FIRM BY THE VARIOUS UTILITY COMPANIES. NO GUARANTEE IS GIVEN AS TO THE COMPLETENESS OR ACCURACY THEREOF.

PRIOR TO CONSTRUCTION, ALL LOCATIONS AND DEPTHS OF EXISTING UTILITIES (IN CONFLICT WITH PROPOSED IMPROVEMENTS) SHALL BE VERIFIED IN THE FIELD. CALL M-I-S-S-D-I-G

ANY INFORMATION OR DATA ON THIS DRAWING IS NOT INTENDED TO BE SUITABLE FOR REUSE BY ANY PERSON, FIRM OR CORPORATION OR ANY OTHERS ON EXTENSIONS OF THIS PROJECT OR FOR ANY USE ON ANY OTHER PROJECT, ANY REUSE WITHOUT WRITTEN VERIFICATION AND ADAPTATION BY THE SURVEYOR OR ENGINEER FOR THE SPECIFIC PURPOSE INTENDED WILL BE AT THE USERS SOLE RISK AND WITHOUT LIABILITY OF LEGAL EXPOSURE TO THE SURVEYOR OR ENGINEER.

STEP 2: CALL "GPRS" (SEE BELOW) TO LOCATE UNDERGROUND UTILITY LINES OWNED BY FMC

BEFORE YOU DIG
CALL GPRS
UNDERGROUND LOCATING
TREY MERRELL 248-207-8135 OR
BRUCE LEMMON 248-504-7247

NOTE:
UTILITY INFORMATION ON THIS DRAWING MAY BE FROM INFORMATION DISCLOSED TO THIS FIRM BY THE VARIOUS UTILITY COMPANIES. NO GUARANTEE IS GIVEN AS TO THE COMPLETENESS OR ACCURACY THEREOF.

PRIOR TO CONSTRUCTION, ALL LOCATIONS AND DEPTHS OF EXISTING UTILITIES (IN CONFLICT WITH PROPOSED IMPROVEMENTS) SHALL BE VERIFIED IN THE FIELD. CALL GPRS

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ANN ARBOR, MI 48103

DATE	ISSUED FOR:
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Designer	T.RESCHKE
Modeler:	R.SEPULVEDA
PM:	B. REED
PIC:	B. REED
ACADFILE:	24-1301-E-002.dwg
Project No.	24-1301

Sheet Title

SITE PLAN - ELECTRICAL

Sheet Number

E-002

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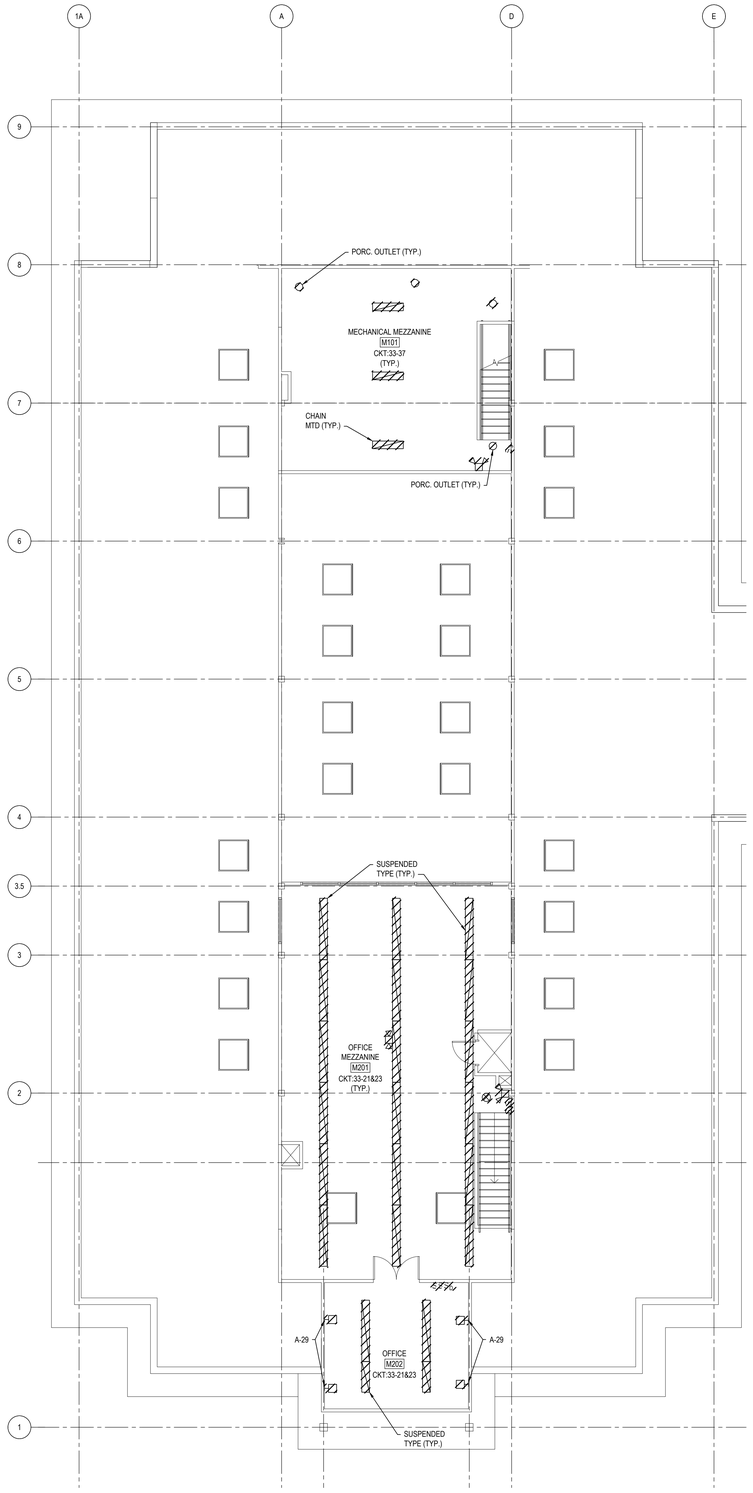


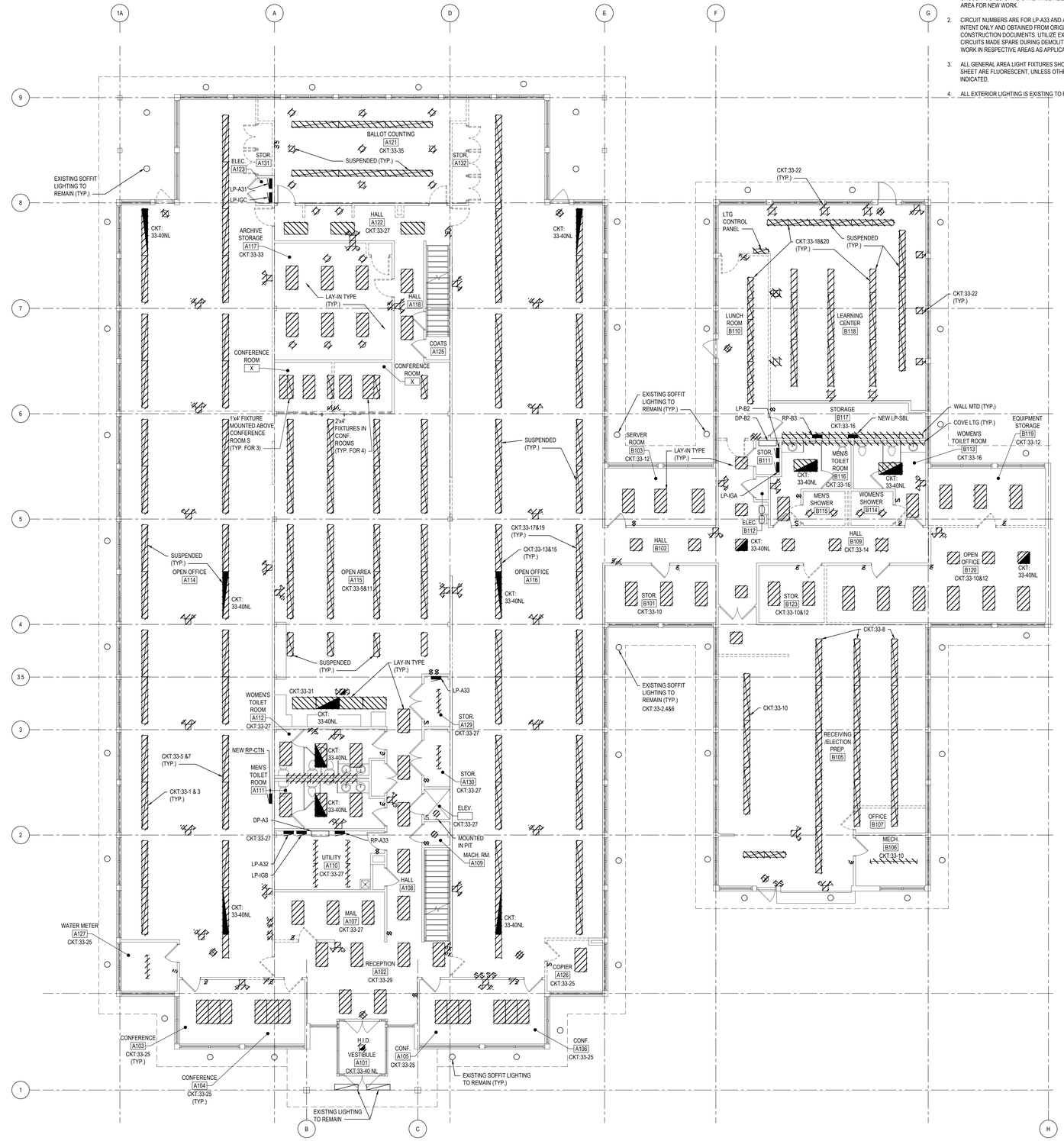
MEZZANINE PLAN - LIGHTING DEMOLITION

NORTH

SCALE: 1/8"=1'-0"

0 4 8 16 Feet

1/8" = 1'-0"



FIRST FLOOR PLAN - LIGHTING DEMOLITION

NORTH

SCALE: 1/8"=1'-0"

0 4 8 16 Feet

1/8" = 1'-0"

SHEET NOTES:

1. DISCONNECT AND REMOVE ALL ITEMS SHOWN CROSSHATCHED OR AS OTHERWISE REQUIRED TO CLEAR AREA FOR NEW WORK.
2. CIRCUIT NUMBERS ARE FOR LP-A33 AND ARE SHOWN FOR INTENT ONLY AND OBTAINED FROM ORIGINAL CONSTRUCTION DOCUMENTS. UTILIZE EXISTING BRANCH CIRCUITS MADE SPARE DURING DEMOLITION FOR ALL NEW WORK IN RESPECTIVE AREAS AS APPLICABLE.
3. ALL GENERAL AREA LIGHT FIXTURES SHOWN ON THIS SHEET ARE FLUORESCENT, UNLESS OTHERWISE INDICATED.
4. ALL EXTERIOR LIGHTING IS EXISTING TO REMAIN.

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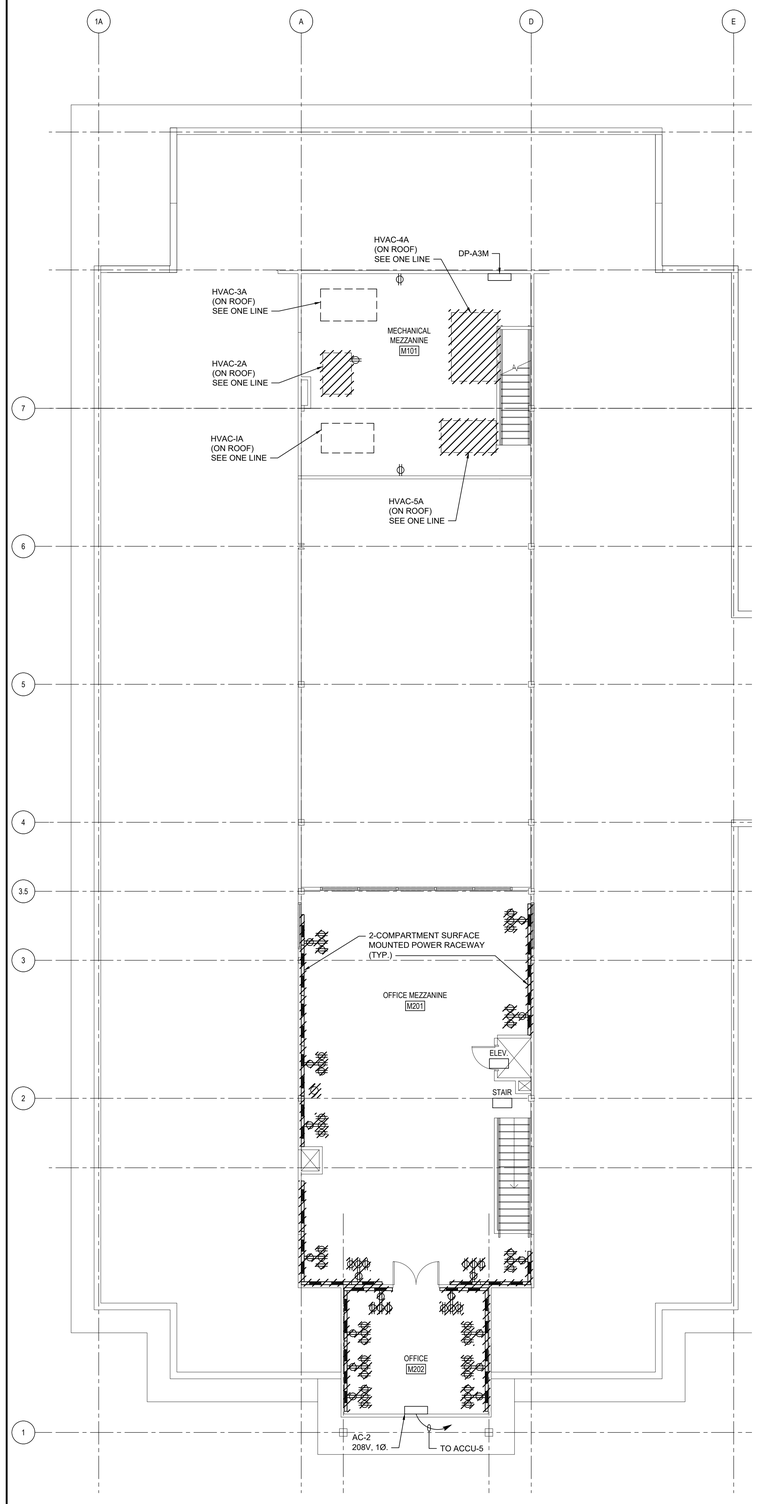
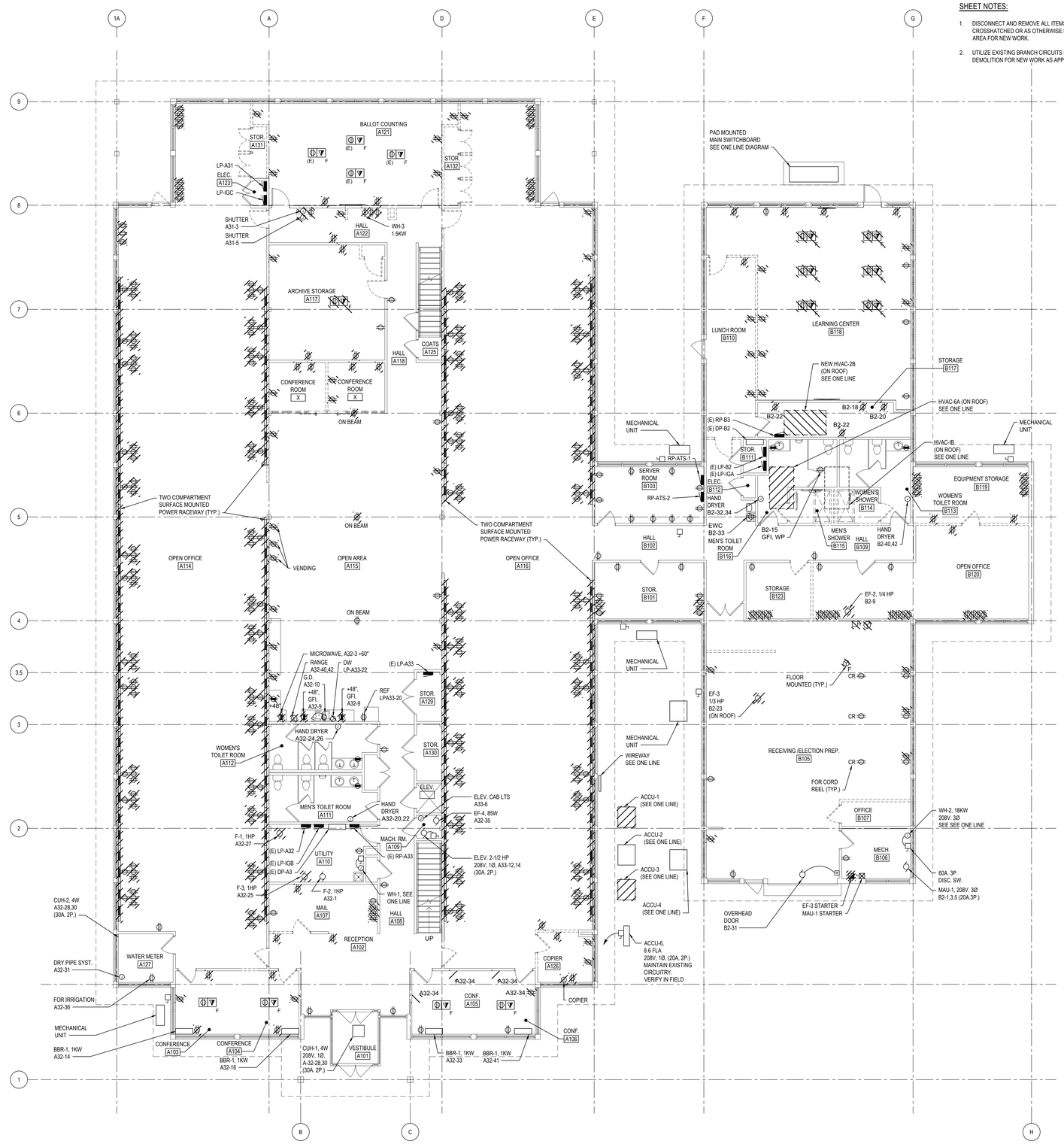
Modeler:	R.SEPULVEDA
PM:	B. REED
PIC:	B. REED
ACADFILE:	24-1301-ED-101.dwg
Project No.	24-1301

Sheet Title
FIRST FLOOR AND MEZZANINE PLANS - LIGHTING DEMOLITION

Sheet Number
ED101





SHEET NOTES:

1. DISCONNECT AND REMOVE ALL ITEMS SHOWN CROSSHATCHED OR AS OTHERWISE REQUIRED. TO CLEAR AREA FOR NEW WORK.
2. UTILIZE EXISTING BRANCH CIRCUITS MADE SPARE DURING DEMOLITION FOR NEW WORK AS APPLICABLE.

NORTH

MEZZANINE PLAN - POWER DEMOLITION

1/8" = 1'-0"

0 4 8 16 Feet

NORTH

FIRST FLOOR PLAN - POWER DEMOLITION

1/8" = 1'-0"

0 4 8 16 Feet

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Modeler:	R.SEPULVEDA
PM:	B. REED
PIC:	B. REED
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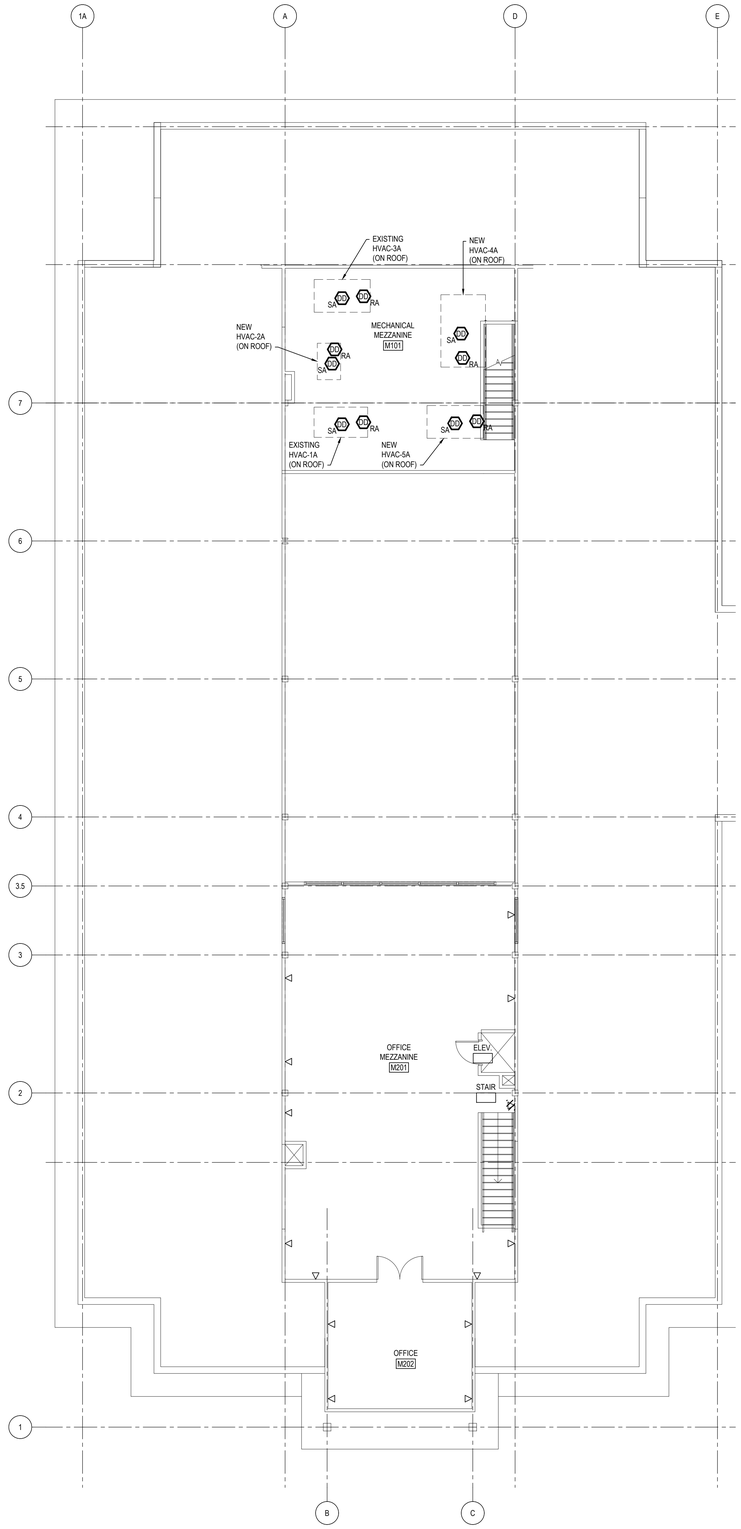
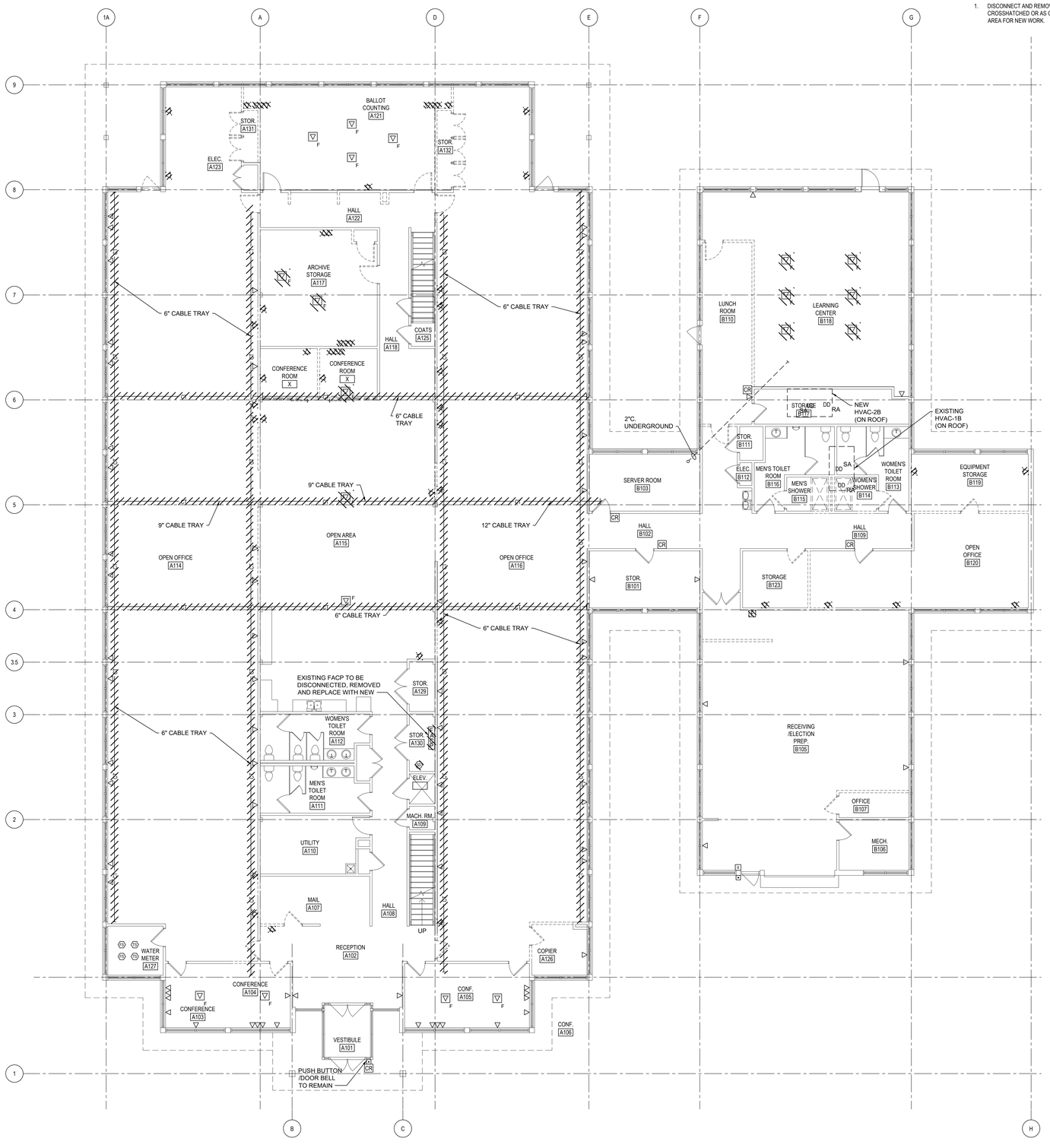
Project No.	24-1301

Sheet Title
FIRST FLOOR AND MEZZANINE PLANS - POWER DEMOLITION

Sheet Number
ED102





SHEET NOTES:

1. DISCONNECT AND REMOVE ALL ITEMS SHOWN CROSSHATCHED OR AS OTHERWISE REQUIRED TO CLEAR AREA FOR NEW WORK.

NORTH

MEZZANINE PLAN - COMMUNICATION DEMOLITION

1/8" = 1'-0"

0 4 8 16 Feet

NORTH

FIRST FLOOR PLAN - COMMUNICATION DEMOLITION

1/8" = 1'-0"

0 4 8 16 Feet

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PIC:	B. REED
ACADFILE:	24-1301-ED-103.dwg
Project No.	24-1301

Sheet Title
FIRST FLOOR & MEZZANINE PLANS - COMMUNICATION DEMO

Sheet Number
ED103

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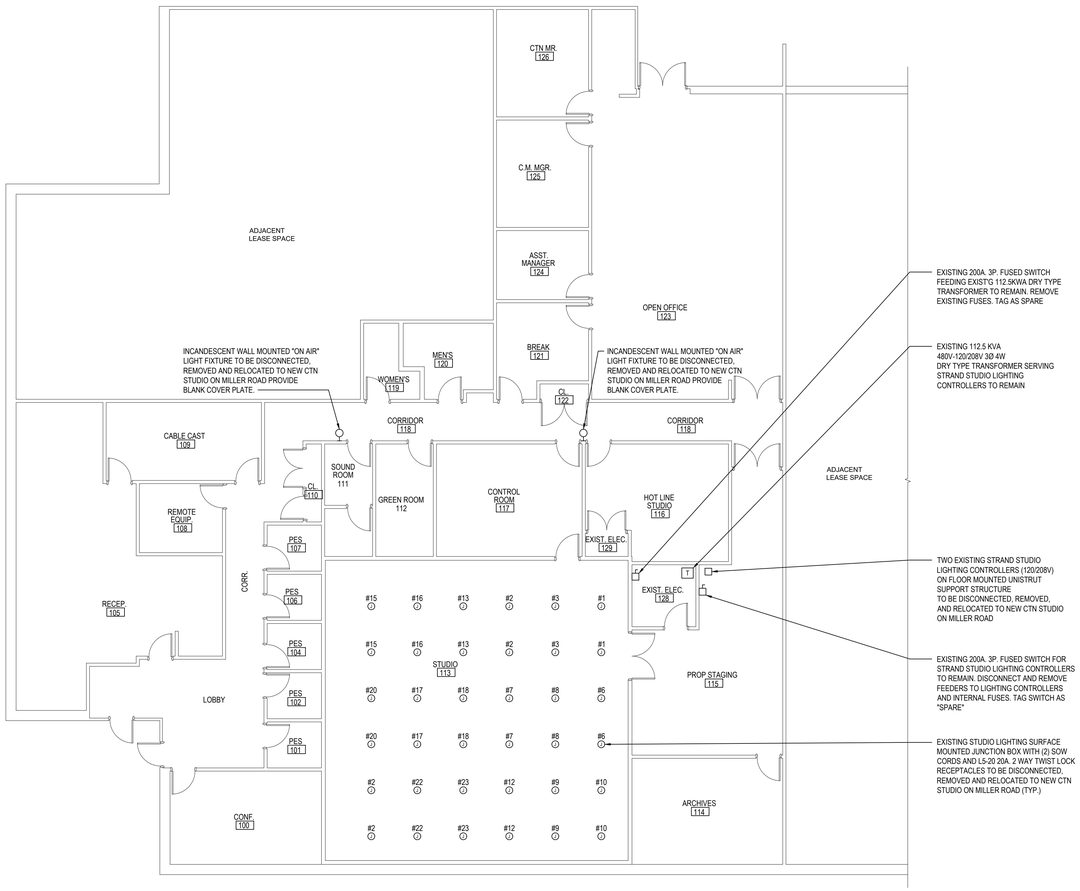

NORTH

PARTIAL FLOOR PLAN CTN INDUSTRIAL PARKWAY - ELECTRICAL DEMOLTION

SCALE: 1/8" = 1'-0"

0 4 8 16 Feet 1/8" = 1'-0"

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Modeler:	R.SEPULVEDA
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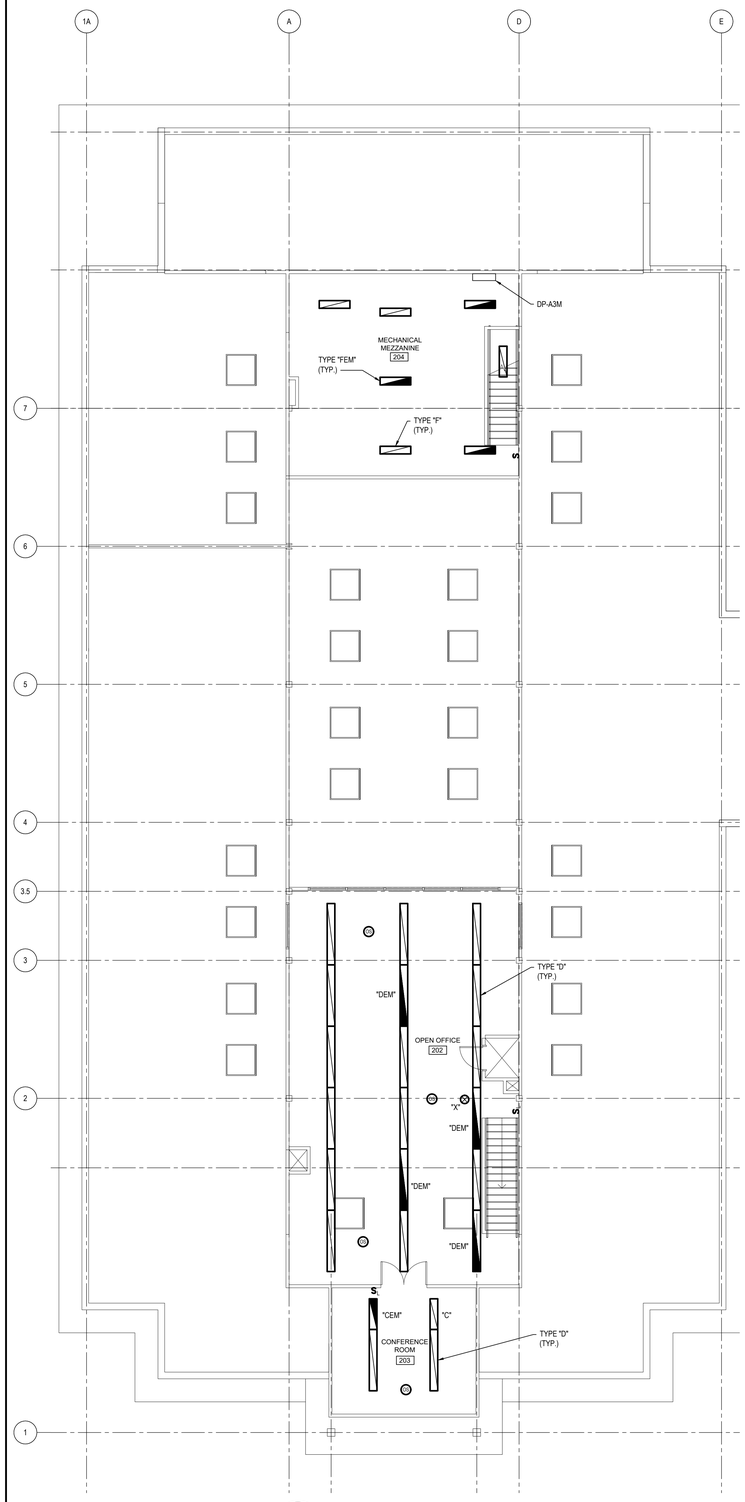
PIC:	B.REED
ACADFILE:	24-1301-ED104.dwg
Project No.	24-1301

Sheet Title
PARTIAL FLOOR PLAN CTN INDUSTRIAL PARKWAY - ELEC. DEMO.

Sheet Number
ED104

SHEET NOTES:

1. CONTRACTOR TO UTILIZE EXISTING LIGHTING BRANCH CIRCUITS MADE SPARE DURING DEMOLITION WHERE APPLICABLE. (SPACES WHERE LIGHTING IS NOT BEING CONNECTED TO NEW EMERGENCY STANDBY LIGHTING PANEL LP-SBL).
2. CONTRACTOR TO PROVIDE COMPOSITE SHOP DRAWING SUBMITTAL INCLUDING FIXTURE CUT SHEETS, CONTROLS, WIRING, ETC. PREPARED BY APPROVED LIGHT FIXTURE CONTROLS MANUFACTURER.



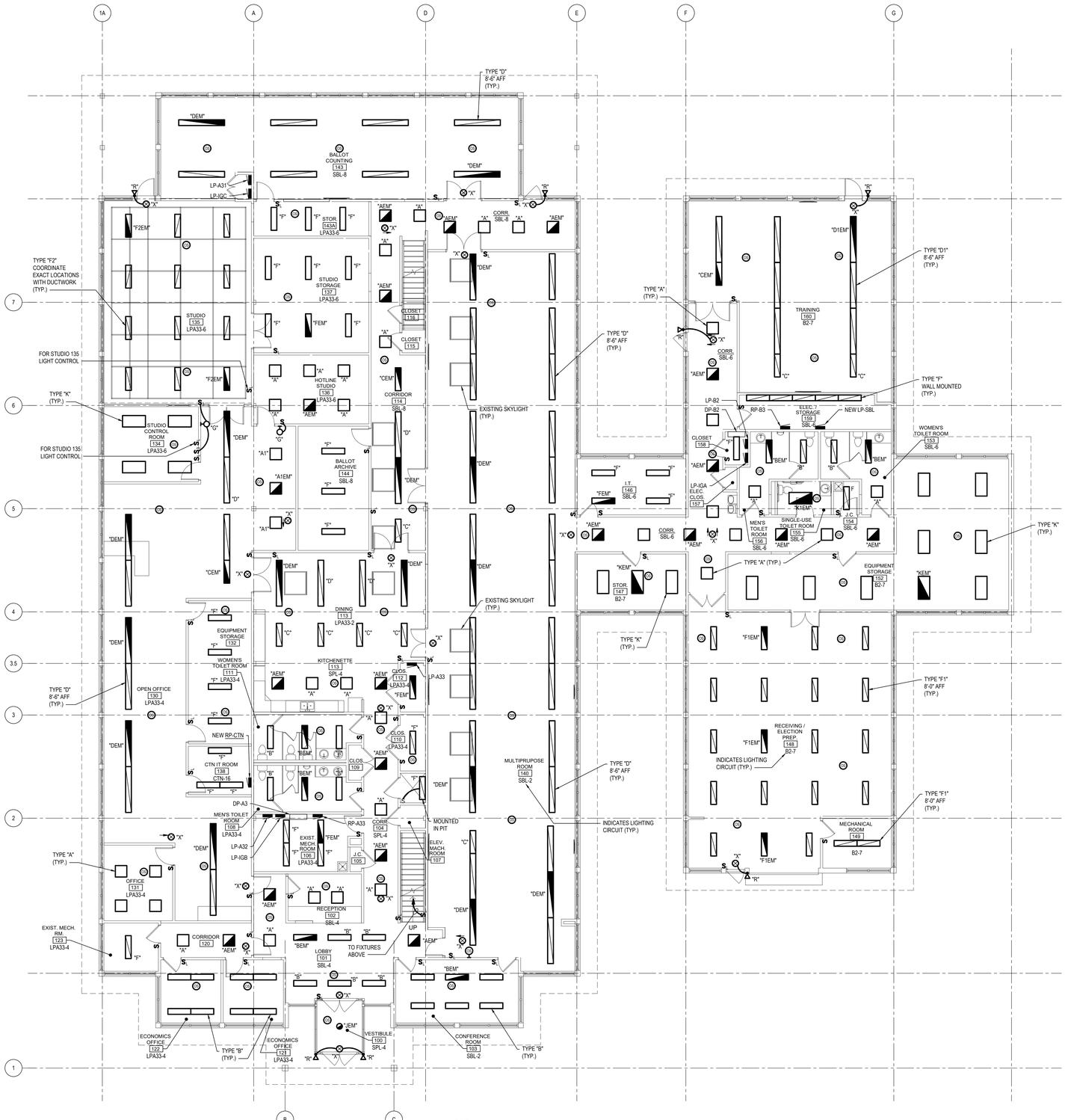
MEZZANINE PLAN - LIGHTING

NORTH

SCALE: 1/8"=1'-0"

0 4 8 16 Feet

1/8" = 1'-0"



FIRST FLOOR PLAN - LIGHTING

NORTH

SCALE: 1/8"=1'-0"

0 4 8 16 Feet

1/8" = 1'-0"

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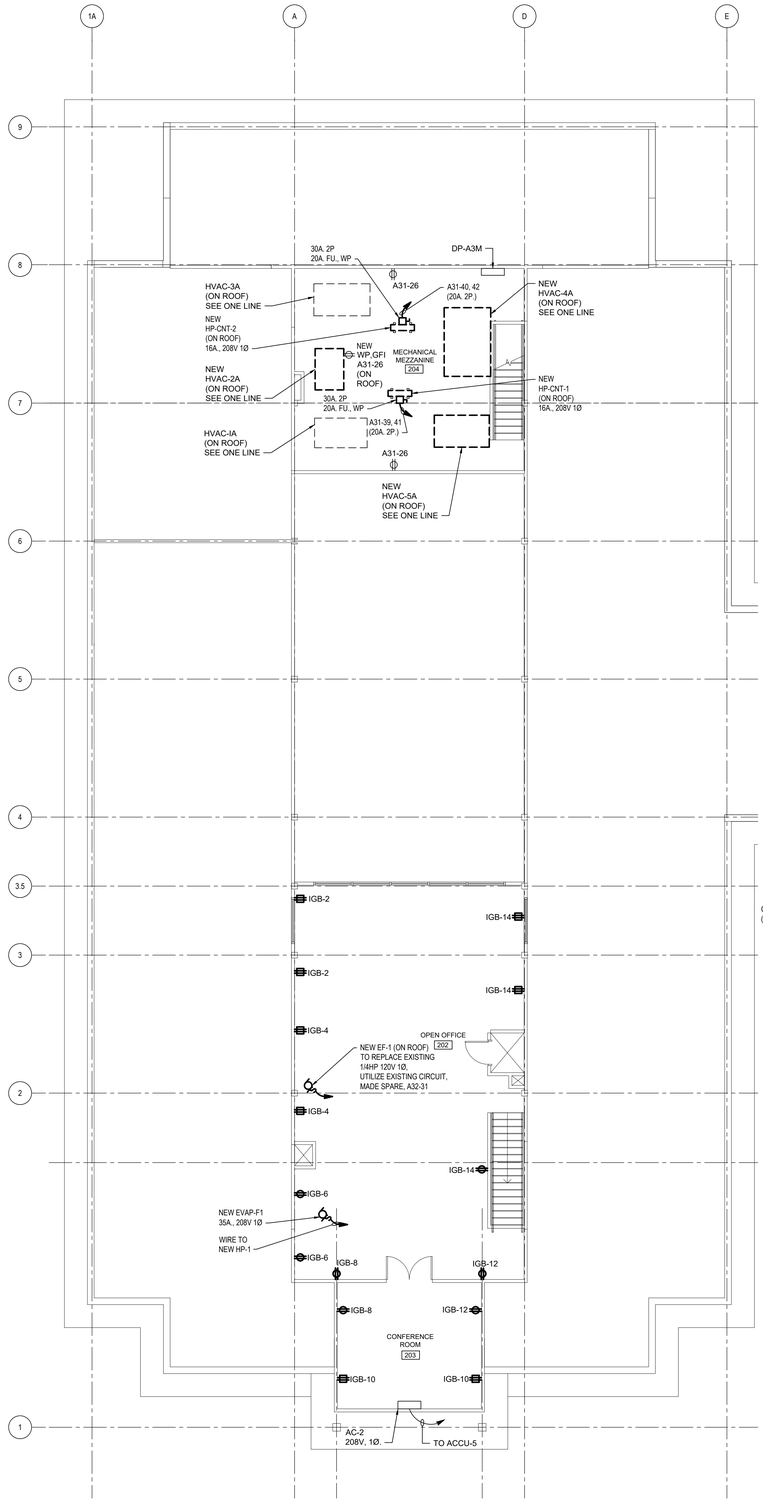
Modeler:	R.SEPULVEDA
PM:	B. REED
PIC:	B. REED
ACADFILE:	24-1301-EL-101.dwg
Project No.	24-1301

Sheet Title

FIRST FLOOR AND MEZZANINE PLANS - LIGHTING

Sheet Number

EL101

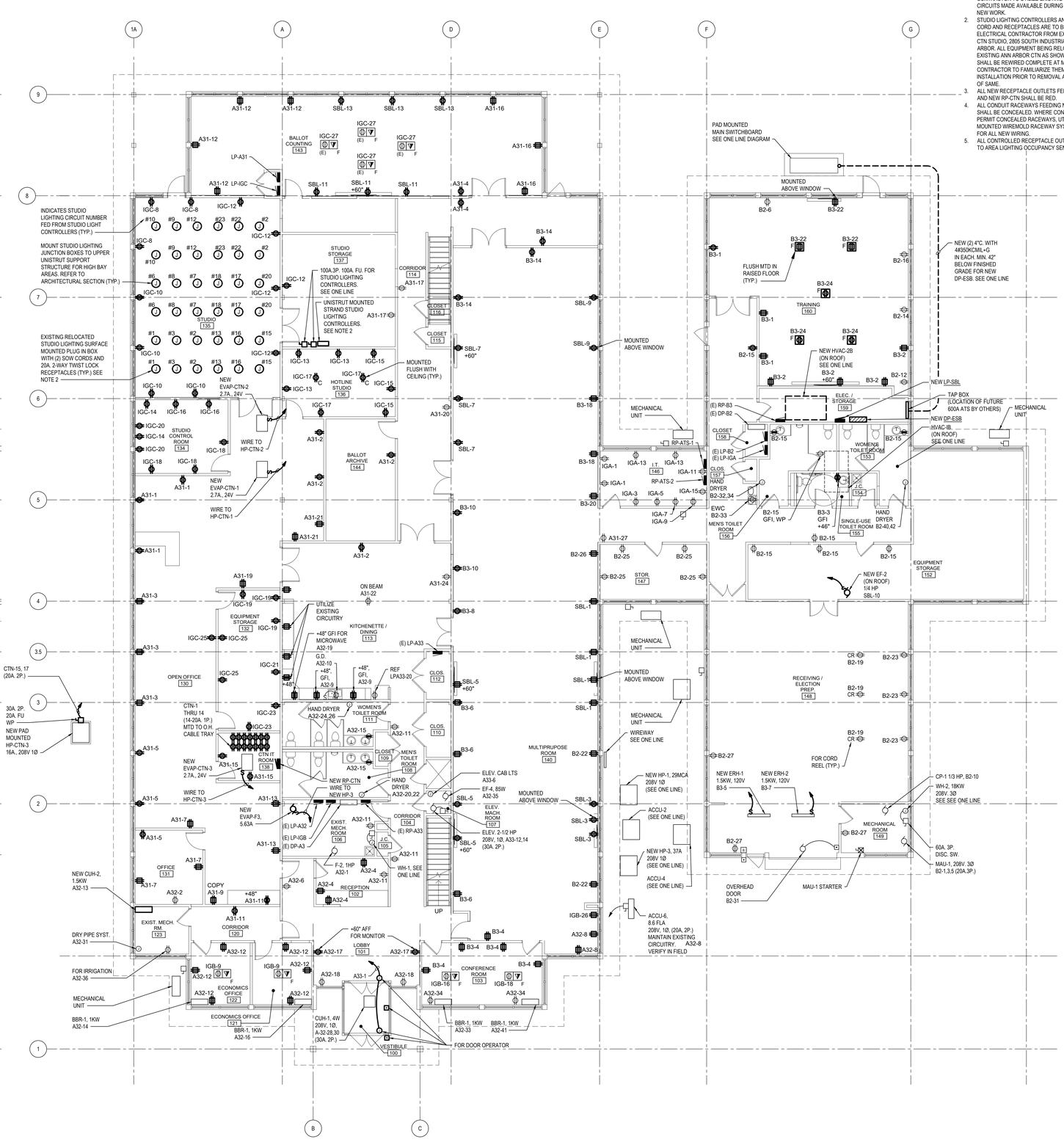


MEZZANINE PLAN - POWER

NORTH

SCALE: 1/8"=1'-0"

0 4 8 16 Feet 1/8" = 1'-0"



FIRST FLOOR PLAN - POWER

NORTH

SCALE: 1/8"=1'-0"

0 4 8 16 Feet 1/8" = 1'-0"

SHEET NOTES:

1. CIRCUIT NUMBERS HAVE BEEN SHOWN FOR INTENT ONLY. CONTRACTOR TO UTILIZE EXISTING SPARE BRANCH CIRCUITS MADE AVAILABLE DURING DEMOLITION FOR ALL NEW WORK.
2. STUDIO LIGHTING CONTROLLERS AND PLUG-IN BOXES WITH CORD AND RECEPTACLES ARE TO BE RELOCATED BY ELECTRICAL CONTRACTOR FROM EXISTING ANN ARBOR CTN STUDIO, 2805 SOUTH INDUSTRIAL PARKWAY, ANN ARBOR. ALL EQUIPMENT BEING RELOCATED FROM THE EXISTING ANN ARBOR CTN AS SHOWN ON SHEET ED104 SHALL BE REWIRED COMPLETE AT MILLER RD. LOCATION. CONTRACTOR TO FAMILIARIZE THEMSELVES WITH EXISTING INSTALLATION PRIOR TO REMOVAL AND RE-INSTALLATION OF SAME.
3. ALL NEW RECEPTACLE OUTLETS FED FROM NEW LP-SBL AND NEW RP-CTN SHALL BE RED.
4. ALL CONDUIT RACEWAYS FEEDING NEW OUTLETS/DEVICES SHALL BE CONCEALED. WHERE CONDITIONS DO NOT PERMIT CONCEALED RACEWAYS, UTILIZE SURFACE MOUNTED WIREMOLD RACEWAY SYSTEMS FOR ROUTING FOR ALL NEW WIRING.
5. ALL CONTROLLED RECEPTACLE OUTLETS SHALL BE WIRED TO AREA LIGHTING OCCUPANCY SENSOR.

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ANN ARBOR, MI 48103

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Modeler:	R.SEPULVEDA
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PIC:	B. REED
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Project No.	24-1301

Sheet Title

FIRST FLOOR AND MEZZANINE PLANS - POWER

Sheet Number

EP101

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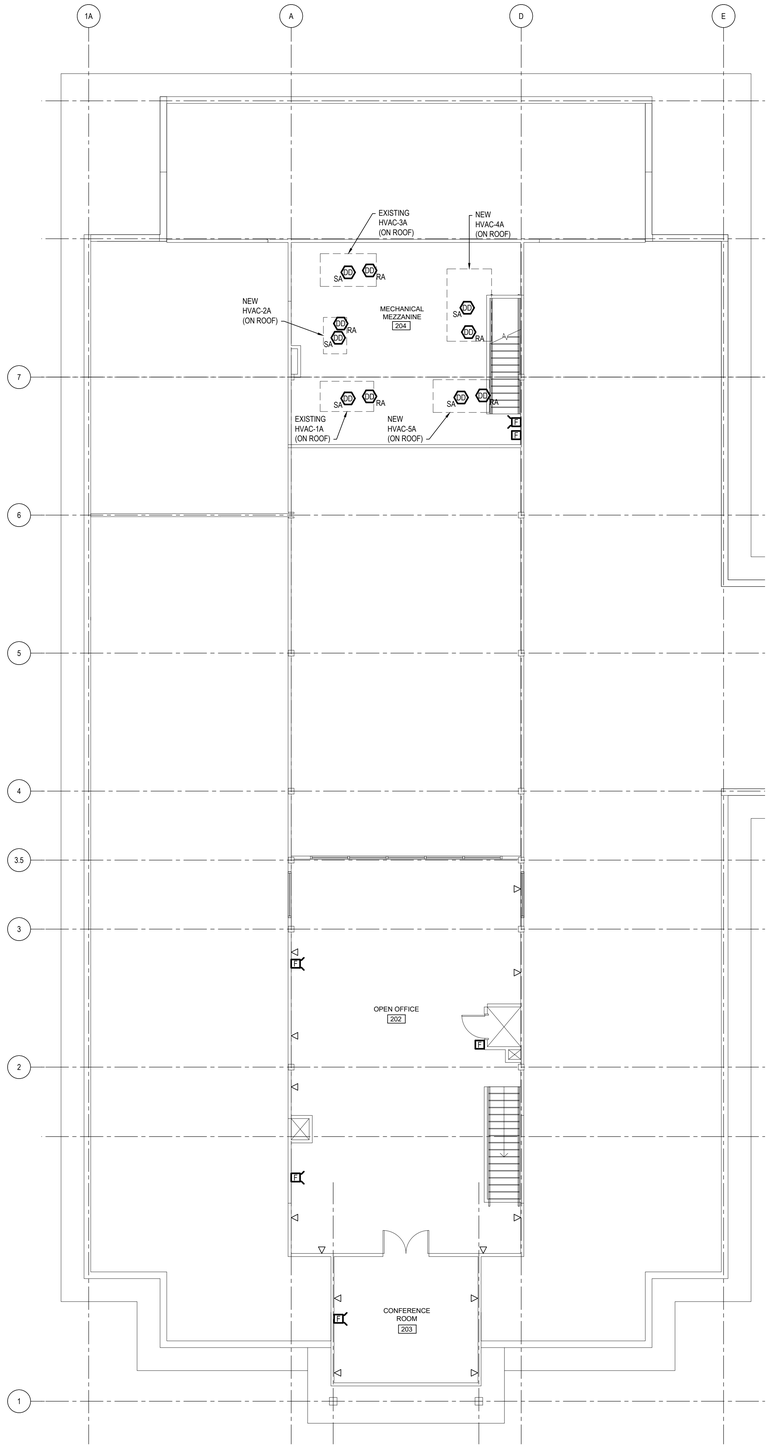
SHEET NOTES:

1. CONTRACTOR TO PROVIDE ALL LOW VOLTAGE/I.T./FIBER/AUDIO VISUAL CABLING AND DEVICES REQUIRED FOR COMPLETE AND OPERATIONAL SYSTEMS.
2. CONTRACTOR TO OBTAIN AND COORDINATE ALL NEW LOW VOLTAGE WIRING AND DEVICE SPECIFICATIONS, AND FINAL LOCATIONS OF DEVICES AND EQUIPMENT WITH CITY OF ANN ARBOR I.T./SECURITY GROUP.
3. ALL CONDUIT RACEWAYS TO LOW VOLTAGE DEVICES AND OUTLETS SHALL BE CONCEALED. WHERE CONDITIONS DO NOT PERMIT CONDUIT CONCEALMENT, UTILIZE WIREMOLD SURFACE MOUNTED RACEWAYS TO ROUTE NEW WIRES/CABLES.
4. ALL NEW CABLE TRAY SYSTEMS SHALL BE SIDE MOUNTED TO TRUSS BEAMS OR WALLS. PROVIDED WITH DIVIDER TO SEGREGATE FIRE ALARM CABLING FROM OTHER LOW VOLTAGE WIRING/CABLING. CABLE TRAY SHALL BE MONO SYSTEMS SOLID BOTTOM SBA6-XX-120 WITH SBA6-DIV-120 OR APPROVED EQUAL.

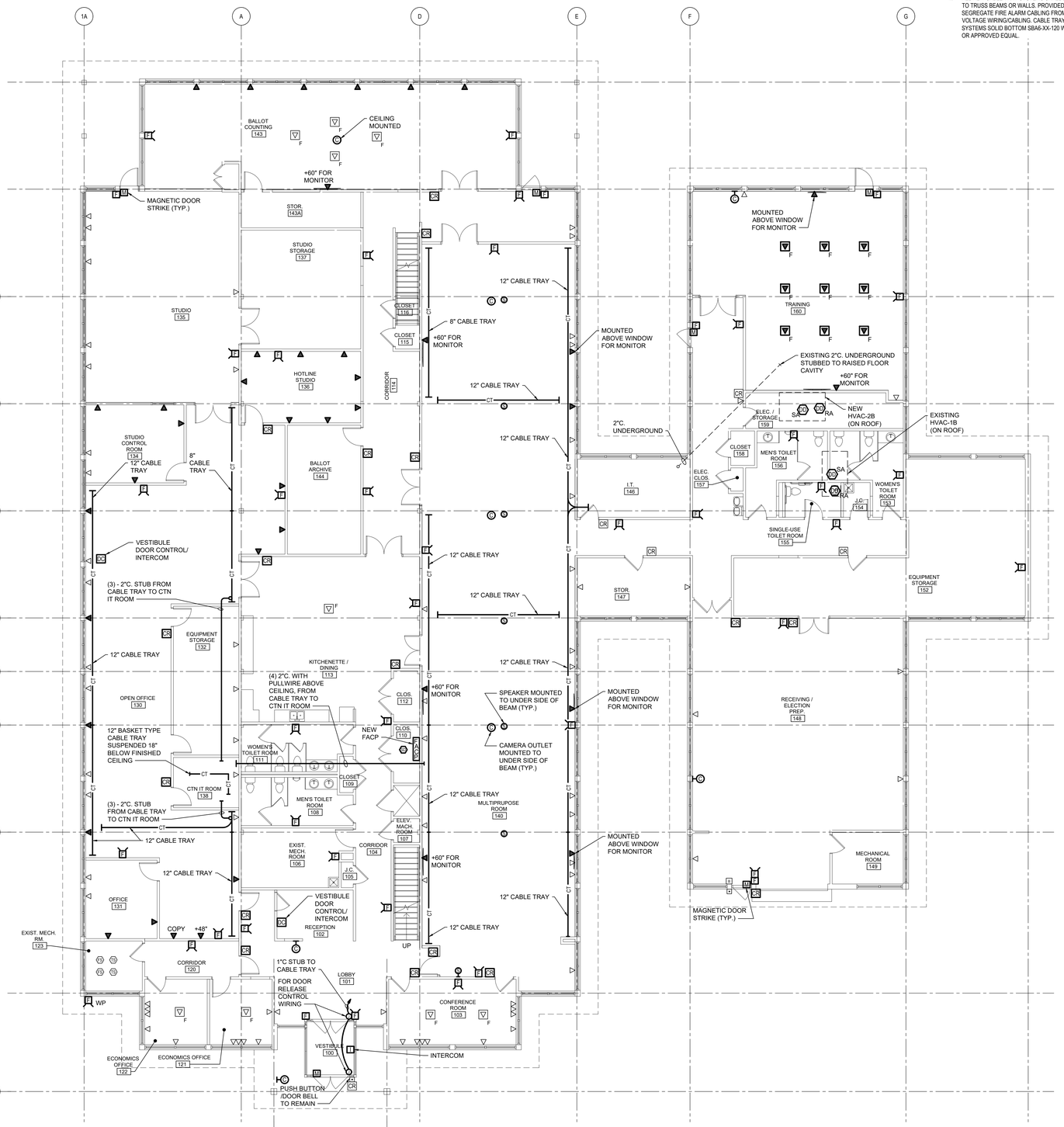


MEZZANINE PLAN - COMMUNICATION

NORTH

SCALE: 1/8"=1'-0"

0 4 8 16 1/8" = 1'-0" Feet



FIRST FLOOR PLAN - COMMUNICATION

NORTH

SCALE: 1/8"=1'-0"

0 4 8 16 1/8" = 1'-0" Feet

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ANN ARBOR, MI 48103

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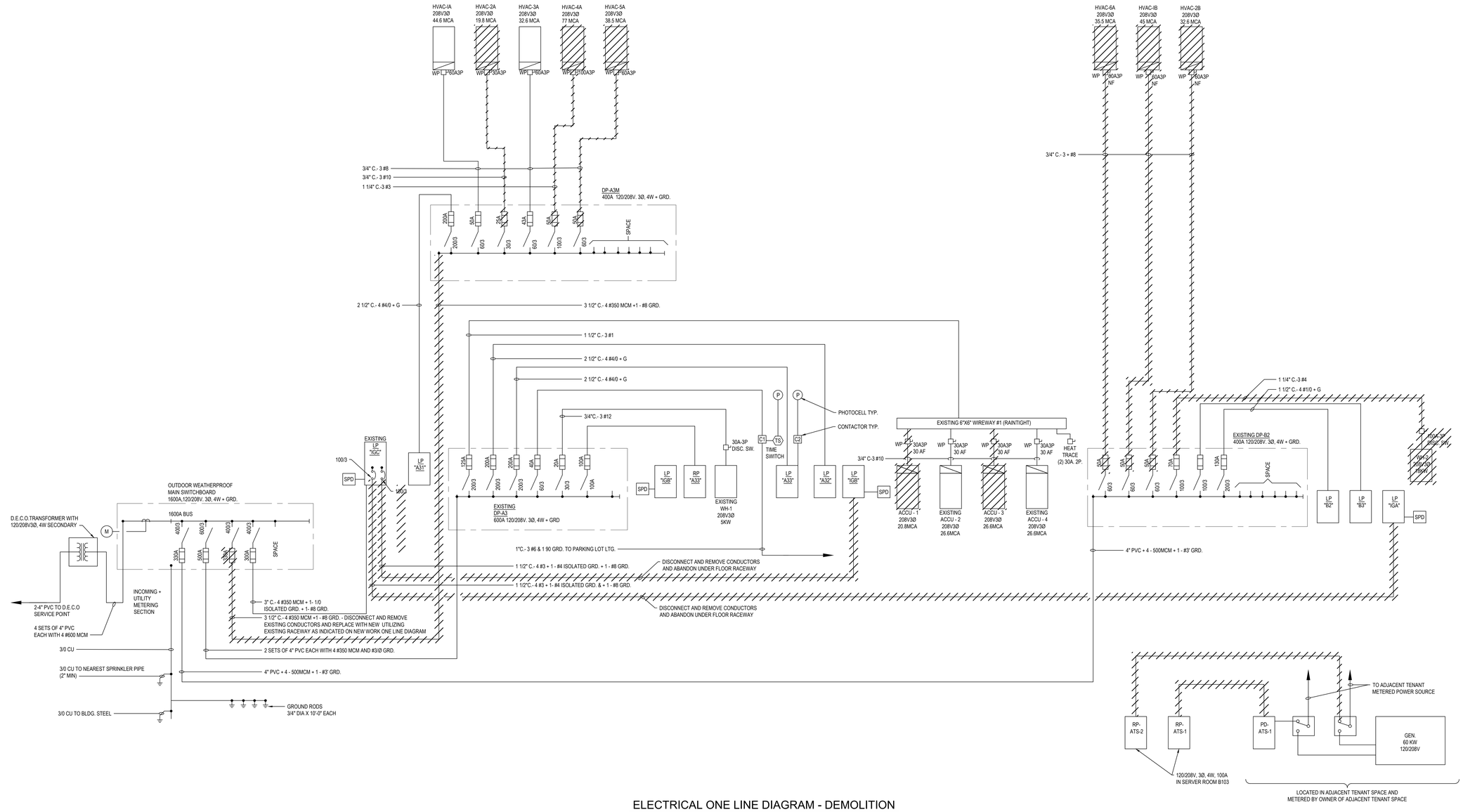
Designer:	T. RESCHKE
Modeler:	N. POLLARD
PM:	B. REED
PIC:	B. REED
ACADFILE:	24-1301-EC-101.dwg
Project No.	24-1301

Sheet Title

FIRST FLOOR AND MEZZANINE PLANS - COMMUNICATION

Sheet Number

EC101



ELECTRICAL ONE LINE DIAGRAM - DEMOLITION

SCALE: NO SCALE

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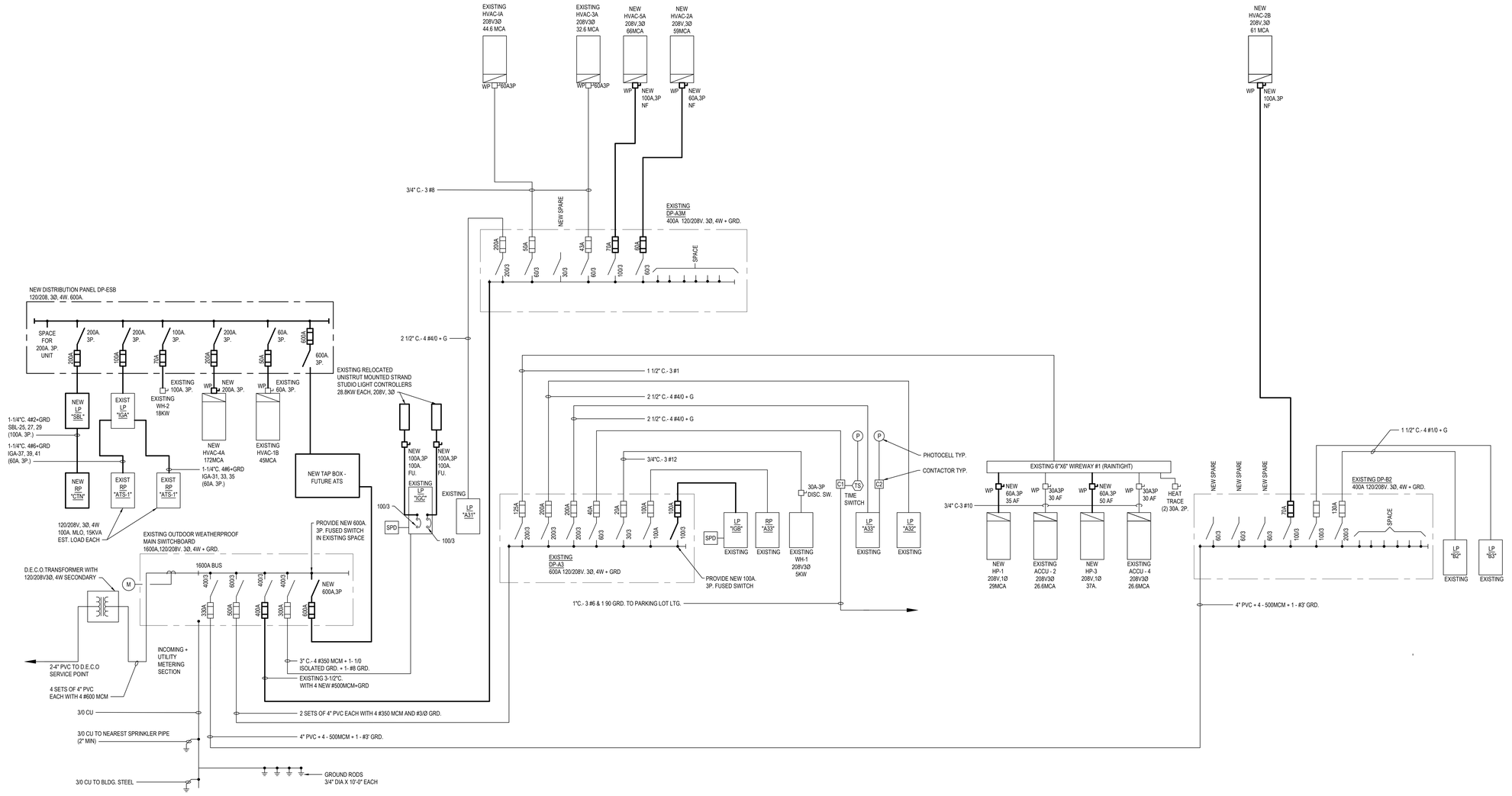
PM:	B. REED
PIC:	B. REED
ACADFILE:	24-1301-E-601.dwg
Project No.	24-1301

Sheet Title
ELECTRICAL ONE LINE DIAGRAM - DEMOLITION

Sheet Number
E-601

MAIN SWITCHBOARD ELECTRICAL LOAD SUMMARY

DISTRIBUTION PANEL - DP-A3	126.9KVA CONN.
DISTRIBUTION PANEL - DP-B2	50KVA CONN.
DISTRIBUTION PANEL - DP-A3M	87.5KVA CONN.
DISTRIBUTION PANEL - DP-A3M	87.5KVA CONN.
DISTRIBUTION PANEL - DP-ESB	173.8KVA CONN.
	525.7KVA CONN.
	1460A CONN.



ELECTRICAL ONE LINE DIAGRAM - NEW WORK

SCALE: NO SCALE

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CITY OF ANN ARBOR

ANN ARBOR ELECTION FACILITY

3021 MILLER RD.
ANN ARBOR, MI 48103

DATE	ISSUED FOR:
5/1/25	IFC

Designer	T.RESCHKE
Modeler:	R.SEPULVEDA
PM:	B. REED
PIC:	B. REED
ACADFILE:	24-1301-E-602.dwg
Project No.	24-1301

Sheet Title
ELECTRICAL ONE LINE DIAGRAM - NEW WORK

Sheet Number
E-602

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120/208VOLT–3PHASE–4WIRE+GRND PANELBOARD SCHEDULE

PANELBOARD DESIGNATION: EXISTING LP-A31 LOCATION: .
225 AMP BUS | M.C.B. X | M.L.O. | MOUNTING: FLUSH | SURFACE X
SPECIAL REQUIREMENTS: . SOURCE: .

CKT NO.	VA	LOAD TYPE	A B C	LOAD TYPE	VA	CKT No.
1	540	NEW RECEPT	20A 20A	NEW RECEPT	720	2
3	540	NEW RECEPT	20A 20A	NEW RECEPT	360	4
5	540	NEW RECEPT	20A 20A	NEW SPARE	.	6
7	540	NEW RECEPT	20A 20A	NEW SPARE	.	8
9	600	NEW COPY	20A 20A	NEW SPARE	.	10
11	360	NEW RECEPT	20A 20A	NEW RECEPT	720	12
13	360	NEW RECEPT	20A 20A	NEW RECEPT	540	14
15	360	NEW RECEPT	20A 20A	NEW SPARE	.	16
17	360	RECEPT	20A 20A	NEW SPARE	.	18
19	180	NEW RECEPT	20A 20A	RECEPT	180	20
21	360	NEW RECEPT	20A 20A	RECEPT	180	22
23	.	.	20A 20A	RECEPT	180	24
25	.	.	20A 20A	RECEPT (1) NEW	540	26
27	180	RECEPT	20A 20A	NEW SPARE	.	28
29	.	NEW SPARE	20A 20A	NEW SPARE	.	30
31	.	NEW SPARE	20A 20A	NEW SPARE	.	32
33	.	NEW SPARE	20A 20A	NEW SPARE	.	34
35	.	NEW SPARE	20A 20A	NEW SPARE	.	36
37	.	NEW SPARE	20A 20A	NEW SPARE	.	38
39	1664	NEW HP-CTN-2 & EVAP-CTN-2	20A 20A	NEW HP-CTN-1 & EVAP-CTN-1	1664	40
41	1664				1664	42

LIGHTING . VA AT 100 % = . VA
RECEPTACLE 8100 VA AT 100 % = 8100 VA (FIRST 10,000 VA AT 100%)
RECEPTACLE . VA AT 50 % = . VA
MISC. 7256 VA AT 100 % = 7256 VA
TOTAL 15,356 VA TOTAL DEMAND = 15,356 VA / 360 V = 41 A

NOTE:

DISCONNECT AND REMOVE 20A. 1P. SPARE BRANCH BREAKERS POSITIONS 39, 40, 41, AND 42. PROVIDE (2) NEW 20A. 2P. BREAKERS IN SPACE PROVIDED FOR NEW HEAT PUMPS AS INDICATED.

120/208VOLT–3PHASE–4WIRE+GRND PANELBOARD SCHEDULE

PANELBOARD DESIGNATION: EXISTING LP-A32 LOCATION: .
225 AMP BUS | M.C.B. X | M.L.O. | MOUNTING: FLUSH | SURFACE X
SPECIAL REQUIREMENTS: FED FROM 200A 3P FUSED SWITCH SOURCE: .

CKT NO.	VA	LOAD TYPE	A B C	LOAD TYPE	VA	CKT No.
1	1600	F-2 1HP	20A 20A	RECEPTACLE	180	2
3	360	NEW RECEPTACLE	20A 20A	NEW RECEPTACLE	540	4
5	360	NEW RECEPTACLE	20A 20A	RECEPTACLE	180	6
7	.	NEW SPARE	20A 20A	RECEPTACLE	360	8
9	360	RECEPT. (KITCHEN COUNTER)	20A 20A	RECEPT. GARBAGE DISPOSAL	1200	10
11	720	RECEPT. (HALL/MECH RM.)	20A 20A	RECEPTACLE	1080	12
13	1500	NEW CUH-2	20A 20A	BBR-1	1000	14
15	360	RECEPT. (TOILET ROOMS)	20A 20A	BBR-1	1000	16
17	360	NEW RECEPT	20A 20A	RECEPTACLE	360	18
19	1200	NEW MICROWAVE RECPT.	20A 20A	HAND DRYER	1000	20
21	360	RECEPTACLE	20A 20A		1000	22
23	.	NEW SPARE	20A 20A	HAND DRYER	1000	24
25	.	NEW SPARE	20A 20A		1000	26
27	.	NEW SPARE	20A 30A	CUH-1	2000	28
29	.	NEW SPARE	20A 30A		2000	30
31	1000	DRY STAND PIPE	30A 20A	SPARE	.	32
33	1000	BBR-1	20A 20A	RECEPT	360	34
35	85	EF-4 (ELEVATOR)	20A 20A	IRRIGATION	200	36
37	696	NEW EF-1	30A 20A	RECEPTACLE	360	38
39	360	RECEPTACLE	50A 20A		360	40
41	1000	BBR-1	20A	NEW SPARE	.	42

LIGHTING . VA AT 100 % = . VA
RECEPTACLE 6300 VA AT 100 % = 6300 VA (FIRST 10,000 VA AT 100%)
RECEPTACLE . VA AT 50 % = . VA
MISC. 20,281 VA AT 100 % = 20,281 VA
TOTAL 26,581 VA TOTAL DEMAND = 26,581 VA / 360 V = 74 A

120/208VOLT–3PHASE–4WIRE+GRND PANELBOARD SCHEDULE

PANELBOARD DESIGNATION: EXISTING RP-A33 LOCATION: .
100 AMP BUS | M.C.B. X | M.L.O. | MOUNTING: FLUSH | SURFACE X
SPECIAL REQUIREMENTS: . SOURCE: .

CKT NO.	VA	LOAD TYPE	A B C	LOAD TYPE	VA	CKT No.
1	1600	NEW DOOR OPERATOR	20A 20A	CONDENSATE PUMP	200	2
3		SPARE	20A 20A	SPARE	.	4
5		SPARE.	20A 20A	ELEVATOR CAB	200	6
7	1000	MECHANICAL UNIT.	20A 20A	FANS	400	8
9	1000		20A	SPACE	.	10
11	1000	MECHANICAL UNIT.	20A 30A	ELEVATOR 2-1/2 HP	1600	12
13	1000		20A		1600	14
15	1000	MECHANICAL UNIT.	20A 20A	MECHANICAL UNIT	1500	16
17	1000		20A		1500	18
19	1000	MECHANICAL UNIT.	20A 20A	MECHANICAL UNIT	1500	20
21	1000		20A		1500	22
23		SPACE	– –	SPACE	.	24

LIGHTING . VA AT 100 % = . VA
RECEPTACLE . VA AT 100 % = . VA (FIRST 10,000 VA AT 100%)
RECEPTACLE . VA AT 50 % = . VA
MISC. 18,000 VA AT 100 % = 18,000 VA
TOTAL 18,000 VA TOTAL DEMAND = 18,000 VA / 360 V = 50 A

120/208VOLT–3PHASE–4WIRE+GRND PANELBOARD SCHEDULE

PANELBOARD DESIGNATION: EXISTING RP-B2 LOCATION: .
200 AMP BUS | M.C.B. X | M.L.O. | MOUNTING: FLUSH | SURFACE X
SPECIAL REQUIREMENTS: . SOURCE: .

CKT NO.	VA	LOAD TYPE	A B C	LOAD TYPE	VA	CKT No.
1	1800		20A 20A	NEW SPARE	.	2
3	1800	MAU-1	20A		.	4
5	1800		20A 20A	RECEPT	180	6
7	1040	NEW LIGHTING	20A 20A	SPARE	.	8
9		SPARE	20A 20A	RECEPT.	180	10
11		SPARE	20A 20A	RECEPT.	180	12
13		SPARE	20A 20A	RECEPT.	180	14
15	1440	RECEPT.	20A 20A	RECEPT.	180	16
17		SPARE	20A 20A	RECEPT.	180	18
19	540	RECEPT.	20A 30A	SPARE	.	20
21		SPARE	20A 30A	NEW RECEPT.	180	22
23	540	RECEPT	20A 20A	SPARE	.	24
25	720	RECEPT	20A 20A	NEW RECEPT	360	26
27	540	RECEPT	20A	SPACE	.	28
29		SPACE	20A	SPACE	.	30
31	1200	DOOR OP.	20A 20A	HAND DRYER	1000	32
33	600	EWC	20A		1000	34
35		SPARE	20A 30A	SPACE	.	36
37		SPARE	20A 20A	SPARE	.	38
39		SPARE	20A 20A	HAND DRYER	1000	40
41		SPARE	20A		1000	42

LIGHTING 1040 VA AT 100 % = 1040 VA
RECEPTACLE 5220 VA AT 100 % = 5220 VA (FIRST 10,000 VA AT 100%)
RECEPTACLE . VA AT 50 % = . VA
MISC. 10,600 VA AT 100 % = 10,600 VA
TOTAL 16,860 VA TOTAL DEMAND = 16,860 VA / 360 V = 47 A

120/208VOLT–3PHASE–4WIRE+GRND PANELBOARD SCHEDULE

PANELBOARD DESIGNATION: EXISTING RP-B3 LOCATION: .
100 AMP BUS | M.C.B. X | M.L.O. | MOUNTING: FLUSH X | SURFACE
SPECIAL REQUIREMENTS: . SOURCE: .

CKT NO.	VA	LOAD TYPE	A B C	LOAD TYPE	VA	CKT No.
1	360	NEW RECEPT	20A 20A	NEW RECEPT	720	2
3	180	NEW RECEPT	20A 20A	NEW RECEPT	900	4
5	1500	NEW ERH-1	20A 20A	NEW RECEPT	540	6
7	1500	NEW ERH-2	20A 20A	NEW RECEPT	180	8
9	1500	MECHANICAL EQUIPMENT	20A 20A	NEW RECEPT	360	10
11	1500		20A 20A	.	.	12
13	.	SPACE	20A 20A	NEW RECEPT	540	14
15	.	SPACE	20A 20A	NEW RECEPT	360	16
17	.	SPACE	20A 20A	NEW RECEPT	360	18
19	.	SPACE	20A 20A			20
21	.	SPACE	20A 20A	NEW RECEPT	540	22
23	.	SPACE	20A 20A	NEW RECEPT	540	24

LIGHTING . VA AT 100 % = . VA
RECEPTACLE 5040 VA AT 100 % = 5040 VA (FIRST 10,000 VA AT 100%)
RECEPTACLE . VA AT 50 % = . VA
MISC. 6000 VA AT . % = 6000 VA
TOTAL 11,040 VA TOTAL DEMAND = 11,040 VA / 360 V = 31 A

NOTES:

PROVIDE NEW 20A. 1P. BRANCH BREAKERS IN POSITIONS 8,10,12,14,16,18,20,22, AND 24.

120/208VOLT–3PHASE–4WIRE+GRND PANELBOARD SCHEDULE

PANELBOARD DESIGNATION: EXISTING LP-A3A LOCATION: .
225 AMP BUS | M.C.B. X | M.L.O. | MOUNTING: FLUSH | SURFACE X
SPECIAL REQUIREMENTS: . SOURCE: .

CKT NO.	VA	LOAD TYPE	A B C	LOAD TYPE	VA	CKT No.
1	1600	RECEPT (I.T.)	30A 20A	RECEPTACLE (I.T.)	1200	2
3	1200	RECEPT (I.T.)	30A 20A	RECEPTACLE	360	4
5	1200	RECEPT (I.T.)	20A 20A	RECEPTACLE	360	6
7	1200	RECEPT (I.T.)	20A 20A	RECEPTACLE (I.T.)	1200	8
9	1200	RECEPT (I.T.)	20A 20A	RECEPTACLE	360	10
11	1200	RECEPT (I.T.)	20A 20A	SPARE	.	12
13	1600	RECEPT (I.T.)	20A 20A	RECEPTACLE	360	14
15	1200	RECEPT (I.T.)	20A –	SPACE	.	16
17		SPARE	20A –	SPACE	.	18
19	360	RECEPTACLE	20A 20A	RECEPTACLE	360	20
21		SPARE	20A 20A	MECHANICAL UNIT	1500	22
23	360	RECEPTACLE	20A 20A		1500	24
25	360	RECEPTACLE	20A 20A	MECHANICAL UNIT	200	26
27		SPARE	20A 20A		200	28
29		SPARE	20A 20A	MECHANICAL UNIT	1500	30
* 31	5000		60A 20A		1500	32
* 33	5000	EXISTING RP-ATS-2	20A	MECHANICAL UNIT	200	34
35	5000		20A		200	36
* 37	5000		60A 20A	MECHANICAL UNIT	750	38
* 39	5000	EXISTING RP-ATS-1	20A		750	40
* 41	5000			SPACE		42

LIGHTING . VA AT 100 % = . VA
RECEPTACLE 2280 VA AT 100 % = 2280 VA (FIRST 10,000 VA AT 100%)
RECEPTACLE . VA AT 50 % = . VA
MISC. 40,400 VA AT 100 % = 40,400 VA
TOTAL 51,100 VA TOTAL DEMAND = 51,100 VA / 360 V = 142 A

* DISCONNECT AND REMOVE EXISTING BRANCH BREAKERS, POSITIONS 31, 33, 37, 9 AND 41. REPLACE WITH TWO (2) NEW 60A. 3P. BRANCH FEEDER BREAKERS TO SERVE EXISTING RP-ATS-1 AND RP-ATS-2 AS SHOWN ON ONE LINE DIAGRAM.

120/208VOLT–3PHASE–4WIRE+GRND PANELBOARD SCHEDULE

PANELBOARD DESIGNATION: EXISTING LP-IGB LOCATION: .
225 AMP BUS | M.C.B. X | M.L.O. | MOUNTING: FLUSH | SURFACE X
SPECIAL REQUIREMENTS: . SOURCE: .

CKT NO.	VA	LOAD TYPE	A B C	LOAD TYPE	VA	CKT No.
1		SPARE	20A 20A	NEW RECEPT	360	2
3		SPARE	20A 20A	NEW RECEPT	360	4
5		SPARE	20A 20A	NEW RECEPT	360	6
7		SPARE	20A 20A	NEW RECEPT	360	8
9	360	RECEPTACLE	20A 20A	NEW RECEPT	360	10
11		SPARE	20A 20A	NEW RECEPT	360	12
13	360	RECEPTACLE	20A 20A	NEW RECEPT	540	14
15		SPARE	20A 20A	RECEPT	180	16
17		SPARE	20A 20A	RECEPT	180	18
19		SPARE	20A 30A	SPARE	.	20
21		SPARE	20A 30A	SPARE	.	22
23		SPARE	20A 20A	RECEPTACLE	360	24
25		SPARE	20A 20A	RECEPT	180	26
27		SPARE	20A 20A	SPACE	.	28
29		SPARE	20A 30A	MECHANICAL UNIT	1500	30
31		SPACE	– 40A		1500	32
33		SPACE	–	SPARE	.	34
35		SPACE	– 40A	NEW EVC	3328	36
37		SPACE	–		3328	38
39		SPACE	– 40A	NEW EVC	3328	40
41		SPACE	–		3328	42

LIGHTING . VA AT 100 % = . VA
RECEPTACLE 3960 VA AT 100 % = 3960 VA (FIRST 10,000 VA AT 100%)
MISC. 16,312 VA AT . % = 16,312 VA
TOTAL 20,272 VA TOTAL DEMAND = 20,272 VA / 360 V = 57 A

NOTE:

PROVIDE (2) NEW 40A. 2P. BRANCH BREAKER IN SPACE PROVIDED, POSTIONS 36, 38, 40, AND 42 FOR NEW OUTDOOR EVC.

120/208VOLT–3PHASE–4WIRE+GRND PANELBOARD SCHEDULE

PANELBOARD DESIGNATION: EXISTING LP-IGC LOCATION: .
400A AMP BUS | M.C.B. X | M.L.O. | MOUNTING: FLUSH | SURFACE X
SPECIAL REQUIREMENTS: . SOURCE: .

CKT NO.	VA	LOAD TYPE	A B C	LOAD TYPE	VA	CKT No.
1	9600		100A 100A		9600	2
3	9600	STRAND LIGHTING CONTROL		STRAND LIGHTING CONTROL	9600	4
5	9600				9600	6
7			50A 20A	NEW RECEPT	540	8
9		SURGE PROTECTION	20A 20A	NEW RECEPT	720	10
11			20A 20A	NEW RECEPT	900	12
13	540	NEW RECEPT	20A 20A	NEW RECEPT	360	14
15	540	NEW RECEPT	20A 20A	NEW RECEPT	360	16
17	540	NEW RECEPT	20A 20A	NEW RECEPT	540	18
19	540	NEW RECEPT	20A 20A	NEW RECEPT	360	20
21	180	NEW RECEPT	20A 20A	SPARE	.	22
23	360	NEW RECEPT	20A 20A	SPARE	.	24
25	540	NEW RECEPT	20A 20A	SPARE	.	26
27	720	RECEPT	20A 20A	SPARE	.	28
29		SPARE	20A 20A	SPARE	.	30
31		SPARE	20A 20A	SPARE	.	32
33		SPARE	20A 20A	SPARE	.	34
35		SPARE	20A 20A	SPARE	.	36
37		SPARE	20A 20A	SPARE	.	38
39		SPARE	20A 20A	SPARE	.	40
41		SPARE	20A 20A	SPARE	.	42

LIGHTING 57,600 VA AT 100 % = 57,600 VA
RECEPTACLE 7920 VA AT 100 % = 7920 VA (FIRST 10,000 VA AT 100%)
MISC. 16,312 VA AT 100 % = 16,312 VA
TOTAL 81,832 VA TOTAL DEMAND = 81,832 VA / 360 V = 227 A

120/208VOLT–3PHASE–4WIRE+GRND PANELBOARD SCHEDULE

PANELBOARD DESIGNATION: EXISTING LP-A33 LOCATION: .
225 AMP BUS | M.C.B. X | M.L.O. | MOUNTING: FLUSH | SURFACE X
SPECIAL REQUIREMENTS: . SOURCE: .

CKT NO.	VA	LOAD TYPE	A B C	LOAD TYPE	VA	CKT No.
1		SPARE	20A 20A	NEW LIGHTING	420	2
3		SPARE	20A 20A	NEW LIGHTING	880	4
5		SPARE	20A 20A	NEW LIGHTING	660	6
7		SPARE	20A 20A	NEW LIGHTING	990	8
9		SPARE	20A 20A	SPARE	.	10
11		SPARE	20A 20A	SPARE	.	12
13		SPARE	20A –	SPACE	.	14
15		SPARE	20A 20A	SPARE	.	16
17		SPARE	20A 20A	SPARE	.	18
19		SPARE	20A 20A	EXISTING REFRIG.	600	20
21		SPARE	20A 20A	NEW SPARE	.	22
23		SPARE	20A 20A	EXISTING F.A. OUTLET	1000	24
25		SPARE	20A 20A	EXISTING F.A. OUTLET	1000	26
27		SPARE	20A –	SPACE	.	28
29		SPARE	20A –	SPACE	.	30
31		SPARE	20A 20A	SPARE	.	32
33		SPARE	20A 20A	SPARE	.	34
35		SPARE	20A 20A	EXISTING OUTSIDE BLDG LTS	1200	36
37	1200	EXISTING OUTSIDE LIGHTS - MAIN ENTRANCE	20A 20A	EXISTING OUTSIDE BLDG LTS	1200	38
39		SPARE	20A 20A	EXISTING OUTSIDE BLDG LTS	1200	40
41	1200	EXISTING OUTSIDE LIGHTS - MAIN ENTRANCE	20A 20A	EXISTING OUTSIDE BLDG LTS	1200	42

LIGHTING 10,150 VA AT 100 % = 10,150 VA
RECEPTACLE . VA AT 100 % = . VA (FIRST 10,000 VA AT 100%)
RECEPTACLE . VA AT 50 % = . VA
MISC. 2900 VA AT . % = 2900 VA
TOTAL 13,050 VA TOTAL DEMAND = 13,050 VA / 360 V = 37 A

120/208VOLT–3PHASE–4WIRE+GRND PANELBOARD SCHEDULE

PANELBOARD DESIGNATION: NEW LP-SBL LOCATION: .
200 AMP BUS | M.C.B. X | M.L.O. | MOUNTING: FLUSH | SURFACE X
SPECIAL REQUIREMENTS: 22,000 AIC SOURCE: .

CKT NO.	VA	LOAD TYPE	A B C	LOAD TYPE	VA	CKT No.
1	540	NEW RECEPTACLE	20A 20A	NEW LIGHTING	1385	2
3	540	NEW RECEPTACLE	20A 20A	NEW LIGHTING	370	4
5		SPARE	20A 20A	NEW LIGHTING	501	6
7		SPARE	20A 20A	NEW LIGHTING	774	8
9	360	NEW RECEPTACLE.	20A 20A	NEW EF-2	696	10
11	720	NEW RECEPTACLE.	20A 20A	SPARE	.	12
13	540	NEW RECEPTACLE.	20A 20A	SPARE	.	14
15		SPARE	20A 20A	SPARE	.	16
17		SPARE	20A 20A	SPARE	.	18
19		SPARE	20A 20A	SPARE	.	20
21		SPARE	20A 20A	SPARE	.	22
23		SPARE	20A 20A	SPARE	.	24
25	6730		100A	SPACE	.	26
27	6730	NEW RP-CTN		SPACE	.	28
29	6730			SPACE	.	30

LIGHTING 3090 VA AT 100 % = 3090 VA
RECEPTACLE 2700 VA AT 100 % = 2700 VA
MISC. 20,824 VA AT 100 % = 20,824 VA
TOTAL 26,614 VA TOTAL DEMAND = 26,614 VA / 360 V = 74 A

120/208VOLT–3PHASE–4WIRE+GRND PANELBOARD SCHEDULE

PANELBOARD DESIGNATION: NEW RP-CTN LOCATION: CTN LT. ROOM
100 AMP BUS | M.C.B. X | M.L.O. | MOUNTING: FLUSH | SURFACE X
SPECIAL REQUIREMENTS: 22,000 AIC SOURCE: .

CKT NO.	VA	LOAD TYPE	A B C	LOAD TYPE	VA	CKT No.
1	1200	NEW I.T. RECEPTACLE	20A 20A	NEW I.T. RECEPTACLE	1200	2
3	1200	NEW I.T. RECEPTACLE	20A 20A	NEW I.T. RECEPTACLE	1200	4
5	1200	NEW I.T. RECEPTACLE	20A 20A	NEW I.T. RECEPTACLE	1200	6
7	1200	NEW I.T. RECEPTACLE	20A 20A	NEW I.T. RECEPTACLE	1200	8
9	1200	NEW I.T. RECEPTACLE	20A 20A	NEW I.T. RECEPTACLE	1200	10
11	1200	NEW I.T. RECEPTACLE	20A 20A	NEW I.T. RECEPTACLE	1200	12
13	1200	NEW I.T. RECEPTACLE	20A 20A	NEW I.T. RECEPTACLE	1200	14
15	1664	NEW HP-CTN-3	20A 20A	NEW I.T. LIGHTING	60	16
17	1664		20A 20A	SPARE	.	18
19		SPARE	20A 20A	SPARE	.	20
21		SPARE	20A 20A	SPARE	.	22
23		SPARE	20A 20A	SPARE	.	24
25		SPACE	– –	SPACE	.	26
27		SPACE	– –	SPACE	.	28
29		SPACE	– –	SPACE	.	30

LIGHTING 60 VA AT 100 % = 60 VA
RECEPTACLE . VA AT 100 % = 10000 VA (FIRST 10,000 VA AT 100%)
RECEPTACLE . VA AT 50 % = . VA
MISC. 20,128 VA AT 100 % = 20,128 VA
TOTAL 20,188 VA TOTAL DEMAND = 20,188 VA / 360 V = 56 A

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CITY OF ANN ARBOR
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ANN ARBOR, MI 48103

DATE	ISSUED FOR:
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Modeler:	R.SEPULVEDA
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Sheet Title
ELECTRICAL SCHEDULES

Sheet Number
E-603

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LIGHTING FIXTURE SCHEDULE

TYPE	DESCRIPTION
"A"	LED 2'x2' LAY-IN TYPE WITH 120V. DIMMABLE DRIVER AND 3500K, 2000 LUMEN OUTPUT. 16W. MARK # WHSPR 2X2 80CRI 35K 2000LM MIN1 120 SWC ZT OR APPROVED EQUAL.
"AEM"	SAME AS TYPE "A" EXCEPT WITH EMERGENCY BATTERY PACK. MARK # WHSPR 2x2 80CRI 35K 2000LM MIN1 120 SWC E10 WLCP ZT OR APPROVED EQUAL.
"A1"	SAME AS TYPE "A" EXCEPT FLANGE TYPE. MARK # WHSPR 2X2 80CRI 35K 2000LM MIN1 120 SWC ZT DGA22 OR APPROVED EQUAL.
"A1EM"	SAME AS TYPE "AEM" EXCEPT FLANGE TYPE. MARK # WHSPR 2x2 80CRI 35K 2000LM MIN1 120 SWC E10 WLCP ZT DGA22 OR APPROVED EQUAL.
"B"	LED 1'x4' LAY-IN TYPE WITH 120V. DIMMABLE DRIVER AND 3500K, 2000 LUMEN OUTPUT. 16W. MARK # WHSPR 1x4 80CRI 35K 2000LM MIN1 120 SWC ZT OR APPROVED EQUAL.
"BEM"	SAME AS TYPE "B" EXCEPT WITH EMERGENCY BATTERY PACK. MARK # WHSPR 1x4 80CRI 35K 2000LM MIN1 120 SWC E110W LCP ZT OR APPROVED EQUAL.
"C"	LED 4FT (REFER TO PLANS FOR TANDUM LENGTHS) SUSPENDED (REFER TO PLANS AND ARCHITECTURAL ELEVATIONS FOR CABLE LENGTHS) LINEAR DIRECT/INDIRECT TYPE WITH 120V. DIMMABLE DRIVER AND 3500K, 1000 LUMEN/FT OUTPUT. 24W. LITHONIA # GRDLSL4FT MSL4 80 CRI 35K 1D 1000LMF 20/80 MIN1 ZT 120 SCT F2/XXXAC 210 MCS SLP OR APPROVED EQUAL.
"CEM"	SAME AS TYPE "C" EXCEPT WITH EMERGENCY BATTERY PACK. LITHONIA # GRDLSL4FT MSL4 80 CRI 35K ID 1000LMF 20/80 MIN1 ZT 120 SCT E10WLCP F2/XXXAC210 MCS SLP OR APPROVED EQUAL.
"C1"	SAME AS TYPE "C" EXCEPT WITH 800 LUMEN/FT OUTPUT. 20W. LITHONIA # GRDLSL4FT MSL4 80 CRI 35K ID 800LMF 20/80 MIN1 ZT 120 SCT F2/XXXAC 210 MCS SLP OR APPROVED EQUAL.
"C1EM"	SAME AS TYPE "C1" EXCEPT WITH EMERGENCY BATTERY PACK. LITHONIA # GRDLSL4FT MSL4 80 CRI 35K ID 800LMF 20/80 MIN1 ZT 120 SCT E10WLCP F2/XXXAC 210 MCS SLP OR APPROVED EQUAL.
"D"	SAME AS TYPE "C" EXCEPT WITH 8FT LONG. 48W. LITHONIA # GRDLSL8FT MSL4 80 CRI 35K ID 1000LMF 20/80 MIN1 ZT 120 SCT F2/XXXAC 210 MCS SLP OR APPROVED EQUAL.
"DEM"	SAME AS TYPE "D" EXCEPT WITH EMERGENCY BATTERY PACK. LITHONIA # GRDLSL8FT MSL4 80 CRI 35K ID 1000LMF 20/80 MIN1 ZT 120 SCT 2E10WLCP F2/XXXAC 210 MCS SLP OR APPROVED EQUAL.
"D1"	SAME AS TYPE "C1" EXCEPT WITH 8FT LONG. 40W. LITHONIA # GRDLSL8FT MSL4 80 CRI 35K ID 800LMF 20/80 MIN1 ZT 120 SCT F2/XXXAC 210 MCS SLP OR APPROVED EQUAL.
"D1EM"	SAME AS TYPE "D1" EXCEPT WITH EMERGENCY BATTERY PACK. LITHONIA # GRDLSL8FT MSL4 80 CRI 35K ID 800LMF 20/80 MIN1 ZT 120 SCT 2E10WLCP F2/XXXAC 210 MCS SLP OR APPROVED EQUAL.
"F"	LED 4FT SURFACE MOUNTED STRIP FIXTURE WITH 120V. DIMMABLE DRIVER AND 3500K, 3000 LUMEN OUTPUT. 19W. LITHONIA #CLXL48 3000LM SEF RDL WD MVOLT GZ10 35K 80CRI OR APPROVED EQUAL.
"FEM"	SAME AS TYPE "F" EXCEPT WITH EMERGENCY BATTERY PACK. LITHONIA #CLXL48 3000LM SEF RDL WD MVOLT GZ10 35K 80CRI E10W SPD OR APPROVED EQUAL.
"F1"	SAME AS TYPE "F" EXCEPT SUSPENDED (REFER TO PLANS AND ARCHITECTURAL ELEVATIONS FOR CABLE LENGTHS). 19W. LITHONIA #CLXL48 3000LM SEF RDL WD MVOLT GZ10 35K 80CRI ZAC FP120 OR APPROVED EQUAL.
"F1EM"	SAME AS TYPE "F1" EXCEPT WITH EMERGENCY BATTERY PACK. LITHONIA #CLXL48 3000LM SEF RDL WD MVOLT GZ10 35K 80CRI E10W SLD ZAC 120 OR APPROVED EQUAL.
"F2"	SAME AS TYPE "F1" EXCEPT WITH BLACK FINISH LITHONIA # CLXL48 3000LM SEF RDL WD MVOLT GZ10 35K 80CRI ZAC FP120BK OR APPROVED EQUAL.
"F2EM"	SAME AS TYPE "F2" EXCEPT WITH EMERGENCY BATTERY PACK. LITHONIA #CLXL48 3000LM SEF RDL WD MVOLT GZ10 35K 80CRI E10W ZAC FP120BK OR APPROVED EQUAL.
"G"	INCANDESCENT WALL MOUNTED "ON-AIR" INDICATOR LIGHT TO BE RELOCATED FROM EXISTING CTN SITE. CONTRACTOR TO COORDINATE REMOVAL FROM EXISTING CTN SITE AND RELOCATION OF FIXTURE WITH OWNER.
"JEM"	LED 8" ROUND RECESSED DOWNLIGHT WITH CLEAR REFLECTOR, 120V. DIMMABLE DRIVER, EMERGENCY BATTERY PACK AND 3500K, 2000 LUMEN OUTPUT. LITHONIA # GTLF4 20L 120 EZ1 LP835 OR APPROVED EQUAL.
"K"	LED 2'x4' LAY-IN TYPE WITH 120V. DIMMABLE DRIVER AND 3500K, 3000 LUMEN OUTPUT. 21W. MARK # WHSPR 2X4 80CRI 35K3000LM MIN1 120 SWC ZT OR APPROVED EQUAL.
"KEM"	SAME AS TYPE "K" EXCEPT WITH EMERGENCY BATTERY PACK MARK # WHSPR 2X4 80CRI 35K 3000LM MIN1 120 SWC E10WLCPZT OR APPROVED EQUAL.
"K1EM"	SAME AS TYPE "K" EXCEPT FLANGE TYPE MARK # WHSPR 2X4 80CRI 35K 3000LM MIN1 120 SWC E10WLCPZT DGA24 OR APPROVED EQUAL.
"X"	LED UNIVERSAL MOUNTED EMERGENCY EXIT LIGHT FIXTURE WITH 6" HIGH RED LETTER ON WHITE BACKGROUND, BATTERY, SOLID STATE CHARGER, TEST SWITCH AND PILOT LIGHT. PROVIDE OUTDOOR REMOTE HEADS AS APPLICABLE AT EXTERIOR DOORS. LITHONIA # LQMSW3R MVOLT ELN OR APPROVED EQUAL.

LIGHTING CONTROL SCHEDULE

ROOM NUMBER	ROOM NAME	CONTROLS	SEQUENCE OF OPERATION
100	VESTIBULE	1. PROGRAMMABLE TIME SWITCH	1. LIGHTS TO TURN ON/OFF BASED ON PROGRAMMABLE TIME SCHEDULE. 2. LIGHT TO TURN ON VIA OCCUPANCY SENSOR DURING TIMED "OFF".
101	LOBBY	1. OCCUPANCY SENSOR 2. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% UPON OCCUPANCY DETECTION OR MANUAL ON. 2. LIGHTING IS TO TURN OFF 7.5 MIN AFTER OCCUPANCY IS LAST DETECTED, OR MANUAL OFF.
102	RECEPTION	1. OCCUPANCY / DAYLIGHT SENSOR 2. DIMMING SWITCH 3. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% UPON MANUAL ON. 2. LIGHTS TO BE CONTINUOUSLY DIMMABLE VIA MANUAL CONTROL 3. 7.5 MIN AFTER OCCUPANCY IS LAST DETECTED, OR MANUAL OFF LIGHTING IS TO TURN OFF.
103	CONFERENCE ROOM	1. OCCUPANCY / DAYLIGHT SENSOR 2. DIMMING SWITCH 3. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% FOR MANUAL ON. 2. LIGHTS TO BE DIMMED BASED ON DAYLIGHT CONTRIBUTION WHERE APPLICABLE AND CONTINUOUSLY DIMMABLE VIA MANUAL CONTROL. 3. 7.5 MIN AFTER OCCUPANCY IS LAST DETECTED, OR MANUAL CONTROL LIGHTING IS TO TURN OFF.
104	CORRIDOR	1. OCCUPANCY SENSOR 2. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% UPON OCCUPANCY DETECTION OR MANUAL ON. 2. LIGHTING IS TO TURN OFF 7.5 MIN AFTER OCCUPANCY IS LAST DETECTED, OR MANUAL OFF.
106	MECHANICAL ROOM	1. ON/OFF	1. LIGHTS TO BE TURNED ON 100% MANUAL ON. 2. LIGHTS SHALL BE TURNED OFF MANUALLY UPON EXITING SPACE.
107	ELEV. MACHINE ROOM	1. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% UPON OR MANUAL ON. 2. LIGHTING IS TO TURN OFF MANUALLY UPON LEAVING SPACE.
108	MEN'S TOILET ROOM	1. OCCUPANCY SENSOR 2. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% UPON OCCUPANCY DETECTION OR MANUAL ON. 2. 7.5 MINUTES AFTER OCCUPANCY IS LAST DETECTED, OR MANUAL OFF LIGHTING IS TO TURN OFF.
110	CLOSET	1. OCCUPANCY SENSOR 2. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% UPON MANUAL ON. 2. LIGHTING IS TO TURN OFF 7.5 MIN AFTER OCCUPANCY IS LAST DETECTED, OR MANUAL OFF.
111	WOMEN'S TOILET ROOM	1. OCCUPANCY SENSOR 2. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% UPON OCCUPANCY DETECTION OR MANUAL ON. 2. 7.5 MINUTES AFTER OCCUPANCY IS LAST DETECTED, OR MANUAL OFF LIGHTING IS TO TURN OFF.
112	CLOSET	1. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% UPON MANUAL ON. 2. LIGHTING IS TO TURN OFF MANUALLY UPON LEAVING SPACE.
113	KITCHENETTE/DINING	1. OCCUPANCY / DAYLIGHT SENSOR 2. DIMMING SWITCH 3. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 50% UPON OCCUPANCY DETECTION AND 100% FOR MANUAL ON. 2. LIGHTS ARE TO BE DIMMED BASED ON DAYLIGHT CONTRIBUTION WHERE APPLICABLE, AND CONTINUOUSLY DIMMABLE VIA MANUAL CONTROL. 3. 7.5 MINUTES AFTER OCCUPANCY IS LAST DETECTED, OR MANUALLY OFF, LIGHTING IS TO TURN OFF.
114	CORRIDOR	1. OCCUPANCY SENSOR 2. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% UPON OCCUPANCY DETECTION OR MANUAL ON. 2. LIGHTING IS TO TURN OFF 7.5 MIN AFTER OCCUPANCY IS LAST DETECTED, OR MANUALLY OFF.
120	CORRIDOR	1. OCCUPANCY SENSOR 2. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% UPON OCCUPANCY DETECTION OR MANUAL ON. 2. LIGHTING IS TO TURN OFF 7.5 MIN AFTER OCCUPANCY IS LAST DETECTED, OR MANUALLY OFF.
121	ECONOMICS OFFICE	1. OCCUPANCY / DAYLIGHT SENSOR 2. DIMMING SWITCH 3. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% FOR MANUAL ON. 2. LIGHTS TO BE CONTINUOUSLY DIMMABLE VIA MANUAL CONTROL. 3. 7.5 MIN AFTER OCCUPANCY IS LAST DETECTED, OR MANUAL CONTROL, LIGHTING IS TO TURN OFF.
122	ECONOMICS OFFICE	1. OCCUPANCY / DAYLIGHT SENSOR 2. DIMMING SWITCH 3. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% FOR MANUAL ON. 2. LIGHTS TO BE CONTINUOUSLY DIMMABLE VIA MANUAL CONTROL. 3. 7.5 MIN AFTER OCCUPANCY IS LAST DETECTED, OR MANUAL CONTROL, LIGHTING IS TO TURN OFF.
123	MECHANICAL ROOM	1. ON/OFF	1. LIGHTS TO BE TURNED ON 100% MANUAL ON. 2. LIGHTS SHALL BE TURNED OFF MANUALLY UPON EXITING SPACE.
130	OPEN OFFICE	1. OCCUPANCY DAYLIGHT SENSOR 2. DIMMING SWITCH 3. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 50% UPON OCCUPANCY DETECTION AND 100% FOR MANUAL ON. 2. LIGHTS ARE TO BE DIMMED BASED ON DAYLIGHT CONTRIBUTION WHERE APPLICABLE, AND CONTINUOUSLY DIMMABLE VIA MANUAL CONTROL. 3. 7.5 MINUTES AFTER OCCUPANCY IS LAST DETECTED, OR MANUALLY OFF, LIGHTING IS TO TURN OFF.
131	OFFICE	1. OCCUPANCY / DAYLIGHT SENSOR 2. DIMMING SWITCH 3. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% FOR MANUAL ON. 2. LIGHTS TO BE DIMMED BASED ON DAYLIGHT CONTRIBUTION WHERE APPLICABLE AND CONTINUOUSLY DIMMABLE VIA MANUAL CONTROL. 3. 7.5 MIN AFTER OCCUPANCY IS LAST DETECTED, OR MANUAL CONTROL LIGHTING IS TO TURN OFF.
132	EQUIPMENT STORAGE	1. OCCUPANCY SENSOR 2. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% UPON MANUAL ON. 2. 7.5 MINUTES AFTER OCCUPANCY IS LAST DETECTED, OR MANUALLY OFF LIGHTING IS TO TURN OFF.
134	STUDIO CONTROL ROOM	1. OCCUPANCY / DAYLIGHT SENSOR 2. DIMMING SWITCH 3. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% FOR MANUAL ON. 2. LIGHTS TO BE DIMMED BASED ON DAYLIGHT CONTRIBUTION WHERE APPLICABLE AND CONTINUOUSLY DIMMABLE VIA MANUAL CONTROL. 3. 7.5 MIN AFTER OCCUPANCY IS LAST DETECTED, OR MANUAL CONTROL LIGHTING IS TO TURN OFF.
135	STUDIO TYPE "F1" HOUSE LIGHTING ONLY	1. DIMMING SWITCH 2. ON/OFF	1. LIGHTS ARE TO TURN ON 100% UPON MANUAL ON. 2. LIGHTS ARE TO BE CONTINUOUSLY DIMMABLE VIA MANUAL CONTROL. 3. LIGHTS TO BE TURNED OFF MANUALLY.
136	HOTLINE STUDIO	1. OCCUPANCY SENSOR 2. DIMMING SWITCH 3. ON/OFF	1. LIGHTS TO BE TURNED ON 100% MANUAL ON. 2. LIGHTS SHALL BE TURNED OFF MANUALLY UPON EXITING SPACE.
137	STUDIO STORAGE	1. OCCUPANCY SENSOR 2. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% UPON MANUAL ON. 2. 7.5 MINUTES AFTER OCCUPANCY IS LAST DETECTED, OR MANUALLY OFF, LIGHTING IS TO TURN OFF.
138	CTN I.T.	1. ON/OFF	1. LIGHTS ARE TO TURN ON 100% UPON MANUAL ON. 2. LIGHTING IS TO TURN OFF MANUALLY UPON LEAVING SPACE.
140	MULTIPURPOSE ROOM	1. OCCUPANCY / DAYLIGHT SENSOR 2. DIMMING SWITCH 3. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 50% UPON OCCUPANCY DETECTION AND 100% FOR MANUAL ON. 2. LIGHTS ARE TO BE DIMMED BASED ON DAYLIGHT CONTRIBUTION WHERE APPLICABLE, AND CONTINUOUSLY DIMMABLE VIA MANUAL CONTROL. 3. 7.5 MINUTES AFTER OCCUPANCY IS LAST DETECTED, OR MANUALLY OFF, LIGHTING IS TO TURN OFF.
143	BALLOT COUNTING	1. OCCUPANCY / DAYLIGHT SENSOR 2. DIMMING SWITCH 3. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 50% UPON OCCUPANCY DETECTION AND 100% FOR MANUAL ON. 2. LIGHTS ARE TO BE DIMMED BASED ON DAYLIGHT CONTRIBUTION WHERE APPLICABLE, AND CONTINUOUSLY DIMMABLE VIA MANUAL CONTROL. 3. 7.5 MINUTES AFTER OCCUPANCY IS LAST DETECTED, OR MANUALLY OFF, LIGHTING IS TO TURN OFF.
143A	STORAGE	1. OCCUPANCY SENSOR 2. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% UPON MANUAL ON. 2. 7.5 MINUTES AFTER OCCUPANCY IS LAST DETECTED, OR MANUALLY OFF, LIGHTING IS TO TURN OFF.
144	BALLOT ARCHIVE	1. OCCUPANCY SENSOR 2. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% UPON MANUAL ON. 2. 7.5 MINUTES AFTER OCCUPANCY IS LAST DETECTED, OR MANUALLY OFF, LIGHTING IS TO TURN OFF.
146	I.T.	1. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% UPON OCCUPANCY DETECTION OR MANUAL ON. 2. LIGHTING IS TO TURN OFF MANUALLY UPON LEAVING SPACE.
147	STORAGE	1. OCCUPANCY / DAYLIGHT SENSOR 2. DIMMING SWITCH 3. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% FOR MANUAL ON. 2. LIGHTS TO BE DIMMED BASED ON DAYLIGHT CONTRIBUTION WHERE APPLICABLE AND CONTINUOUSLY DIMMABLE VIA MANUAL CONTROL. 3. 7.5 MIN AFTER OCCUPANCY IS LAST DETECTED, OR MANUAL CONTROL, LIGHTING IS TO TURN OFF.
148	RECEIVING/ELECTION PREP	1. OCCUPANCY / DAYLIGHT SENSOR 2. DIMMING SWITCH 3. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 50% UPON OCCUPANCY DETECTION AND 100% FOR MANUAL ON. 2. LIGHTS ARE TO BE DIMMED BASED ON DAYLIGHT CONTRIBUTION WHERE APPLICABLE, AND CONTINUOUSLY DIMMABLE VIA MANUAL CONTROL. 3. 7.5 MINUTES AFTER OCCUPANCY IS LAST DETECTED, OR MANUALLY OFF, LIGHTING IS TO TURN OFF.
149	MECHANICAL ROOM	1. ON/OFF	1. LIGHTS TO BE TURNED ON 100% MANUAL ON. 2. LIGHTS SHALL BE TURNED OFF MANUALLY UPON EXITING SPACE.
152	EQUIPMENT STORAGE	1. OCCUPANCY / DAYLIGHT SENSOR 2. DIMMING SWITCH 3. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% FOR MANUAL ON. 2. LIGHTS TO BE DIMMED BASED ON DAYLIGHT CONTRIBUTION WHERE APPLICABLE AND CONTINUOUSLY DIMMABLE VIA MANUAL CONTROL. 3. 7.5 MIN AFTER OCCUPANCY IS LAST DETECTED, OR MANUAL CONTROL LIGHTING IS TO TURN OFF.
153	WOMEN'S TOILET ROOM	1. OCCUPANCY SENSOR 2. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% UPON OCCUPANCY DETECTION OR MANUAL ON. 2. 7.5 MINUTES AFTER OCCUPANCY IS LAST DETECTED, OR MANUAL OFF LIGHTING IS TO TURN OFF.
154	JAN. CLOS.	1. OCCUPANCY SENSOR 2. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% UPON MANUAL ON. 2. 7.5 MINUTES AFTER OCCUPANCY IS LAST DETECTED, OR MANUALLY OFF LIGHTING IS TO TURN OFF.
155	SINGLE-USE TOILET ROOM	1. OCCUPANCY SENSOR 2. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% UPON OCCUPANCY DETECTION OR MANUAL ON. 2. 7.5 MINUTES AFTER OCCUPANCY IS LAST DETECTED, OR MANUAL OFF LIGHTING IS TO TURN OFF.
156	MEN'S TOILET ROOM	1. OCCUPANCY SENSOR 2. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% UPON OCCUPANCY DETECTION OR MANUAL ON. 2. 7.5 MINUTES AFTER OCCUPANCY IS LAST DETECTED, OR MANUAL OFF LIGHTING IS TO TURN OFF.
158	CLOSET	1. ON/OFF	1. LIGHTS ARE TO TURN ON 100% MANUAL ON. 2. LIGHTING IS TO TURN OFF MANUALLY UPON EXITING SPACE.
159	ELEC./STORAGE	1. ON/OFF	1. LIGHTS ARE TO TURN ON 100% MANUAL ON. 2. LIGHTING IS TO TURN OFF MANUALLY UPON EXITING SPACE.
160	TRAINING	1. OCCUPANCY / DAYLIGHT SENSOR 2. DIMMING SWITCH 3. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 100% FOR MANUAL ON. 2. LIGHTS TO BE DIMMED BASED ON DAYLIGHT CONTRIBUTION WHERE APPLICABLE AND CONTINUOUSLY DIMMABLE VIA MANUAL CONTROL. 3. 7.5 MIN AFTER OCCUPANCY IS LAST DETECTED, OR MANUAL CONTROL LIGHTING IS TO TURN OFF.
202	MEZZANINE OPEN OFFICE	1. OCCUPANCY SENSOR 2. DIMMING SWITCH 3. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 50% UPON OCCUPANCY DETECTION AND 100% FOR MANUAL ON. 2. LIGHTS TO BE DIMMABLE VIA MANUAL CONTROL 3. 7.5 MIN AFTER OCCUPANCY IS LAST DETECTED, OR MANUALLY OFF, LIGHTING IS TO TURN OFF.
203	MEZZANINE CONFERENCE ROOM	1. OCCUPANCY SENSOR 2. DIMMING SWITCH 3. ON/OFF	1. LIGHTS ARE TO RAMP UP TO 50% UPON OCCUPANCY DETECTION AND 100% FOR MANUAL ON. 2. LIGHTS TO BE DIMMABLE VIA MANUAL CONTROL 3. 7.5 MIN AFTER OCCUPANCY IS LAST DETECTED, OR MANUALLY OFF, LIGHTING IS TO TURN OFF.

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DATE	ISSUED FOR:
5/1/25	IFC

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LIGHTING CONTROL SCHEDULE

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E-604

DiClemente Siegel Design Inc.
Engineering and Architecture

SPECIFICATIONS

ANN ARBOR

ELECTION FACILITY RENOVATION

ANN ARBOR, MICHIGAN

DSD PROJECT NO. 24-1301.00

5/1/25

ISSUED FOR BID

SPECIFICATIONS

FOR

ANN ARBOR

ELECTION FACILITY RENOVATION

ANN ARBOR, MICHIGAN

Prepared by:

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DSD PROJECT NO. 24-1301.00

5/1/25

ISSUED FOR BID

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Framing with engineered wood products.
3. Shear wall panels.
4. Rooftop equipment bases and support curbs.
5. Wood blocking, cants, and nailers.
6. Wood furring and grounds.
7. Wood sleepers.
8. Plywood backing panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
4. Shear panels.
5. Power-driven fasteners.
6. Post-installed anchors.
7. Metal framing anchors.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.

2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal (38-mm actual) thickness or less; 19 percent for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.

C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, [furring,] [stripping,] and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with

the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

E. Application: Treat items indicated on Drawings, and the following:

1. Framing for raised platforms.
2. Framing for stages.
3. Concealed blocking.
4. Framing for non-load-bearing partitions.
5. Framing for non-load-bearing exterior walls.
6. Roof construction.
7. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

A. Framing Other Than Non-Load-Bearing Partitions: Any species and grade with a modulus of elasticity of at least 1,500,000 psi (10 350 MPa) and an extreme fiber stress in bending of at least 1000 psi (6.9 MPa) for 2-inch nominal (38-mm actual) thickness and 12-inch nominal (286-mm actual) width for single-member use.

1. Application: Framing, blocking other than interior partitions.

B. Exposed Framing: Hand-select material for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.

1. Species and Grade: As indicated above for load-bearing construction of same type.

2.5 ENGINEERED WOOD PRODUCTS

A. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D5456 and manufactured with an exterior-type adhesive complying with ASTM D2559.
1. Extreme Fiber Stress in Bending, Edgewise: 3100 psi (21.3 MPa) for 12-inch nominal-(286-mm actual-) depth members.
2. Modulus of Elasticity, Edgewise: 2,000,000 psi (13 700 MPa).

2.6 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.

B. Dimension Lumber Items: [**Construction or No. 2**] [**Standard, Stud, or No. 3**] grade lumber of any species.

C. Concealed Boards: [**15**] [**19**] percent maximum moisture content and [**any of**]the following species and grades:

1. Mixed southern pine or southern pine; No. [**2**] [**3**] grade; SPIB.
2. Eastern softwoods; No. [**2**] [**3**] Common grade; NeLMA.
3. Northern species; No. [**2**] [**3**] Common grade; NLGA.
4. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

2.7 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1-1/2 inch (36-mm) nominal thickness.

2.8 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

C. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC308 as appropriate for the substrate.

2.9 METAL FRAMING ANCHORS

A. Allowable design loads, as published by manufacturer, shall meet or exceed those of basis-of-design products. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 (Z180) coating designation.

1. Use for interior locations unless otherwise indicated.

C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653/A653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.

1. Use for wood-preservative-treated lumber and where indicated.

2.10 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch (25-mm) nominal thickness, compressible to 1/32 inch (0.8 mm); selected from manufacturer's standard widths to suit width of sill members indicated.

B. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.

C. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).

D. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

D. Install shear wall panels to comply with manufacturer's written instructions.

E. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

F. Do not splice structural members between supports unless otherwise indicated.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

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

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

3.2 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior trim, including non-fire-rated interior door and sidelight frames.
2. Interior plywood, hardboard, and board paneling.
3. Shelving and hang rods.

1.2 DEFINITIONS

A. MDF: Medium-density fiberboard.

B. MDO: Plywood with a medium-density overlay on the face.

C. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

B. Samples: For each exposed product and for each color and texture specified.

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by grading agency.

B. Softwood Plywood: DOC PS 1.

C. Hardboard: ANSI A135.4.

D. MDF: ANSI A208.2, Grade 130.

E. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.

F. Melamine-Faced Particleboard: Particleboard complying with ANSI A208.1, Grade M-2, finished on both faces with thermally fused, melamine-impregnated decorative paper and complying with NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

1. Color: As selected by Architect from manufacturer's full range.

2.2 INTERIOR TRIM

A. Softwood Lumber Trim for Transparent Finish (Stain or Clear Finish):

1. Species and Grade:

a. Eastern white pine; NeLMA or NLGA Premium or 2 Common.
b. Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NLGA or WWPA 2 Common (Sterling).
c. Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NeLMA, NLGA, or WWPA Premium or 2 Common (Sterling).
d. White woods; WWPA 2 Common.
e. Douglas fir-larch or Douglas fir south; NLGA, WCLIB, or WWPA Prime or D finish.
f. Southern pine; SPIB C & Btr finish.
g. Western red cedar; NLGA, WCLIB, or WWPA Grade B.

2. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
3. Finger Jointing: Not allowed.
4. Face Surface: Surfaced (smooth).

B. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):

1. Species and Grade: White maple; NHLA Clear.
2. Maximum Moisture Content: 9 percent.
3. Finger Jointing: Not allowed.
4. Gluing for Width: Use for lumber trim wider than 6 inches (150 mm).
5. Veneered Material: Allowed.
6. Face Surface: Surfaced (smooth).
7. Matching: Selected for compatible grain and color.

C. Lumber Trim for Opaque Finish (Painted Finish):

1. Species and Grade:

a. Eastern white pine; NeLMA or NLGA Finish or 1 Common.
b. Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NLGA or WWPA 1 Common (Colonial).
c. Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NeLMA, NLGA, or WWPA 1 Common (Colonial).
d. White woods; WWPA 1 Common.
e. Species and Grade: Douglas fir-larch or Douglas fir south; NLGA, WCLIB, or WWPA Superior or C & Btr finish.
f. Spruce-pine-fir; NeLMA, NLGA, WCLIB, or WWPA 1 Common.
g. Alder, aspen, basswood, cottonwood, gum, magnolia, soft maple, sycamore, tupelo, or yellow poplar; NHLA A Finish.

2. Maximum Moisture Content for softwoods: 15 percent with at least 85 percent of shipment at 12 percent or less.
3. Maximum Moisture Content for Hardwoods: 9 percent.
4. Finger Jointing: Allowed.
5. Face Surface: Surfaced (smooth).
6. Optional Material: Primed MDF of same actual dimensions as lumber indicated may be used in lieu of lumber.

D. Softwood Moldings for Transparent Finish (Stain or Clear Finish): MMPA WM 4, N-grade wood moldings. Made to patterns included in MMPA's "WM/Series Softwood Moulding Patterns."

1. Species: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine.
2. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
3. Finger Jointing: Not allowed.
4. Matching: Selected for compatible grain and color.
5. Base Pattern: As selected by Architect.
6. Shoe-Mold Pattern: As selected by Architect.
7. Casing Pattern: As selected by Architect.
8. Mull-Casing Pattern: As selected by Architect.
9. Stop Pattern: As selected by Architect.
10. Chair-Rail Pattern: As selected by Architect.

E. Hardwood Moldings for Transparent Finish (Stain or Clear Finish): MMPA WM 4, N-grade wood moldings made to patterns included in MMPA's "HWM/Series Hardwood Moulding Patterns."

1. Species: White maple.
2. Maximum Moisture Content: 9 percent.
3. Finger Jointing: Not allowed.
4. Matching: Selected for compatible grain and color.
5. Optional Material: Kiln-dried softwood or MDF, with exposed surfaces veneered with species indicated, may be used in lieu of solid wood.
6. Base Pattern: As selected by Architect.
7. Shoe-Mold Pattern: As selected by Architect.
8. Casing Pattern: As selected by Architect.
9. Mull-Casing Pattern: As selected by Architect.
10. Stop Pattern: As selected by Architect.
11. Chair-Rail Pattern: As selected by Architect.

F. Moldings for Opaque Finish (Painted Finish): Made to patterns included in MMPA's "WM/Series Softwood Moulding Patterns."

1. Softwood Moldings: MMPA WM 4, P grade.

    a. Species: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine.
    b. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.

2. Hardwood Moldings: MMPA WM 4, P-grade.

    a. Species: Aspen, basswood, cottonwood, gum, magnolia, soft maple, tupelo, or yellow poplar.
    b. Maximum Moisture Content: 9 percent.

3. Finger Jointing: Allowed.

4. Optional Material: Primed MDF.
5. Base Pattern: As selected by Architect.
6. Shoe-Mold Pattern: As selected by Architect.
7. Casing Pattern: As selected by Architect.
8. Mull-Casing Pattern: As selected by Architect.
9. Stop Pattern: As selected by Architect.
10. Chair-Rail Pattern: As selected by Architect.

2.3 PANELING

A. Hardwood Veneer Plywood Paneling: Manufacturer's stock hardwood plywood panels complying with HPVA HP-1.
   1. Face Veneer Species and Cut: Rotary-cut white birch.
   2. Veneer Matching: As selected by Architect.
   3. Backing Veneer Species: Any hardwood compatible with face species.
   4. Construction: Veneer core.
   5. Thickness: 1/4 inch (6.4 mm).
   6. Panel Size:
      a. 48 by 96 inches (1219 by 2438 mm).
   7. Glue Bond: Type II (interior).
   8. Face Pattern: Manufacturer's standard channel-grooved pattern, with grooves at edges, center, and third points of panels, and at other locations to provide pattern resembling random-width boards.
   9. Finish: As selected by Architect from manufacturer's full range.

B. Hardboard Paneling: Interior factory-finished hardboard paneling complying with ANSI A135.5.
   1. Thickness: 1/4 inch (6.4 mm).
   2. Finish: Class I.
   3. Surface-Burning Characteristics: As follows, tested according to ASTM E84:
      a. Flame-Spread Index: 25 or less.
      b. Smoke-Developed Index: 450 or less.
   4. Colors, Textures, and Patterns: As selected by Architect from manufacturer's full range.

C. Board Paneling, MMPA: Interior wood-board paneling complying with MMPA WM 9.
   1. Species: As selected by Architect.
   2. Grade: Clear No. 1.
   3. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
   4. Pattern: As selected by Architect.
   5. Net Coverage Width: As selected by Architect.

D. Board Paneling:
   1. Species and Grade:
      a. Eastern white pine; NeLMA or NLGA Premium or 2 Common.
      b. Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NLGA or WWPA 2 Common (Sterling).

c. Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NeLMA, NLGA, or WWPA Premium or 2 Common (Sterling).
d. Southern pine; SPIB No. 2 Paneling.
e. Western red cedar; NLGA, WCLIB, or WWPA Clear Heart.

2. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
3. Pattern:

a. V-joint, tongue and groove, WWPA WP 4.
b. Pickwick, tongue and groove, WWPA WP 2.
c. Rounded-edge channel groove, tongue and groove, WWPA WP 6.
d. Edge and center bead, tongue and groove, WWPA E & CB Ceiling.

4. Net Coverage Width: As selected by Architect.

2.4 SHELVING AND HANG RODS

A. Exposed and Utility Shelving: Made from one of the following materials, 3/4 inch (19 mm) thick:

1. Particleboard with solid-wood front edge.
2. MDF with solid-wood front edge.
3. MDO softwood plywood with solid-wood edge.
4. Melamine-faced particleboard with applied-PVC front edge.
5. Wood boards as specified above for hardwood lumber trim for transparent finish.
6. Softwood Boards:

a. Kiln-dried eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NeLMA, NLGA, or WWPA Premium or 2 Common (Sterling).
b. Kiln-dried Douglas fir-larch, Douglas fir south, or hem-fir; SPIB Prime or D finish; NLGA, WCLIB, or WWPA; or southern pine; C finish.

B. Shelf Cleats: 3/4-by-3-1/2-inch (19-by-89-mm) boards as specified above for shelving.

C. Shelf Brackets with Rod Support: BHMA A156.16, B04051; prime-painted formed steel.

D. Shelf Brackets without Rod Support: BHMA A156.16, B04041; prime-painted formed steel.

E. Standards for Adjustable Shelf Brackets: BHMA A156.9, B04102; zinc-plated steel.

F. Adjustable Shelf Brackets: BHMA A156.9, B04112; zinc-plated steel.

G. Standards for Adjustable Shelf Supports: BHMA A156.9, B04071; zinc-plated steel.

H. Adjustable Shelf Supports: BHMA A156.9, B04081 or B04091; zinc-plated steel.

I. Metal Clothes Rods: 1-5/16-inch- (33-mm-) diameter, chrome-plated-steel tubes.

J. Metal Rod Flanges: Chrome-plated steel.

2.5 MISCELLANEOUS MATERIALS

A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.

C. Paneling Adhesive: Comply with paneling manufacturer's written instructions for adhesives.

D. Multipurpose Construction Adhesive: Formulation, complying with ASTM D3498, that is recommended for indicated use by adhesive manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

3.2 INSTALLATION, GENERAL

A. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials.

1. Use concealed shims where necessary for alignment.
2. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
3. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
4. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining interior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.
5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.3 INSTALLATION OF STANDING AND RUNNING TRIM

A. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available.

1. Do not use pieces less than 24 inches (610 mm) long, except where necessary.
2. Stagger joints in adjacent and related standing and running trim.
3. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint.
4. Use scarf joints for end-to-end joints.

5. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
6. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
7. Install trim after gypsum-board joint finishing operations are completed.
8. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting.
9. Fasten to prevent movement or warping.
10. Countersink fastener heads on exposed carpentry work and fill holes.

3.4 INSTALLATION OF PANELING

A. Plywood Paneling: Select and arrange panels on each wall to minimize noticeable variations in grain character and color between adjacent panels.

1. Leave 1/4-inch (6-mm) gap to be covered with trim at top, bottom, and openings.
2. Install with uniform tight joints between panels.
3. Attach panels to supports with manufacturer's recommended panel adhesive and fasteners.
4. Space fasteners and adhesive as recommended by panel manufacturer.
5. Conceal fasteners to greatest practical extent.
6. Arrange panels with grooves and joints over supports.

    a. Fasten to supports with nails of type and at spacing recommended by panel manufacturer.
    b. Use fasteners with prefinished heads matching groove color.

B. Hardboard Paneling: Install according to manufacturer's written instructions.

1. Leave 1/4-inch (6-mm) gap to be covered with trim at top, bottom, and openings.
2. Butt adjacent panels with moderate contact.
3. Use fasteners with prefinished heads matching paneling color.
4. Wood Stud or Furring Substrate: Install with 1-inch (25-mm) annular-ring shank hardboard nails.
5. Plaster or Gypsum-Board Substrate: Install with 1-5/8-inch (41-mm) annular-ring shank hardboard nails.
6. Nailing: Space nails 4 inches (100 mm) o.c. at panel perimeter and 8 inches (200 mm) o.c. at intermediate supports unless otherwise required by manufacturer.

C. Board Paneling: Install according to manufacturer's written instructions.

1. Arrange in random-width pattern suggested by manufacturer unless boards or planks are of uniform width.
2. Install in full lengths without end joints.
3. Stagger end joints in random pattern to uniformly distribute joints on each wall.
4. Install with uniform end joints with only end-matched (tongue-and-groove) joints within each field of paneling.
5. Install with uniform end joints. Locate end joints only over furring or blocking.
6. Select and arrange boards on each wall to minimize noticeable variations in grain character and color between adjacent boards.
7. Install with uniform tight joints between boards.
8. Fasten paneling by face nailing, setting nails, and filling over nail heads.
9. Fasten paneling with trim screws, set below face and filled.
10. Fasten paneling by blind nailing through tongues.

11. Fasten paneling with paneling system manufacturer's concealed clips.
12. Fasten paneling to gypsum wallboard with panel adhesive.

3.5 INSTALLATION OF SHELVING AND CLOTHES RODS

A. Cut shelf cleats at ends of shelves about 1/2 inch (13 mm) less than width of shelves and sand exposed ends smooth.

1. Install shelf cleats by fastening to framing or backing with finish nails or trim screws, set below face and filled.
2. Space fasteners not more than 16 inches (400 mm) o.c. Use two fasteners at each framing member or fastener location for cleats 4 inches nominal (89 mm actual) in width and wider.
3. Apply a bead of multipurpose construction adhesive to back of shelf cleats before installing.
4. Remove adhesive that is squeezed out after fastening shelf cleats in place.

B. Install shelf brackets according to manufacturer's written instructions, spaced not more than 32 inches (800 mm) o.c. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.

C. Install standards for adjustable shelf supports according to manufacturer's written instructions. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors. Space fasteners not more than 12 inches (300 mm) o.c.

D. Install standards for adjustable shelf brackets according to manufacturer's written instructions, spaced not more than 36 inches (900 mm) o.c. and within 6 inches (150 mm) of ends of shelves. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.

E. Cut shelves to neatly fit openings with only enough gap to allow shelves to be removed and reinstalled.

1. Install shelves, fully seated on cleats, brackets, and supports.
2. Fasten shelves to cleats with finish nails or trim screws, set flush.
3. Fasten shelves to brackets to comply with bracket manufacturer's written instructions.

F. Install rod flanges for rods as indicated.

1. Fasten to shelf cleats, framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.
2. Install rods in rod flanges.

END OF SECTION 062023

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior standing and running trim.
2. Interior frames and jambs.
3. Interior stairs and railings.
4. Wood furring, blocking, shims, and hanging strips for installing interior architectural woodwork items that are not concealed within other construction.
5. Shop priming of interior architectural woodwork.
6. Shop finishing of interior architectural woodwork.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [**Project site**] <**Insert location**>.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Anchors.
2. Adhesives.
3. Shop finishing materials.
4. Fire-Retardant Treatment: Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings:

1. Include the following:

a. Dimensioned plans, elevations, and sections.
b. Attachment details.

2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.
4. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples: For each exposed product and for each shop-applied color and finish specified.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For architectural woodwork manufacturer and Installer.

B. Product Certificates: For the following:

1. Composite wood and agrifiber products.
2. Adhesives.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTLAS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.6 QUALITY ASSURANCE

A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

1. Installer Qualifications: Licensed participant in AWI's Quality Certification Program.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups of typical interior architectural woodwork as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL WOODWORK MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements.:

2.2 ARCHITECTURAL WOODWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. Provide labels and certificates from AWI certification program indicating that woodwork and installation] complies with requirements of grades specified.

2.3 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

A. Architectural Woodwork Standards Grade: **Custom**.

B. Hardwood Lumber:

1. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.
2. Cut: Quarter cut/quarter sawn.
3. Wood Moisture Content: 5 to 10 percent.
4. Provide split species on trim that faces areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.
5. For trim item**ase**] wider than available lumber, use veneered construction. Do not glue for width.

    a. For veneered base, use hardwood lumber core, glued for width.

6. For base wider than available lumber, glue for width. Do not use veneered construction.
7. For rails thicker than available lumber, use veneered construction. Do not glue for thickness.

C. Softwood Lumber:

1. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.
2. Cut: Plain sawn.
3. Wood Moisture Content: 5 to 10 percent.
4. Provide split species on trim that faces areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.
5. For trim items[other than base] wider than available lumber, use veneered construction. Do not glue for width.

    a. For veneered base, use softwood lumber core, glued for width.

6. For base wider than available lumber, glue for width. Do not use veneered construction.
7. For rails thicker than available lumber, use veneered construction. Do not glue for thickness.
8. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (76 mm) wide.

2.4 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

A. Architectural Woodwork Standards Grade: **Custom**.

1. Wood Species: Any closed-grain hardwood.
2. Wood Moisture Content: **5 to 10** percent.

2.5 INTERIOR FRAMES AND JAMBS FOR TRANSPARENT FINISH

A. Architectural Woodwork Standards Grade: [**Premium**] [**Custom**] [**Economy**].

B. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.
   1. Cut: Quarter cut/quarter sawn.
   2. Wood Moisture Content: 4 to 9 percent.
   3. Provide split species on frames and jambs that face areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.

C. For frames or jambs wider than available lumber, use veneered construction. Do not glue for width.

   1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (76 mm) wide.

2.6 INTERIOR FRAMES AND JAMBS FOR OPAQUE FINISH

A. Architectural Woodwork Standards Grade: **Custom**.

B. Wood Species: Any closed-grain hardwood.

   1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (76 mm) wide.
   2. Wood Moisture Content: 4 to 9 percent.

2.7 INTERIOR WOOD STAIRS AND RAILINGS

A. Architectural Woodwork Standards Grade: Custom.

B. Wood for Transparent Finish:

   1. Species and cut:

      a. Stringers: Hard maple, plain sawn.
      b. Risers: [Hard maple, plain sawn.
      c. Treads: Hard maple, plain sawn.
      d. Railings: Hard maple, plain sawn.
      e. Balusters: Hard maple, plain sawn.
      f. Newels: Hard maple, plain sawn.
      g. Moldings: Hard maple, plain sawn.

   2. Wood Moisture Content: **4 to 9** percent.

C. Wood for Opaque Finish:

   1. Species: Any closed-grain hardwood.
   2. Wood Moisture Content: 4 to 9 percent.

D. Rough Carriages for Stairs: Laminated veneer lumber, made with an exterior-type adhesive complying with ASTM D2559, and with the following allowable design values as determined according to ASTM D5456:

1. Extreme Fiber Stress in Bending, Edgewise: 3100 psi (21.3 MPa) for 12-inch nominal- (286-mm actual-) depth members.
2. Modulus of Elasticity, Edgewise: 2,000,000 psi (13 800 MPa).

E. Rough Carriages for Stairs: Select Structural, grade, kiln-dried to 15 percent maximum moisture content:

1. Acceptable Species:

a. Hem-fir (north).
b. Southern pine.
c. Douglas fir-larch.
d. Douglas fir-larch (north).
e. Spruce-pine-fir.
f. Hem-fir.
g. Douglas fir-south.
h. Spruce-pine-fir (south).

F. Finishes for Stair Parts:

1. Treads: Opaque.
2. Risers: Opaque.
3. Stringers: Opaque.
4. Balusters: Opaque.
5. Handrails: Opaque.
6. Scotia, Cove, and Other Moldings: Opaque.

G. Handrail Brackets: Cast stainless steel with wall flange drilled and tapped for concealed hanger bolt and with support arm for screwing to underside of rail. Size to provide 1-1/2-inch (38-mm) clearance between handrail and face of wall.

H. Handrail/Bumper Rail Brackets: Pairs of extruded-aluminum channels: one for fastening to back

2.8 HARDWOOD SHEET MATERIALS

A. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of the Architectural Woodwork Standards for each type of interior architectural woodwork and quality grade specified unless otherwise indicated.
1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
2. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
3. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.

4. Softwood Plywood: DOC PS 1.
5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.9 FIRE-RETARDANT-TREATED WOOD MATERIALS

A. Fire-Retardant-Treated Wood Materials: Where fire-retardant-treated materials are indicated, use materials complying with requirements that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products according to test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of the Architectural Woodwork Standards. Do not use materials that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Kiln-dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
2. For items indicated to receive a stained, transparent, or natural finish, use organic resin chemical formulation.
3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
4. Mill lumber before treatment, and implement procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.

C. Fire-Retardant Particleboard: Made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture, to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less according to ASTM E84.
1. For panels 3/4 inch (19 mm) thick and less, comply with ANSI A208.1 for Grade M-2, except for the following minimum properties: modulus of rupture, 1600 psi (11 MPa); modulus of elasticity, 300,000 psi (2070 MPa); internal bond, 80 psi (550 kPa); and screw-holding capacity on face and edge, 250 and 225 lbf (1100 and 1000 N), respectively.
2. For panels 13/16 to 1-1/4 inches (20 to 32 mm) thick, comply with ANSI A208.1 for Grade M-1, except for the following minimum properties: modulus of rupture, 1300 psi (9 MPa); modulus of elasticity, 250,000 psi (1720 MPa); linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 and 175 lbf (1100 and 780 N), respectively.

D. Fire-Retardant Fiberboard: Medium-density fiberboard (MDF) panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture, to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less according to ASTM E84.

2.10 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Nailers: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.

1. Preservative Treatment: Provide softwood lumber treated by pressure process, AWPA U1; Use Category UC3b.

a. Provide where in contact with concrete or masonry.
b. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
c. Preservative Chemicals: Acceptable to authorities having jurisdiction.
d. Mark lumber with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee's (ALSC) Board of Review.

2. Fire-Retardant Treatment: Complying with requirements; provide where indicated.

B. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.

C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.

1. Provide metal expansion sleeves or expansion bolts for post-installed anchors.
2. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

D. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

2.11 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated.

1. Ease edges to radius indicated for the following:

a. Edges of Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.
b. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch (3 mm).

C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.

1. Disassemble components only as necessary for shipment and installation.
2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
3. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.

a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.

b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

D. Stairs: Cut rough carriages to accurately fit treads and risers.

1. Glue treads to risers, and glue and nail treads and risers to carriages.
2. House [**wall**] [**and**] [**face**] stringers, and glue and wedge treads and risers.
3. Fabricate stairs with treads and risers no more than 1/8 inch (3 mm) from indicated position and no more than 1/16 inch (1.5 mm) out of relative position for adjacent treads and risers.

2.12 SHOP PRIMING

A. Preparations for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.

B. Interior Architectural Woodwork for Opaque Finish: Shop prime with one coat of wood primer as specified in Section 099123 "Interior Painting."

1. Backpriming: Apply one coat of primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

C. Interior Architectural Woodwork for Transparent Finish: Shop-seal concealed surfaces with required pretreatments and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."

1. Backpriming: Apply one coat of sealer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

2.13 SHOP FINISHING

A. Finish interior architectural woodwork with transparent finish at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.

B. Preparation for Finishing: Comply with Architectural Woodwork Standards, Section 5 for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of interior architectural woodwork. Apply two coats to end-grain surfaces.

C. Transparent Finish:

1. Architectural Woodwork Standards Grade: **Custom**.
2. Finish: System - 1, Lacquer, Nitrocellulose.
3. Finish: System - 2, Lacquer, Pre Catalyzed.
4. Finish: System - 3, Lacquer, Post Catalyzed.
5. Finish: System - 4, Latex Acrylic, Water Based.

6. Finish: System - 5, Varnish, Conversion.
7. Finish: System - 6, Oil, Synthetic Penetrating.
8. Finish: System - 7, Vinyl, Catalyzed.
9. Finish: System - 8, Acrylic Cross Linking, Water Based.
10. Finish: System - 9, UV Curable, Acrylated Epoxy, Polyester, or Urethane.
11. Finish: System - 10, UV Curable, Water Based.
12. Finish: System - 11, Polyurethane, Catalyzed.
13. Finish: System - 12, Polyurethane, Water Based.
14. Finish: System - 13, Polyester, Catalyzed.
15. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
16. Staining: Match Architect's sample.
17. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
18. Filled Finish for Open-Grain Woods: After staining, apply wash-coat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
19. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter according to ASTM D523.

D. Opaque Finish:

1. Architectural Woodworking Standards Grade: **Custom**.
2. Finish: System - 1, Lacquer, Nitrocellulose.
3. Finish: System - 2, Lacquer, Pre Catalyzed.
4. Finish: System - 3, Lacquer, Post Catalyzed.
5. Finish: System - 4, Latex Acrylic, Water Based.
6. Finish: System - 5, Varnish, Conversion.
7. Finish: System - 7, Vinyl, Catalyzed.
8. Finish: System - 8, Acrylic Cross Linking, Water Based.
9. Finish: System - 9, UV Curable, Acrylated Epoxy, Polyester, or Urethane.
10. Finish: System - 10, UV Curable, Water Based.
11. Finish: System - 11, Polyurethane, Catalyzed.
12. Finish: System - 12, Polyurethane, Water Based.
13. Finish: System - 13, Polyester, Catalyzed.
14. Color: As selected by Architect from manufacturer's full range.
15. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter according to ASTM D523.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.

B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of concealed surfaces.

3.2 INSTALLATION

A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.

B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.

C. Install interior architectural woodwork level, plumb, true in line, and without distortion.

1. Shim as required with concealed shims.
2. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

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

E. Preservative-Treated Wood: Where cut or drilled in field, treat cut ends and drilled holes according to AWPA M4.

F. Fire-Retardant-Treated Wood: Install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

G. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates.

1. Secure with countersunk, concealed fasteners and blind nailing.
2. Use fine finishing nails for exposed fastening, countersunk and filled flush with interior architectural woodwork.
3. For shop-finished items, use filler matching finish of items being installed.

H. Standing and Running Trim:

1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.
2. Do not use pieces less than 36 inches (900 mm) long, except where shorter single-length pieces are necessary.
3. Scarf running joints and stagger in adjacent and related members.
4. Fill gaps, if any, between top of base and wall with plastic wood filler; sand smooth; and finish same as wood base if finished.
5. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches (3 mm in 2400 mm).

I. Stairs: Securely anchor carriages to supporting substrates.

1. Install stairs with treads and risers no more than 1/8 inch (3 mm) from indicated position.
2. Secure with countersunk, concealed fasteners and blind nailing.
3. Use fine finishing nails for exposed fastening, countersunk and filled flush with wood surface.

J. Railings:

1. Install rails with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) variation from a straight line.
2. Stair Rails: Glue and dowel or pin balusters to treads and railings, and railings to newel posts.

    a. Secure with countersunk, concealed fasteners and blind nailing.
    b. Use fine finishing nails for exposed fastening, countersunk and filled flush with wood surface.

3. Wall Rails: Support rails on wall brackets securely fastened to wall framing.

a. Space rail brackets not more than 48 inches (1220mm) o.c.

3.3 FIELD QUALITY CONTROL

A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.

1. Inspection entity shall prepare and submit report of inspection.

END OF SECTION 064023

SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [**Project site**] <**Insert location**>.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Research reports.

C. Field quality control reports.

1.5 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

B. Installer Qualifications: Licensed participant in AWI's Quality Certification Program.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CABINET MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements.

2.2 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.

1. Provide **labels** and certificates from AWI certification program indicating that woodwork complies with requirements of grades specified.

B. Architectural Woodwork Standards Grade: Custom.

C. Type of Construction: Frameless.

D. Door and Drawer-Front Style: Flush overlay.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.

F. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS.
2. Postformed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade HGS.
4. Edges: Grade HGS, PVC edge banding, 3.0 mm thick, matching laminate in color, pattern, and finish.
5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

G. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

I. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated by laminate manufacturer's designations.
2. Match Architect's sample.
3. As selected by Architect from laminate manufacturer's full range in the following categories:

a. Solid colors, matte finish.
b. Solid colors with core same color as surface, matte finish.
c. Wood grains, matte finish.
d. Patterns, matte finish.

2.3 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: **4 to 9** percent.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
2. Particleboard (Medium Density): ANSI A208.1, Grade M-2.
3. Softwood Plywood: DOC PS 1, medium-density overlay.
4. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.4 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction as determined by testing performed on identical products by a qualified testing agency.

1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

2.5 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087100 "Door Hardware."

B. Butt Hinges: 2-3/4-inch (70-mm), five-knuckle steel hinges made from 0.095-inch- (2.4-mm-) thick metal, and as follows:

1. Semiconcealed Hinges for Flush Doors: ANSI/BHMA A156.9, B01361.
2. Semiconcealed Hinges for Overlay Doors: ANSI/BHMA A156.9, B01521.

C. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, [**100**] [**135**] [**170**] degrees of opening[**, self-closing**].

D. Back-Mounted Pulls: ANSI/BHMA A156.9, B02011.

E. Wire Pulls: Back mounted, solid metal, 4 inches (100 mm) long, 5/16 inch (8 mm) in diameter.

F. Catches: Magnetic catches, NSI/BHMA A156.9, B03141.

G. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04071; with shelf rests, B04081.

H. Shelf Rests: ANSI/BHMA A156.9, B04013; metal.

I. Drawer Slides: ANSI/BHMA A156.9.

1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer.

    a. Type: Full extension.
    b. Material: Zinc-plated steel with polymer rollers.

2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
3. For drawers not more than 3 inches (75 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1.
4. For drawers more than 3 inches (75 mm) high, but not more than 6 inches (150 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1.
5. For drawers more than 6 inches (150 mm) high or more than 24 inches (600 mm) wide, provide Grade 1HD-100.
6. For computer keyboard shelves, provide Grade 1.
7. For trash bins not more than 20 inches (500 mm) high and 16 inches (400 mm) wide, provide Grade 1HD-100.

J. Slides for Sliding Glass Doors: ANSI/BHMA A156.9, B07063; aluminum.

K. Door Locks: ANSI/BHMA A156.11, E07121.

L. Drawer Locks: ANSI/BHMA A156.11, E07041.

M. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.

N. Float Glass for Cabinet Doors: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

1. Thickness: 5.0 mm.
2. Tint Color: Gray.

O. Tempered Float Glass for Cabinet Doors: ASTM C1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3, 6 mm thick unless otherwise indicated.

1. Tint Color: Gray.
2. Unframed Glass Doors: Seam exposed edges seamed before tempering.

P. Mirror Glass for Cabinet Doors: ASTM C1503, Mirror Glazing, Quality-Q3.

1. Thickness: 5.0 mm.

Q. Decorative Glass for Cabinet Doors: Provide decorative glass complying with Section 088113 "Decorative Glass Glazing."

R. Tempered Float Glass for Cabinet Shelves: ASTM C1048, Kind FT, Condition A, Type I, **Class 1 (clear)**, Quality-Q3; with exposed edges seamed before tempering, 6 mm thick.

1. Tint Color: **Gray**.

S. Grommets for Cable Passage: 2-inch (51-mm) OD, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Color: Black.

T. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.

1. Dark, Oxidized, Satin Bronze, Oil Rubbed: ANSI/BHMA 613 for bronze base; ANSI/BHMA 640 for steel base; match Architect's sample.
2. Bright Brass, Clear Coated: ANSI/BHMA 605 for brass base; ANSI/BHMA 632 for steel base.
3. Bright Brass, Vacuum Coated: ANSI/BHMA 723 for brass base; ANSI/BHMA 729 for zinc-coated-steel base.
4. Satin Brass, Blackened, Bright Relieved, Clear Coated: ANSI/BHMA 610 for brass base; ANSI/BHMA 636 for steel base.
5. Satin Chromium Plated: ANSI/BHMA 626 for brass or bronze base; ANSI/BHMA 652 for steel base.
6. Bright Chromium Plated: ANSI/BHMA 625 for brass or bronze base; ANSI/BHMA 651 for steel base.
7. Satin Stainless Steel: ANSI/BHMA 630.

U. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.6 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesive for Bonding Plastic Laminate: Contact cement.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.7 FABRICATION

A. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

B. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

C. Install glass to comply with applicable requirements in Section 088000 "Glazing" and in GANA's "Glazing Manual."

1. For glass in frames, secure glass with removable stops.
2. For exposed glass edges, polish and grind smooth.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

B. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.

D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm) using concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch (38-mm) penetration into wood framing, blocking, or hanging strips.

3.2 FIELD QUALITY CONTROL

A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.

1. Inspection entity shall prepare and submit report of inspection.

END OF SECTION 064116

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Immersible joint sealants.
5. Mildew-resistant joint sealants.
6. Latex joint sealants.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples: For each kind and color of joint sealant required.

C. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Preconstruction laboratory test reports.

C. Preconstruction field-adhesion-test reports.

D. Field-adhesion-test reports.

E. Sample warranties.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with masonry substrates.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

1.7 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

B. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

C. Silicone, S, NS, 35, NT: Single-component, nonsag, plus 35 percent and minus 35 percent movement capability. nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 35, Use NT.

D. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

E. Silicone, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.

F. Silicone, S, NS, 50, T, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Uses T and NT.

G. Silicone, S, NS, 25, T, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Uses T and NT.

H. Silicone, S, P, 100/50, T, NT: Single-component, pourable, plus 100 percent and minus 50 percent movement capability traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 100/50, Uses T and NT.

I. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT.

J. Silicone, M, P, 100/50, T, NT: Multicomponent, pourable, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type M, Grade P, Class 100/50, Uses T and NT.

2.3 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C1248.

B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

C. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

D. Silicone, Nonstaining, S, NS, 100/50, T, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.

E. Silicone, Nonstaining, M, NS, 50, NT: Nonstaining, multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type M, Grade NS, Class 50, Use NT.

2.4 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

B. Urethane, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.

C. Urethane, S, NS, 25, T, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Uses T and NT.

D. Urethane, S, P, 35, T, NT: Single-component, pourable, plus 35 percent and minus 35 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 35, Uses T and NT.

E. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT.

F. Urethane, M, NS, 50, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 50, Use NT.

G. Urethane, M, NS, 25, NT: Multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 25, Use NT.

H. Urethane, M, NS, 50, T, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 50, Uses T and NT.

I. Urethane, M, NS, 25, T, NT: Multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 25, Uses T and NT.

J. Urethane, M, P, 50, T, NT: Multicomponent, pourable, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 50, Uses T and NT.

K. Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 25, Uses T and NT.

2.5 IMMERSIBLE JOINT SEALANTS

A. Immersible Joint Sealants. Suitable for immersion in liquids; ASTM C1247, Class 1; tested in deionized water unless otherwise indicated

B. Urethane, Immersible, S, NS, 100/50, NT, I: Immersible, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses NT, and I.

C. Urethane, Immersible, S, NS, 35, NT, I: Immersible, single-component, nonsag, plus 35 percent and minus 35 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 35, Use NT and I.

D. Urethane, Immersible, S, NS, 50, T, NT, I: Immersible, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 50, Uses T, NT, and I.

E. Urethane, Immersible, S, NS, 35, T, NT, I: Immersible, single-component, nonsag, plus 35 percent and minus 35 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 35, Uses T, NT, and I.

F. Urethane, Immersible, S, NS, 25, T, NT, I: Immersible, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Uses T, NT, and I.

G. Urethane, Immersible, S, P, 50, T, NT, I: Immersible, single-component, pourable, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 50, Uses T, NT, and I.

H. Urethane, Immersible, S, P, 25, T, NT, I: Immersible, single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T, NT, and I.

I. Urethane, Immersible, M, NS, 50, T, NT, I: Immersible, multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 50, Uses T, NT, and I.

J. Urethane, Immersible, M, NS, 25, T, NT, I: Immersible, multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 25, Uses T, NT, and I.

K. Urethane, Immersible, M, P, 25, T, NT, I: Immersible, multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 25, Uses T, NT, and I.

2.6 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

C. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

2.7 JOINT-SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.8 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove laitance and form-release agents from concrete.
2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF JOINT SEALANTS

A. General: Comply with ASTM C1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling

agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

1. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
b. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.4 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:

a. Control and expansion joints in brick pavers.
b. Isolation and contraction joints in cast-in-place concrete slabs.
c. Joints between plant-precast architectural concrete paving units.
d. Joints in stone paving units, including steps.
e. Tile control and expansion joints.
f. Joints between different materials listed above.
g. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, M, P, 50, T, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces subject to water immersion.

1. Joint Locations:

a. Joints in pedestrian plazas.
b. Joints in swimming pool decks.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, immersible, S, P, 25, T, NT, I.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Construction joints in cast-in-place concrete.
b. Joints between plant-precast architectural concrete units.
c. Control and expansion joints in unit masonry.
d. Joints in dimension stone cladding.
e. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:

a. Isolation joints in cast-in-place concrete slabs.
b. Control and expansion joints in stone flooring.
c. Control and expansion joints in brick flooring.
d. Control and expansion joints in tile flooring.
e. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, P, 25, T, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Control and expansion joints on exposed interior surfaces of exterior walls.
b. Tile control and expansion joints.
c. Vertical joints on exposed surfaces of unit masonry walls and partitions.
d. Joints on underside of plant-precast structural concrete beams and planks.
e. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, NS, 25, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

F. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Joint Locations:

a. Control joints on exposed interior surfaces of exterior walls.
b. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Acrylic latex.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

G. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

    a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    b. Tile control and expansion joints where indicated.
    c. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

H. Joint-Sealant Application: Concealed mastics.

1. Joint Locations:

    a. Aluminum thresholds.
    b. Sill plates.
    c. Other joints as indicated on Drawings.

2. Joint Sealant: Butyl-rubber based.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 079219 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes acoustical joint sealants.

1.2 ACTION SUBMITTALS

A. Product Data: For each acoustical joint sealant.

B. Sustainable Design Submittals:

C. Samples: For each kind and color of acoustical joint sealant required.

D. Acoustical-Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranties.

1.4 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace acoustical joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish acoustical joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E90.

2.2 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.

1. Manufacturers:
   a. Mapei
   b. Euclid Chemical
   c. Ardex
   d. HTS Chemical
2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

B. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.

C. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

D. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where recommended by acoustical-joint-sealant manufacturer.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.

B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint

sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

END OF SECTION 079219

SECTION 080671 – DOOR HARDWARE SCHEDULE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section references specification sections relating to commercial door hardware for the following:

1. Swinging doors.

B. Commercial door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical and access control door hardware.
3. Electromechanical and access control door hardware power supplies, back-ups and surge protection.
4. Automatic operators.

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

D. Standards: Reference Related Sections for requirements regarding compliance with applicable industry standards.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.
b. Manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
e. Explanation of abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for door hardware.
g. Door and frame sizes and materials.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.

D. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

F. Warranties and Maintenance: Special warranties and maintenance agreements specified in the Related Sections.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.5 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

1.6 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Refer to “PART 3 – EXECUTION” for required specification sections.

PART 3 - EXECUTION

3.1 DOOR HARDWARE SETS

A. The door hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Manufacturer's Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. SU - Securitron
4. RO - Rockwood
5. YA - ASSA ABLOY ACCENTRA
6. OT - Other
7. HS - HES
8. RF - Rixson
9. NO - Norton

Hardware Sets

Set: 1.0

Doors: 100

2	Continuous Hinge	CFM_SLF-HD1 x Length Required x PT		PE	
2	Electric Power Transfer	EL-CEPT	630	SU	⚡
1	Concealed Vert Rod Exit Device, Nightlatch w/Elec. Latch Retraction	7220 B MELR 503F (Storeroom Function) Less Dogging	630	YA	⚡
1	Concealed Vert Rod Exit Device, Exit Only w/Elec. Latch Retraction	7220 B MELR EO Less Dogging	630	YA	⚡
1	Cylinder	As Required to Match Facility Standard		OT	
2	Offset Pull	RM5277-36 x Mtg-Type 12HD	US32D	RO	
2	Conc Overhead Stop	6-X36	630	RF	
2	Surface Closer	PR9500	600x689	NO	
1	Automatic Opener	6331	600x689	NO	⚡
1	Gasketing	Provided by Aluminum Frame Supplier		OT	
2	Sweep	315CN x Length Required		PE	
1	Threshold	278x292AFGT x Length Required x		PE	

	MSES25SS			
1	Credential Reader	Provided by Security Supplier		OT
2	ElectroLynx Harness (door)	QC-C**** x Length Required		MK
2	ElectroLynx Harness (frame)	QC-C1500P		MK
2	Door Position Switch	DPS-M-BK		SU
1	Post & Actuator	500	689	NO
1	Operator Actuator	504		NO
2	Remote Pushbutton	PB3ER		SU
1	Power Supply	AQL_ x Amps & Relays Required (Consolidate as Applicable)		SU
1	Wiring Diagram	Elevation and Point to Point as Specified		OT

Notes:
At openings with existing frames, the hardware supplier shall field inspect existing conditions prior to the submittal stage and provide hardware to suit existing frame.

Prepare existing frame and provide all covers, fillers, and accessories required for proper installation and function of new hardware.

Active door with cylinder and door operator is LHR.

SYSTEM OPERATIONAL NARRATIVE
Doors are normally closed and secured.
Presenting valid credential to reader momentarily retracts latch allowing manual entry or via door operator.
Remote push buttons also momentarily retracts latch allowing manual entry or via door operator.
Entry also possible via key override.
Free egress at all times.
Request to exit switches, incorporated in exit devices, signal an egress.
Door position switches monitor the doors open/closed status.
Latch remains projected during power loss. (Fail Secure)

Set: 2.0

Doors: 114B, 135B, 160B

3	Hanging Devices	To Match Existing Conditions	US32D	MK
1	Rim Exit Device, Storeroom	7200 AU506F (Storeroom Function) Less Dogging	630	YA
2	Cylinder	As Required to Match Facility Standard		OT
1	Conc Overhead Stop	6-X36	630	RF
1	Surface Closer	PR9500	600x689	NO

1	Gasketing	Provided by Aluminum Frame Supplier		OT
1	Sweep	3452CNB x Length Required		PE
1	Threshold	278x292AFGT x Length Required x MSES25SS		PE
1	Door Position Switch	DPS-M-BK		SU

Notes:
At openings with existing doors and frames, the hardware supplier shall field inspect existing conditions prior to the submittal stage and provide hardware to suit existing doors and frame.

Prepare existing door(s) and frame and provide all covers, fillers, and accessories required for proper installation and function of new hardware.

SYSTEM OPERATIONAL NARRATIVE
Door position switch monitors the door's open/closed status.

Set: 3.0

Doors: 148B

3	Hinge	T4A3386 [NRP]	US32D	MK
1	Electric Power Transfer	EL-CEPT	630	SU
1	Electrified Rim Exit, Fail Secure	7100 B AU691F Less Dogging	630	YA
1	Cylinder	As Required to Match Facility Standard		OT
1	Surface Closer	UNI9500	600x689	NO
1	Kick Plate	K1050 10" high CSK BEV	US32D	RO
1	Kick Plate	K1050 10" high CSK BEV	US32D	RO
1	Gasketing	303AS (Head & Jambs)		PE
1	Rain Guard	346C x Width of Frame Head		PE
1	Gasketing	S44BL (Head & Jambs)		PE
1	Sweep	3452CNB x Length Required		PE
1	Threshold	278x292AFGT x Length Required x MSES25SS		PE
1	Credential Reader	Provided by Security Supplier		OT
1	ElectroLynx Harness (door)	QC-C**** x Length Required		MK
1	ElectroLynx Harness (frame)	QC-C1500P		MK
1	Door Position Switch	DPS-M-BK		SU
1	Power Supply	AQL_ x Amps & Relays Required (Consolidate as Applicable)		SU
1	Wiring Diagram	Elevation and Point to Point as Specified		OT

Notes:
SYSTEM OPERATIONAL NARRATIVE
Door is normally closed and secure.
Presenting valid credential to reader momentarily unlocks lever allowing entry.
Entry also possible via key override.
Free egress at all times.
Request to exit switch, incorporated in exit device, signals an egress.
Door position switch monitors the doors open/closed status.
Lever remains locked during power loss. (Fail Secure)

Set: 4.0

Doors: 106

3	Hinge	T4A3386 [NRP]	US32D	MK
1	Rim Exit Device, Storeroom	7105 AU626F (Storeroom Function)	630	YA
1	Cylinder	As Required to Match Facility Standard		OT
1	Surface Closer	UNI9500	600x689	NO
1	Kick Plate	K1050 10" high CSK BEV	US32D	RO
1	Gasketing	303AS (Head & Jambs)		PE
1	Rain Guard	346C x Width of Frame Head		PE
1	Gasketing	S44BL (Head & Jambs)		PE
1	Sweep	3452CNB x Length Required		PE
1	Threshold	278x292AFGT x Length Required x MSES25SS		PE
1	Door Position Switch	DPS-M-BK		SU

Notes:
At openings with existing frames, the hardware supplier shall field inspect existing conditions prior to the submittal stage and provide hardware to suit existing frame.

Prepare existing frame and provide all covers, fillers, and accessories required for proper installation and function of new hardware.

SYSTEM OPERATIONAL NARRATIVE
Door position switch monitors the door's open/closed status.

Set: 5.0

Doors: 101

2	Continuous Hinge	CFM_SLF-HD1 x Length Required x		PE

		PT			
2	Electric Power Transfer	EL-CEPT	630	SU	⚡
1	Concealed Vert Rod Exit Device, Nightlatch w/Elec. Latch Retraction	7220 B MELR 503F (Storeroom Function) Less Dogging	630	YA	⚡
1	Concealed Vert Rod Exit Device, Exit Only w/Elec. Latch Retraction	7220 B MELR EO Less Dogging	630	YA	⚡
1	Cylinder	As Required to Match Facility Standard		OT	
2	Offset Pull	RM5277-36 x Mtg-Type 12HD	US32D	RO	
2	Conc Overhead Stop	6-X36	630	RF	
2	Surface Closer	PR7500	600x689	NO	
1	Automatic Opener	6231	689	NO	⚡
1	Gasketing	Provided by Aluminum Frame Supplier		OT	
2	Sweep	3452CNB x Length Required		PE	
1	Threshold	278x292AFGT x Length Required x MSES25SS		PE	
1	Credential Reader	Provided by Security Supplier		OT	
2	ElectroLynx Harness (door)	QC-C**** x Length Required		MK	⚡
2	ElectroLynx Harness (frame)	QC-C1500P		MK	⚡
2	Door Position Switch	DPS-M-BK		SU	⚡
1	Operator Actuator	505 / 503 (As Required)		NO	⚡
2	Remote Pushbutton	PB3ER		SU	⚡
1	Power Supply	AQL_ x Amps & Relays Required (Consolidate as Applicable)		SU	⚡
1	Wiring Diagram	Elevation and Point to Point as Specified		OT	

Notes:
The hardware supplier is to field inspect existing conditions prior to the submittal stage and provide hardware to suit existing frame.

Prepare existing frame and provide all covers, fillers, and accessories required for proper installation and function of new hardware.

Active door with cylinder and door operator is LHR.

SYSTEM OPERATIONAL NARRATIVE
Doors are normally closed and secured.
Presenting valid credential to reader momentarily retracts latch allowing manual entry or via door operator.
Remote push buttons also momentarily retracts latch allowing manual entry or via door operator.
Entry also possible via key override.

Free egress at all times.
Request to exit switches, incorporated in exit devices, signal an egress.
Door position switches monitor the doors open/closed status.
Latch remains projected during power loss. (Fail Secure)

Set: 6.0

Doors: 114A

6	Hinge	T4A3786 [NRP]	US26D	MK	
2	Surface Vert Rod Exit, Passage	7170 LBR AU628F	630	YA	
1	Surface Closer	PR7500	689	NO	
1	Surface Closer	CPS7500	689	NO	
2	Kick Plate	K1050 10" high CSK BEV	US32D	RO	
1	Door Stop	406 / 409 / 441CU (As Condition Requires)	US26D	RO	
2	Silencer	608-RKW		RO	
1	Credential Reader	Provided by Security Supplier		OT	
2	Door Position Switch	DPS-M-BK		SU	
1	Motion Sensor REX	XMS2		SU	
1	Alarm	PZ1		SU	
1	Power Supply	AQL_ x Amps & Relays Required (Consolidate as Applicable)		SU	
1	Wiring Diagram	Elevation and Point to Point as Specified		OT	

Notes:
SYSTEM OPERATIONAL NARRATIVE
Doors are normally closed and latched.
Push Side:
Free egress at all times.
Presenting a valid credential to reader momentarily disables door position switches allowing egress without audible alarm activation.
Existing without first presenting a valid credential to reader opens door position switches and activates local audible alarm.
Pull Side:
Motion sensing REX momentarily disables door position switches allowing entry without audible alarm activation.
Integrate with fire alarm to disarm alarm activation.

Set: 7.0

Doors: 143B

6	Hinge	T4A3786 [NRP]	US26D	MK	
2	Electric Power Transfer	EL-CEPT	630	SU	⚡
1	Electrified SVR Exit, Fail Secure	7170 LBR B AU691F Less Dogging	630	YA	⚡
1	Surface Vert Rod Exit, Exit Only	7170 LBR B EO Less Dogging	630	YA	⚡
1	Cylinder	As Required to Match Facility Standard		OT	
2	Surface Closer	PR7500	689	NO	
2	Kick Plate	K1050 10" high CSK BEV	US32D	RO	
2	Door Stop	406 / 409 / 441CU (As Condition Requires)	US26D	RO	
2	Silencer	608-RKW		RO	
1	Credential Reader	Provided by Security Supplier		OT	
2	ElectroLynx Harness (door)	QC-C**** x Length Required		MK	⚡
2	ElectroLynx Harness (frame)	QC-C1500P		MK	⚡
2	Door Position Switch	DPS-M-BK		SU	⚡
1	Power Supply	AQL_ x Amps & Relays Required (Consolidate as Applicable)		SU	⚡
1	Wiring Diagram	Elevation and Point to Point as Specified		OT	

Notes:
SYSTEM OPERATIONAL NARRATIVE
Doors are normally closed and secure.
Presenting valid credential to reader momentarily unlocks lever allowing entry.
Entry also possible via key override.
Free egress at al times.
Request to exit switches, incorporated in in exit devices, signal an egress.
Door position switches monitor the doors open/closed status.
Lever remains locked during power loss. (Fail Secure)

Set: 8.0

Doors: 140B

6	Hinge	T4A3786 [NRP]	US26D	MK	
2	Electric Power Transfer	EL-CEPT	630	SU	⚡
1	Electrified SVR Exit, Fail Secure	7170 LBR B AU691F Less Dogging	630	YA	⚡
1	Surface Vert Rod Exit, Exit Only	7170 LBR B EO Less Dogging	630	YA	⚡
1	Cylinder	As Required to Match Facility Standard		OT	
2	Surface Closer	CPS7500	689	NO	

2	Kick Plate	K1050 10" high CSK BEV	US32D	RO	
2	Silencer	608-RKW		RO	
1	Credential Reader	Provided by Security Supplier		OT	
2	ElectroLynx Harness (door)	QC-C**** x Length Required		MK	⚡
2	ElectroLynx Harness (frame)	QC-C1500P		MK	⚡
2	Door Position Switch	DPS-M-BK		SU	⚡
1	Power Supply	AQL_ x Amps & Relays Required (Consolidate as Applicable)		SU	⚡
1	Wiring Diagram	Elevation and Point to Point as Specified		OT	

Notes:
SYSTEM OPERATIONAL NARRATIVE
Doors are normally closed and secure.
Presenting valid credential to reader momentarily unlocks lever allowing entry.
Entry also possible via key override.
Free egress at al times.
Request to exit switches, incorporated in in exit devices, signal an egress.
Door position switches monitor the doors open/closed status.
Lever remains locked during power loss. (Fail Secure)

Set: 8.1

Doors: 130B, 140C

6	Hinge	T4A3786 [NRP]	US26D	MK	
2	Electric Power Transfer	EL-CEPT	630	SU	⚡
1	Electrified SVR Exit, Fail Secure	7170 LBR B AU691F Less Dogging	630	YA	⚡
1	Surface Vert Rod Exit, Exit Only	7170 LBR B EO Less Dogging	630	YA	⚡
1	Cylinder	As Required to Match Facility Standard		OT	
1	Surface Closer	PR7500	689	NO	
1	Surface Closer	CPS7500	689	NO	
2	Kick Plate	K1050 10" high CSK BEV	US32D	RO	
1	Door Stop	406 / 409 / 441CU (As Condition Requires)	US26D	RO	
2	Silencer	608-RKW		RO	
1	Credential Reader	Provided by Security Supplier		OT	
2	ElectroLynx Harness (door)	QC-C**** x Length Required		MK	⚡
2	ElectroLynx Harness (frame)	QC-C1500P		MK	⚡
2	Door Position Switch	DPS-M-BK		SU	⚡
1	Power Supply	AQL_ x Amps & Relays Required		SU	⚡

	(Consolidate as Applicable)			
1 Wiring Diagram	Elevation and Point to Point as Specified		OT	

Notes:
SYSTEM OPERATIONAL NARRATIVE
Doors are normally closed and secure.
Presenting valid credential to reader momentarily unlocks lever allowing entry.
Entry also possible via key override.
Free egress at al times.
Request to exit switches, incorporated in in exit devices, signal an egress.
Door position switches monitor the doors open/closed status.
Lever remains locked during power loss. (Fail Secure)

Set: 9.0

Doors: 130A, 140A

3 Hinge	T4A3786 [NRP]	US26D	MK	
1 Electric Power Transfer	EL-CEPT	630	SU	⚡
1 Electrified Rim Exit, Fail Secure	7100 B AU691F Less Dogging	630	YA	⚡
1 Cylinder	As Required to Match Facility Standard		OT	
1 Surface Closer	PR7500	689	NO	
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO	
1 Door Stop	406 / 409 / 441CU (As Condition Requires)	US26D	RO	
3 Silencer	608-RKW		RO	
1 Credential Reader	Provided by Security Supplier		OT	
1 ElectroLynx Harness (door)	QC-C**** x Length Required		MK	⚡
1 ElectroLynx Harness (frame)	QC-C1500P		MK	⚡
1 Door Position Switch	DPS-M-BK		SU	⚡
1 Power Supply	AQL_ x Amps & Relays Required (Consolidate as Applicable)		SU	⚡
1 Wiring Diagram	Elevation and Point to Point as Specified		OT	

Notes:
SYSTEM OPERATIONAL NARRATIVE
Door is normally closed and secure.
Presenting valid credential to reader momentarily unlocks lever allowing entry.
Entry also possible via key override.
Free egress at all times.
Request to exit switch, incorporated in exit device, signals an egress.

Door position switch monitors the doors open/closed status.
Lever remains locked during power loss. (Fail Secure)

Set: 11.0

Doors: 160A

6	Hinge	T4A3786 [NRP]	US26D	MK	
2	Surface Vert Rod Exit, Classroom	7175 LBR AU626F	630	YA	
4	Cylinder	As Required to Match Facility Standard		OT	
2	Surface Closer	CPS7500	689	NO	
2	Kick Plate	K1050 10" high CSK BEV	US32D	RO	
2	Silencer	608-RKW		RO	

Set: 12.0

Doors: 145

6	Hinge	T4A3786 [NRP]	US26D	MK	
1	Electric Power Transfer	EL-CEPT	630	SU	⚡
1	Automatic Flush Bolt	2842 / 2962 (As Required)	US26D	RO	
1	Dust Proof Strike	570	US26D	RO	
1	Fail Secure Lock	AU 5491LN REX	626	YA	⚡
1	Cylinder	As Required to Match Facility Standard		OT	
1	Coordinator	2600 Series x Mounting Brackets As Required	Black	RO	
2	Surface Closer	7500	689	NO	
2	Kick Plate	K1050 10" high CSK BEV	US32D	RO	
2	Door Stop	406 / 409 / 441CU (As Condition Requires)	US26D	RO	
2	Silencer	608-RKW		RO	
1	Credential Reader	Provided by Security Supplier		OT	
1	ElectroLynx Harness (door)	QC-C**** x Length Required		MK	⚡
1	ElectroLynx Harness (frame)	QC-C1500P		MK	⚡
2	Door Position Switch	DPS-M-BK		SU	⚡
1	Power Supply	AQL_ x Amps & Relays Required (Consolidate as Applicable)		SU	⚡
1	Wiring Diagram	Elevation and Point to Point as Specified		OT	

Notes:
SYSTEM OPERATIONAL NARRATIVE
Door is normally closed and secure.
Presenting valid credential to card reader temporarily unlocks lever allowing entry.
Entry also possible via key override.
Free egress at all times.
Request to exit switch, incorporated in lock, signals an egress.
Door position switch monitors the doors open/closed status.
Lever remains locked during power loss. (Fail Secure)

Set: 13.0

Doors: 148A

6	Hinge	T4A3786 [NRP]	US26D	MK	
2	Electric Power Transfer	EL-CEPT	630	SU	⚡
1	Automatic Flush Bolt	2842 / 2962 (As Required)	US26D	RO	
1	Dust Proof Strike	570	US26D	RO	
1	Fail Secure Lock	AU 5491LN REX	626	YA	⚡
1	Cylinder	As Required to Match Facility Standard		OT	
1	Coordinator	2600 Series x Mounting Brackets As Required	Black	RO	
2	Surface Closer	7500	689	NO	
2	Kick Plate	K1050 10" high CSK BEV	US32D	RO	
2	Door Stop	406 / 409 / 441CU (As Condition Requires)	US26D	RO	
1	Astragal	S772BL x Length Required		PE	
1	Gasketing	303AS (Head & Jambs)		PE	
1	Gasketing	S44BL (Head & Jambs)		PE	
2	Door Bottom	STC411APK x Length Required		PE	
1	Credential Reader	Provided by Security Supplier		OT	
1	ElectroLynx Harness (door)	QC-C**** x Length Required		MK	⚡
1	ElectroLynx Harness (frame)	QC-C1500P		MK	⚡
1	Door Position Switch	DPS-M-BK		SU	⚡
1	Power Supply	AQL_ x Amps & Relays Required (Consolidate as Applicable)		SU	⚡
1	Wiring Diagram	Elevation and Point to Point as Specified		OT	

Notes:
SYSTEM OPERATIONAL NARRATIVE
Door is normally closed and secure.

Presenting valid credential to card reader temporarily unlocks lever allowing entry.
Entry also possible via key override.
Free egress at all times.
Request to exit switch, incorporated in lock, signals an egress.
Door position switch monitors the doors open/closed status.
Lever remains locked during power loss. (Fail Secure)

Set: 14.0

Doors: 152B

6	Hinge	T4A3786 [NRP]	US26D	MK	
1	Electric Power Transfer	EL-CEPT	630	SU	⚡
1	Automatic Flush Bolt	2842 / 2962 (As Required)	US26D	RO	
1	Dust Proof Strike	570	US26D	RO	
1	Fail Secure Lock	AU 5491LN REX	626	YA	⚡
1	Cylinder	As Required to Match Facility Standard		OT	
1	Coordinator	2600 Series x Mounting Brackets As Required	Black	RO	
2	Surface Closer	PR7500	689	NO	
2	Kick Plate	K1050 10" high CSK BEV	US32D	RO	
2	Door Stop	406 / 409 / 441CU (As Condition Requires)	US26D	RO	
2	Silencer	608-RKW		RO	
1	Credential Reader	Provided by Security Supplier		OT	
1	ElectroLynx Harness (door)	QC-C**** x Length Required		MK	⚡
1	ElectroLynx Harness (frame)	QC-C1500P		MK	⚡
1	Door Position Switch	DPS-M-BK		SU	⚡
1	Power Supply	AQL_ x Amps & Relays Required (Consolidate as Applicable)		SU	⚡
1	Wiring Diagram	Elevation and Point to Point as Specified		OT	

Notes:
SYSTEM OPERATIONAL NARRATIVE
Door is normally closed and secure.
Presenting valid credential to card reader temporarily unlocks lever allowing entry.
Entry also possible via key override.
Free egress at all times.
Request to exit switch, incorporated in lock, signals an egress.
Door position switch monitors the doors open/closed status.
Lever remains locked during power loss. (Fail Secure)

Set: 15.0

Doors: 117, 132A, 132B, 136, 138A

3	Hinge	T4A3786 [NRP]	US26D	MK
1	Electric Power Transfer	EL-CEPT	630	SU
1	Fail Secure Lock	AU 5491LN REX	626	YA
1	Cylinder	As Required to Match Facility Standard		OT
1	Surface Closer	7500	689	NO
1	Kick Plate	K1050 10" high CSK BEV	US32D	RO
1	Door Stop	406 / 409 / 441CU (As Condition Requires)	US26D	RO
3	Silencer	608-RKW		RO
1	Credential Reader	Provided by Security Supplier		OT
1	ElectroLynx Harness (door)	QC-C**** x Length Required		MK
1	ElectroLynx Harness (frame)	QC-C1500P		MK
1	Door Position Switch	DPS-M-BK		SU
1	Power Supply	AQL_ x Amps & Relays Required (Consolidate as Applicable)		SU
1	Wiring Diagram	Elevation and Point to Point as Specified		OT

Notes:
SYSTEM OPERATIONAL NARRATIVE
Door is normally closed and secure.
Presenting valid credential to card reader temporarily unlocks lever allowing entry.
Entry also possible via key override.
Free egress at all times.
Request to exit switch, incorporated in lock, signals an egress.
Door position switch monitors the doors open/closed status.
Lever remains locked during power loss. (Fail Secure)

Set: 16.0

Doors: 120

3	Hinge	T4A3786 [NRP]	US26D	MK
1	Electric Power Transfer	EL-CEPT	630	SU
1	Fail Secure Lock	AU 5491LN REX	626	YA
1	Cylinder	As Required to Match Facility Standard		OT
1	Surface Closer	PR7500	689	NO

1	Kick Plate	K1050 10" high CSK BEV	US32D	RO
1	Door Stop	406 / 409 / 441CU (As Condition Requires)	US26D	RO
1	Silencer	608-RKW		RO
1	Credential Reader	Provided by Security Supplier		OT
1	ElectroLynx Harness (door)	QC-C**** x Length Required		MK
1	ElectroLynx Harness (frame)	QC-C1500P		MK
1	Door Position Switch	DPS-M-BK		SU
1	Power Supply	AQL_ x Amps & Relays Required (Consolidate as Applicable)		SU
1	Wiring Diagram	Elevation and Point to Point as Specified		OT

Notes:
SYSTEM OPERATIONAL NARRATIVE
Door is normally closed and secure.
Presenting valid credential to card reader temporarily unlocks lever allowing entry.
Entry also possible via key override.
Free egress at all times.
Request to exit switch, incorporated in lock, signals an egress.
Door position switch monitors the doors open/closed status.
Lever remains locked during power loss. (Fail Secure)

Set: 17.0

Doors: 137

6	Hinge	TA2714 [NRP]	US26D	MK
2	Manual Flush Bolt	555 / 557 (As Required)	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Storeroom Lock	AU 5405LN	626	YA
1	Cylinder	As Required to Match Facility Standard		OT
2	Surf Overhead Stop	10-X36	630	RF
2	Silencer	608-RKW		RO

Set: 18.0

Doors: 154

3	Hinge	TA2714 [NRP]	US26D	MK
1	Storeroom Lock	AU 5405LN	626	YA
1	Cylinder	As Required to Match Facility Standard		OT

1	Door Stop	406 / 409 / 441CU (As Condition Requires)	US26D	RO
1	Silencer	608-RKW		RO

Set: 19.0

Doors: 121, 131

3	Hinge	TA2714 [NRP]	US26D	MK
1	Entry Lock	AU 5407LN	626	YA
1	Cylinder	As Required to Match Facility Standard		OT
1	Door Stop	406 / 409 / 441CU (As Condition Requires)	US26D	RO
3	Silencer	608-RKW		RO

Set: 20.0

Doors: 135A

6	Hinge	TA2714 [NRP]	US26D	MK
2	Manual Flush Bolt	555 / 557 (As Required)	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Classroom Lock	AU 5408LN	626	YA
1	Cylinder	As Required to Match Facility Standard		OT
2	Surf Overhead Stop	10-X36	630	RF
2	Silencer	608-RKW		RO

Set: 21.0

Doors: 134

3	Hinge	TA2714 [NRP]	US26D	MK
1	Classroom Lock	AU 5408LN	626	YA
1	Cylinder	As Required to Match Facility Standard		OT
1	Door Stop	406 / 409 / 441CU (As Condition Requires)	US26D	RO
1	Silencer	608-RKW		RO

Set: 22.0

Doors: 155

3	Hinge	TA2714 [NRP]	US26D	MK
1	Privacy Lock w/Indicators Both Sides	AUR3 8802FL V21	626	YA
1	Surf Overhead Stop	10-X36	630	RF
1	Mop Plate	K1050 6" high CSK BEV	US32D	RO
3	Silencer	608-RKW		RO
1	Coat Hook	RM801	US26D	RO

Set: 23.0

Doors: 102

1	Gate Closer	350 Series (As Mounting Condition Requires)	689	RF

Notes:
Balance of hardware provided by door supplier.

Set: 24.0

Doors: 152A

3 Hinge
1 Storeroom Lock
1 Cylinder
1 Electric Strike
1 Surface Closer
1 Kick Plate
1 Credential Reader
1 Door Position Switch
1 Motion Sensor REX
1 Power Supply
1 Wiring Diagram

Notes:
The hardware supplier is to field inspect existing conditions prior to the submittal stage and provide hardware to suit existing doors and frame.

Prepare existing door(s) and frame and provide all covers, fillers, and accessories required for proper installation and function of new hardware.

SYSTEM OPERATIONAL NARRATIVE
Door normally closed and secure.
Presenting valid credential to reader temporarily opens electric strike allowing entry.

Entry also possible via key override.
Free egress at all times.
Motion sensing request to exit switch signals an egress.
Door position switch monitors the doors open/closed status.
Electric strike remains closed during power loss. (Fail Secure)

Set: 25.0

Doors: 143A

3 Hinge
1 Storeroom Lock
1 Cylinder
1 Door Stop

Notes:
The hardware supplier is to field inspect existing conditions prior to the submittal stage and provide hardware to suit existing doors and frame.

Prepare existing door(s) and frame and provide all covers, fillers, and accessories required for proper installation and function of new hardware.

Set: 26.0

Doors: 146, 147

Existing Hardware to Remain

END OF SECTION 080671

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

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. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.
3. Interior custom hollow-metal doors and frames.
4. Exterior custom hollow-metal doors and frames.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

D. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Field quality control reports.

1.5 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.6 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

B. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies shall meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
1. Steelcraft
2. Ceco Door
3. Trudoor

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.38 deg Btu/F x h x sq. ft. (2.16 W/K x sq. m) when tested according to ASTM C518.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Standard-Duty Doors and Frames: ANSI/SDI A250.8, Level 1; ANSI/SDI A250.4, Level C. At locations indicated in the Door and Frame Schedule.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: Uncoated steel sheet, minimum thickness of 0.032 inch (0.8 mm).
d. Edge Construction: Model 1, Full Flush.
e. Core: Kraft-paper honeycomb.
f. Fire-Rated Core: Manufacturer's standard vertical steel stiffener, laminated mineral board core for fire-rated and temperature-rise-rated doors.

2. Frames:

a. Materials: Uncoated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: Full profile welded.

C. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B. At locations indicated in the Door and Frame Schedule.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
d. Edge Construction: Model 1, Full Flush.
e. Core: Kraft-paper honeycomb.
f. Fire-Rated Core: Manufacturer's standard vertical steel stiffener, laminated mineral board core for fire-rated and temperature-rise-rated doors.

2. Frames:

a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: Full profile welded.

D. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A. At locations indicated in the Door and Frame Schedule.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
d. Edge Construction: Full Flush.
e. Core: Kraft-paper honeycomb.
f. Fire-Rated Core: Manufacturer's standard vertical steel stiffener, laminated mineral board core for fire-rated and temperature-rise-rated doors.

2. Frames:

a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: Full profile welded.

E. Maximum-Duty Doors and Frames: ANSI/SDI A250.8, Level 4; ANSI/SDI A250.4, Level A. At locations indicated in the Door and Frame Schedule.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: Uncoated steel sheet, minimum thickness of 0.067 inch (1.7 mm).
d. Edge Construction: Model 1, Full Flush.
e. Core: Kraft-paper honeycomb.
f. Fire-Rated Core: Manufacturer's standard vertical steel stiffener, laminated mineral board core for fire-rated and temperature-rise-rated doors.

2. Frames:

a. Materials: Uncoated steel sheet, minimum thickness of 0.067 inch (1.7 mm).
b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: Full profile welded.

2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B. At locations indicated in the Door and Frame Schedule.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm), with minimum A60 (ZF180) coating.
d. Edge Construction: Model 1, Full Flush.
e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
g. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
h. Core: Manufacturer's standard.
i. Fire-Rated Core: Manufacturer's standard vertical steel stiffener with insulation core for fire-rated doors.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A60 (ZF180) coating.
b. Construction: Full profile welded.

C. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A. At locations indicated in the Door and Frame Schedule.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A60 (ZF180) coating.
d. Edge Construction: Model 1, Full Flush.
e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
f. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
g. Core: Manufacturer's standard.
h. Fire-Rated Core: Manufacturer's standard vertical steel stiffener with insulation core for fire-rated doors.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A60 (ZF180) coating.
b. Construction: Full profile welded.

2.5 INTERIOR CUSTOM HOLLOW-METAL DOORS AND FRAMES

A. Hollow-Metal Doors and Frames: NAAMM-HMMA 860; ANSI/SDI A250.4, Physical Performance Level A. At locations indicated in the Door and Frame Schedule.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
d. Edge Construction: Continuously welded with no visible seam.
e. Core: Steel stiffened.
f. Fire-Rated Core: Manufacturer's standard core for fire-rated and temperature-rise-rated doors.

2. Frames:

a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: Full profile welded.

B. Commercial Doors and Frames: NAAMM-HMMA 861; ANSI/SDI A250.4, Physical Performance Level A. At locations indicated in the Door and Frame Schedule.

1. Doors:

    a. Type: As indicated in the Door and Frame Schedule.
    b. Thickness: 1-3/4 inches (44.5 mm).
    c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
    d. Edge Construction: Continuously welded with no visible seam.
    e. Core: Steel stiffened.
    f. Fire-Rated Core: Manufacturer's standard core for fire-rated and temperature-rise-rated doors.

2. Frames:

    a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm), except 0.067 inch (1.7 mm) for openings exceeding 4 feet (1219 mm) wide.
    b. Sidelite and Transom Frames: Fabricated from same material as adjacent door frame.
    c. Construction: Full profile welded.

C. Commercial Laminated Doors and Frames: NAAMM-HMMA 867; ANSI/SDI A250.4, Physical Performance Level A. At locations indicated in the Door and Frame Schedule.

1. Doors:

    a. Type: As indicated in the Door and Frame Schedule.
    b. Thickness: 1-3/4 inches (44.5 mm).
    c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
    d. Edge Construction: Continuously welded with no visible seam.
    e. Core: Kraft-paper honeycomb.
    f. Fire-Rated Core: Manufacturer's standard vertical steel stiffener for fire-rated and temperature-rise-rated doors.

2. Frames:

    a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
    b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
    c. Construction: Full profile welded.

2.6 EXTERIOR CUSTOM HOLLOW-METAL DOORS AND FRAMES

A. Commercial Doors and Frames: NAAMM-HMMA 861; ANSI/SDI A250.4, Physical Performance Level A. At locations indicated in the Door and Frame Schedule.

1. Doors:

    a. Type: As indicated in the Door and Frame Schedule.
    b. Thickness: 1-3/4 inches (44.5 mm).
    c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.30 mm), with minimum G60 or A60 (ZF180) coating.
    d. Edge Construction: Continuously welded with no visible seam.
    e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
    f. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.

Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.

g. Core: Steel stiffened.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), except 0.067 inch (1.7 mm) for openings exceeding 4 feet (1219 mm) wide; with minimum G60 or A60 (ZF180) coating.
b. Construction: Full profile welded.

B. Commercial Laminated Doors and Frames: NAAMM-HMMA 867; ANSI/SDI A250.4, Physical Performance Level A. At locations indicated in the Door and Frame Schedule.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum G60 or A60 (ZF180) coating.
d. Edge Construction: Continuously welded with no visible seam.
e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
f. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
g. Core: Kraft-paper honeycomb.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum G60 or A60 (ZF180) coating.
b. Construction: Full profile welded.

2.7 BORROWED LITES

A. Fabricate of uncoated steel sheet, minimum thickness of 0.042 inch (1.0 mm).

B. Construction: Full profile welded.

C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.

D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.8 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at top of underlayment.

D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

2.9 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

G. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

H. Glazing: Comply with requirements in Section 088000 "Glazing."

2.10 FABRICATION

A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding, or by rigid mechanical anchors.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.

1. Provide stops and moldings flush with face of door, and with beveled stops unless otherwise indicated.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

2.11 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. Hollow-Metal Frames: Comply with ANSI/SDI A250.11 or NAAMM-HMMA 840.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

    a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    b. Install frames with removable stops located on secure side of opening.

2. Fire-Rated Openings: Install frames according to NFPA 80.
3. Floor Anchors: Secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

4. Solidly pack mineral-fiber insulation inside frames.
5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

B. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8 or NAAMM-HMMA 841 and NAAMM-HMMA guide specification indicated.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door according to NFPA 80, Section 5.2.
2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements according to NFPA 101, Section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 REPAIR

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

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed storefront systems.
2. Aluminum-framed entrance door systems.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
2. Include point-to-point wiring diagrams.

C. Samples: For each type of exposed finish required.

D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

E. Delegated-Design Submittal: For aluminum-framed entrances and storefronts, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

B. Product test reports.

C. Source quality-control reports.

D. Field quality-control reports.

E. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated and accredited by the International Accreditation Service or the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement as complying with ISO/IEC 17025 and acceptable to Owner and Architect.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 WARRANTY

A. Special Warranty: Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked-enamel, powder-coat, or organic finishes within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

C. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.

B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.

a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.

3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:

a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans of less than 11 feet 8-1/4 inches (3.6 m).

E. Structural: Test according to ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Water Penetration under Static Pressure: Test according to ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft. (480 Pa).

G. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):

a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K as determined according to NFRC 100.
b. Entrance Doors: U-factor of not more than 0.68 Btu/sq. ft. x h x deg F (3.86 W/sq. m x K) as determined according to NFRC 100.

2. Solar Heat-Gain Coefficient (SHGC):

a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.35 as determined according to NFRC 200.
b. Entrance Doors: SHGC of not more than 0.25 as determined according to NFRC 200.

3. Air Leakage:

a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa) when tested according to ASTM E283.
b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. (5.08 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

4. Condensation Resistance Factor (CRF):

a. Fixed Glazing and Framing Areas: CRF for the system of not less than 55 as determined according to AAMA 1503.
b. Entrance Doors: CRF of not less than 63 as determined according to AAMA 1503.

H. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 3 for basic protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 STOREFRONT SYSTEMS

A. Manufacturers:
1. Kawneer
2. Arcadia Inc.
3. Oldcastle Building

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction: Thermally broken.

2. Interior Vestibule Framing Construction: Thermally broken.
3. Glazing System: Retained mechanically with gaskets on four sides.
4. Finish: Color anodic finish.
5. Fabrication Method: Field-fabricated stick system.
6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
7. Steel Reinforcement: As required by manufacturer.

C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.3 ENTRANCE DOOR SYSTEMS

A. Manufacturers:
1. Trulite
2. Kawneer
3. Coral Architectural Products

B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 2-inch (50.8-mm) overall thickness, with minimum 0.188-inch- (4.8-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

    a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: As indicated.
3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.

    a. Provide nonremovable glazing stops on outside of door.

2.4 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door, to comply with requirements in this Section.

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products complying with BHMA standard referenced.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
3. Opening-Force Requirements:

a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 15 lbf (67 N) to set the door in motion and not more than 5 lbf (22 N) to open the door to its minimum required width.
b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.

C. Designations: Requirements for design, grade, function, finish, quantity, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

D. Pivot Hinges: BHMA A156.4, Grade 1.

1. Offset-Pivot Hinges: Provide top, bottom, and intermediate offset pivots at each door leaf.

E. Butt Hinges: BHMA A156.1, Grade 1, radius corner.

1. Nonremovable Pins: Provide setscrew in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.
2. Exterior Hinges: Stainless steel, with stainless-steel pin.
3. Quantities:

a. For doors up to 87 inches (2210 mm) high, provide three hinges per leaf.
b. For doors more than 87 and up to 120 inches (2210 and up to 3048 mm) high, provide four hinges per leaf.

F. Continuous-Gear Hinges: BHMA A156.26.

G. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.

H. Manual Flush Bolts: BHMA A156.16, Grade 1.

I. Automatic and Self-Latching Flush Bolts: BHMA A156.3, Grade 1.

J. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

K. Cylinders:

1. As specified in Section 087100 "Door Hardware."
2. BHMA A156.5, Grade 1.

a. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE" to be furnished by Owner.

L. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

M. Operating Trim: BHMA A156.6.

N. Removable Mullions: BHMA A156.3 extruded aluminum.

1. When used with panic exit devices, provide removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305. Use only mullions that have been tested with exit devices to be used.

O. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.

P. Concealed Overhead Holders and Stops: BHMA A156.8, Grade 1.

Q. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.

R. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

S. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

T. Thresholds: BHMA A156.21 raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (12.7 mm).

U. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

2.5 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

2.6 MATERIALS

A. Sheet and Plate: ASTM B209 (ASTM B209M).

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).

C. Extruded Structural Pipe and Tubes: ASTM B429/B429M.

D. Structural Profiles: ASTM B308/B308M.

E. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

F. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: As selected by Architect from full range of industry colors and color densities.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

D. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color and Gloss: As selected by Architect from manufacturer's full range.

E. Superior-Performance Organic Finish, Three-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color and Gloss: As selected by Architect from manufacturer's full range.

F. Superior-Performance Organic Finish, Four-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color and Gloss: As selected by Architect from manufacturer's full range.

G. Superior-Performance Organic Finish, Single-Coat FEVE: Fluoropolymer finish complying with AAMA 2605.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color and Gloss: As selected by Architect from manufacturer's full range.

H. Superior-Performance Organic Finish, Two-Coat FEVE: Fluoropolymer finish complying with AAMA 2605.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
2. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Seal perimeter and other joints watertight unless otherwise indicated.

G. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

H. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.

I. Install joint filler behind sealant as recommended by sealant manufacturer.

J. Install components plumb and true in alignment with established lines and grades.

3.2 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 088000 "Glazing."

3.3 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOORS

A. Install entrance doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Field Quality-Control Testing: Perform the following test on mockups.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

a. Perform a minimum of two tests in areas as directed by Architect.

2. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

a. Perform a minimum of two tests in areas as directed by Architect.

3. Water Penetration: ASTM E1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa), and shall not evidence water penetration.

C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

E. END OF SECTION 084113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:

a. Swinging doors.
b. Sliding doors.
c. Folding doors.

2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

B. Keying Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For electrified door hardware.

1. Include diagrams for power, signal, and control wiring.
2. Include details of interface of electrified door hardware and building safety and security systems.

C. Samples: For each exposed product in each finish specified.

D. Door hardware schedule.

E. Keying schedule.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.

1. Scheduling Responsibility: Preparation of door hardware and keying schedule.
2. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as Architectural Hardware Consultant (AHC) and an Electrified Hardware Consultant (EHC).

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:

a. Electromagnetic and Delayed-Egress Locks: Five years from date of Substantial Completion.
b. Exit Devices: Two years from date of Substantial Completion.
c. Manual Closers: 10 years from date of Substantial Completion.
d. Concealed Floor Closers: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.

C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the DOJ's "2010 ADA Standards for Accessible Design".

2.2 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

1. Manufacturers:
   a. Ives
   b. McKinney Products

2.3 SELF-CLOSING HINGES AND PIVOTS

A. Self-Closing Hinges and Pivots: BHMA A156.17.
1. Manufacturers:
   a. Ives
   b. McKinney Products

2.4 CONTINUOUS HINGES

A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

B. Pin-and-Barrel-Type Hinges:
1. Manufacturers:
   a. Ives
   b. Pemko
   c. McKinney Products

C. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.
1. Manufacturers:
   a. Ives
   b. Pemko
   c. McKinney Products

2.5 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
3. Deadbolts: Minimum 1-inch (25-mm) bolt throw.

C. Lock Backset: 2-3/4 inches (70 mm) unless otherwise indicated.

D. Lock Trim:

1. Description: As indicated on Drawings.
2. Levers: Forged or Cast.

3. Escutcheons (Roses): Forged or Cast.
4. Dummy Trim: Match lever lock trim and escutcheons.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.

F. Bored Locks: BHMA A156.2; Grade 1 Series 8200 or L.
1. Manufacturers:
   a. Schlage
   b. Sargent

G. Mortise Locks: BHMA A156.13; Security Grade 1; stamped steel case with steel or brass parts; Series 8200 or L.
1. Manufacturers:
   a. Schlage
   b. Sargent

2.6 AUXILIARY LOCKS

A. Bored Auxiliary Locks: BHMA A156.36: Grade 1 with strike that suits frame.
1. Manufacturers:
   a. Schlage
   b. Sargent

B. Mortise Auxiliary Locks: BHMA A156.36; Grade 1 with strike that suits frame.
1. Manufacturers:
   a. Schlage
   b. Sargent

C. Narrow Stile Auxiliary Locks: BHMA A156.36; Grade 1 with strike that suits frame.
1. Manufacturers:
   a. Schlage
   b. Sargent

D. Push-Button Combination Locks: BHMA A156.36; cylindrical; Grade 1; lock opens by entering a one- to five-digit code by pushing correct buttons in correct sequence; automatically relocks when door is closed; with strike that suits frame.
1. Manufacturers:
   a. Schlage
   b. Sargent

2.7 ELECTRIC STRIKES

A. Electric Strikes: BHMA A156.31; Grade 1 with faceplate to suit lock and frame.
   1. Manufacturers:
      a. Von Duprin
      b. Folger Adams

2.8 ELECTROMAGNETIC LOCKS

A. Electromagnetic Locks: BHMA A156.23; electrically powered; with electromagnet attached to frame and armature plate attached to door; full-exterior or full-interior type, as required by application indicated.
   1. Manufacturers:
      a. Schlage
      b. Sargent

B. Delayed-Egress Electromagnetic Locks: BHMA A156.24, electrically powered, with electromagnet attached to frame and armature plate attached to door; depressing push bar for more than three seconds initiates irreversible alarm and adjustable time delay for egress. When integrated with fire alarm, fire alarm voids time delay.
   1. Manufacturers:
      a. Schlage
      b. Sargent

2.9 ELECTROMECHANICAL LOCKS

A. Electromechanical Locks: BHMA A156.25; Grade 1 motor or solenoid driven; with strike that suits frame.
   1. Manufacturers:
      a. Schlage
      b. Sargent
   2. Type: Mortise latchbolt.

2.10 SELF-CONTAINED ELECTRONIC LOCKS

A. Self-Contained Electronic Locks: BHMA A156.25, mortise; with internal, battery-powered, self-contained electronic locks; consisting of complete lockset, motor-driven lock mechanism, and actuating device; enclosed in zinc-dichromate-plated, wrought-steel case, and strike that suits frame. Provide key override, low-battery detection and warning, LED status indicators, and ability to program at the lock.
   1. Manufacturers:
      a. Schlage
      b. Sargent

2.11 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.
   1. Manufacturers:
      a. Ives

b. Rockwood Manufacturing
c. Schlage

2.12 AUTOMATIC AND SELF-LATCHING FLUSH BOLTS

A. Automatic Flush Bolts: BHMA A156.3, Type 25; minimum 3/4-inch (19-mm) throw; with dust-proof strikes; designed for mortising into door edge.
1. Manufacturers:
a. Ives
b. Rockwood Manufacturing
c. Schlage

B. Self-Latching Flush Bolts: BHMA A156.3, Type 27; minimum 3/4-inch (19-mm) throw; with dust-proof strikes designed for mortising into door edge.
1. Manufacturers:
a. Ives
b. Rockwood Manufacturing
c. Schlage

2.13 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.
1. Manufacturers:
a. Sargent
b. Von Duprin

2.14 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.
1. Manufacturers:

a. Schlage

B. Standard Lock Cylinders: BHMA A156.5; Grade 1 permanent cores; face finished to match lockset.

1. Core Type: Interchangeable.

C. High-Security Lock Cylinders: BHMA A156.30; Grade 1 permanent cores that are removable; face finished to match lockset.

1. Type: M, mechanical.

D. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

E. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.15 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.

1. No Master Key System: Only change keys operate cylinders.

a. Provide three cylinder change keys.

2. Master Key System: Change keys and a master key operate cylinders.

a. Provide three cylinder change keys and five master keys.

3. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.

a. Provide three cylinder change keys and five each of master and grand master keys.

4. Great-Grand Master Key System: Change keys, a master key, a grand master key, and a great-grand master key operate cylinders.

a. Provide three cylinder change keys and five each of master, grand master, and great-grand master keys.

5. Existing System:

a. Master key or grand master key locks to Owner's existing system.
b. Re-key Owner's existing master key system into new keying system.

6. Keyed Alike: Key all cylinders to same change key.

B. Keys: Brass.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: Information to be furnished by Owner.

2.16 KEY CONTROL SYSTEM

A. Key Control Cabinet: BHMA A156.28; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.
1. Multiple-Drawer Cabinet: Grade 1 cabinet with drawers equipped with key-holding panels and key envelope storage, and progressive-type ball-bearing suspension slides. Include single cylinder lock to lock all drawers.
2. Wall-Mounted Cabinet: Grade 1 cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.
3. Portable Cabinet: Grade 1 tray for mounting in file cabinet, equipped with key-holding panels, envelopes, and cross-index system.

2.17 OPERATING TRIM

A. Operating Trim: BHMA A156.6; brass unless otherwise indicated.

2.18 ACCESSORIES FOR PAIRS OF DOORS

A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release**;** and with internal override.

B. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.

C. Astragals: BHMA A156.22.

2.19 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Manufacturers:

a. LCN

b. Sargent

2.20 CONCEALED CLOSERS

A. Concealed Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Manufacturers:
   a. LCN
   b. Sargent

2.21 CLOSER HOLDER RELEASE DEVICES

A. Closer Holder Release Devices: BHMA A156.15; Grade 1; closer connected with separate or integral releasing and fire- or smoke-detecting devices. Door shall become self-closing on interruption of signal to release device. Automatic release is activated by smoke detection system and loss of power.

1. Manufacturers:
   a. LCN

b. Sargent

2.22 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16.

2.23 ELECTROMAGNETIC STOPS AND HOLDERS

A. Electromagnetic Door Holders: BHMA A156.15, Grade 1; wall-mounted electromagnetic single or floor-mounted electromagnet single or double unit with strike plate attached to swinging door; coordinated with fire detectors and interface with fire-alarm system for labeled fire-rated door assemblies.

2.24 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8.

2.25 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

B. Maximum Air Leakage: When tested according to ASTM E283 with tested pressure differential of 0.3-inch wg (75 Pa), as follows:

1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
2. Gasketing on Single Doors: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
3. Gasketing on Double Doors: 0.50 cfm per foot (0.000774 cu. m/s per m) of door opening.

2.26 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

2.27 SLIDING DOOR HARDWARE

A. Sliding Door Hardware: BHMA A156.14; consisting of complete sets including rails, hangers, supports, bumpers, floor guides, and accessories indicated.

2.28 FOLDING DOOR HARDWARE

A. General: BHMA A156.14; complete sets including overhead rails, hangers, supports, bumpers, floor guides, and accessories indicated.

2.29 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

2.30 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

2.31 AUXILIARY ELECTRIFIED DOOR HARDWARE

A. Auxiliary Electrified Door Hardware:

2.32 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights indicated on Drawings unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).

E. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as directed by Owner.
2. Furnish permanent cores to Owner for installation.

F. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

G. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings and/or in equipment rooms. Verify location with Architect.

1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.

H. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

I. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

J. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

1. Do not notch perimeter gasketing to install other surface-applied hardware.

K. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

L. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.2 ADJUSTING

A. Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.3 DOOR HARDWARE SCHEDULE

A. Hardware Set: As indicated in drawings.

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass products.
2. Laminated glass.
3. Insulating glass.
4. Glazing sealants.
5. Glazing tapes.
6. Miscellaneous glazing materials.

1.2 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.

C. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For glass.

B. Product test reports.

C. Preconstruction adhesion and compatibility test report.

D. Sample warranties.

1.6 QUALITY ASSURANCE

A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.7 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.

B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:

1. Design Wind Pressures: As indicated on Drawings.
2. Design Snow Loads: As indicated on Drawings.
3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

C. Windborne-Debris-Impact Resistance: Exterior glazing shall pass ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 3 for basic protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.

2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on LBL's WINDOW 7 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
2. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on LBL's WINDOW 7 computer program.
3. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

2.2 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.3 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

B. Ultraclear Annealed Float Glass: ASTM C1036, Type I, Class I (clear), Quality-Q3; and with visible light transmission of not less than 91 percent and SHGC of not less than 0.87.

C. Tinted Annealed Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.

D. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

E. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

F. Reflective- and Low-E-Coated Vision Glass: ASTM C1376.

G. Ceramic-Coated Vision Glass: ASTM C1048, Condition C, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3; and complying with Specification No. 95-1-31 in NGA's "Engineering Standards Manual."

H. Ceramic-Coated Spandrel Glass: ASTM C1048, Type I, Condition B, Quality-Q3.

I. Silicone-Coated Spandrel Glass: ASTM C1048, Type I, Condition C, Quality-Q3.

J. Reflective- and Low-E-Coated Spandrel Glass: ASTM C1376, Kind CS.

2.4 LAMINATED GLASS

A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
   1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
   2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
   3. Interlayer Color: Clear unless otherwise indicated.

B. Windborne-Debris-Impact-Resistant Laminated Glass: Comply with requirements specified above for laminated glass except laminate glass with one of the following to comply with interlayer manufacturer's written instructions:
   1. Construction: Laminate glass with polyvinyl butyral interlayer reinforced with polyethylene terephthalate film to comply with interlayer manufacturer's written instructions.
   2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
   3. Interlayer Color: Clear unless otherwise indicated.

2.5 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.

   1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
   2. Perimeter Spacer: Manufacturer's standard spacer material and construction, Polypropylene-covered stainless steel in color selected by Architect.

   3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.

B. Neutral-Curing Silicone Glazing Sealant, Class 100/50: Complying with ASTM C920, Type S, Grade NS, Use NT.

C. Neutral-Curing Silicone Glazing Sealant, Class 50: Complying with ASTM C920, Type S, Grade NS, Use NT.

D. Neutral-Curing Silicone Glazing Sealant, Class 25: Complying with ASTM C920, Type S, Grade NS, Use NT.

E. Acid-Curing Silicone Glazing Sealant, Class 25: Complying with ASTM C920, Type S, Grade NS, Use NT.

2.7 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks:

1. Silicone with Shore A durometer hardness of 85, plus or minus 5.

2. Type recommended in writing by sealant or glass manufacturer.

C. Spacers:

1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
2. Type recommended in writing by sealant or glass manufacturer.

D. Edge Blocks:

1. Silicone with Shore A durometer hardness per manufacturer's written instructions.
2. Type recommended in writing by sealant or glass manufacturer.

E. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

3.2 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Apply heel bead of elastomeric sealant.

F. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.4 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

END OF SECTION 088000

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.

B. Evaluation reports for embossed, high-strength steel studs and tracks, firestop tracks, post-installed anchors, and power-actuated fasteners.

1.4 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, or the Steel Stud Manufacturers Association.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C645 requirements for steel unless otherwise indicated.
2. Protective Coating: ASTM A653/A653M, G60 (Z180), hot-dip galvanized unless otherwise indicated.

B. Studs and Tracks: ASTM C645. Use either conventional steel studs and tracks or embossed, high-strength steel studs and tracks.

1. Manufacturers:
   a. Clark Dietrick Building Systems
   b. Cemco
   c. Scafco
2. Minimum Base-Steel Thickness: As indicated on drawings or as required by performance requirements for horizontal deflection, 0.0329 inch (0.836 mm).
3. Depth: As indicated on Drawings.

C. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing 1-1/2-inch (38-mm) minimum vertical movement.

2. If retaining "Single Long-Leg Track System" Subparagraph below, indicate type of bridging required on Drawings or by inserts. Strap and 1-1/2-inch (38-mm) cold-rolled steel channel are commonly used.

3. Single Long-Leg Track System: ASTM C645 top track with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
4. Double-Track System: ASTM C645 top outer tracks, inside track with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
5. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

D. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Steel Thickness: As indicated on Drawings0.0329 inch (0.836 mm).

F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
1. Depth: As indicated on drawings or 1-1/2 inches (38 mm) whichever is greater.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.

G. Hat-Shaped, Rigid Furring Channels: ASTM C645.
1. Minimum Base-Steel Thickness: 0.0329 inch (0.836 mm).
2. Depth: **As** indicated on Drawings.

H. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.
   1. Configuration: Hat shaped.

I. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

   1. Depth: As indicated on Drawings.
   2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch (0.8 mm).
   3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

J. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-steel thickness of 0.0179 inch (0.455 mm), and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

B. Hanger Attachments to Concrete:

   1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, AC193, AC58, or AC308 as appropriate for the substrate.

      a. Uses: Securing hangers to structure.
      b. Type: Torque-controlled, expansion anchor, torque-controlled, adhesive anchor, or adhesive anchor.
      c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
      d. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

D. Flat Hangers: Steel sheet, 1 by 3/16 inch (25 by 5 mm) by length indicated.

E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.

   1. Depth: As indicated on Drawings.

F. Furring Channels (Furring Members):

   1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
   2. Steel Studs and Tracks: ASTM C645. Use either conventional steel studs and tracks or embossed, high-strength steel studs and tracks.

a. Minimum Base-Steel Thickness: As indicated on Drawings or min. 0.0296 inch (0.752 mm) whichever is greater.
b. Depth: As indicated on Drawings.

3. Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch (22 mm) deep.

a. Minimum Base-Steel Thickness: As indicated on Drawings or min. 0.0296 inch (0.752 mm) whichever is greater.

4. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.

a. Configuration: Hat shaped.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.
2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C1063 that apply to framing installation.
3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C844 that apply to framing installation.
4. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

    a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:

    a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches (610 mm) o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.3 INSTALLING CEILING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

    a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

    a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Exterior gypsum board for ceilings and soffits.
3. Tile backing panels.
4. Texture finishes.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum wallboard.
2. Gypsum board, Type X.
3. Flexible gypsum board.
4. Gypsum ceiling board.
5. Foil-backed gypsum board.
6. Abuse-resistant gypsum board.
7. Impact-resistant gypsum board.
8. Mold-resistant gypsum board.
9. Gypsum board, Type C.
10. Exterior gypsum soffit board.
11. Glass-mat gypsum sheathing board.
12. Glass-mat, water-resistant backing board.
13. Cementitious backer units.
14. Interior trim.
15. Exterior trim.
16. Joint treatment materials.
17. Laminating adhesive.
18. Sound-attenuation blankets.
19. Acoustical sealant.
20. Textured finishes.

B. Samples: For each texture finish indicated on same backing indicated for Work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Wallboard: ASTM C1396/C1396M.
   1. Manufacturers:
      a. American Gypsum
      b. USG
      c. CertainTeed
      d. National Gypsum
   2. Thickness: 1/2 inch (12.7 mm).
   3. Long Edges: Tapered for prefilling.

B. Gypsum Board, Type X: ASTM C1396/C1396M.

   1. Manufacturers:
      a. American Gypsum
      b. USG
      c. CertainTeed
      d. National Gypsum
   2. Thickness: 5/8 inch (15.9 mm).
   3. Long Edges: Tapered for prefilling.

C. Flexible Gypsum Board: ASTM C1396/C1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.
   1. Manufacturers:
      a. American Gypsum
      b. USG
      c. CertainTeed
      d. National Gypsum
   2. Thickness: 1/4 inch (6.4 mm).
   3. Long Edges: Tapered.

D. Gypsum Ceiling Board: ASTM C1396/C1396M.
   1. Manufacturers:
      a. American Gypsum
      b. USG
      c. CertainTeed
      d. National Gypsum
   2. Thickness: 1/2 inch (12.7 mm).
   3. Long Edges: Tapered.

E. Foil-Backed Gypsum Board: ASTM C1396/C1396M.
   1. Manufacturers:
      a. American Gypsum

b. USG
c. CertainTeed
d. National Gypsum

2. Core: 5/8 inch (15.9 mm), Type X.
3. Long Edges: [**Tapered**] [**Tapered and featured (rounded or beveled) for prefilling**].

F. Abuse-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.
1. Manufacturers:
a. American Gypsum
b. USG
c. CertainTeed
d. National Gypsum
2. Core: 5/8 inch (15.9 mm), Type X.
3. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds [**Level 1**] [**Level 2**] [**Level 3**] requirements.
4. Indentation: ASTM C1629/C1629M, meets or exceeds [**Level 1**] [**Level 2**] [**Level 3**] requirements.
5. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds [**Level 1**] [**Level 2**] [**Level 3**] requirements.
6. Long Edges: Tapered.
7. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

G. Impact-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.
1. Manufacturers:
a. American Gypsum
b. USG
c. CertainTeed
d. National Gypsum
2. Core: 5/8 inch (15.9 mm), Type X.
3. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds [**Level 1**] [**Level 2**] [**Level 3**] requirements.
4. Indentation: ASTM C1629/C1629M, meets or exceeds [**Level 1**] [**Level 2**] [**Level 3**] requirements.
5. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds [**Level 1**] [**Level 2**] [**Level 3**] requirements.
6. Hard-Body Impact: ASTM C1629/C1629M, meets or exceeds [**Level 1**] [**Level 2**] [**Level 3**] requirements according to test in Annex A1.
7. Long Edges: Tapered.
8. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

H. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.
1. Manufacturers:
a. American Gypsum
b. USG
c. CertainTeed
d. National Gypsum
2. Core: 5/8 inch (15.9 mm), Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.4 SPECIALTY GYPSUM BOARD

A. Gypsum Board, Type C: ASTM C1396/C1396M. Manufactured to have increased fire-resistive capability.
   1. Manufacturers:
      a. American Gypsum
      b. USG
      c. CertainTeed
      d. National Gypsum
   2. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
   3. Long Edges: Tapered.

2.5 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

A. Exterior Gypsum Soffit Board: ASTM C1396/C1396M, with manufacturer's standard edges.
   1. Manufacturers:
      a. American Gypsum
      b. USG
      c. CertainTeed
      d. National Gypsum
   2. Core: 5/8 inch (15.9 mm), Type X.

B. Glass-Mat Gypsum Sheathing Board: ASTM C1177/C1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.
   1. Manufacturers:
      a. American Gypsum
      b. USG
      c. CertainTeed
      d. National Gypsum
   2. Core: 5/8 inch (15.9 mm), Type X.

2.6 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.
   1. Manufacturers:
      a. American Gypsum
      b. USG
      c. CertainTeed
      d. National Gypsum
   2. Core: 5/8 inch (15.9 mm), Type X.
   3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

B. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.
   1. Manufacturers:
      a. American Gypsum
      b. USG
      c. CertainTeed
      d. National Gypsum
   2. Thickness: 5/8 inch (15.9 mm).
   3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.7 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
2. Shapes:

a. Cornerbead.
b. Bullnose bead.
c. LC-Bead: J-shaped; exposed long flange receives joint compound.
d. L-Bead: L-shaped; exposed long flange receives joint compound.
e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
f. Expansion (control) joint.
g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Exterior Trim: ASTM C1047.

1. Material: [**Hot-dip galvanized-steel sheet, plastic, or rolled zinc**] <**Insert material**>.
2. Shapes:

a. Cornerbead.
b. LC-Bead: J-shaped; exposed long flange receives joint compound.
c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

2.8 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping, all-purpose compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use sandable topping compound.
4. Finish Coat: For third coat, use sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

D. Joint Compound for Exterior Applications:

1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

E. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
2. Cementitious Backer Units: As recommended by backer unit manufacturer.
3. <**Insert products**>.

2.9 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

G. Vapor Retarder: As specified in Section 072600 "Vapor Retarders."

2.10 TEXTURE FINISHES

A. Primer: As recommended by textured finish manufacturer.

B. Aggregate Finish: Water-based, job-mixed, aggregated, drying-type texture finish for spray

C. Non-Aggregate Finish: Premixed, vinyl texture finish for spray application.
1. Texture: Spatter knock-down.

D. Acoustical Finish: Water-based, chemical-setting or drying-type, job-mixed texture finish for spray application.
1. Application Thickness: 1/2 inch (12.7 mm).

2. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 25 or less.
    b. Smoke-Developed Index: 450 or less.

3. NRC: 0.55 according to ASTM C423.

PART 3 - EXECUTION

3.1 INSTALLATION AND FINISHING OF PANELS

A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

B. Comply with ASTM C840.

C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

D. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

E. Prefill open joints, rounded or beveled edges**,** and damaged surface areas.

F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for acoustical tile.
3. Level 3: Where indicated on Drawings.
4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

5. Level 5: Where indicated on Drawings.

    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

H. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

I. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

J. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.2 APPLYING TEXTURE FINISHES

A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.

B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture free of starved spots or other evidence of thin application or of application patterns.

3.3 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

C. Delegated-Design Submittal: For seismic restraints for ceiling systems.

1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, using input from installers of the items involved.

B. Product test reports.

C. Research reports.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

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 restraints for ceiling systems.

B. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A according to ASTM E1264.
2. Smoke-Developed Index: 450 or less.

2.2 ACOUSTICAL PANELS

A. Manufacturers:
1. Armstrong
2. CertainTeed
3. USG

B. Acoustical Panel Standard: Manufacturer's standard panels according to ASTM E1264.

C. Color: As indicated in a schedule.

D. Light Reflectance (LR): 88%.

E. Ceiling Attenuation Class (CAC): 40.

F. Noise Reduction Coefficient (NRC): .80.

G. Articulation Class (AC): 170.

H. Edge/Joint Detail: As indicated by manufacturer's designation.

I. Thickness: As indicated in a schedule.

J. Modular Size: As indicated on Drawings.

2.3 METAL SUSPENSION SYSTEM

A. Metal Suspension-System Standard: Manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M.

B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation; with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Cold-rolled steel.
5. Cap Finish: Painted in color as selected from manufacturer's full range.

C. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip

galvanized, G30 (Z90) coating designation; with prefinished 9/16-inch- (15-mm-) wide metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Cold-rolled steel.
5. Cap Finish: Painted in color as selected from manufacturer's full range.

2.4 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

B. Hold-Down Clips: Manufacturer's standard hold-down.

C. Impact Clips: Manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

D. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.

2.5 METAL EDGE MOLDINGS AND TRIM

A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

PART 3 - EXECUTION

3.1 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated.

B. Layout openings for penetrations centered on the penetrating items.

3.2 INSTALLATION

A. Install acoustical panel ceilings according to ASTM C636/C636M**,** seismic design requirements, and manufacturer's written instructions.

B. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Do not use exposed fasteners, including pop rivets, on moldings and trim.

3. Arrange directionally patterned acoustical panels as follows:

   a. As indicated on reflected ceiling plans.
   b. Install panels with pattern running in one direction parallel to long axis of space.
   c. Install panels in a basket-weave pattern.

4. Install hold-down clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform inspections.

1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermoset-rubber base.
2. Thermoplastic-rubber base.
3. Vinyl base.
4. Rubber stair accessories.
5. Vinyl stair accessories.
6. Rubber molding accessories.
7. Vinyl molding accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. <Double click to insert sustainable design text for adhesives.>
2. <Double click to insert sustainable design text for sealants.>
3. <Double click to insert sustainable design text for resilient base and stair products laboratory reports.>
4. <Double click to insert sustainable design text for environmental product declarations.>

C. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. <Double click to insert sustainable design text for floor finishes.>

2.2 THERMOSET-RUBBER BASE <**Insert drawing designation**>

A. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Product Standard: ASTM F1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).

1. Style and Location:

a. Style A, Straight: [**Provide in areas with carpet**] <**Insert requirements**>.
b. Style B, Cove: [**Provide in areas with resilient floor coverings**] <**Insert requirements**>.

c. Style C, Butt to: [**Provide in areas indicated**] <**Insert requirements**>.

C. Thickness: 0.125 inch (3.2 mm).

D. Height: [**2-1/2 inches (64 mm)**] [**4 inches (102 mm)**] [**6 inches (152 mm)**] [**As indicated on Drawings**].

E. Lengths: [**Cut lengths 48 inches (1219 mm) long**] [**Coils in manufacturer's standard length**] [**Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length**].

F. Outside Corners: [**Job formed**] [**Preformed**] [**Job formed or preformed**].

G. Inside Corners: [**Job formed**] [**Preformed**] [**Job formed or preformed**].

H. Colors: [**As indicated by manufacturer's designations**] [**Match Architect's sample**] <**Insert colors**>.

2.3 THERMOPLASTIC-RUBBER BASE <**Insert drawing designation**>

A. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Product Standard: ASTM F1861, Type TP (rubber, thermoplastic).

1. Group: [**I (solid, homogeneous)**] [**or**] [**II (layered)**].
2. Style and Location:

a. Style A, Straight: [**Provide in areas with carpet**] <**Insert requirements**>.
b. Style B, Cove: [**Provide in areas with resilient floor coverings**] <**Insert requirements**>.
c. Style C, Butt to: [**Provide in areas indicated**] <**Insert requirements**>.
d. Style D, Sculptured: [**Provide in areas indicated**] <**Insert requirements**>.

1) Profile: [**As indicated**] <**Insert requirement**>.

C. Thickness: [**0.125 inch (3.2 mm)**] <**Insert dimension**>.

D. Height: [**2-1/2 inches (64 mm)**] [**4 inches (102 mm)**] [**6 inches (152 mm)**] [**As indicated on Drawings**].

E. Lengths: [**Cut lengths 48 inches (1219 mm) long**] [**Coils in manufacturer's standard length**] [**Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length**].

F. Outside Corners: [**Job formed**] [**Preformed**] [**Job formed or preformed**].

G. Inside Corners: [**Job formed**] [**Preformed**] [**Job formed or preformed**].

H. Colors: [**As indicated by manufacturer's designations**] [**Match Architect's sample**] <**Insert colors**>.

2.4 VINYL BASE <**Insert drawing designation**>

A. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Product Standard: ASTM F1861, Type TV (vinyl, thermoplastic).

1. Group: [**I (solid, homogeneous)**] [**or**] [**II (layered)**].
2. Style and Location:

a. Style A, Straight: [**Provide in areas with carpet**] <**Insert requirements**>.
b. Style B, Cove: [**Provide in areas with resilient floor coverings**] <**Insert requirements**>.

C. Minimum Thickness: [**0.125 inch (3.2 mm)**] [**0.080 inch (2.0 mm)**] <**Insert dimension**>.

D. Height: [**2-1/2 inches (64 mm)**] [**4 inches (102 mm)**] [**6 inches (152 mm)**] [**As indicated on Drawings**].

E. Lengths: [**Cut lengths 48 inches (1219 mm) long**] [**Coils in manufacturer's standard length**] [**Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length**].

F. Outside Corners: [**Job formed**] [**Preformed**] [**Job formed or preformed**].

G. Inside Corners: [**Job formed**] [**Preformed**] [**Job formed or preformed**].

H. Colors and Patterns: [**As indicated by manufacturer's designations**] [**Match Architect's sample**] <**Insert colors and patterns**>.

2.5 RUBBER STAIR ACCESSORIES <**Insert drawing designation**>

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. <Double click here to find, evaluate, and insert list of manufacturers and products.>

C. Stair Treads: ASTM F2169.

1. Type: [**TS (rubber, vulcanized thermoset)**] [**or**] [**TP (rubber, thermoplastic)**].
2. Class: [**1 (smooth, flat)**] [**2 (pattern; embossed, grooved, or ribbed)**].
3. Group: [**1 (embedded abrasive strips)**] [**2 (with contrasting color for the visually impaired)**].
4. Nosing Style: [**Square, adjustable to cover angles between 60 and 90 degrees**] [**Square**] [**Round**].
5. Nosing Height: [**1-1/2 inches (38 mm)**] [**2 inches (51 mm)**] [**2-3/16 inches (56 mm)**] <**Insert dimension**>.
6. Thickness: [**1/4 inch (6 mm) and tapered to back edge**] <**Insert thickness**>.
7. Size: Lengths and depths to fit each stair tread in [**one piece**] [**one piece or, for treads exceeding maximum lengths manufactured, in equal-length units**].
8. Integral Risers: Smooth, flat; in height that fully covers substrate.

D. Separate Risers: Smooth, flat; in height that fully covers substrate; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.

1. Style: [**Coved toe, 7 inches (178 mm) high by length matching treads**] [**Toeless, by length matching treads**].
2. Thickness: [**0.125 inch (3.2 mm)**] [**Manufacturer's standard**] <**Insert thickness**>.

E. Stringers: Height and length after cutting to fit risers and treads and to cover stair stringers, produced by same manufacturer as treads, and recommended by manufacturer for installation with treads.

1. Thickness: [**0.125 inch (3.2 mm)**] [**0.080 inch (2.0 mm)**] [**Manufacturer's standard**] <**Insert thickness**>.

F. Landing Tile: [**Matching treads; produced by same manufacturer as treads and recommended by manufacturer for installation with treads**] <**Insert requirements**>.

G. Locations: [**Provide rubber stair accessories in areas indicated**] <**Insert requirements**>.

H. Colors and Patterns: [**As indicated by manufacturer's designations**] [**Match Architect's sample**] <**Insert colors and patterns**>.

2.6 VINYL STAIR ACCESSORIES <**Insert drawing designation**>

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. <Double click here to find, evaluate, and insert list of manufacturers and products.>

C. Stair Treads: ASTM F2169, Type TV (vinyl, thermoplastic).

1. Class: [**1 (smooth, flat)**] [**2 (pattern; embossed, grooved, or ribbed)**].
2. Group: [**1 (embedded abrasive strips)**] [**2 (with contrasting color for the visually impaired)**].
3. Nosing Style: [**Square, adjustable to cover angles between 60 and 90 degrees**] [**Square**] [**Round**].
4. Nosing Height: [**1-1/2 inches (38 mm)**] [**2 inches (51 mm)**] [**2-3/16 inches (56 mm)**] <**Insert dimension**>.
5. Thickness: [**1/4 inch (6 mm) and tapered to back edge**] <**Insert thickness**>.
6. Size: Lengths and depths to fit each stair tread in [**one piece**] [**one piece or, for treads exceeding maximum lengths manufactured, in equal-length units**].
7. Integral Risers: Smooth, flat; in height that fully covers substrate.

D. Separate Risers: Smooth, flat; in height that fully covers substrate; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.

1. Style: [**Coved toe, 7 inches (178 mm) high by length matching treads**] [**Toeless, by length matching treads**].
2. Thickness: [**0.125 inch (3.2 mm)**] [**0.080 inch (2.0 mm)**] [**Manufacturer's standard**] <**Insert thickness**>.

E. Stringers: Height and length after cutting to fit risers and treads and to cover stair stringers, produced by same manufacturer as treads, and recommended by manufacturer for installation with treads.

1. Thickness: [**0.125 inch (3.2 mm)**] [**0.080 inch (2.0 mm)**] [**Manufacturer's standard**] <**Insert thickness**>.

F. Landing Tile: [**Matching treads; produced by same manufacturer as treads and recommended by manufacturer for installation with treads**] <**Insert requirements**>.

G. Locations: [**Provide vinyl stair accessories in areas indicated**] <**Insert requirements**>.

H. Colors and Patterns: [**As indicated by manufacturer's designations**] [**Match Architect's sample**] <**Insert colors and patterns**>.

2.7 RUBBER MOLDING ACCESSORY <**Insert drawing designation**>

A. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Description: Rubber [**stair-tread nosing**] [**cap for cove carpet**] [**cap for cove resilient floor covering**] [**carpet bar for tackless installations**] [**carpet edge for glue-down applications**] [**nosing for carpet**] [**nosing for resilient floor covering**] [**reducer strip for resilient floor covering**] [**joiner for tile and carpet**] [**transition strips**] <**Insert description**>.

C. Profile and Dimensions: [**As indicated**] <**Insert profile and dimensions**>.

D. Locations: [**Provide rubber molding accessories in areas indicated**] <**Insert requirements**>.

E. Colors and Patterns: [**As indicated by manufacturer's designations**] [**Match Architect's sample**] <**Insert colors and patterns**>.

2.8 VINYL MOLDING ACCESSORY <**Insert drawing designation**>

A. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Description: Vinyl [**stair-tread nosing**] [**cap for cove carpet**] [**cap for cove resilient floor covering**] [**carpet bar for tackless installations**] [**carpet edge for glue-down applications**] [**nosing for carpet**] [**nosing for resilient floor covering**] [**reducer strip for resilient floor covering**] [**joiner for tile and carpet**] [**transition strips**] <**Insert description**>.

C. Profile and Dimensions: [**As indicated**] <**Insert profile and dimensions**>.

D. Locations: [**Provide vinyl molding accessories in areas indicated**] <**Insert requirements**>.

E. Colors and Patterns: [**As indicated by manufacturer's designations**] [**Match Architect's sample**] <**Insert colors and patterns**>.

2.9 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

1. <Double click to insert sustainable design text for VOC content for adhesives.>

C. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.

D. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than [**9**] [**10**] <**Insert number**> pH.
4. Moisture Testing: Perform tests so that each test area does not exceed [**200 sq. ft. (18.6 sq. m)**] [**1000 sq. ft. (304.8 sq. m)**] <**Insert area**>, and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [**3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)**] <**Insert rate**> in 24 hours.
    b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum [**75**] <**Insert number**> percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until materials are the same temperature as space where they are to be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.2 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than [**3 inches (76 mm)**] <**Insert dimension**> in length.

a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than [**3 inches (76 mm)**] <**Insert dimension**> in length.

a. [**Miter**] [**Cope**] [**Miter or cope**] corners to minimize open joints.

3.3 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Stair Accessories:

1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
2. Tightly adhere to substrates throughout length of each piece.
3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Floor Polish: Remove soil, adhesive, and blemishes from resilient stair treads before applying liquid floor polish.

1. Apply [**one**] [**two**] [**three**] <**Insert requirement**> coat(s).

C. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Modular carpet tile.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [**Project site**] <**Insert location**>.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. <Double click to insert sustainable design text for adhesives.>
2. <Double click to insert sustainable design text for carpeting products.>
3. <Double click to insert sustainable design text for flooring.>

C. Shop Drawings: For carpet tile installation, plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

D. Samples: For each exposed product and for each color and texture required.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Certified by the International Certified Floorcovering Installers Association at the [**Commercial II**] [**Master II**] <**Insert description**> certification level.

1.7 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty Period: [**10**] <**Insert number**> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE <**Insert drawing designation**>

A. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Color: [**As indicated by manufacturer's designations**] [**Match Architect's samples**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

C. Pattern: [**Match Architect's samples**] <**Insert pattern**>.

D. Fiber Content: [**100 percent nylon 6, 6**] [**100 percent nylon 6**] [**100 percent polypropylene**] [**100 percent wool**] [**80 percent wool; 20 percent nylon 6, 6**] [**80 percent wool; 20 percent nylon 6**] <**Insert percentage**>.

E. Fiber Type: <**Insert proprietary fiber type**>.

F. Pile Characteristic: [**Level-loop**] [**Cut**] [**Cut-and-loop**] <**Insert construction**> pile.

G. Yarn Twist: <**Insert TPI (TPCM)**>.

H. Yarn Count: <**Insert count**>.

I. Density: <**Insert oz./cu. yd. (g/cu. cm)**>.

J. Pile Thickness: <**Insert inches (mm)**> for finished carpet tile[**according to ASTM D6859**].

K. Stitches: <**Insert stitches per inch (mm)**>.

L. Gage: <**Insert ends per inch (mm)**>.

M. Surface Pile Weight: <**Insert oz./sq. yd. (g/sq. m)**>.

N. Total Weight: <**Insert oz./sq. yd. (g/sq. m)**> for finished carpet tile.

O. Primary Backing/Backcoating: [**Manufacturer's standard composite materials**] [**PVC**] [**Fiberglass-reinforced PVC**] [**Fiberglass-reinforced amorphous resin**] [**Reinforced polyurethane composite cushion**] [**Reinforced polyurethane composite**] [**Reinforced thermoplastic copolymer**] <**Insert specific primary backing materials; consult manufacturers**>.

P. Secondary Backing: [**Manufacturer's standard material**] <**Insert specific secondary backing material**>.

Q. Backing System: <**Insert proprietary name**>.

R. Size: [**18 by 18 inches (457 by 457 mm)**] [**24 by 24 inches (610 by 610 mm)**] [**18 by 36 inches (457 by 914 mm)**] [**36 by 36 inches (914 by 914 mm)**] <**Insert dimensions**>.

S. Applied Treatments:

1. Soil-Resistance Treatment: [**Manufacturer's standard treatment**] <**Insert treatment**>.
2. Antimicrobial Treatment: [**Manufacturer's standard treatment**] <**Insert treatment**> that protects carpet tiles as follows:

    a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.

T. Sustainable Design Requirements:

1. Sustainable Product Certification: [**Silver**] [**Gold**] [**Platinum**] level certification according to ANSI/NSF 140.
2. <Double click to insert sustainable design text for carpet and cushion.>

U. Performance Characteristics:

1. Appearance Retention Rating: [**Moderate traffic, 2.5**] [**Heavy traffic, 3.0**] [**Severe traffic, 3.5**] <**Insert number**> minimum according to ASTM D7330.
2. Critical Radiant Flux Classification: Not less than [**0.45 W/sq. cm**] [**0.22 W/sq. cm**] according to NFPA 253.
3. Dry Breaking Strength: Not less than 100 lbf (445 N) according to ASTM D2646.
4. Tuft Bind: Not less than [**3 lbf (13 N)**] [**5 lbf (22 N)**] [**6.2 lbf (28 N)**] [**8 lbf (36 N)**] [**10 lbf (45 N)**] <**Insert value**> according to ASTM D1335.
5. Delamination: Not less than [**3.5 lbf/in. (0.6 N/mm)**] [**4 lbf/in. (0.7 N/mm)**] <**Insert value**> according to ASTM D3936.
6. Dimensional Tolerance: Within 1/32 inch (0.8 mm) of specified size dimensions, as determined by physical measurement.
7. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
8. Noise Reduction Coefficient (NRC): <**Insert NRC**> according to ASTM C423.
9. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
10. Colorfastness to Light: Not less than 4 after [**40**] [**60**] <**Insert number**> AFU (AATCC fading units) according to AATCC 16, Option E.
11. Electrostatic Propensity: Less than [**3.5**] [**2**] <**Insert number**> kV according to AATCC 134.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

1. <Double click to insert sustainable design text for VOC content of adhesive.>
2. <Double click to insert sustainable design text for adhesives.>

PART 3 - EXECUTION

3.1 EXAMINATION

A. Concrete Slabs:

1. Moisture Testing: Perform tests so that each test area does not exceed [**200 sq. ft. (18.6 sq. m)**] [**1000 sq. ft. (304.8 sq. m)**] <**Insert area**>, and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [**3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)**] <**Insert emission**> in 24 hours.
b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum [**75**] <**Insert number**> percent relative humidity level measurement.
c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

B. Wood Subfloors: Verify that underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

C. Metal Subfloors: Verify that underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

D. Painted Subfloors: Perform bond test recommended in writing by adhesive manufacturer.

1. Access Flooring Systems: Verify access floor substrate is compatible with carpet tile and adhesive, if any, and underlayment surface is gaps greater than [**1/8 inch (3 mm)**] <**Insert dimension**> and protrusions more than 1/32 inch (0.8 mm).

3.2 PREPARATION

A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks,

holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: [**As recommended in writing by carpet tile manufacturer**] [**Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive**] [**Partial glue down; install periodic tiles with releasable, pressure-sensitive adhesive**] [**Free lay; install carpet tiles without adhesive**].

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns [**indicated on Drawings**] [**recommended in writing by carpet tile manufacturer**].

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

I. Access Flooring: Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

J. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on [**interior substrates.**] [**the following interior substrates:**]

1. Concrete.
2. Cement board.
3. Clay masonry.
4. Concrete masonry units (CMUs).
5. Steel and iron.
6. Galvanized metal.
7. Aluminum (not anodized or otherwise coated).
8. Wood.
9. Plastic.
10. Gypsum board.
11. Plaster.
12. Spray-textured ceilings.
13. Cotton or canvas insulation covering.
14. ASJ insulation covering.

1.2 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.

B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.

E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.

F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

B. Sustainable Design Submittals:

1. <Double click to insert sustainable design text for paints and coatings.>

C. Samples: For each type of paint system and in each color and gloss of topcoat.

1.4 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Products: Subject to compliance with requirements, [**provide product**] [**provide one of the products**] [**available products that may be incorporated into the Work include, but are not limited to products**] listed in the Interior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. <Double click to insert sustainable design text for paints.>

D. Colors: [**As selected by Architect from manufacturer's full range**] [**Match Architect's samples**] [**As indicated in a color schedule**] <**Insert requirements**>.

1. [**Ten**] [**Twenty**] [**Thirty**] <**Insert number**> percent of surface area will be painted with deep tones.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Masonry (Clay and CMUs): 12 percent.
4. Wood: 15 percent.
5. Gypsum Board: 12 percent.
6. Plaster: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

This Section may be edited using AVITRU's SpecBuilder and the MPI Architectural Painting Decision Tree. <**Double click here to connect.**>

3.4 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Latex System [**MPI INT 3.1A**] [**MPI INT 3.1E**]:

a. Prime Coat: Primer, alkali resistant, water based[**, MPI #3**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Prime Coat: Latex, interior, matching topcoat.
c. Intermediate Coat: Latex, interior, matching topcoat.
d. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[**, MPI #53**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior (MPI Gloss Level 2)[**, MPI #44**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior (MPI Gloss Level 3)[**, MPI #52**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior (MPI Gloss Level 4)[**, MPI #43**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #54**].

1) <**Insert manufacturer's name; product name or designation**>.

i. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[**, MPI #114**].

1) <**Insert manufacturer's name; product name or designation**>.

2. Latex over Latex Aggregate System [**MPI INT 3.1B**]:

a. Prime Coat: Textured coating, latex, flat[**, MPI #42**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[**, MPI #53**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior (MPI Gloss Level 2)[**, MPI #44**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior (MPI Gloss Level 3)[**, MPI #52**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior (MPI Gloss Level 4)[**, MPI #43**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #54**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[**, MPI #114**].

1) <**Insert manufacturer's name; product name or designation**>.

3. Latex Aggregate System [**MPI INT 3.1N**]:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Textured coating, latex, nonflat[**, MPI #41**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Textured coating, latex, flat[**, MPI #42**].

1) <**Insert manufacturer's name; product name or designation**>.

4. Institutional Low-Odor/VOC Latex System [**MPI INT 3.1M**]:

a. Prime Coat: Primer sealer, interior, institutional low odor/VOC[**, MPI #149**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[**, MPI #143**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[**, MPI #144**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[**, MPI #145**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[**, MPI #146**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[**, MPI #147**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[**, MPI #148**].

1) <**Insert manufacturer's name; product name or designation**>.

5. High-Performance Architectural Latex System [**MPI INT 3.1C**]:

a. Prime Coat: Primer, alkali resistant, water based[**, MPI #3**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[**, MPI #138**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[**, MPI #139**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[**, MPI #140**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[**, MPI #141**].

1) <**Insert manufacturer's name; product name or designation**>.

6. Water-Based Light Industrial Coating System [**MPI INT 3.1L**]:

a. Prime Coat: Primer, alkali resistant, water based[**, MPI #3**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3)[**, MPI #151**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5)[**, MPI #153**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6)[**, MPI #154**].

1) <**Insert manufacturer's name; product name or designation**>.

7. Alkyd System [**MPI INT 3.1D**]:

a. Prime Coat: Primer, alkali resistant, water based[**, MPI #3**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[**, MPI #49**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3)[**, MPI #51**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #47**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[**, MPI #48**].

1) <**Insert manufacturer's name; product name or designation**>.

B. Concrete Substrates, Traffic Surfaces:

1. Latex Floor Enamel System [**MPI INT 3.2A**]:

a. Prime Coat: Floor paint, latex, matching topcoat.
b. Intermediate Coat: Floor paint, latex, matching topcoat.
c. Topcoat: Floor paint, latex, low gloss (maximum MPI Gloss Level 3)[**, MPI #60**].

1) <**Insert manufacturer's name; product name or designation**>.

2. Alkyd Floor Enamel System [**MPI INT 3.2B**]:

a. Prime Coat: Floor enamel, alkyd, matching topcoat.
b. Intermediate Coat: Floor enamel, alkyd, matching topcoat.
c. Topcoat: Floor enamel, alkyd, gloss (MPI Gloss Level 6)[**, MPI #27**].

1) <**Insert manufacturer's name; product name or designation**>.

3. Concrete Stain System [**MPI INT 3.2E**]:

a. First Coat: Stain, interior, for concrete floors, matching topcoat.
b. Topcoat: Stain, interior, for concrete floors[**, MPI #58**].

1) <**Insert manufacturer's name; product name or designation**>.

4. Water-Based Concrete Floor Sealer System [**MPI INT 3.2G**]:

a. First Coat: Sealer, water based, for concrete floors, matching topcoat.
b. Topcoat: Sealer, water based, for concrete floors**[, MPI #99]**.

5. Solvent-Based Concrete Floor Sealer System [**MPI INT 3.2F**]:

a. First Coat: Sealer, solvent based, for concrete floors, matching topcoat.
b. Topcoat: Sealer, solvent based, for concrete floors**[, MPI #104]**.

1) <**Insert manufacturer's name; product name or designation**>.

C. Cement Board Substrates:

1. Latex System [**MPI INT 3.3A**]:

a. Prime Coat: Primer, alkali resistant, water based**[, MPI #3]**.

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1)**[, MPI #53]**.

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior (MPI Gloss Level 2)**[, MPI #44]**.

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior (MPI Gloss Level 3)**[, MPI #52]**.

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior (MPI Gloss Level 4)**[, MPI #43]**.

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)**[, MPI #54]**.

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)**[, MPI #114]**.

1) <**Insert manufacturer's name; product name or designation**>.

2. Institutional Low-Odor/VOC Latex System [**MPI INT 3.3G**]:

a. Prime Coat: Primer sealer, interior, institutional low odor/VOC**[, MPI #149]**.

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)**[, MPI #143]**.

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[**, MPI #144**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[**, MPI #145**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[**, MPI #146**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[**, MPI #147**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[**, MPI #148**].

1) <**Insert manufacturer's name; product name or designation**>.

3. High-Performance Architectural Latex System [**MPI INT 3.3B**]:

a. Prime Coat: Primer, alkali resistant, water based[**, MPI #3**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[**, MPI #138**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[**, MPI #139**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[**, MPI #140**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[**, MPI #141**].

1) <**Insert manufacturer's name; product name or designation**>.

4. Water-Based Light Industrial Coating System [**MPI INT 3.3H**]:

a. Prime Coat: Primer, alkali resistant, water based[**, MPI #3**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3)[**, MPI #151**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5)[**, MPI #153**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6)[**, MPI #154**].

1) <**Insert manufacturer's name; product name or designation**>.

5. Alkyd System [**MPI INT 3.3C**]:

a. Prime Coat: Primer, alkali resistant, water based[**, MPI #3**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[**, MPI #49**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3)[**, MPI #51**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #47**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[**, MPI #48**].

1) <**Insert manufacturer's name; product name or designation**>.

D. Clay Masonry Substrates:

1. Latex System [**MPI INT 4.1A**]:

a. Prime Coat: Primer, alkali resistant, water based[**, MPI #3**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[**, MPI #53**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior (MPI Gloss Level 2)[**, MPI #44**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior (MPI Gloss Level 3)[**, MPI #52**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior (MPI Gloss Level 4)[**, MPI #43**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #54**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[**, MPI #114**].

1) <**Insert manufacturer's name; product name or designation**>.

2. Latex Aggregate System [**MPI INT 4.1B**]:

a. Prime Coat: Primer for textured coating, latex, flat[**, as recommended in writing by topcoat manufacturer**].
b. Intermediate Coat: Intermediate coat for textured coating, latex, flat[**, as recommended in writing by topcoat manufacturer**].
c. Topcoat: Textured coating, latex, nonflat[**, MPI #41**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Textured coating, latex, flat[**, MPI #42**].

1) <**Insert manufacturer's name; product name or designation**>.

3. Institutional Low-Odor/VOC Latex System [**MPI INT 4.1M**]:

a. Prime Coat: Primer sealer, interior, institutional low odor/VOC[**, MPI #149**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[**, MPI #143**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[**, MPI #144**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[**, MPI #145**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[**, MPI #146**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[**, MPI #147**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[**, MPI #148**].

1) <**Insert manufacturer's name; product name or designation**>.

4. High-Performance Architectural Latex System [**MPI INT 4.1L**]:

a. Prime Coat: Primer, alkali resistant, water based[**, MPI #3**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[**, MPI #138**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[**, MPI #139**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[**, MPI #140**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[**, MPI #141**].

1) <**Insert manufacturer's name; product name or designation**>.

5. Water-Based Light Industrial Coating System [**MPI INT 4.1C**]:

a. Prime Coat: Primer, alkali resistant, water based[**, MPI #3**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3)[**, MPI #151**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5)[**, MPI #153**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6)[**, MPI #154**].

1) <**Insert manufacturer's name; product name or designation**>.

6. Alkyd System [**MPI INT 4.1D**]:

a. Prime Coat: Primer, alkali resistant, water based[**, MPI #3**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[**, MPI #49**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3)[**, MPI #51**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #47**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[**, MPI #48**].

1) <**Insert manufacturer's name; product name or designation**>.

E. CMU Substrates:

1. Latex System [**MPI INT 4.2A**]:

a. Block Filler: Block filler, latex, interior/exterior[**, MPI #4**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[**, MPI #53**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior (MPI Gloss Level 2)[**, MPI #44**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior (MPI Gloss Level 3)[**, MPI #52**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior (MPI Gloss Level 4)[**, MPI #43**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #54**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[**, MPI #114**].

1) <**Insert manufacturer's name; product name or designation**>.

2. Latex Aggregate System [**MPI INT 4.2B**]:

a. Prime Coat: Primer for textured coating, latex, flat[**, as recommended in writing by topcoat manufacturer**].
b. Intermediate Coat: Intermediate coat for textured coating, latex, flat[**, as recommended in writing by topcoat manufacturer**].
c. Topcoat: Textured coating, latex, nonflat[**, MPI #41**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Textured coating, latex, flat[**, MPI #42**].

1) <**Insert manufacturer's name; product name or designation**>.

3. Institutional Low-Odor/VOC Latex System [**MPI INT 4.2E**]:

a. Block Filler: Block filler, latex, interior/exterior[**, MPI #4**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[**, MPI #143**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[**, MPI #144**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[**, MPI #145**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[**, MPI #146**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[**, MPI #147**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[**, MPI #148**].

1) <**Insert manufacturer's name; product name or designation**>.

4. High-Performance Architectural Latex System [**MPI INT 4.2D**] [**MPI INT 4.2P**]:

a. Block Filler: Block filler, latex, interior/exterior[**, MPI #4**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Prime Coat: Primer, alkali resistant, water based[**, MPI #3**].

1) <**Insert manufacturer's name; product name or designation**>.

c. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[**, MPI #138**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[**, MPI #139**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[**, MPI #140**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[**, MPI #141**].

1) <**Insert manufacturer's name; product name or designation**>.

5. Water-Based Light Industrial Coating System [**MPI INT 4.2K**]:

a. Block Filler: Block filler, latex, interior/exterior[**, MPI #4**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3)[**, MPI #151**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5)[**, MPI #153**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6)[**, MPI #154**].

1) <**Insert manufacturer's name; product name or designation**>.

6. Alkyd System [**MPI INT 4.2C**] [**MPI INT 4.2N**]:

a. Block Filler: Block filler, latex, interior/exterior[**, MPI #4**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Sealer Coat: Primer sealer, latex, interior[**, MPI #50**].

1) <**Insert manufacturer's name; product name or designation**>.

c. Intermediate Coat: Alkyd, interior, matching topcoat.
d. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[**, MPI #49**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Alkyd, interior (MPI Gloss Level 3)[**, MPI #51**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #47**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[**, MPI #48**].

1) <**Insert manufacturer's name; product name or designation**>.

F. Steel Substrates:

1. Latex System, Alkyd Primer [**MPI INT 5.1Q**] [**MPI INT 5.1QQ**]:

a. Prime Coat: Primer, alkyd, quick dry, for metal[**, MPI #76**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Prime Coat: Primer, alkyd, anti-corrosive, for metal[**, MPI #79**].

1) <**Insert manufacturer's name; product name or designation**>.

c. Prime Coat: Shop primer specified in Section where substrate is specified.
d. Intermediate Coat: Latex, interior, matching topcoat.
e. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[**, MPI #53**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior (MPI Gloss Level 2)[**, MPI #44**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior (MPI Gloss Level 3)[**, MPI #52**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior (MPI Gloss Level 4)[**, MPI #43**].

1) <**Insert manufacturer's name; product name or designation**>.

i. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #54**].

1) <**Insert manufacturer's name; product name or designation**>.

j. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[**, MPI #114**].

1) <**Insert manufacturer's name; product name or designation**>.

2. Latex over Shop-Applied Quick-Drying Shop Primer System [**MPI INT 5.1X**]:

a. Prime Coat: Primer, quick dry, for shop application[**, MPI #275**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[**, MPI #53**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior (MPI Gloss Level 2)[**, MPI #44**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior (MPI Gloss Level 3)[**, MPI #52**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior (MPI Gloss Level 4)[**, MPI #43**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #54**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[**, MPI #114**].

1) <**Insert manufacturer's name; product name or designation**>.

3. Institutional Low-Odor/VOC Latex System [**MPI INT 5.1S**]:

a. Prime Coat: Primer, rust inhibitive, water based[**MPI #107**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[**, MPI #143**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[**, MPI #144**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[**, MPI #145**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[**, MPI #146**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[**, MPI #147**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[**, MPI #148**].

1) <**Insert manufacturer's name; product name or designation**>.

4. High-Performance Architectural Latex System [**MPI INT 5.1R**] [**MPI INT 5.1R**]:

a. Prime Coat: Primer, alkyd, quick dry, for metal[**, MPI #76**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Prime Coat: Primer, alkyd, anti-corrosive, for metal[**, MPI #79**].

1) <**Insert manufacturer's name; product name or designation**>.

c. Prime Coat: Shop primer specified in Section where substrate is specified.
d. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[**, MPI #138**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[**, MPI #139**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[**, MPI #140**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[**, MPI #141**].

1) <**Insert manufacturer's name; product name or designation**>.

5. Water-Based Light Industrial Coating System [**MPI INT 5.1B**]:

a. Prime Coat: Primer, rust-inhibitive, water based[**MPI #107**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3)[**, MPI #151**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5)[**, MPI #153**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6)[**, MPI #154**].

1) <**Insert manufacturer's name; product name or designation**>.

6. Water-Based Dry-Fall System [**MPI INT 5.1C**] [**MPI INT 5.1CC**]:

a. Prime Coat: Primer, alkyd, quick dry, for metal[**, MPI #76**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Prime Coat: Primer, alkyd, anti-corrosive, for metal[**, MPI #79**].

1) <**Insert manufacturer's name; product name or designation**>.

c. Prime Coat: Shop primer specified in Section where substrate is specified.
d. Topcoat: Dry fall, latex, flat[**, MPI #118**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Dry fall, water based, for galvanized steel, flat (MPI Gloss Level 1)[**, MPI #133**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Dry fall, latex (MPI Gloss Level 3)[**, MPI #155**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Dry fall, latex (MPI Gloss Level 5)[**, MPI #226**].

1) <**Insert manufacturer's name; product name or designation**>.

7. Alkyd System [**MPI INT 5.1E**] [**MPI INT 5.1EE**]:

a. Prime Coat: Primer, alkyd, quick dry, for metal[**, MPI #76**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Prime Coat: Primer, alkyd, anti-corrosive, for metal[**, MPI #79**].

1) <**Insert manufacturer's name; product name or designation**>.

c. Prime Coat: Shop primer specified in Section where substrate is specified.
d. Intermediate Coat: Alkyd, interior, matching topcoat.
e. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[**, MPI #49**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Alkyd, interior (MPI Gloss Level 3)[**, MPI #51**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #47**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[**, MPI #48**].

1) <**Insert manufacturer's name; product name or designation**>.

8. Alkyd over Surface-Tolerant Primer System [**MPI INT 5.1T**]:

a. Prime Coat: Primer, metal, surface tolerant[**MPI #23**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[**, MPI #49**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3)[**, MPI #51**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #47**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[**, MPI #48**].

9. Quick-Dry Enamel System [**MPI INT 5.1A**]:

    a. Prime Coat: Primer, alkyd, quick dry, for metal[**, MPI #76**].

        1) <**Insert manufacturer's name; product name or designation**>.

    b. Intermediate Coat: Alkyd, quick dry, matching topcoat.
    c. Topcoat: Alkyd, quick dry, semi-gloss (MPI Gloss Level 5)[**, MPI #81**].

        1) <**Insert manufacturer's name; product name or designation**>.

    d. Topcoat: Alkyd, quick dry, gloss (MPI Gloss Level 7)[**, MPI #96**].

        1) <**Insert manufacturer's name; product name or designation**>.

10. Alkyd Dry-Fall System [**MPI INT 5.1D**] [**MPI INT 5.1DD**]:

    a. Prime Coat: Primer, alkyd, quick dry, for metal[**, MPI #76**].

        1) <**Insert manufacturer's name; product name or designation**>.

    b. Prime Coat: Primer, alkyd, anti-corrosive, for metal[**, MPI #79**].

        1) <**Insert manufacturer's name; product name or designation**>.

    c. Prime Coat: Shop primer specified in Section where substrate is specified.
    d. Topcoat: Dry fall, alkyd, flat[**, MPI #55**].

        1) <**Insert manufacturer's name; product name or designation**>.

    e. Topcoat: Dry fall, alkyd (MPI Gloss Level 3)[**, MPI #89**].

        1) <**Insert manufacturer's name; product name or designation**>.

    f. Topcoat: Dry fall, alkyd, semi-gloss (MPI Gloss Level 5)[**, MPI #225**].

        1) <**Insert manufacturer's name; product name or designation**>.

11. Aluminum Paint System [**MPI INT 5.1M**] [**MPI INT 5.1MM**]:

    a. Prime Coat: Primer, alkyd, quick dry, for metal[**, MPI #76**].

        1) <**Insert manufacturer's name; product name or designation**>.

    b. Prime Coat: Primer, alkyd, anti-corrosive, for metal[**, MPI #79**].

        1) <**Insert manufacturer's name; product name or designation**>.

    c. Prime Coat: Shop primer specified in Section where substrate is specified.
    d. Intermediate Coat: Aluminum paint, matching topcoat.
    e. Topcoat: Aluminum paint[**, MPI #1**].

        1) <**Insert manufacturer's name; product name or designation**>.

G. Galvanized-Metal Substrates:

1. Latex System [**MPI INT 5.3A**]:

   a. Prime Coat: Primer, galvanized, water based[**, MPI #134**].

      1) <**Insert manufacturer's name; product name or designation**>.

   b. Intermediate Coat: Latex, interior, matching topcoat.
   c. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[**, MPI #53**].

      1) <**Insert manufacturer's name; product name or designation**>.

   d. Topcoat: Latex, interior (MPI Gloss Level 2)[**, MPI #44**].

      1) <**Insert manufacturer's name; product name or designation**>.

   e. Topcoat: Latex, interior (MPI Gloss Level 3)[**, MPI #52**].

      1) <**Insert manufacturer's name; product name or designation**>.

   f. Topcoat: Latex, interior (MPI Gloss Level 4)[**, MPI #43**].

      1) <**Insert manufacturer's name; product name or designation**>.

   g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #54**].

      1) <**Insert manufacturer's name; product name or designation**>.

   h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[**, MPI #114**].

      1) <**Insert manufacturer's name; product name or designation**>.

2. Institutional Low-Odor/VOC Latex System [**MPI INT 5.3N**]:

   a. Prime Coat: Primer, galvanized, water based[**, MPI #134**].

      1) <**Insert manufacturer's name; product name or designation**>.

   b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
   c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[**, MPI #143**].

      1) <**Insert manufacturer's name; product name or designation**>.

   d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[**, MPI #144**].

      1) <**Insert manufacturer's name; product name or designation**>.

   e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[**, MPI #145**].

      1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[**, MPI #146**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[**, MPI #147**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[**, MPI #148**].

1) <**Insert manufacturer's name; product name or designation**>.

3. High-Performance Architectural Latex System [**MPI INT 5.3M**]:

a. Prime Coat: Primer, galvanized, water based[**, MPI #134**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[**, MPI #138**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[**, MPI #139**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[**, MPI #140**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[**, MPI #141**].

1) <**Insert manufacturer's name; product name or designation**>.

4. Water-Based Light Industrial Coating System MPI INT 5.3B:

a. Prime Coat: Primer, galvanized, water based[**, MPI #134**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3)[**, MPI #151**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5)[**, MPI #153**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6)[**, MPI #154**].

1) <**Insert manufacturer's name; product name or designation**>.

5. Water-Based Dry-Fall System [**MPI INT 5.3H**]:

a. Prime Coat: Dry fall, water based, for galvanized steel, matching topcoat.
b. Topcoat: Dry fall, water based, for galvanized steel, flat (MPI Gloss Level 1)[**, MPI #133**].

1) <**Insert manufacturer's name; product name or designation**>.

6. Alkyd over Cementitious Primer System [**MPI INT 5.3C**]:

a. Prime Coat: Primer, galvanized, cementitious[**, MPI #26**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[**, MPI #49**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3)[**, MPI #51**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #47**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[**, MPI #48**].

1) <**Insert manufacturer's name; product name or designation**>.

7. Alkyd Dry-Fall System (Cementitious Primer) [**MPI INT 5.3F**]:

a. Prime Coat: Primer, galvanized, cementitious[**, MPI #26**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Topcoat: Dry fall, alkyd, flat[**, MPI #55**].

1) <**Insert manufacturer's name; product name or designation**>.

c. Topcoat: Dry fall, alkyd (MPI Gloss Level 3) [**, MPI #89**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Dry fall, alkyd, semi-gloss (MPI Gloss Level 5)[**, MPI #225**].

1) <**Insert manufacturer's name; product name or designation**>.

8. Aluminum Paint System (Cementitious Primer) [**MPI INT 5.3G**]:

a. Prime Coat: Primer, galvanized, cementitious[**, MPI #26**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Aluminum paint, matching topcoat.
c. Topcoat: Aluminum paint[**, MPI #1**].

1) <**Insert manufacturer's name; product name or designation**>.

H. Aluminum (Not Anodized or Otherwise Coated) Substrates:

1. Latex System [**MPI INT 5.4H**]:

a. Prime Coat: Primer, quick dry, for aluminum[**, MPI #95**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[**, MPI #53**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior (MPI Gloss Level 2)[**, MPI #44**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior (MPI Gloss Level 3)[**, MPI #52**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior (MPI Gloss Level 4)[**, MPI #43**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #54**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[**, MPI #114**].

1) <**Insert manufacturer's name; product name or designation**>.

2. Institutional Low-Odor/VOC Latex System [**MPI INT 5.4G**]:

a. Prime Coat: Primer, quick dry, for aluminum[**, MPI #95**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[**, MPI #143**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[**, MPI #144**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[**, MPI #145**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[**, MPI #146**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[**, MPI #147**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[**, MPI #148**].

1) <**Insert manufacturer's name; product name or designation**>.

3. High-Performance Architectural Latex System [**MPI INT 5.4F**]:

a. Prime Coat: Primer, quick dry, for aluminum[**, MPI #95**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[**, MPI #138**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[**, MPI #139**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[**, MPI #140**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[**, MPI #141**].

1) <**Insert manufacturer's name; product name or designation**>.

4. Water-Based Light Industrial Coating System [**MPI INT 5.4E**]:

a. Prime Coat: Primer, quick dry, for aluminum[**, MPI #95**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3)[**, MPI #151**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5)[**, MPI #153**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6)[**, MPI #154**].

1) <**Insert manufacturer's name; product name or designation**>.

5. Alkyd System [**MPI INT 5.4A**] [**MPI INT 5.4J**]:

a. Prime Coat: Primer, vinyl wash[**, MPI #80**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Prime Coat: Primer, quick dry, for aluminum[**, MPI #95**].

1) <**Insert manufacturer's name; product name or designation**>.

c. Intermediate Coat: Alkyd, interior, matching topcoat.
d. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[**, MPI #49**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Alkyd, interior (MPI Gloss Level 3)[**, MPI #51**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #47**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[**, MPI #48**].

1) <**Insert manufacturer's name; product name or designation**>.

I. Wood Substrates: Glued-laminated construction.

1. Latex over Latex Primer System [**MPI INT 6.1M**]:

    a. Prime Coat: Primer, latex, for interior wood[**, MPI #39**].

        1) <**Insert manufacturer's name; product name or designation**>.

    b. Intermediate Coat: Latex, interior, matching topcoat.
    c. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[**, MPI #53**].

        1) <**Insert manufacturer's name; product name or designation**>.

    d. Topcoat: Latex, interior (MPI Gloss Level 2)[**, MPI #44**].

        1) <**Insert manufacturer's name; product name or designation**>.

    e. Topcoat: Latex, interior (MPI Gloss Level 3)[**, MPI #52**].

        1) <**Insert manufacturer's name; product name or designation**>.

    f. Topcoat: Latex, interior (MPI Gloss Level 4)[**, MPI #43**].

        1) <**Insert manufacturer's name; product name or designation**>.

    g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #54**].

        1) <**Insert manufacturer's name; product name or designation**>.

    h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[**, MPI #114**].

        1) <**Insert manufacturer's name; product name or designation**>.

2. Latex over Alkyd Primer System [**MPI INT 6.1A**]:

    a. Prime Coat: Primer sealer, alkyd, interior[**, MPI #45**].

        1) <**Insert manufacturer's name; product name or designation**>.

    b. Intermediate Coat: Latex, interior, matching topcoat.
    c. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[**, MPI #53**].

        1) <**Insert manufacturer's name; product name or designation**>.

    d. Topcoat: Latex, interior (MPI Gloss Level 2)[**, MPI #44**].

        1) <**Insert manufacturer's name; product name or designation**>.

    e. Topcoat: Latex, interior (MPI Gloss Level 3)[**, MPI #52**].

        1) <**Insert manufacturer's name; product name or designation**>.

    f. Topcoat: Latex, interior (MPI Gloss Level 4)[**, MPI #43**].

        1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #54**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[**, MPI #114**].

1) <**Insert manufacturer's name; product name or designation**>.

3. Institutional Low-Odor/VOC Latex System [**MPI INT 6.1Q**]:

a. Prime Coat: Primer, latex, for interior wood[**, MPI #39**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[**, MPI #143**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[**, MPI #144**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[**, MPI #145**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[**, MPI #146**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[**, MPI #147**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[**, MPI #148**].

1) <**Insert manufacturer's name; product name or designation**>.

4. High-Performance Architectural Latex System [**MPI INT 6.1N**]:

a. Prime Coat: Primer, latex, for interior wood[**, MPI #39**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[**, MPI #138**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[**, MPI #139**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[**, MPI #140**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[**, MPI #141**].

1) <**Insert manufacturer's name; product name or designation**>.

5. Alkyd System [**MPI INT 6.1B**]:

a. Prime Coat: Primer sealer, alkyd, interior[**, MPI #45**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[**, MPI #49**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3)[**, MPI #51**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #47**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[**, MPI #48**].

1) <**Insert manufacturer's name; product name or designation**>.

J. Wood Substrates: Exposed framing.

1. Latex over Latex Primer System [**MPI INT 6.2D**]:

a. Prime Coat: Primer, latex, for interior wood[**, MPI #39**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[**, MPI #53**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior (MPI Gloss Level 2)[**, MPI #44**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior (MPI Gloss Level 3)[**, MPI #52**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior (MPI Gloss Level 4)[**, MPI #43**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #54**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[**, MPI #114**].

1) <**Insert manufacturer's name; product name or designation**>.

2. Latex over Alkyd Primer System [**MPI INT 6.2A**]:

a. Prime Coat: Primer sealer, alkyd, interior[**, MPI #45**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[**, MPI #53**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior (MPI Gloss Level 2)[**, MPI #44**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior (MPI Gloss Level 3)[**, MPI #52**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior (MPI Gloss Level 4)[**, MPI #43**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #54**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[**, MPI #114**].

1) <**Insert manufacturer's name; product name or designation**>.

3. Institutional Low-Odor/VOC Latex System [**MPI INT 6.2L**]:

a. Prime Coat: Primer, latex, for interior wood[**, MPI #39**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[**, MPI #143**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[**, MPI #144**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[**, MPI #145**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[**, MPI #146**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[**, MPI #147**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[**, MPI #148**].

1) <**Insert manufacturer's name; product name or designation**>.

4. High-Performance Architectural Latex System [**MPI INT 6.2B**]:

a. Prime Coat: Primer, latex, for interior wood[**, MPI #39**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[**, MPI #138**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[**, MPI #139**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[**, MPI #140**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[**, MPI #141**].

1) <**Insert manufacturer's name; product name or designation**>.

5. Alkyd System [**MPI INT 6.2C**]:

a. Prime Coat: Primer sealer, alkyd, interior[**, MPI #45**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[**, MPI #49**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3)[**, MPI #51**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #47**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[**, MPI #48**].

1) <**Insert manufacturer's name; product name or designation**>.

K. Wood Substrates: [**Wood trim**] [**Architectural woodwork**] [**Doors**] [**Windows**] [**and**] [**wood board paneling**].

1. Latex over Latex Primer System [**MPI INT 6.3T**]:

a. Prime Coat: Primer, latex, for interior wood[**, MPI #39**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[**, MPI #53**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior (MPI Gloss Level 2)[**, MPI #44**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior (MPI Gloss Level 3)[**, MPI #52**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior (MPI Gloss Level 4)[**, MPI #43**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #54**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[**, MPI #114**].

1) <**Insert manufacturer's name; product name or designation**>.

2. Latex over Alkyd Primer System [**MPI INT 6.3U**]:

a. Prime Coat: Primer sealer, alkyd, interior[**, MPI #45**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[**, MPI #53**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior (MPI Gloss Level 2)[**, MPI #44**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior (MPI Gloss Level 3)[**, MPI #52**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior (MPI Gloss Level 4)[**, MPI #43**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #54**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[**, MPI #114**].

1) <**Insert manufacturer's name; product name or designation**>.

3. Institutional Low-Odor/VOC Latex System [**MPI INT 6.3V**]:

a. Prime Coat: Primer, latex, for interior wood[**, MPI #39**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[**, MPI #143**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[**, MPI #144**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[**, MPI #145**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[**, MPI #146**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[**, MPI #147**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[**, MPI #148**].

1) <**Insert manufacturer's name; product name or designation**>.

4. High-Performance Architectural Latex System [**MPI INT 6.3A**]:

a. Prime Coat: Primer, latex, for interior wood[**, MPI #39**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[**, MPI #138**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[**, MPI #139**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[**, MPI #140**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[**, MPI #141**].

1) <**Insert manufacturer's name; product name or designation**>.

5. Water-Based Alkyd System [**MPI INT 6.3BB**]:

a. Prime Coat: Primer, latex, for interior wood[**, MPI #39**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Alkyd, water based, matching topcoat.
c. Topcoat: Alkyd, water based, gloss (MPI Gloss Level 6-7)[**, MPI #157**].

1) <**Insert manufacturer's name; product name or designation**>.

6. Alkyd System [**MPI INT 6.3B**]:

a. Prime Coat: Primer sealer, alkyd, interior[**, MPI #45**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[**, MPI #49**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3)[**, MPI #51**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #47**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[**, MPI #48**].

1) <**Insert manufacturer's name; product name or designation**>.

L. Wood Substrates: [**Wood paneling**] [**and**] [**casework**].

1. Latex over Latex Primer System [**MPI INT 6.4R**]:

a. Prime Coat: Primer, latex, for interior wood[**, MPI #39**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[**, MPI #53**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior (MPI Gloss Level 2)[**, MPI #44**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior (MPI Gloss Level 3)[**, MPI #52**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior (MPI Gloss Level 4)[**, MPI #43**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #54**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[**, MPI #114**].

1) <**Insert manufacturer's name; product name or designation**>.

2. Latex over Alkyd Sealer System [**MPI INT 6.4A**]:

a. Prime Coat: Primer sealer, alkyd, interior[**, MPI #45**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[**, MPI #53**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior (MPI Gloss Level 2)[**, MPI #44**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior (MPI Gloss Level 3)[**, MPI #52**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior (MPI Gloss Level 4)[**, MPI #43**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #54**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[**, MPI #114**].

1) <**Insert manufacturer's name; product name or designation**>.

3. Institutional Low-Odor/VOC Latex System [**MPI INT 6.4T**]:

a. Prime Coat: Primer, latex, for interior wood[**, MPI #39**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[**, MPI #143**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[**, MPI #144**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[**, MPI #145**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[**, MPI #146**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[**, MPI #147**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[**, MPI #148**].

1) <**Insert manufacturer's name; product name or designation**>.

4. High-Performance Architectural Latex System [**MPI INT 6.4S**]:

a. Prime Coat: Primer, latex, for interior wood[**, MPI #39**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[**, MPI #138**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[**, MPI #139**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[**, MPI #140**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[**, MPI #141**].

1) <**Insert manufacturer's name; product name or designation**>.

5. Alkyd over Alkyd Sealer System [**MPI INT 6.4B**]:

a. Prime Coat: Primer sealer, alkyd, interior[**, MPI #45**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Alkyd, interior, matching topcoat.

c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[**, MPI #49**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3)[**, MPI #51**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #47**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[**, MPI #48**].

1) <**Insert manufacturer's name; product name or designation**>.

M. Wood Substrates: Traffic surfaces, including [**floors**] [**and**] [**stairs**].

1. Latex Porch & Floor Enamel System [**MPI INT 6.5G**]:

a. Prime Coat: Primer sealer, alkyd, interior[**, MPI #45**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Floor paint, latex, matching topcoat.
c. Topcoat: Floor paint, latex, low gloss (maximum MPI Gloss Level 3)[**, MPI #60**].

1) <**Insert manufacturer's name; product name or designation**>.

2. Alkyd Floor Enamel System [**MPI INT 6.5A**]:

a. Prime Coat: Floor enamel, alkyd, matching topcoat.
b. Intermediate Coat: Floor enamel, alkyd, matching topcoat.
c. Topcoat: Floor enamel, alkyd, gloss (MPI Gloss Level 6)[**, MPI #27**].

1) <**Insert manufacturer's name; product name or designation**>.

N. Plastic Substrates:

1. Latex System [**MPI INT 6.8E**]:

a. Prime Coat: Primer, bonding, solvent based[**, MPI #69**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[**, MPI #53**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior (MPI Gloss Level 2)[**, MPI #44**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior (MPI Gloss Level 3)[**, MPI #52**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior (MPI Gloss Level 4)[**, MPI #43**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #54**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[**, MPI #114**].

1) <**Insert manufacturer's name; product name or designation**>.

2. Institutional Low-Odor/VOC Latex System [**MPI INT 6.8F**]:

a. Prime Coat: Primer, bonding, solvent based[**, MPI #69**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[**, MPI #143**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[**, MPI #144**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[**, MPI #145**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[**, MPI #146**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[**, MPI #147**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[**, MPI #148**].

1) <**Insert manufacturer's name; product name or designation**>.

3. High-Performance Architectural Latex System [**MPI INT 6.8A**]:

a. Prime Coat: Primer, bonding, solvent based[**, MPI #69**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[**, MPI #138**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[**, MPI #139**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[**, MPI #140**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[**, MPI #141**].

1) <**Insert manufacturer's name; product name or designation**>.

4. Alkyd System [**MPI INT 6.8B**]:

a. Prime Coat: Primer, bonding, solvent based[**, MPI #69**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[**, MPI #49**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3)[**, MPI #51**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #47**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[**, MPI #48**].

1) <**Insert manufacturer's name; product name or designation**>.

O. Spray-Textured Ceiling Substrates:

1. Latex, Flat System [**MPI INT 9.1A**]: Spray applied.

a. Prime Coat: Latex, interior, flat, matching topcoat.
b. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[**, MPI #53**].

1) <**Insert manufacturer's name; product name or designation**>.

2. Latex System [**MPI INT 9.1E**]: Spray applied.

    a. Prime Coat: Latex, interior, matching topcoat.
    b. Intermediate Coat: Latex, interior, matching topcoat.
    c. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[**, MPI #53**].

        1) <**Insert manufacturer's name; product name or designation**>.

    d. Topcoat: Latex, interior (MPI Gloss Level 2)[**, MPI #44**].

        1) <**Insert manufacturer's name; product name or designation**>.

    e. Topcoat: Latex, interior (MPI Gloss Level 3)[**, MPI #52**].

        1) <**Insert manufacturer's name; product name or designation**>.

    f. Topcoat: Latex, interior (MPI Gloss Level 4)[**, MPI #43**].

        1) <**Insert manufacturer's name; product name or designation**>.

    g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #54**].

        1) <**Insert manufacturer's name; product name or designation**>.

    h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[**, MPI #114**].

        1) <**Insert manufacturer's name; product name or designation**>.

3. Alkyd, Flat System [**MPI INT 9.1C**]:

    a. Prime Coat: Alkyd, interior, flat matching topcoat.
    b. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[**, MPI #49**].

        1) <**Insert manufacturer's name; product name or designation**>.

4. Alkyd over Alkyd Sealer System [**MPI INT 9.1D**]:

    a. Prime Coat: Primer sealer, alkyd, interior[**, MPI #45**].

        1) <**Insert manufacturer's name; product name or designation**>.

    b. Intermediate Coat: Alkyd, interior, matching topcoat.
    c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[**, MPI #49**].

        1) <**Insert manufacturer's name; product name or designation**>.

    d. Topcoat: Alkyd, interior (MPI Gloss Level 3)[**, MPI #51**].

        1) <**Insert manufacturer's name; product name or designation**>.

    e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #47**].

        1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[**, MPI #48**].

1) <**Insert manufacturer's name; product name or designation**>.

P. [**Gypsum Board**] [**and**] [**Plaster**] Substrates:

1. Latex over Latex Sealer System [**MPI INT 9.2A**]:

a. Prime Coat: Primer sealer, latex, interior[**, MPI #50**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Prime Coat: Latex, interior, matching topcoat.
c. Intermediate Coat: Latex, interior, matching topcoat.
d. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[**, MPI #53**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior (MPI Gloss Level 2)[**, MPI #44**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior (MPI Gloss Level 3)[**, MPI #52**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior (MPI Gloss Level 4)[**, MPI #43**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #54**].

1) <**Insert manufacturer's name; product name or designation**>.

i. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[**, MPI #114**].

1) <**Insert manufacturer's name; product name or designation**>.

2. Latex over Alkyd Primer System (for Plaster Only) [**MPI INT 9.2K**]:

a. Prime Coat: Primer sealer, alkyd, interior[**, MPI #45**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[**, MPI #53**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior (MPI Gloss Level 2)[**, MPI #44**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior (MPI Gloss Level 3)[**, MPI #52**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior (MPI Gloss Level 4)[**, MPI #43**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #54**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[**, MPI #114**].

1) <**Insert manufacturer's name; product name or designation**>.

3. Institutional Low-Odor/VOC Latex System [**MPI INT 9.2M**]:

a. Prime Coat: Primer sealer, interior, institutional low odor/VOC[**, MPI #149**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[**, MPI #143**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[**, MPI #144**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[**, MPI #145**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[**, MPI #146**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[**, MPI #147**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[**, MPI #148**].

1) <**Insert manufacturer's name; product name or designation**>.

4. High-Performance Architectural Latex System [**MPI INT 9.2B**]:

a. Prime Coat: Primer sealer, latex, interior[**, MPI #50**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[**, MPI #138**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3)[**, MPI #139**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4)[**, MPI #140**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5)[**, MPI #141**].

1) <**Insert manufacturer's name; product name or designation**>.

5. Alkyd over Latex Sealer System [**MPI INT 9.2C**]:

a. Prime Coat: Primer sealer, latex, interior[**, MPI #50**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[**, MPI #49**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3)[**, MPI #51**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #47**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[**, MPI #48**].

1) <**Insert manufacturer's name; product name or designation**>.

Q. [**Cotton or Canvas**] [**and**] [**ASJ**] Insulation-Covering Substrates: Including [**pipe and duct coverings**] <**Insert description**>.

1. Latex System [**MPI INT 10.1A**]:

a. Prime Coat: Primer sealer, latex, interior[**, MPI #50**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1)[**, MPI #53**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior (MPI Gloss Level 2)[**, MPI #44**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior (MPI Gloss Level 3)[**, MPI #52**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior (MPI Gloss Level 4)[**, MPI #43**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #54**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[**, MPI #114**].

1) <**Insert manufacturer's name; product name or designation**>.

2. Institutional Low-Odor/VOC Latex System [**MPI INT 10.1D**]:

a. Prime Coat: Primer sealer, latex, interior[**, MPI #50**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1)[**, MPI #143**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2)[**, MPI #144**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)[**, MPI #145**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4)[**, MPI #146**].

1) <**Insert manufacturer's name; product name or designation**>.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5)[**, MPI #147**].

1) <**Insert manufacturer's name; product name or designation**>.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6)[**, MPI #148**].

1) <**Insert manufacturer's name; product name or designation**>.

3. Alkyd System [**MPI INT 10.1B**]:

a. Prime Coat: Primer sealer, latex, interior[**, MPI #50**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1)[**, MPI #49**].

1) <**Insert manufacturer's name; product name or designation**>.

d. Topcoat: Alkyd, interior, (MPI Gloss Level 3)[**, MPI #51**].

1) <**Insert manufacturer's name; product name or designation**>.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5)[**, MPI #47**].

1) <**Insert manufacturer's name; product name or designation**>.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[**, MPI #48**].

1) <**Insert manufacturer's name; product name or designation**>.

4. Aluminum Paint System [**MPI INT 10.1C**]:

a. Prime Coat: Primer sealer, latex, interior[**, MPI #50**].

1) <**Insert manufacturer's name; product name or designation**>.

b. Intermediate Coat: Aluminum paint matching topcoat.
c. Topcoat: Aluminum paint[**, MPI #1**].

1) <**Insert manufacturer's name; product name or designation**>.

END OF SECTION 099123

SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

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. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Mechanical sleeve seals.
3. Sleeves.
4. Escutcheons.
5. Grout.
6. Fire-suppression equipment and piping demolition.
7. Equipment installation requirements common to equipment sections.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Mechanical sleeve seals.

1.5 QUALITY ASSURANCE

A. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

D. Coordinate systems shutdown (water, fire protection, hot water heating, steam, chilled water, etc.) with Project Representative.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Refer to individual Division 21 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

a. Link-Seal.
b. Metraflex Co.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.4 SLEEVES

A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

B. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.5 ESCUTCHEONS

A. Description: Plastic wall and ceiling escutcheons, with an ID to closely fit around pipe and an OD that completely covers opening.

2.6 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 FIRE-SUPPRESSION DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove fire-suppression systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, 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.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls and ceilings. Paint escutcheons to match the adjoining wall or ceiling.

M. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

1. Sleeves placed in floors shall be flush with the ceiling and shall have planed, square ends, extending 2 inches above the finished floor, unless otherwise specified or detailed.
2. Where sleeves pass through reinforced concrete floors, they shall be properly set in position before the concrete is poured, and shall be maintained in position by the Contractor until the concrete is set.
3. Sleeves placed in concrete beams shall be flush with the side of the beam and large enough to accommodate the bare pipe only. All other sleeves shall be of adequate size to accommodate pipe insulation undiminished in size.
4. Pipes passing through above grade floor slabs and masonry walls shall have the space between the pipe or insulation and the sleeve packed with non-asbestos wicking or other suitable, approved, non-combustible material.
5. Pipes passing through walls of Mechanical Equipment Rooms shall be made gas-tight by caulking the space between the pipe and sleeve with a fiber saturated with an approved type of plastic material.
6. Install sleeves in new walls and slabs as new walls and slabs are constructed.
7. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 CONCRETE BASES

A. Refer to Division 03 Section "Cast-in-Place Concrete" or "Miscellaneous Cast-in-Place Concrete."

B. Anchor equipment to concrete base according to equipment manufacturer's written instructions.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.6 GROUTING

A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.

END OF SECTION 210500

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

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. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinklers.
5. Alarm devices.
6. Manual control stations.
7. Control panels.
8. Pressure gages.

B. Related Sections:

1. Division 21 Section "Fire-Suppression Standpipes" for standpipe piping.
2. Division 21 Section "Electric-Drive, Centrifugal Fire Pumps" for fire pumps, pressure-maintenance pumps, and fire-pump controllers.

1.3 DEFINITIONS

A. High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psig (1200 kPa), but not higher than 250 psig (1725 kPa).

B. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig (1200 kPa) maximum.

1.4 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

B. Deluge Sprinkler System: Open sprinklers are attached to piping connected to water supply through deluge valve. Fire-detection system, in same area as sprinklers, opens valve. Water flows into piping system and discharges from attached sprinklers when valve opens.

C. Combined Sprinkler / Standpipe System: A standpipe system having piping that supplies both hose connections and automatic sprinklers.

1.5 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.

B. High-Pressure Piping System Component: Listed for 250-psig (1725-kPa) minimum working pressure.

C. Delegated Design: Design sprinkler system(s) per NFPA 13-2013, FM Global and additional design criteria on documents where indicated.

D. Sprinkler system design shall be approved by authorities having jurisdiction.

E. Sprinkler system shall be hydraulically designed and have a density of at least that required by the hazard rating of the area protected.

1.6 SUBMITTALS

A. Review Procedure for Projects involving with classrooms:

1. Contractor shall submit the shop drawings, working plans including product data and hydraulic calculations where applicable, to the Factory Mutual (FM) Global and Architect/Engineer (A/E) for their review, and to the Fire Marshall and IPF Planning, Design and Construction (PDC) for their record. Review shall be based on applicable NFPA Standards, current version or as specified in the construction document.
2. FM Global shall provide review comments back to the A/E, the Fire Marshall and PDC.
3. A/E shall consult with the PDC prior to applying comments from the FM Global, and return the shop drawings with review comments back to the Contractor. Repeat the process until the A/E approves the submittals.
4. Contractor shall submit the A/E approved shop drawings to the State of Michigan Office of Fire Safety for final approval prior to installation.

B. Review Procedure for Projects not involving with classrooms:

1. Contractor shall submit the shop drawings, working plans including product data and hydraulic calculations where applicable, to the Factory Mutual Global (FMG) and Architect/Engineer (A/E) for their review, and to the Fire Marshall and IPF Planning, Design and Construction (PDC) for their record. Review shall be based on applicable NFPA Standards, current version or as specified in the construction document.
2. FM Global shall provide review comments back to the A/E, the Fire Marshall and PDC.

3. A/E shall consult with the PDC prior to applying comments from the FM Global, and return the shop drawings with review comments back to the Contractor. Repeat the process until the A/E approves the submittals.
4. Contractor shall submit the A/E approved shop drawings to the Fire Marshal thru Project Representative for final approval prior to installation.

C. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

D. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13 and FM Global that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

F. Welding certificates.

G. Fire-hydrant flow test report.

H. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

I. Field quality-control reports.

J. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."

1.8 PROJECT CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Owner's written permission.

1.9 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Standard Weight, Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Hot dipped galvanized where indicated. Pipe ends may be factory or field formed to match joining method.

B. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends, hot dipped galvanized where indicated.

C. Steel Couplings: ASTM A 865, threaded, hot dipped galvanized where indicated.

D. Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern, hot dipped galvanized where indicated.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME 16.1, Class 125.

G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

H. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

I. Grooved-Joint, Steel-Pipe Appurtenances:

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

a. Shurjoint Piping Products.
b. Tyco Fire & Building Products LP.
c. Victaulic Company.

2. Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe, hot dipped galvanized where indicated.
3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig (1200 kPa).
3. Minimum Pressure Rating for High-Pressure Piping: 250 psig (1725 kPa).

B. Ball Valves:

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

    a. Anvil International, Inc.
    b. NIBCO.
    c. Victaulic Company.

2. Standard: UL 1091 except with ball instead of disc.
3. Valves NPS 1-1/2 (DN 40) and Smaller: Bronze body with threaded ends.
4. Valves NPS 2 and NPS 2-1/2 (DN 50 and DN 65): Bronze body with threaded ends or ductile-iron body with grooved ends.
5. Valves NPS 3 (DN 80): Ductile-iron body with grooved ends.

C. Butterfly Valves:

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

    a. Anvil International, Inc.
    b. Kennedy Valve; a division of McWane, Inc.
    c. Milwaukee Valve Company.
    d. NIBCO INC.
    e. Shurjoint Piping Products.
    f. Tyco Fire & Building Products LP.
    g. Victaulic Company.

2. Standard: UL 1091.
3. Valves NPS 2 (DN 50) and Smaller: Bronze body with threaded ends.
4. Valves NPS 2-1/2 (DN 65) and Larger: Cast or ductile iron body with flanged or grooved ends.

D. Check Valves:

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

    a. Anvil International, Inc.
    b. Clow Valve Company; a division of McWane, Inc.
    c. Crane Co.; Crane Valve Group; Crane Valves.
    d. Crane Co.; Crane Valve Group; Jenkins Valves.
    e. Crane Co.; Crane Valve Group; Stockham Division.
    f. Fire-End & Croker Corporation.
    g. Kennedy Valve; a division of McWane, Inc.
    h. Milwaukee Valve Company.
    i. Mueller Co.; Water Products Division.
    j. NIBCO INC.
    k. Potter Roemer.
    l. Reliable Automatic Sprinkler Co., Inc.
    m. Shurjoint Piping Products.
    n. Tyco Fire & Building Products LP.

o. Victaulic Company.
p. Viking Corporation.

2. Standard: UL 312.
3. Type: Swing check.
4. Body Material: Cast iron.
5. End Connections: Flanged or grooved.

E. OS&Y Gate Valves:

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

a. Clow Valve Company; a division of McWane, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Milwaukee Valve Company.
g. Mueller Co.; Water Products Division.
h. NIBCO INC.
i. Shurjoint Piping Products.
j. Tyco Fire & Building Products LP.

2. Standard: UL 262.
3. Valves NPS 2 (DN 50) and Smaller: Bronze body with threaded ends.
4. Valves NPS 2-1/2 (DN 65) and Larger: Cast or ductile iron body with flanged or grooved ends.

F. Indicating-Type Butterfly Valves:

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

a. Anvil International, Inc.
b. Kennedy Valve; a division of McWane, Inc.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Shurjoint Piping Products.
f. Tyco Fire & Building Products LP.
g. Victaulic Company.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Valves NPS 2 (DN 50) and Smaller:

a. Valve Type: Ball or butterfly.
b. Body Material: Bronze.
c. End Connections: Threaded.

5. Valves NPS 2-1/2 (DN 65) and Larger:

   a. Valve Type: Butterfly.
   b. Body Material: Cast or ductile iron.
   c. End Connections: Flanged, grooved, or wafer.

6. Valve Operation: Integral electrical, 115-V ac, prewired, two-circuit, supervisory switch visual indicating device.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig (1200 kPa) minimum.

2.6 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:

   a. Standard-Pressure Piping Specialty Valves: 175 psig (1200 kPa) minimum.
   b. High-Pressure Piping Specialty Valves: 250 psig (1725 kPa) minimum.

3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

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

   a. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.

2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Automatic (Ball Drip) Drain Valves:

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

    a. Reliable Automatic Sprinkler Co., Inc.
    b. Tyco Fire & Building Products LP.

2. Standard: UL 1726.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4 (DN 20).
6. End Connections: Threaded.

2.7 FIRE-DEPARTMENT CONNECTIONS

A. Wall Mounted Storz Type, Fire-Department Connection:

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

    a. Elkhart Brass Mfg. Company, Inc.
    b. Guardian Fire Equipment, Inc.
    c. Potter Roemer.

2. Standard: UL 405.
3. Type: Wall mounted.
4. Pressure Rating: 175 psig (1200 kPa) minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Straight pattern Storz adapter, forged aluminum with powder coat finish matching local fire department sizes.
7. Caps: Forged aluminum with powder coat finish Storz cap with cable connector.
8. Identification Plate: Round, brass, wall type.
9. Outlet: 5” with pipe threads.
10. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE” or “AUTO SPKR."
11. Finish: Forged aluminum with powder coat and galvanized steel elbow.

2.8 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

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

    a. Shurjoint Piping Products.
    b. Tyco Fire & Building Products LP.
    c. Victaulic Company.

2. Standard: UL 213.

3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

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

    a. AGF Manufacturing Inc.
    b. Reliable Automatic Sprinkler Co., Inc.
    c. Tyco Fire & Building Products LP.
    d. Victaulic Company.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

C. Branch Line Testers:

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

    a. Elkhart Brass Mfg. Company, Inc.
    b. Fire-End & Croker Corporation.
    c. Potter Roemer.

2. Standard: UL 199.
3. Pressure Rating: 175 psig (1200 kPa).
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

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

    a. AGF Manufacturing Inc.
    b. Tyco Fire & Building Products LP.

c. Victaulic Company.
d. Viking Corporation.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

2.9 SPRINKLERS

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

1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire & Building Products LP.
3. Victaulic Company.
4. Viking Corporation.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig (1200 kPa) minimum.
3. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig (1725 kPa) minimum.
4. Temperature Rating: 165 deg. F unless otherwise indicated.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
4. Element Type: Glass bulb.

D. Open Sprinklers with Heat-Responsive Element Removed: UL 199.

1. Characteristics:

a. Nominal 1/2-inch (12.7-mm) Orifice: With Discharge Coefficient K between 5.3 and 5.8.
b. Nominal 17/32-inch (13.5-mm) Orifice: With Discharge Coefficient K between 7.4 and 8.2.

E. Sprinkler Finishes:

1. Chrome plated.

2. Bronze.
3. Painted.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

G. Sprinkler Guards:

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

a. Reliable Automatic Sprinkler Co., Inc.
b. Tyco Fire & Building Products LP.
c. Victaulic Company.
d. Viking Corporation.

2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.10 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:

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

a. Tyco Fire & Building Products LP.
b. Victaulic Company.
c. Viking Corporation.

2. Standard: UL 753.
3. Type: Mechanically operated, with Pelton wheel.
4. Alarm Gong: Cast aluminum with red-enamel factory finish.
5. Size: 10-inch (250-mm) diameter.
6. Components: Shaft length, bearings, and sleeve to suit wall construction.
7. Inlet: NPS 3/4 (DN 20).
8. Outlet: NPS 1 (DN 25) drain connection.

C. Electrically Operated Alarm Bell:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Notifier; a Honeywell company.
b. Potter Electric Signal Company.

2. Standard: UL 464.

3. Type: Vibrating, metal alarm bell.
4. Size: 10-inch (250-mm) diameter.
5. Finish: Red-enamel factory finish, suitable for outdoor use.

D. Water-Flow Indicators:

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

    a. McDonnell & Miller; ITT Industries.
    b. Potter Electric Signal Company.
    c. System Sensor; a Honeywell company.
    d. Viking Corporation.

2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig (1725 kPa).
7. Design Installation: Horizontal or vertical.

E. Pressure Switches:

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

    a. Potter Electric Signal Company.
    b. System Sensor; a Honeywell company.
    c. Tyco Fire & Building Products LP.
    d. Viking Corporation.

2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

F. Valve Supervisory Switches:

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

    a. Kennedy Valve; a division of McWane, Inc.
    b. Potter Electric Signal Company.
    c. System Sensor; a Honeywell company.

2. Standard: UL 346.
3. Type: Electrically supervised.

4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

G. Indicator-Post Supervisory Switches:

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

a. Potter Electric Signal Company.
b. System Sensor; a Honeywell company.

2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.11 PRESSURE GAGES

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

1. AMETEK; U.S. Gauge Division.
2. Ashcroft, Inc.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.

D. Pressure Gage Range: 0 to 250 psig (0 to 1725 kPa) minimum.

E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

F. Air System Piping Gage: Include "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Division 21 Section "Facility Fire-Suppression Water-Service Piping."

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Comply with requirements for backflow preventers in Division 22 Section "Domestic Water Piping Specialties."

3.3 WATER-SUPPLY CONNECTIONS

A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Division 22 Section "Domestic Water Piping."

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping. Comply with requirements for backflow preventers in Division 22 Section "Domestic Water Piping Specialties."

3.4 PIPING INSTALLATION

A. Refer to Division 21 Section "Common Work Result for Fire Suppression" for basic installation requirements.

B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

C. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13. Unless indicated otherwise, inspector's test connections shall be located at the end of the most remote branch line in the upper story. Test valve shall be located not over 7' above the floor and in lockable rooms. Discharge shall be to floor drain equipped with a funnel.

H. Install sprinkler piping with drains for complete system drainage. Terminate drain lines to the nearest floor drain with funnel or to a service sink.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. For combined sprinkler / standpipe systems, install 2-1/2” hose valve and sprinkler control assembly including OS&Y valves with tamper, flow switch, and inspector’s test and drain valves in each floor. Connect drain lines to drain risers.

K. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

L. Install alarm devices in piping systems. A flow alarm switch shall be provided in the sprinkler riser and shall be wired into the fire alarm system. Where a main line branches out, a separate alarm shall be installed on each branch to a different building or section of building. A separate flow alarm switch for the standpipe risers is not required for the combined system.

M. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

N. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

O. Fill sprinkler system piping with water.

P. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Division 21 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Division 21 Section "Fire-Suppression Systems Insulation."

Q. Underground pipe and fittings for fire protection shall be installed in accordance with AWWA specification. Refer to Water Distribution Section in Division 2 for details.

3.5 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

J. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

3.6 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. System water supply valves, isolation control valves, and other valves in feed mains shall be supervised by locking valves open. Padlocks with Best cylinders will be provided by and installed by the Contractors.

D. Install backflow preventers in potable-water-supply sources.

E. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.7 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Provide automatic sprinklers of ordinary or intermediate temperature rating in the elevator machine room. Each system shall have a readily accessible shut-off valve, that is electronically supervised, located outside the protected area, per agreement signed by the Bureau of Fire Services, Plan Review Division and the Bureau of Construction Codes, Elevator Safety Division.

3.8 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire-department connections.

B. Install yard-type, fire-department connections in concrete slab support. Comply with requirements for concrete in Division 03 Section "Cast-in-Place Concrete."

C. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.9 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

C. All exposed sprinkler piping in unfinished areas shall be painted red. All exposed piping in finished areas shall be painted to match the adjoining walls and ceilings. At intervals not to exceed 50 feet, provide printed identification and flow direction labels entitled "SPRINKLER-FIRE." Color shall be white letters on red background. Labels shall be snap on style equal to Seton "Setmark."

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run excess-pressure pumps.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.12 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves and pressure-maintenance pumps.

3.13 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

B. Piping between Domestic Water Supply Connection and Backflow Preventers: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

C. Standard-pressure, wet-pipe sprinkler system, NPS 2 (DN 50) and smaller, shall be one the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 (DN 65) and larger, shall be the following:

1. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.

E. High-pressure, wet-pipe sprinkler system, NPS 4 (DN 100) and smaller, shall be the following:

1. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.

F. High-pressure, wet-pipe sprinkler system, NPS 5 (DN 125) and larger, shall be the following:

1. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.

3.14 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Pendent, recessed, flush, and concealed sprinklers as indicated.
3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated.
5. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Residential Sprinklers: Dull chrome.
5. Upright, Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes; with listed guard in exposed areas.

END OF SECTION 211313

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

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. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Mechanical sleeve seals.
3. Sleeves.
4. Escutcheons.
5. Grout.
6. Plumbing demolition.
7. Equipment installation requirements common to equipment sections.
8. Concrete bases.
9. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

C. Certificate of Acceptance: Provide certificate as described in this section.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

D. Permits and Inspections

1. The Plumbing Contractor shall obtain and pay for all permits required by the State of Michigan Department of Licensing and Regulatory Affairs, Plumbing Division.

2. The Plumbing Contractor shall submit, to precede request for final payment, a copy of the Certificate of Acceptance of the plumbing systems.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

D. Coordinate systems shutdown (water, fire protection, hot water heating, steam, chilled water, etc.) with Project Representative. Activation and shut down of existing systems shall be conducted by personnel only.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

    a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASTM A-354 Grade BD and SAE J-429 Grade 8 for steam and condensate application, and ASTM A-354 and SAE J-429 Grade 5 for other low service temperature applications, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys, 95/5 tin-copper. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:

1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
2. CPVC Piping: ASTM F 493.

H. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

    a. Link-Seal.
    b. Metraflex Co.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

Use galvanized steel pipes in kitchen areas only unless directed otherwise.

A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, plain ends.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, 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.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections. T-drill system for mechanically formed tee connections and couplings, and Victaulic hole cut piping system are not allowed.

J. Install piping to allow application of insulation.

K. Piping shall not project beyond walls or steel lines nor shall it hang below slabs more than is absolutely necessary. Particular attention shall be paid to the required clearances.

L. Offset piping where required to avoid interference with other work, to provide greater headroom or clearance, or to conceal pipe more readily. Offsets shall be properly drained or trapped where necessary.

M. Provide swing joints and expansion bends wherever required to allow the piping to expand without undue stress to connections or equipment.

N. Isolate pipe from the building construction to prevent transmission of vibration to the structure and to eliminate noise.

O. Exposed piping around fixtures or in other conspicuous places shall not show tool marks at fittings.

P. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

Q. Select system components with pressure rating equal to or greater than system operating pressure.

R. Eccentric reducing couplings shall be provided in all cases where air or water pockets would otherwise occur due to a reduction in pipe size. Eccentric couplings shall make the pipe flush on the top for water lines.

S. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
    f. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
    g. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

2. Existing Piping: Use the following:

    a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
    b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.

c. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
d. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with rough-brass finish.
e. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
f. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

T. All pipes extending through the roof shall be flashed with six pound lead flashing extending 6 inches beyond the pipe, welded to a lead sleeve extended up around the vent pipes, and rolled over into the pipe.

U. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

1. Sleeves placed in floors shall be flush with the ceiling and shall have planed, square ends, extending 2 inches above the finished floor, unless otherwise specified or detailed.
2. Where sleeves pass through reinforced concrete floors, they shall be properly set in position before the concrete is poured, and shall be maintained in position by the Contractor until the concrete is set.
3. Sleeves placed in concrete beams shall be flush with the side of the beam and large enough to accommodate the bare pipe only. All other sleeves shall be of adequate size to accommodate pipe insulation undiminished in size.
4. Pipes passing through above grade floor slabs and masonry walls shall have the space between the pipe or insulation and the sleeve packed with non-asbestos wicking or other suitable, approved, non-combustible material.
5. Pipes passing through walls of Mechanical Equipment Rooms shall be made gas-tight by caulking the space between the pipe and sleeve with a fiber saturated with an approved type of plastic material.

V. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

W. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten

bolts against pressure plates that cause sealing elements to expand and make watertight seal.

X. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

Y. Verify final equipment locations for roughing-in.

Z. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

AA. Return hot water line shall be no further than 15’ from the fixture needing hot water.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

B. Unions shall be used in preference to couplings where their use will facilitate dismantling the pipe for maintenance.

C. Install transition couplings at joints of dissimilar piping.

D. No Uni-flange pipe adapters will be allowed.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 CONCRETE BASES

A. Refer to Division 03 Section "Cast-in-Place Concrete" or "Miscellaneous Cast-in-Place Concrete."

B. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section 055000 "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

END OF SECTION 220500

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

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. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.
6. Silicone sealants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

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

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.

B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.

C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.

D. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

E. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

F. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

G. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

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

1. Jay R. Smith Mfg Co; a division of Morris Group International.
2. Zurn Industries, LLC.

B. Description: Manufactured, Dura-coated or Duco-coated cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

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

1. Advance Products & Systems, Inc.
2. GPT; an EnPro Industries company.
3. Metraflex Company (The).

B. Description:

1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Designed to form a hydrostatic seal of 20 psig minimum.
3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
4. Pressure Plates: Carbon steel.
5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B 633 of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

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

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.
4. Metraflex Company (The).

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

C. Plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.6 SILICONE SEALANTS

A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, Use NT.

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

   a. GE Construction Sealants; Momentive Performance Materials Inc.
   b. The Dow Chemical Company.

2. Sealant shall have a VOC content of 250 g/L or less.
3. Sealant shall have a VOC content of g/L or less.
4. Sealant shall have a VOC content of 250 g/L or less.
5. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
6. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of

Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

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

   a. May National Associates, Inc.; a subsidiary of Sika Corporation.

2. Sealant shall have a VOC content of 250 g/L or less.
3. Sealant shall have a VOC content of 250 g/L or less.
4. Sealant shall have a VOC content of 250 g/L or less.
5. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
6. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

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

   a. Smooth-On.

2. Sealant shall have a VOC content of 250 g/L or less.
3. Sealant shall have a VOC content of 250 g/L or less.
4. Sealant shall have a VOC content of 250 g/L or less.
5. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
6. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas above finished floor level.

3. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Use silicone sealant to seal the space around outside of stack-sleeve fittings.

B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Use grout or silicone sealant to seal the space around outside of sleeve-seal fittings.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Concrete Slabs-on-Grade:

a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

2. Concrete Slabs above Grade:

    a. Piping Smaller Than NPS 6: Stack-sleeve fittings.

3. Interior Partitions:

    a. Piping Smaller Than NPS 6: Steel pipe sleeves.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

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. Escutcheons.

1.3 DEFINITIONS

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed and salvaged, or removed and reinstalled.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. BrassCraft Manufacturing Co.; a Masco company.
2. Dearborn Brass.
3. Jones Stephens Corp.
4. Keeney Manufacturing Company (The).
5. Mid-America Fittings, Inc.
6. ProFlo; a Ferguson Enterprises, Inc. brand.

2.2 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.

E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

2.3 FLOOR PLATES

A. Split Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
b. Chrome-Plated Piping: One-piece steel cast brass or split-casting brass with polished, chrome-plated finish.
c. Insulated Piping: One-piece steel with finish.
d. Insulated Piping: One-piece cast brass with finish.
e. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
f. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with finish.
g. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with finish.
h. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

2. Escutcheons for Existing Piping to Remain:

a. Insulated Piping: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish
b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 220518

SECTION 220523.12 - BALL VALVES FOR PLUMBING PIPING

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. Brass ball valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and soldered ends.
3. Set ball valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for solder-joint connections.
6. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
2. Handlever: For quarter-turn valves smaller than NPS 4.

H. Valves in Insulated Piping:

1. Include 2-inch stem extensions.
2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRASS BALL VALVES

A. Brass Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim, Threaded or Soldered Ends:

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

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Hammond Valve.
c. Jomar Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.

2. Description:

a. Standard: MSS SP-110 or MSS SP-145.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Forged brass.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

B. Brass Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim, Press Ends:

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

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.

2. Description:

a. Standard: MSS SP-110 or MSS SP-145.
b. CWP Rating: Minimum 200 psig.
c. Body Design: Two piece.
d. Body Material: Forged brass.
e. Ends: Press.
f. Press Ends Connections Rating: Minimum 200 psig.
g. Seats: PTFE or RPTFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.
k. O-Ring Seal: Buna-N or EPDM.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
4. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Brass ball valves, two-piece with full port and stainless steel trim. Provide with threaded or solder-joint ends.

B. Pipe NPS 2-1/2 and Larger:

1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.

END OF SECTION 220523.12

SECTION 220523.14 - CHECK VALVES FOR PLUMBING PIPING

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. Bronze lift check valves.
2. Bronze swing check valves.
3. Bronze swing check valves, press ends.
4. CPVC ball check valves.
5. PVC ball check valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for solder joint.
5. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE LIFT CHECK VALVES

A. Bronze Lift Check Valves with Bronze Disc, Class 125:

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

a. Crane; a Crane brand.
b. Jenkins Valves; a Crane brand.
c. Stockham; a Crane brand.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.

f. Disc: Bronze.

B. Bronze Lift Check Valves with Nonmetallic Disc, Class 125:

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

a. Hammond Valve.
b. Milwaukee Valve Company.
c. NIBCO INC.
d. Red-White Valve Corp.
e. WATTS.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig.
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: NBR, PTFE.

2.3 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 125:

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

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Crane; a Crane brand.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Red-White Valve Corp.
g. Stockham; a Crane brand.
h. WATTS.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

B. Bronze Swing Check Valves with Nonmetallic Disc, Class 125:

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

a. Apollo Flow Controls; Conbraco Industries, Inc.

b. Crane; a Crane brand.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Red-White Valve Corp.
g. Stockham; a Crane brand.
h. WATTS.

2. Description:

a. Standard: MSS SP-80, Type 4.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: PTFE.

C. Bronze Swing Check Valves, Press Ends:

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

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Milwaukee Valve Company.
c. NIBCO INC.

2. Description:

a. Standard: MSS SP-80 and MSS SP-139.
b. CWP Rating: Minimum 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 584, bronze.
e. Ends: Press.
f. Press Ends Connection Rating: Minimum 200 psig.
g. Disc: Brass or bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Check Valves: Install check valves for proper direction of flow.

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Pump-Discharge Check Valves:

a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or spring; or iron, center-guided, metal-seat or resilient-seat check valves.
c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

C. End Connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered or press-ends.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded.
3. For Copper Tubing, NPS 5 and Larger: Flanged.
4. For Steel Piping, NPS 2 and Smaller: Threaded.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded.
6. For Steel Piping, NPS 5 and Larger: Flanged.

7. For Grooved-End Copper Tubing and Steel Piping: Grooved.

3.5 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

3.6 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG

3.7 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze swing check valves with bronze or nonmetallic disc, Class 125, with soldered or threaded end connections.
2. Bronze swing check valves with press-end connections.

B. Pipe NPS 2-1/2 and Larger:

1. Iron swing check valves with metal or nonmetallic-to-metal seats, Class 125, with threaded or flanged end connections.
2. Iron swing check valves with closure control lever and spring, Class 125, with threaded or flanged end connections.
3. Iron, grooved-end swing check valves, 300 CWP.
4. Iron, center-guided check valves with compact wafer, Class 125.
5. Iron, center-guided check valves with globe seat, Class 125, with threaded or flanged end connections.
6. Iron, dual-plate check valves with metal seat, Class 125, with threaded or flanged end connections.
7. Iron, single-plate check valves with resilient seat, Class 125, with threaded or flanged end connections.

END OF SECTION 220523.14

SECTION 220523.15 - GATE VALVES FOR PLUMBING PIPING

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. Bronze gate valves.
2. Iron gate valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. NRS: Nonrising stem.

C. OS&Y: Outside screw and yoke.

D. RS: Rising stem.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set gate valves closed to prevent rattling.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for solder joint.
5. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 and NSP 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. RS Valves in Insulated Piping: With 2-inch stem extensions.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE GATE VALVES

A. Bronze Gate Valves, NRS, Class 125:

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

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Crane; a Crane brand.
c. Hammond Valve.
d. Jomar Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Red-White Valve Corp.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Material: Bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.

h. Handwheel: Malleable iron, bronze, or aluminum.

B. Bronze Gate Valves, Press Ends:

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

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.

2. Description:

a. Standard: MSS SP-80 and MSS SP-139.
b. CWP Rating: Minimum 200 psig.
c. Body Material: Bronze with integral seat and union-ring bonnet.
d. Ends: Press.
e. Press Ends Connection Rating: Minimum 200 psig.
f. Stem: Brass or bronze non-rising.
g. Disc: Solid wedge; bronze.
h. Packing: Graphite.
i. Port: Full.
j. Handwheel: Malleable iron, bronze, or aluminum.

2.3 IRON GATE VALVES

A. Iron Gate Valves, OS&Y, Class 125:

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

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Crane; a Crane brand.
c. Hammond Valve.
d. Legend Valve & Fitting, Inc.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Red-White Valve Corp.
h. WATTS.

2. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 200 psig.
c. Body Material: Gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. Use gate valves for shutoff service only.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

C. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze gate valves, NRS, Class 125 with soldered or threaded ends.
2. Bronze gate valves, press ends.

B. Pipe NPS 2-1/2 and Larger: Iron gate valves, OS&Y, Class 125 with flanged ends.

END OF SECTION 220523.15

SECTION 220529 - HANGERS AND SUPPORTS 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. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe positioning systems.
6. Equipment supports.

B. Related Sections:

1. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
2. Division 22 Section "Vibration Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to 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.

1.5 SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

D. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

E. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Clevis.
2. Fee and Mason.
3. Anvil.
4. PHD Manufacturing, Inc.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
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 washer made of hot dip galvanized or cadmium plated.

B. Stainless-Steel Pipe Hangers and Supports:

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.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, 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 THERMAL-HANGER SHIELD INSERTS

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

1. PHS Industries, Inc.
2. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa).

C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa).

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.7 EQUIPMENT SUPPORTS

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

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. 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 from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

A. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

B. Install hangers and supports to allow controlled thermal 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.

C. Install lateral bracing with pipe hangers and supports to prevent swaying.

D. 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 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

E. Holes shall not be drilled or punched in beams and supporting members. Do not support piping from roof deck, other piping, ducts or equipment.

F. Hangers and supports shall also be provided at every change of direction and within 1' of any pipe fittings and valves.

G. Pipe hangers in fan rooms and in mechanical equipment rooms shall be provided with suitable vibration isolation units to eliminate noise transmission between the piping and the building structure.

H. Hanger components shall not be used for purposes other than for which they were designed.

I. Vertical runs of piping not subject to appreciable expansion shall be supported by approved wrought steel clamps or collars, securely clamped to the risers. Where required, spring supports and guides shall be provided.

J. Where negligible movement of pipe occurs at hanger locations, rod hangers may be used for suspended lines. For piping supported from below, bases, brackets or structural cross members may be used.

K. If the vertical angle of the hanger is greater than 4 degrees, a traveling device shall be provided for horizontal movement. For piping supported from below, rollers or roller carriages shall be used.

L. Where significant vertical movement of the pipe occurs at the hanger location, a resilient support shall be used. Spring Cushion Hangers may be used where vertical movement does not exceed 1/4".

M. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

N. Riser Supports

1. On a riser subject to expansion, only one support of the rigid type shall be used.
2. Riser clamps shall have a positive means of engagement between the pipe and the clamp.
3. Vertical runs of piping not subject to appreciable expansion shall be supported by approved wrought steel clamps or collars, securely clamped to the risers. Where required, spring supports and guides shall be provided.

O. Anchors, Guides and Restraints: Anchors, guides and restraints shall be provided wherever necessary to support risers, to maintain pipe in position, and to properly distribute expansion.

P. Supplemental Framing: Supplemental framing, angles, channels or beams, shall be provided where the anchor locations do not align with the building structure or where the intended loads exceed the structural framing maximum load carrying capacity.

Q. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

R. 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.

S. 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. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) 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 (305 mm) long and 0.048 inch (1.22 mm) thick.
    b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
    c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
    d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
    e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.

5. Pipes NPS 8 (DN 200) and Larger: Include reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

T. Plastic Pipe Hanger Installation:

1. Rigid plastic piping shall normally be supported by the same type of hangers used with steel pipe. In pressure application, hangers shall be provided with pads or cushions on the bearing surfaces.
2. Flexible plastic tubing shall be supported continuously by metal angles or channels with special hangers.

U. Polypropylene Pipe Hanger Installation: Support continuously between its hangers in either angle iron or sheet metal angles.

V. Fiberglass Pipe Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

W. Glass Piping Hanger Installation:

1. Hangers shall be provided with pads or cushions on the bearing surfaces. Supports shall be as recommended by the pipe manufacturer.
2. Hangers shall be placed approximately one foot from each side of fittings or couplings. At least two hangers shall be used for each 10-foot section.

3.2 EQUIPMENT SUPPORTS

X. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

Y. Grouting: Place grout under supports for equipment and make bearing surface smooth.

Z. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 ADJUSTING

AA. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

BB. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.4 HANGER AND SUPPORT SCHEDULE

CC. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

DD. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

EE. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

FF. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

GG. Use carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications.

HH. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

II. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

JJ. Use padded hangers for piping that is subject to scratching.

KK. Use thermal-hanger shield inserts for insulated piping and tubing.

LL. Use of "C" clamps and beam clamps of "C" pattern and any modifications thereof is prohibited.

MM. 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 (DN 15 to DN 750).
2. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
3. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
4. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
5. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
6. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction might occur.
7. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
8. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
9. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

NN. 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 (DN 24 to DN 600).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

OO. 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 (150 mm) for heavy loads.
2. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

PP. 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. Use of "C" clamps and beam clamps of "C" pattern and any modifications thereof is prohibited.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles. Use only when it is not possible to use center loading beam clamps. Subject to prior approval by the A/E.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
6. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
7. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

QQ. 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.

RR. 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 (32 mm).

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.

SS. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

TT. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

UU. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

VV. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION 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. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 ACTION SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Emed.
2. Marking Services Inc.
3. Seton Name Plate Co.

2.2 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
2. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
4. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Stainless-steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number. Equipment schedule shall be included in operation and maintenance data.

2.3 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.

B. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

D. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

E. Fasteners: Stainless-steel rivets or self-tapping screws.

F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

G. Label Content: Include caution and warning information, plus emergency notification instructions.

2.4 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.5 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.

2.6 VALVE TAGS

A. Valve Tags: 1-1/2” diameter round with 3/16” top hole, stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.

1. Tag Material: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: #16 solid brass jack chain.
3. No painted tags will be accepted.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

C. Number sequences shall be from 1 thru 999 with top line legends as follow:

1.	Domestic Cold Water	CW
2.	Domestic Hot Water	HW
3.	Domestic Hot Water Return	HWR
4.	Compressed Air	A
5.	Natural Gas	GAS
6.	Vacuum	VAC
7.	Reverse Osmosis Water	RO
8.	Deionized Water	DI

2.7 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment including the following:

1. Motor Driven Equipment
2. Starters and Disconnect Switches
3. Control Devices

B. Locate equipment labels where accessible and visible.

C. Location signs shall be provided for safety showers, eyewash stations, and emergency gas shutoff

3.3 PIPE LABEL INSTALLATION

A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
7. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.

C. Pipe Label Legends:

1. General Services

a. Compressed Air – Control
b. Compressed Air – Laboratory
c. Deionized Water Supply
d. Deionized Water Return
e. Domestic Cold Water
f. Domestic Hot Water Supply
g. Domestic Hot Water Return
h. Process Water
i. Natural Gas
j. Reverse Osmosis Water Supply
k. Reverse Osmosis Water Return
l. Sanitary Waste
m. Storm - Primary
n. Storm - Overflow

o. Vacuum – Cleaning
p. Vacuum – Laboratory
q. Vent

2. Special Services

a. Oxygen, nitrogen, nitrous oxide, etc.
b. Chemical Waste.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. All valves and regulators (except those directly serving equipment) shall be provided with a brass tag securely wired in place on the valve stem below the packing gland nut. Tags shall clearly indicate the part of system, or room name and/or number controlled by the valve.

C. Furnish four (4) hot-press laminated typewritten copies of valve schedule, giving valve number controlled by the valve and location of valve. One copy will be mounted on a directory board in the main mechanical room, and one copy will be placed in each of the three mechanical brochures.

D. Prepare separate directories and drawings for the plumbing, heating, and air conditioning systems showing system layout as installed, and giving the number, location, and purpose of each component. The Contractor shall contact the A/E before starting the directory to insure proper tagging and listing.

E. Where it is necessary to operate more than one valve to control a section of piping, this fact and the numbers of the secondary valves shall be noted on the directory.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

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. Insulation Materials:

    a. Calcium silicate.
    b. Cellular glass.
    c. Flexible elastomeric.
    d. Mineral fiber.
    e. Phenolic.
    f. Polyolefin.
    g. Polystyrene.

2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied cloths.
10. Field-applied jackets.
11. Tapes.
12. Securements.
13. Corner angles.

B. Related Sections include the following:

1. Division 21 Section "Fire-Suppression Systems Insulation."
2. Division 23 Section "HVAC Insulation."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. LEED Submittal:

1. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.

C. Shop Drawings:

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.
8. Detail field application for each equipment type.

D. 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.

E. 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.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment 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.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Calcium Silicate:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Industrial Insulation Group (The); Thermo-12 Gold.

2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Duct Wrap.
d. Owens Corning; All-Service Duct Wrap.

I. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; HTB 23 Spin-Glas.
b. Owens Corning; High Temperature Flexible Batt Insulations.

J. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; Commercial Board.
b. Johns Manville; 800 Series Spin-Glas.
c. Knauf Insulation; Insulation Board.
d. Owens Corning; Fiberglas 700 Series.

2. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; 1000 Series Spin-Glas.
b. Owens Corning; High Temperature Industrial Board Insulations.

K. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Johns Manville; Micro-Lok.
    b. Knauf Insulation; 1000 Pipe Insulation.
    c. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

L. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. CertainTeed Corp.; CrimpWrap.
    b. Johns Manville; MicroFlex.
    c. Knauf Insulation; Pipe and Tank Insulation.
    d. Owens Corning; Fiberglas Pipe and Tank Insulation.

M. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Armacell LLC; Tubolit.
    b. Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.

N. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed 0.26 Btu x in./h x sq. ft. x deg F (0.038 W/m x K) after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Dow Chemical Company (The); Styrofoam.
    b. Knauf Insulation; Knauf Polystyrene.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F (10 to 427 deg C).

1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F (29 to plus 60 deg C).

G. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

H. PVC Jacket Adhesive: Compatible with PVC jacket.

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

2.6 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
4. Color: White or gray.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
4. Color: Aluminum.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
4. Color: White.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 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 C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, 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. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; Zeston.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. 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.

5. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; Metal Jacketing Systems.

2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.

a. Finish and thickness are indicated in field-applied jacket schedules.
b. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
c. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
d. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

a. Material, finish, and thickness are indicated in field-applied jacket schedules.
b. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
c. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
d. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

D. Underground Direct-Buried Jacket: 125-mil- (3.2-mm-) thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Pittsburgh Corning Corporation; Pittwrap.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

2.10 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing or closed seal.
2. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing or closed seal.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy or 0.062-inch (1.6-mm) soft-annealed, stainless steel.

2.11 CORNER ANGLES

A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. 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 equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and 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, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom 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 application and finishing.

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 at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install 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.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). 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 2 inches (50 mm) o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer 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 more than 75 percent of its nominal thickness.

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 (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar 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. Manholes.
5. Handholes.

6. 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 (50 mm) 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 (50 mm).
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 Division 07 Section "Penetration Firestopping"irestopping 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 Division 07 Section "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) o.c. in both directions.
    d. Do not overcompress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins and attach speed washers.
    g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches (75 mm).
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch (150-mm) centers, starting at corners. Install 3/8-inch- (10-mm-) diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from galvanized steel, at least 0.040 inch (1.0 mm) thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.6 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.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be 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 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 used for adjacent pipe. Overlap adjoining pipe insulation by not less than two 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 two 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 and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
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.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. 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 shall conform 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 adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two 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 (50 mm) 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.

3.7 FIELD-APPLIED JACKET INSTALLATION

E. 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 (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

F. 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 (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

G. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. 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.

H. Where metal jackets are indicated, install with 2-inch (50-mm) 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 (300 mm) o.c. and at end joints.

3.8 FIELD QUALITY CONTROL

I. Perform tests and inspections.

J. Tests and Inspections:

1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

K. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 EQUIPMENT INSULATION SCHEDULE

L. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

M. Heat-exchanger (water-to-water for domestic water heating service) insulation shall be one of the following:

1. Calcium Silicate: 3 inches (75 mm) thick.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.
3. Mineral-Fiber Pipe and Tank: 2 inches (50 mm) thick.

N. Steam-to-hot-water converter insulation shall be one of the following:

1. Calcium Silicate: 3 inches (75 mm) thick.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.
3. Mineral-Fiber Pipe and Tank: 2 inches (50 mm) thick.

O. Domestic water pump insulation shall be the following:

1. Mineral-Fiber Board: 1 inch (25 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.
2. Flexible Elastomeric: 1 inch (25 mm) thick.

P. Domestic chilled-water (potable) pump insulation shall be the following:

1. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.
2. Flexible Elastomeric: 1 inch (25 mm) thick.

Q. Domestic water, domestic chilled-water (potable), and domestic hot-water hydropneumatic tank insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch (25 mm) thick.
2. Mineral-Fiber Board: 1 inch (25 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.
3. Mineral-Fiber Pipe and Tank: 1 inch (25 mm) thick.
4. Polyolefin: 1 inch (25 mm) thick.

R. Domestic hot-water storage tank insulation shall be one of the following, of thickness to provide a minimum R-value of 12.5:

1. Mineral-Fiber Board: 2-lb/cu. ft. (32-kg/cu. m) nominal density.
2. Mineral-fiber pipe and tank.

S. Domestic water storage tank insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch (25 mm) thick.
2. Mineral-Fiber Board: 1 inch (25 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.
3. Mineral-Fiber Pipe and Tank: 1 inch (25 mm) thick.

T. Domestic chilled-water (potable) storage tank insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch (25 mm) thick.
2. Mineral-Fiber Board: 1 inch (25 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.
3. Mineral-Fiber Pipe and Tank: 1 inch (25 mm) thick.
4. Polyolefin: 1 inch (25 mm) thick.

3.10 PIPING INSULATION SCHEDULE, GENERAL

U. 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.

V. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Vertical portions of the storm and sanitary drains.
2. Chemical waste.
3. Drainage piping located in crawl spaces.
4. Underground piping.
5. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

W. PVC jackets shall be installed on insulated piping in conjunction with fitting covers to provide a total sealed system as required by USDA and FDA for applications in food and pharmaceutical facilities.

X. Insulate cold pipes conveying fluids below ambient temperature with vapor retardant jackets with self sealing laps.

1. Domestic cold water.
2. Horizontal portions of the storm and sanitary drain.
3. Chilled water.
4. Condensate drain.
5. Refrigerant suction.

3.11 INDOOR PIPING INSULATION SCHEDULE

Y. Domestic Cold Water:

1. All pipe sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch (25 mm) thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
c. Polyolefin: 1 inch (25 mm) thick.

Z. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 (DN 32) and Smaller: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch (19 mm) thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (13 mm) thick.
c. Polyolefin: 1 inch (19 mm) thick.

2. NPS 1-1/2 (DN 40) and Larger: Insulation shall be one of the following:

a. Flexible Elastomeric: 1.5 inch (25 mm) thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1.5 inch (25 mm) thick.
c. Polyolefin: 1.5 inch (25 mm) thick.

AA. Domestic Chilled Water (Potable):

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch (25 mm) thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
c. Polyolefin: 1 inch (25 mm) thick.

BB. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch (25 mm) thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
c. Polyolefin: 1 inch (25 mm) thick.

CC. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch (25 mm) thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
c. Polyolefin: 1 inch (25 mm) thick.

DD. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1/2 inch (13 mm) thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (13 mm) thick.
c. Polyolefin: 1/2 inch (13 mm) thick.

EE. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches (38 mm) thick.

FF. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 3/4 inch (19 mm) thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
c. Polyolefin: 1 inch (19 mm) thick.

GG. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet (3 m) of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
c. Polyolefin: 1 inch (19 mm) thick.

HH. Exposed or concealed sanitary drains prone to condensation:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch (13 mm) thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (13 mm) thick.

II. Hot Service Drains:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Calcium Silicate: 1-1/2 inches (38 mm) thick.
b. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch (25 mm) thick.

JJ. Hot Service Vents:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Calcium Silicate: 1-1/2 inches (38 mm) thick.
b. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch (25 mm) thick.

3.12 OUTDOOR AND TUNNEL PIPING INSULATION SCHEDULE

KK. Domestic Cold Water:

1. All pipe sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1.5 inch (25 mm) thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1.5 inch (25 mm) thick.
c. Polyolefin: 1.5 inch (25 mm) thick.

LL. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 (DN 32) and Smaller: Insulation shall be one of the following:

a. Flexible Elastomeric: 1.5 inch (19 mm) thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1.5 inch (13 mm) thick.
c. Polyolefin: 1.5 inch (19 mm) thick.

2. NPS 1-1/2 (DN 40) and Larger: Insulation shall be one of the following:

a. Flexible Elastomeric: 2 inch (25 mm) thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inch (25 mm) thick.
c. Polyolefin: 2 inch (25 mm) thick.

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

MM. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

NN. Equipment, Concealed:

1. None.

OO. Equipment, Exposed:

1. None.

PP. Piping, Concealed:

1. None.

QQ. Piping exposed in mechanical equipment rooms or in finished spaces below 10' above finished floor:

1. PVC: 20 mils (0.5 mm) thick.
2. Aluminum, Smooth: 0.016 inch (0.41 mm) thick.

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

RR. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

SS. Equipment, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):

1. Aluminum, Smooth: 0.024 inch (0.61 mm) thick.
2. Stainless Steel, Type 304, Smooth 2B Finish: 0.016 inch (0.41 mm) thick.

TT. Equipment, Exposed, Larger Than 48 Inches (1200 mm) in Diameter or with Flat Surfaces Larger Than 72 Inches (1800 mm):

1. Aluminum, Smooth with 1-1/4-Inch- (32-mm-) Deep Corrugations: 0.032 inch (0.81 mm) thick.
2. Stainless Steel, Type 304, Smooth, with 1-1/4-Inch- (32-mm-) Deep Corrugations: 0.020 inch (0.51 mm) thick.

UU. Piping, Exposed:
1. Aluminum, Smooth: 0.024 inch (0.61 mm) thick.
2. Stainless Steel, Type 304, Smooth 2B Finish: 0.016 inch (0.41 mm) thick.
3. Jacket seams shall be located on bottom side of horizontal piping.

END OF SECTION 220700

SECTION 220719 - PLUMBING PIPING INSULATION

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 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.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation" for equipment insulation.

1.3 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.

1.4 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.

1.5 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.

B. 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 and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less and smoke-developed index of 150 or less.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 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.

1.8 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.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 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 shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel shall 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 shall be qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials.

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

a. Aeroflex USA, Inc.
b. Armacell LLC.
c. K-Flex USA.

G. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.

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

a. Johns Manville; a Berkshire Hathaway company.
b. Knauf Insulation.
c. Manson Insulation Inc.
d. Owens Corning.

2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ.
3. 850 deg F.
4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

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

a. 3M Industrial Adhesives and Tapes Division.
b. Ideal Tape Co., Inc., an American Biltrite Company.
c. Knauf Insulation.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.3 SECUREMENTS

A. Bands:

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

a. ITW Insulation Systems; Illinois Tool Works, Inc.
b. RPR Products, Inc.

2. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

2.4 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers, :

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

a. Plumberex Specialty Products, Inc.
b. Truebro.
c. Zurn Industries, LLC.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures, :

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

a. Truebro.
b. Zurn Industries, LLC.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

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, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom 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.

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.
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 more than 25 percent of its nominal thickness.

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 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

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.

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 made from same material and density as that of adjacent pipe insulation. Each piece shall be 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 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 shall conform 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 factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied 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 preformed 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.
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 preformed 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 sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed 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 FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install 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 sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as that of pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. 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.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF MINERAL-FIBER 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 factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied 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 preformed 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 mineral-fiber 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 preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed 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 preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered 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.

3.9 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless steel bands at 12-inch intervals, and tighten bands without deforming insulation materials.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless steel bands at 12-inch intervals.

B. 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 factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders 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.

C. Insulation Installation on Pipe Flanges:

1. Install preformed 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 block insulation of same material and thickness as that of pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

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

E. Insulation Installation on Valves and Pipe Specialties:

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

3.10 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install 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 polyolefin sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet 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.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.11 FIELD-APPLIED JACKET INSTALLATION

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.

3.12 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.

3.13 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.14 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.

3.15 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 and Smaller: Insulation shall be one of the following:

   a. Flexible Elastomeric: 1/2 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

2. NPS 1-1/4 and Larger: Insulation shall be one of the following:

   a. Flexible Elastomeric: 1 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:

   a. Flexible Elastomeric: 3/4 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be one of the following:

   a. Flexible Elastomeric: 1 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be one of the following:

   a. Flexible Elastomeric: 3/4 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

END OF SECTION 220719

SECTION 221116 - DOMESTIC WATER PIPING

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. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
2. Encasement for piping.

B. Related Section:

1. Division 22 Section "Facility Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Construction Representative no fewer than seven days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without Construction Representative's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

C. Piping materials shall bear label, stamp, or other markings of specified testing agency.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) water tube, annealed temper.

C. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

D. Appurtenances for Grooved-End Copper Tubing:

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

a. Anvil International.
b. Grinnell Mechanical Products.
c. Shurjoint Piping Products.
d. Victaulic Company.

2. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.

3. Mechanical Couplings for Grooved-End Copper Tubing:

a. Copper-tube dimensions and design similar to AWWA C606.
b. Ferrous housing sections.
c. EPDM-rubber gaskets suitable for hot and cold water.
d. Bolts and nuts.
e. Minimum Pressure Rating: 300 psig (2070 kPa).
f.

2.3.1 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Compact-Pattern, Mechanical-Joint Fittings:

1. AWWA C153/A21.53, ductile iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

E. Appurtenances for Grooved-End, Ductile-Iron Pipe:

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

1) Shurjoint Piping Products.
2) Victaulic Company.

2. Fittings for Grooved-End, Ductile-Iron Pipe: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions that match pipe.

3. Mechanical Couplings for Grooved-End, Ductile-Iron-Piping:

a. AWWA C606 for ductile-iron-pipe dimensions.
b. Ferrous housing sections.
c. EPDM-rubber gaskets suitable for hot and cold water.
d. Bolts and nuts.

2.3 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe:

1. ASTM A 53/A 53M, Type E, Grade B, Standard Weight.
2. Include ends matching joining method.

B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless steel pipe with threaded ends.

C. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

D. Malleable-Iron Unions:

1. ASME B16.39, Class 150.
2. Hexagonal-stock body.
3. Ball-and-socket, metal-to-metal, bronze seating surface
4. Threaded ends.

E. Flanges: ASME B16.1, Class 125, cast iron.

F. Appurtenances for Grooved-End, Galvanized-Steel Pipe:

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

    1) Anvil International.
    2) Grinnell Mechanical Products
    3) Shurjoint Piping Products.
    4) Victaulic Company.

2. Fittings for Grooved-End, Galvanized-Steel Pipe: Galvanized, ASTM A 47/A 47M, malleable-iron casting; ASTM A 106/A 106M, steel pipe; or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
3. Fittings for Grooved-End, Galvanized-Steel Pipe:

    a. AWWA C606 for steel-pipe dimensions.
    b. Ferrous housing sections.
    c. EPDM-rubber gaskets suitable for hot and cold water.
    d. Bolts and nuts.

G. Zinc used in galvanizing shall meet the requirements of ASTM B-6 and shall be applied using 2 ounces of zinc per square foot of coated surface.

H. Reducing couplings, snap-joint couplings, and Vic-boltless couplings are not acceptable.

I. Hole cut piping, pressfit, and plain end piping systems will not be accepted.

J. Gasket material for water service up to 200 degree F shall be EPDM rubber, grade E.

2.4 STAINLESS-STEEL PIPE AND FITTINGS

A. Stainless-Steel Pipe: Schedule 10S, ASTM A 312/A 312M, Type 304/304L, seamless or electric resistance welded pipe.

B. Grooved-Joint Systems:

1. Manufacturers:

    a. Anvil International, Inc.; Gruvlok Manufacturing; Model 7400SS.
    b. Tyco Fire & Building Products; Grinnell Mechanical Products; Model 472.
    c. Victaulic Company; Style 489.
    d. Shurjoint Piping Products.

2. Grooved-End, Stainless Steel-Piping Fittings: Schedule 10S, Type 304L or 316L stainless steel from material conforming to ASTM A 403 or pipe conforming to ASTM A 312, or sheet conforming to ASTM A 240; with dimensions matching stainless steel pipe.

3. Grooved-End, Stainless Steel-Piping Couplings: ASTM A 743, cast Type 316L stainless steel, EPDM gaskets, and stainless steel bolts and nuts.

a. Rigid Type: To provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9.

C. Flanges: ASME B16.1, Classes 125 and 250, constructed of ASTM A 351, Type 304L stainless steel.

2.5 PEX TUBE AND FITTINGS

A. PEX Distribution System: ASTM F 877, SDR 9 tubing.

B. Fittings for PEX Tube: ASTM F 1807, metal-insert type with copper or stainless-steel crimp rings and matching PEX tube dimensions.

2.6 PIPING JOINING MATERIALS

A. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.7 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Form: Sheet.

C. Color: Black or natural.

2.8 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

2.9 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Manufacturers:

a. Central Plastics Company.
b. Watts Industries, Inc.; Water Products Div.
c. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Manufacturers:

a. Central Plastics Company.
b. Watts Industries, Inc.; Water Products Div.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

a. Lochinvar Corp.

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

a. Perfection Corp.; Clearflow Dielectric Waterway.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.
d. Victaulic Co. of America.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Refer to Division 22 Section “Common Work Results for Plumbing” for basic installation requirements.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install eccentric reducing couplings, flush on the top for water lines, where air or water pockets would otherwise occur due to a reduction in pipe size.

D. Cap and plug all openings in pipes with suitable metal plugs or cap to keep out dirt and rubbish during construction until equipment is connected.

E. Install domestic water piping level without pitch and plumb.

F. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.

G. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

H. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

I. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

J. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment. Use ball for piping NPS 6 and smaller. Use butterfly valves for piping NPS 8 and larger.

K. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."

L. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.2 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

E. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

F. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

G. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

H. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Roll groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

I. Flanged Joints: Select appropriate asbestos-free gasket material, size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

J. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Piping: Join according to ASTM D 2855.

K. Joints for PEX Piping: Join according to ASTM F 1807.

L. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.3 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

3.4 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

1. NPS 2 (DN 50) and Smaller: Use dielectric couplings or nipples.
2. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric nipples.
3. NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, riser clamps.
2. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
6. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
7. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.

E. Install supports for vertical copper tubing every 10 feet (3 m).

F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
5. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.

8. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.

G. Install supports for vertical steel piping every 15 feet (4.5 m).

H. Install hangers for cast iron piping with the following horizontal spacing:

1. 10 feet maximum.
2. Minimum of one hanger per pipe section close to joint on the barrel. Also at change of direction and branch connections.

I. Install hangers for ductile iron piping with the following horizontal spacing:

1. 10 feet maximum.
2. Minimum of one hanger per pipe section close to the joint behind the bell and at change of direction and branch connections.

J. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Pipe sizes indicated shall be carried full size to equipment served. Any change of size to match equipment connection shall be made within one foot of the equipment. At temperature control valves with sizes smaller than connected lines, reduction shall be made immediately adjacent to valves.

D. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

E. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

3.7 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

    a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow standing for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

A. All piping shall be cleaned before the installation, and flushed after the installation and before system startup.

B. Equipment, detergents, solvents and other cleaning agents shall be furnished by a qualified water treatment services.

C. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
d. Repeat procedures if biological examination shows contamination.
e. Submit water samples in sterile bottles to authorities having jurisdiction.

D. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

E. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

F. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Brazed joints may be used on aboveground copper tubing. Extruded-tee connections are prohibited.

D. In-building-slab, domestic water, trap seal primer piping, NPS 1 (DN 25) and smaller, shall be the following:
1. PEX tube, fittings for PEX tube, and crimped joints.

E. Under-building-slab, domestic water, building service piping, NPS 2 and smaller, shall be the following:

1. Soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A); copper pressure-seal fittings; and pressure-sealed joints.

F. Under-building-slab, domestic water, building-service piping, NPS 2-1/2 and larger, shall be the following:

1. Mechanical-joint, ductile-iron pipe; standard- or compact- pattern mechanical-joint fittings; and mechanical joints.

G. Aboveground domestic water piping, NPS 2 (DN 50) and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); wrought- copper solder-joint fittings; and soldered joints.

H. Aboveground domestic water piping, NPS 2-1/2 and larger, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); grooved-joint copper-tube appurtenances; and grooved joints.
2. Stainless-Steel Pipe: Schedule 10S, ASTM A 312/A 312M, Type 304/304L; grooved-joint stainless steel appurtenances; and grooved joints.

I. Aboveground, combined domestic-water-service and fire-service-main piping, NPS 5 (DN 125) and larger, shall be the following:

1. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.

3.12 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 6 and smaller. Use butterfly valves with flanged ends for piping NPS 8 and larger.
2. Throttling Duty: Use ball or globe valves for piping NPS 2 (DN 50) and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

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. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated water mixing valves.
6. Strainers.
7. Hose bibbs.
8. Wall hydrants.
9. Water hammer arresters.
10. Air vents.
11. Trap-seal primer valves.
12. Trap-seal primer systems.
13. Flexible connectors
14. Water Meters

B. Related Sections include the following:

1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Division 22 Section "Domestic Water Piping" for water meters.
3. Division 22 Section "Domestic Water Filtration Equipment" for water filters in domestic water piping.
4. Division 22 Section "Emergency Plumbing Fixtures" for water tempering equipment.
5. Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 ACTION SUBMITTALS

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

B. Shop Drawings: Diagram power, signal, and control wiring.

1.5 INFORMATION SUBMITTALS

C. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 and NSF 14. Mark "NSF-pw" on plastic piping components.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa) unless otherwise indicated.

2.3 VACUUM BREAKERS

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

a. Ames Co.
b. Apollo Valves by Conbraco Industries, Inc.
c. Conbraco Industries, Inc.
d. FEBCO; SPX Valves & Controls.
e. Sioux Chief.
f. Watts Industries, Inc.; Water Products Div.
g. Woodford Manufacturing Company.
h. Zurn Plumbing Products Group; Wilkins Div.

B. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Standard: ASSE 1001.
2. Body: Bronze.
3. Inlet and Outlet Connections: Threaded.
4. Finish: Rough bronze.

C. Hose-Connection Vacuum Breakers:

1. Standard: ASSE 1011
2. Body: Brass, nonremovable, with automatic drain.
3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
4. Finish: Rough bronze.

D. Pressure Vacuum Breakers:

1. Standard: ASSE 1020.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
4. Accessories: Ball valves, on inlet and outlet.

E. Laboratory-Faucet Vacuum Breakers:

1. Standard: ASSE 1035.
2. Body: Bronze.
3. End Connections: Threaded.
4. Finish: Chrome plated.

F. Spill-Resistant Vacuum Breakers:

1. Standard: ASSE 1056.
2. Operation: Continuous-pressure applications.

3. Accessories: Ball valves, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide Watts Industries, Inc.; Water Products Div. Model 909 or equivalent products by one of the following:

   a. Apollo Valves by Conbraco Industries, Inc.
   b. FEBCO; SPX Valves & Controls.
   c. Watts Industries, Inc.; Water Products Div.; Model 909
   d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved steel with interior lining complying with AWWA C550 or that is FDA approved stainless steel for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Accessories:

a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Beverage-Dispensing-Equipment Backflow Preventers:

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

a. Watts Industries, Inc.; Water Products Div.
b. Zurn Plumbing Products Group; Wilkins Div.
c. Apollo Valves by Conbraco Industries, Inc.
d.

2. Standard: ASSE 1022.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel.
6. End Connections: Threaded.

C. Reduced-Pressure-Detector, Fire-Protection Backflow-Preventer Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide Watts Industries, Inc.; Water Products Div. Model 909 or equivalent products by one of the following:

a. Ames Co.
b. FEBCO; SPX Valves & Controls.
c. Watts Industries, Inc.; Water Products Div. Model 909
d. Zurn Plumbing Products Group; Wilkins Div.
e. Apollo Valves by Conbraco Industries, Inc.

2. Standard: ASSE 1047 and FM Global approved or UL listed.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved Steel with interior lining complying with AWWA C550 or that is FDA approved Stainless steel.
6. End Connections: Flanged.
7. Accessories:

a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators

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

    a. Conbraco Industries, Inc.
    b. Watts Industries, Inc.; Water Products Div.
    c. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.6 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

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

    a. Armstrong International, Inc.
    b. ITT Industries; Bell & Gossett Div.
    c. Taco, Inc.

2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: Brass or bronze.
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves:

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

    a. Armstrong International, Inc.
    b. ITT Industries; Bell & Gossett Div.
    c. Taco, Inc.

2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
3. Size: Same as connected piping, but not smaller than NPS 2-1/2.
4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.7 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing Valves:

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

    a. Armstrong International, Inc.
    b. Leonard Valve Company.
    c. Powers; a Watts Industries Co.
    d. Symmons Industries, Inc.
    e. Apollo Valves by Conbraco Industries, Inc.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Cabinet-type as indicated, thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
9. Valve Finish: Rough bronze.
10. Piping Finish: Copper.
11. Cabinet: Factory-fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.

B. Individual-Fixture, Water Tempering Valves:

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

    a. Apollo Valves by Conbraco Industries, Inc.
    b. Leonard Valve Company.
    c. Powers; a Watts Industries Co.; Hydroguard Series e480.
    d. Symmons.
    e. Apollo Valves by Conbraco Industries, Inc.

2. Standard: ASSE 1016/1070, thermostatically controlled water tempering valve.
3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
4. Body: Solid brass construction with corrosion-resistant interior components.
5. Temperature Control: Adjustable temperature selection with locknut to prevent tampering.
6. Inlets and Outlet: Threaded. Integral checks on inlets.

2.8 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.

3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size: 0.094 inch.
6. Drain: Pipe plug.

2.9 HOSE BIBBS

A. Hose Bibbs:

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

    a. Chicago Faucet.
    b. Nibco.
    c. T.S. Brass
    d. Watts Regulator.
    e. Woodford.

2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral or field-installation, non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Service Areas: Rough bronze.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation: Wheel handle.
13. Include wall flange with each chrome- or nickel-plated hose bibb.

2.10 WALL HYDRANTS

A. Non-freeze Wall Hydrants:

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

    a. Tyler Pipe; Wade Div.; Cat. No. 8601,175
    b. Woodford.
    c. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.

6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.
9. Box and Cover Finish: Nickel-Bronze.
10. Operating Keys(s): Two with each wall hydrant.

B. Moderate-Climate/Vestibule Wall Hydrants:

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

   a. Tyler Pipe; Wade Div.; Cat. No. 8600MT
   b. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Inlet: NPS 3/4 or NPS 1.
6. Outlet: Concealed, with integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011; and garden-hose thread complying with ASME B1.20.7.
7. Box: Deep, flush mounting with cover.
8. Box and Cover Finish: Polished nickel bronze.
9. Operating Keys(s): Two with each wall hydrant.

2.11 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

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

   a. AMTROL, Inc.
   b. Josam Company.
   c. MIFAB, Inc.
   d. PPP Inc.
   e. Sioux Chief Manufacturing Company, Inc.
   f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   g. Tyler Pipe; Wade Div.
   h. Watts Drainage Products Inc.
   i. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.12 AIR VENTS

A. Manual Air Vents:

1. Manufacturers:

a. Bell & Gossett; No. 4V

2. Type: Loosed key screwdriver stop.
3. Pressure Rating: 150 psi minimum pressure rating at 250 degree F.
4. Material: Stainless steel.
5. Connections: ½" FPT / ¾" MPT.

B. Automatic Air Vents:

1. Manufacturers:

a. Bell & Gossett; No. 4V

2. Material: Brass body with non-ferrous internals.
3. Pressure Rating: 150 psi minimum pressure rating at 240 degree F.
4. Connections: ½" FPT / ¾" MPT.

2.13 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

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

a. MIFAB, Inc.
b. PPP Inc.
c. Sioux Chief Manufacturing Company, Inc.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Watts Industries, Inc.; Water Products Div.

2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Valves:

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

a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
3. Size: NPS 1-1/4 minimum.
4. Material: Chrome-plated, cast brass.

2.14 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

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

   a. PPP Inc.

2. Standard: ASSE 1044.
3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
4. Cabinet: Recessed-mounting steel box with stainless-steel cover.
5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
6. Vacuum Breaker: ASSE 1001.
7. Number Outlets: Four, Six or Eight as indicated.
8. Size Outlets: NPS ½ or NPS 5/8.

2.15 SPECIALTY VALVES

A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.

2.16 FLEXIBLE CONNECTORS

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

1. Flex-Hose Co., Inc.
2. Metraflex, Inc.

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 250 psig (1725 kPa).
2. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.

C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 250 psig (1725 kPa).
2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

2.17 WATER METERS

A. Description: Magnetic drive turbo meter type with an accuracy of not less than ± 2%, cast iron body with flanged connections, trim as required for the type of service, and rated for 150 psi working pressure.

B. Meters shall be provided with output to remote monitoring equipment for Building Energy Management System and mechanical register. Provide pulse accumulators with dry switching contacts. Pulse shall have a minimum pulse duration of 20 ms, minimum pulse interval of 20 ms, maximum bounce time of 10 ms, maximum pulse frequency of 25 Hz, and a maximum power consumption of 0.75 VA. Appropriate value shall be assigned to each pulse to keep frequency below 25 Hz.

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

1. Meters 6” and larger: Yokogowa ADMAG AXF Magnetic Flowmeters.
2. Meters below 6”: Sensus Omni T2 programmed for 1000 gallons display multiplier and 100 gallons per pulse ouput.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Install in an accessible location to facilitate testing and servicing with the height between 12” and 60” above the floor or grade unless instructed otherwise by applicable code.
2. Locate backflow preventers in same room as connected equipment or system.
3. Install backflow preventers with an air gap drain cup provided by same manufacturer, located under the pressure differential section, and piped full size of the air gap to the nearest floor drain.
4. Do not install bypass piping around backflow preventers.

C. Install vacuum breakers on all outlets where hoses can be attached, such as laboratory faucets, service sinks, wall hydrant, etc.

D. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and water regulators if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified.

E. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

F. Install water hammer arresters in water piping according to PDI-WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors/panels.

G. Install air vents at high points of water piping.

H. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

I. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

J. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

K. Install trap primers in accessible locations. Do not install trap primers in ceilings.

L. Install temperature and pressure relief valves in the shell of each domestic hot water generators, and as indicated on the drawings. Pipe the discharge connection from each valve to the drainage system through an open drain.

M. Install integral spring check on all two-handle faucets where hoses can be attached.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.3 FLEXIBLE CONNECTOR INSTALLATION

A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.

B. Install bronze-hose flexible connectors in copper domestic water tubing.

C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.4 WATER METER INSTALLATION

A. Install water meters according to AWWA M6.

B. Provide water sample test ports in conjunction with installation of water meters in both new constructions and renovations. Exact locations will be determined by T.B. Simon Power Plant through Construction Representative.

C. Install turbine-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.

3.5 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Reduced-pressure-principle backflow preventers.
3. Carbonated-beverage-machine backflow preventers.
4. Reduced-pressure-detector, fire-protection backflow-preventer assemblies.
5. Water pressure-reducing valves.
6. Calibrated balancing valves.
7. Primary, thermostatic, water mixing valves.
8. Supply-type, trap-seal primer valves.
9. Trap-seal primer systems.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each pressure vacuum breaker and reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.7 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

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. This Section includes the following for soil, waste, and vent piping inside the building:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

B. Related Sections include the following:

1. Division 22 Section "Sanitary Sewerage Pumps."
2. Division 22 Section "Facility Sanitary Sewers."
3. Division 22 Section "Chemical Waste-Systems for Laboratory and Healthcare Facilities" for chemical-waste and vent piping systems.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.4 ACTION SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. LEED Submittal:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Comply with requirements in "Piping Applications" Article for applications of pipe, tube, fitting, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Heavy-Duty, Hubless-Piping Couplings:

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

a. ANACO-Husky; Series 4000.
b. Clamp-All Corp.

2. Standards: ASTM C 1277 and ASTM C 1540.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

C. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Sanitary sewer piping outside the building is specified in Division 22 Section "Facility Sanitary Sewers."

B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

D. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

E. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

F. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

G. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of cast iron increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

I. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

K. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.2 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.3 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Backwater Valves: Install backwater valves in piping subject to sewage backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Backwater valve are specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install individual, straight, horizontal piping runs:

    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, valve, and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10 mm) minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
5. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.

F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and 5 (DN 100 and 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
5. NPS 8 to NPS 12 (DN 200 to DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

H. Install supports for vertical PVC piping every 48 inches (1200 mm).

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install horizontal backwater valves with cleanout cover flush with floor.
5. Comply with requirements for backwater valves cleanouts and drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
6. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.6 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL

A. Drainage system shall be inspected and tested in accordance with State of Michigan Plumbing Code.

B. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

C. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.

D. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

E. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot (30 kPa) head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.8 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 PIPING SCHEDULE

A. Aboveground, soil and waste piping shall be any of the following:

1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

B. Aboveground, vent piping shall be any of the following:

1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

C. Underground, soil, waste, and vent piping shall be of the following:

1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.

END OF SECTION 221316

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. This Section includes the following sanitary drainage piping specialties:

1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Trap Seal Protection Devices
5. Miscellaneous sanitary drainage piping specialties.
6. Grease Interceptors

B. Related Sections include the following:

1. Division 22 Section "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves:

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

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.14.1.
3. Size: Same as connected piping.
4. Body: Cast iron.
5. Cover: Cast iron with bolted or threaded access check valve.
6. End Connections: Hubless.
7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

2.2 CLEANOUTS

A. Cast-Iron Floor Cleanouts:

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

    a. Josam Company; Josam Div.
    b. Sioux Chief Manufacturing Company, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Heavy-duty, adjustable housing.
5. Body or Ferrule: Cast iron.

6. Outlet Connection: Spigot.
7. Closure: Brass plug with straight threads and gasket.
8. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
9. Frame and Cover Shape: Round.
10. Top Loading Classification: Heavy Duty.
11. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

B. Cast-Iron Wall Cleanouts:

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

   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, stainless-steel cover plate with screw.

2.3 FLOOR DRAINS

A. General Floor Drains:

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

   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Cast iron.
5. Seepage Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom.
8. Top or Strainer Material: Nickel bronze.
9. Top of Body and Strainer Finish: Nickel bronze.
10. Top Shape: Round.

11. Dimensions of Top or Strainer: 6”
12. Top Loading Classification: Light Duty.
13. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet.
14. Trap Seal Protection: Barrier type.

B. Shower/Toilet Floor Drains:

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

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Cast iron.
5. Seepage Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom.
8. Top or Strainer Material: Nickel bronze.
9. Top of Body and Strainer Finish: Nickel bronze.
10. Top Shape: Round.
11. Dimensions of Top or Strainer: 7”
12. Top Loading Classification: Light Duty.
13. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet.
14. Trap Seal Protection: Barrier type.

C. Gang Shower Floor Drains

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

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Cast iron.
5. Seepage Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom.
8. Top or Strainer Material: Nickel bronze.

9. Top of Body and Strainer Finish: Nickel bronze.
10. Top Shape: Rectangular.
11. Dimensions of Top or Strainer: 8 x 4
12. Top Loading Classification: Light Duty.
13. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet.
14. Trap Seal Protection: Barrier type.

D. Mechanical Room and Areaway Floor Drains:

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

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Cast iron.
5. Seepage Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom.
8. Sediment Bucket: Required.
9. Top or Strainer Material: Nickel bronze.
10. Top of Body and Strainer Finish: Nickel bronze.
11. Top Shape: Round.
12. Dimensions of Top or Strainer: 8”
13. Top Loading Classification: Heavy Duty.
14. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet.
15. Trap Seal Protection: Barrier type.

E. Floor Drains with Backwater Valves:

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

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3 with backwater valve.
3. Pattern: Floor drain.
4. Body Material: Cast iron.
5. Seepage Flange: Required.

6. Clamping Device: Required.
7. Outlet: Bottom.
8. Backwater Valve: Integral, ASME A112.14.1, swing-check type.
9. Top or Strainer Material: Nickel bronze.
10. Top of Body and Strainer Finish: Nickel bronze.
11. Top Shape: Round.
12. Dimensions of Top or Strainer: 9”
13. Top Loading Classification: Extra Heavy-Duty.
14. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet.
15. Trap Seal Protection: Barrier type.
16. Trap Material: Cast iron.
17. Trap Pattern: Deep-seal P-trap.
18. Trap Features: Cleanout.

2.4 AIR-ADMITTANCE VALVES

A. Fixture Air-Admittance Valves:

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

    a. Durgo, Inc.
    b. Oatey.
    c. ProSet Systems Inc.
    d. RectorSeal.
    e. Studor, Inc.

2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected fixture or branch vent piping.

B. Stack Air-Admittance Valves:

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

    a. Durgo, Inc.
    b. Oatey.
    c. Studor, Inc.

2. Standard: ASSE 1050 for vent stacks.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected stack vent or vent stack.

C. Wall Box:

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

    a. Durgo, Inc.
    b. Oatey.
    c. RectorSeal.
    d. Studor, Inc.

2. Description: White plastic housing with white plastic grille, made for recessed installation. Include bottom pipe connection and space to contain one air-admittance valve.
3. Size: About 9 inches wide by 8 inches high by 4 inches deep.

2.5 TRAP SEAL PROTECTION DEVICES

A. Barrier Type Trap Seal Protection Devices:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. SureSeal Manufacturing; Inline Floor Drain Trap Sealer.
2. Standard: ASSE 1072-2007.
3. Body: ASB Plastic
4. Diaphragm & Sealing Gasket: Neoprene Rubber
5. Size: 2 inch (50 mm), 3 inch (75 mm), 3-1/2 inch (89 mm), or 4 inch (100 mm).
6. Gravity Drain Outlet Connection: Compression fit sealing gasket 80 durometer.

2.6 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

    a. NPS 2: 4-inch minimum water seal.
    b. NPS 2-1/2 and Larger: 5-inch minimum water seal.

B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

2.7 GREASE INTERCEPTORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Josam Company; Josam Div.
2. MIFAB, Inc.
3. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Standard: ASME A112.14.3 and PDI-G101, for intercepting and retaining fats, oils, and greases from food-preparation or -processing wastewater.

C. Description: Removable for cleaning, not to be set in concrete. Acid resistant coated interior and exterior fabricated steel with internal air relief by-pass, brass clean out plug at outlet side and visible double wall trap seal with removable combination pressure equalizing flow diffusing baffle and sediment tray, gasketed nonskid secured cover, and complete flow control fitting on inlet.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.
5. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor. In no cases shall access be from below, through the ceiling space.
6. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall. Cleanout plug shall not be recessed more than 1 inch from the cover plate at the finished wall.
7. Cleanouts for water closets shall be brought up to above flood rim of the fixtures.

D. Plumbing fixtures are not to be used in place of cleanouts for the removal of obstruction.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
5. Install trap-seal protection devices in floor drains during trim out stage of project.

F. All floor drains shall be flashed with six pound sheet lead, 24 inches square, fitted to the clamping rings on the drains, and with outside edges of flashing worked into the floor construction to effect a watertight installation.

G. All floor drains and cleanouts which occur in the ground floors which are waterproofed shall be flashed.

H. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

I. Install fixture air-admittance valves on fixture drain piping.

J. Install stack air-admittance valves at top of stack vent and vent stack piping.

K. Install air-admittance-valve wall boxes recessed in wall.

L. Install deep-seal traps on floor drains and other waste outlets.

M. Install floor-drain, barrier type trap seal protection device on inlet to floor drains that require trap-seal protection.

1. Size: Same as floor drain inlet.

N. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system. Indirect waste receptors shall not be installed above ceilings or in any inaccessible, concealed or unventilated atrea.

O. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

P. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

Q. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

R. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.

1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each grease interceptor.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221413 – FACILITY STORM DRAINAGE PIPING

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. This Section includes the following storm drainage piping inside the building.

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

B. Related Sections include the following:

1. Division 22 Section "Sump Pumps."
2. Division 33 Section "Storm Utility Drainage Piping" for storm drainage piping outside the building.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.
2. Storm Drainage, Force-Main Piping: 50 psig (345 kPa).

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Storm-Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of storm-drainage service.
2. Do not proceed with interruption of storm-drainage service without Owner's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

2.3 Comply with requirements in "Piping Applications" Article for applications of pipe, tube, fitting, and joining methods for specific services, service locations, and pipe sizes.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Heavy-Duty, Hubless-Piping Couplings:

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

1) ANACO-Husky; Series 4000.
2) Clamp-All Corp.
3) Mission Rubber Company; a division of MCP Industries, Inc.

2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.5 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight. Include square-cut-grooved or threaded ends matching joining method.

B. Galvanized-Cast-Iron Drainage Fittings: ASME B16.12, threaded.

C. Steel-Pipe Pressure Fittings:

1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. Galvanized-Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.
4. Cast-Iron Flanges: ASME B16.1, Class 125.
5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.

D. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:

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

a. Anvil International.
b. Grinnell Mechanical Products.
c. Shurjoint Piping Products.
d. Victaulic Co. of America.

2. Galvanized, Grooved-End Fittings for Galvanized-Steel Piping: ASTM A 536, ductile-iron casting; ASTM A 47/A 47M malleable-iron casting; or ASTM A 106/A 106M steel pipe with dimensions matching ASTM A 53/A 53M steel pipe, and complying with AWWA C606 for grooved ends.
3. Grooved Mechanical Couplings for Galvanized-Steel Piping: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys, EPDM-rubber gasket suitable for hot and cold water, and bolts and nuts.

2.6 DUCTILE-IRON PIPE AND FITTINGS

A. Ductile-Iron, Mechanical-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot end, unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, mechanical-joint ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Ductile-Iron, Grooved-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51 with round-cut-grooved ends according to AWWA C606.
2. Ductile-Iron-Pipe Appurtenances:

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

1) Anvil International.
2) Shurjoint Piping Products.
3) Star Pipe Products.
4) Victaulic Co. of America.

b. Grooved-End, Ductile-Iron Fittings: ASTM A 536, ductile-iron castings with dimensions matching AWWA C110/A21.10 ductile-iron pipe or AWWA C153/A21.53 ductile-iron fittings and complying with AWWA C606 for grooved ends .

c. Grooved Mechanical Couplings for Ductile-Iron Pipe: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber center-leg gasket suitable for hot and cold water, and bolts and nuts.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Utility Drainage Piping."

B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

C. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Storm Drainage Piping Specialties."

D. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.

E. Install underground, steel, force-main piping. Install encasement on piping according to ASTM A 674 or AWWA C105.

F. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to storm sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

G. Install underground, ductile-iron, special pipe fittings according to AWWA C600.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

H. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

I. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

J. Make changes in direction for storm piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

K. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:

1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

L. Install force mains at elevations indicated.

M. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

O. All roof drains shall be flashed with six pound sheet lead, 36 inches square, fitted to the clamping rings on the drains, and with outside edges of flashing worked into the roof construction to effect a watertight installation. Flashing and roofing shall be installed such that a uniform, gradual pitch is maintained to the drain.

3.2 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

C. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fittings. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

3.3 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves: Install shutoff valve on each sump pump discharge.

1. Install full-port ball valve for piping NPS 2 (DN 50) and smaller.
2. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sump pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
2. Install backwater valves in accessible locations.
3. Backwater valve are specified in Division 22 Section "Storm Drainage Piping Specialties."

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

   a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, valve, and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10 mm) minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
5. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.

6. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).

F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
5. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
8. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.

H. Install supports for vertical steel piping every 15 feet (4.5 m).

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

B. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
2. Install horizontal backwater valves with cleanout cover flush with floor.
3. Comply with requirements for backwater valves, cleanouts and drains specified in Division 22 Section "Storm Drainage Piping Specialties."

C. Connect force-main piping to the following:

1. Storm Sewer: To exterior force main or storm manhole.
2. Sump Pumps: To sump pump discharge.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.6 IDENTIFICATION

A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL

A. Drainage system shall be inspected and tested in accordance with State of Michigan Plumbing Code.

B. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

C. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.

D. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

E. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

F. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.8 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground storm drainage piping shall be any of the following:

1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and coupled joints.
2. Galvanized-steel pipe, drainage fittings, and threaded joints.

C. Underground storm drainage piping shall be any of the following:

1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and coupled joints.

D. Aboveground storm drainage force mains NPS 2 (DN 40) and smaller shall be any of the following:

1. Galvanized-steel pipe, pressure fittings, and threaded joints.

E. Aboveground storm drainage force mains NPS 2-1/2 (DN 65) and larger shall be any of the following:

1. Steel pipe, pressure fittings, and threaded joints.
2. Grooved-end steel pipe, grooved-joint system fittings and couplings, and grooved joints.

F. Underground storm drainage force mains shall be any of the following:

1. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile-iron fittings; glands, gaskets, and bolts; and mechanical joints.
2. Include grooved-joint system fittings and couplings and grooved joints where indicated.

END OF SECTION 221413

SECTION 224213.13 - COMMERCIAL WATER CLOSETS

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. Water closets.
2. Toilet seats.
3. Supports.

B. Related Requirements:

1. Section 224100 "Residential Plumbing Fixtures" for residential water closets.
2. Section 224300 "Medical Plumbing Fixtures" for healthcare water closets.
3. Section 224600 "Security Plumbing Fixtures" for security water closets.

1.3 DEFINITIONS

A. Effective Flush Volume: Average of two reduced flushes and one full flush per fixture.

B. Remote Water Closet: Located more than 30 feet from other drain line connections or fixture and where less than 1.5 drainage fixture units are upstream of the drain line connection.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than six of each type.

PART 2 - PRODUCTS

2.1 WALL-MOUNTED WATER CLOSETS

A. Water Closets Wall mounted, top spud, antimicrobial flushometer bowl.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Kohler Co; K-4325-SS Kingston™ Wall-mounted 1.6 or 1.28 gpf flushometer valve toilet bowl with top inlet, require or owner approved product by one of the following:

a. American Standard.
b. Sloan Valve Company.
c. Zurn Industries, LLC.
d. Kohler Co.

2. Bowl:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Finish: Antimicrobial
d. Type: Siphon jet.
e. Style: Flushometer valve.
f. Height: Standard.
g. Rim Contour: Elongated.
h. Water Consumption: 1.6 gal. per flush.
i. Spud Size and Location: NPS 1-1/2; top.

2.2 TOILET SEATS

A. Toilet Seats TS-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Kohler Co; Model # K-4731-GA "Stronghold" Elongated toilet seat with support arms or owner approved product by one of the following:

a. American Standard.
b. Bemis Manufacturing Company.
c. Centoco Manufacturing Corporation.
d. Church Seats; Bemis Manufacturing Company.
e. Olsonite Seat Co.
f. Zurn Industries, LLC.

2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.

4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Self-sustaining, check.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: White.

2.3 SUPPORTS

A. Water Closet Carrier:

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

   a. J.R. Smith.
   b. Zurn Industries, LLC.

2. Standard: ASME A112.6.1M.
3. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.

4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.
5. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

SECTION 224216.13 - COMMERCIAL LAVATORIES

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. Lavatories.
2. Faucets.
3. Supply fittings.
4. Waste fittings.
5. Supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranty.

B. Manufacturer's certificates.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Servicing and adjustments of automatic faucets.

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. 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.

PART 2 - PRODUCTS

2.1 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 372 for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. 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.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers:

1. NPS 1/2.
2. ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

2.2 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/2 by NPS 1-1/4.
2. Material: Chrome-plated, two-piece, 18 gauge with cleanout plug, cast-brass trap and ground-joint swivel elbow with 0.032-inch- thick brass tube to wall; and chrome-plated, brass or steel wall flange.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.

B. Examine counters and walls for suitable conditions where lavatories will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install lavatories level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.

D. 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 220518 "Escutcheons for Plumbing Piping."

E. Seal joints between lavatories, counters, 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."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 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 water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

3.6 TESTING AND ADJUSTING

A. Set field-adjustable temperature set points of temperature-actuated water mixing valves. Adjust set point within allowable temperature range.

B. Test and adjust installation.

END OF SECTION 224216.13

SECTION 224216.16 - COMMERCIAL SINKS

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. Service sinks.
2. Kitchen/utility sinks.
3. Manually operated sink faucets.
4. Supply fittings.
5. Waste fittings.
6. Sink supports.
7. Grout.

B. Related Requirements:

1. Section 114000 "Foodservice Equipment" for NSF-compliant foodservice and handwash sinks.
2. Section 224100 "Residential Plumbing Fixtures" for residential sinks.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sinks and faucets to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
   a. Servicing and adjustments for automatic faucets.

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. 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.

PART 2 - PRODUCTS

2.1 SERVICE SINKS

A. Service Sinks - Plastic, Floor Mounted: SS-1 .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ELKAY
   b. Just
   c. Fiat.
   d. Mustee.
   e. Zurn Industries, LLC.
2. Source Limitations: Obtain sinks from single source from single manufacturer.

2.2 KITCHEN/UTILITY SINKS

A. Kitchen/Utility Sinks - Stainless Steel, Counter Mounted: Sink-1 .

1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkay; "Crosstown" ADA compliant undermount single bowl dual mount sink model # ECTSRAD25226TBG or owner approved product by one of the following:
   a. Advance Tabco.
   b. Just Manufacturing.
   c. Elkay
2. Waste Fittings:
   a. Standard: ASME A112.18.2/CSA B125.2.
   b. Trap(s):
      1) Size: NPS 1-1/2 .
      2) Material:
         a) Chrome-plated, two-piece, cast-brass trap with cleanout plugs and swivel elbow with 18-gauge brass tube to wall ; and chrome-plated brass or steel wall flange.
3. Mounting: under counter with sealant.

B. Commercial Sink Faucets

   a. American Standard.
   b. Elkay.
   c. Kohler Co.
   d. Delta

2. Source Limitations: Obtain sink faucets from single source from single manufacturer.
3. Standard: ASME A112.18.1/CSA B125.1.
4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
5. Body Type: Centerset .
6. Body Material: Commercial, solid brass, or die-cast housing with brazed copper and brass waterway.
7. Finish: Chrome plated .
8. Mounting Type: Deck, exposed .
9. Vacuum Breaker: Not required for hose outlet.
10. Spout Outlet: Aerator .

2.3 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. 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.

D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key .

F. Risers:

1. NPS 3/8 .
2. Chrome-plated, rigid-copper pipe .

2.4 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/2.
2. Material:
   a. Chrome-plated, two-piece, cast-brass trap and swivel elbow with 18-gauge brass tube to wall with cleanout plug ; and chrome-plated brass or steel wall flange.

2.5 GROUT

A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000 psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.

B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sinks level and plumb in accordance with rough-in drawings.

B. Install supports, affixed to building substrate, for wall-hung sinks.

C. Install wall-mounted sinks at accessible mounting height in accordance with ICC A117.1.

D. Set floor-mounted sinks in leveling bed of cement grout.

E. Install water-supply piping with stop on each supply to each sink faucet.

1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

F. 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 220518 "Escutcheons for Plumbing Piping."

G. Seal joints between sinks and 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."

H. 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."

3.3 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 water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 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 shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.5 ADJUSTING

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

B. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.6 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

SECTION 224700 - DRINKING FOUNTAINS AND WATER COOLERS

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. This Section includes the following drinking fountains and water coolers and related components:

1. Drinking Fountains.
2. Water coolers.
3. Fixture supports.

1.3 DEFINITIONS

A. Accessible Drinking Fountain or Water Cooler: Fixture that can be approached and used by people with disabilities.

B. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.

C. Fitting: Device that controls flow of water into or out of fixture.

D. Fixture: Drinking fountain or water cooler unless one is specifically indicated.

E. Remote Water Cooler: Electrically powered equipment for generating cooled drinking water.

F. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.4 SUBMITTALS

A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act" ; and Public Law 101-336, "Americans with Disabilities Act" ; for fixtures for people with disabilities.

C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

D. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

E. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

2.2 WATER COOLERS

A. Electric Water Coolers:

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

a. Elkay Manufacturing Co. (Note: Elkay Bottle Fillers Not Allowed)
b. Halsey Taylor.
c. Haws Corporation; Model HWBFA8L.VRC
d. Oasis Corporation.

2.3 FIXTURE SUPPORTS

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

1. Josam Co.
2. MIFAB Manufacturing, Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.

1. Type I: Hanger-type carrier with two vertical uprights.
2. Type II: Bi-level, hanger-type carrier with three vertical uprights.
3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.

B. Examine walls and floors for suitable conditions where fixtures are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.

B. Use mounting frames for recessed water coolers, unless otherwise indicated.

C. Set freestanding and pedestal drinking fountains on floor.

D. Set remote water coolers on floor, unless otherwise indicated.

E. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.

B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.

C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.

D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball valves. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.

1. Remove and replace malfunctioning units and retest as specified above.
2. Report test results in writing.

3.6 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust water cooler temperature settings.

3.7 CLEANING

A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 224700

SECTION 224716 - PRESSURE WATER COOLERS

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. Pressure water coolers.
2. Supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of pressure water cooler and bottle filling station.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include diagrams for power wiring.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For pressure water coolers and bottle filling stations to include in maintenance manuals.

1.5 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. Filter Cartridges: Equal to 10 percent of quantity installed for each type and size indicated, but no fewer than 1 of each.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Standards:

1. Pressure water coolers and bottle filling stations intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 or NSF 372, or be certified in compliance with NSF 61 or 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. Comply with ASHRAE 34 for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.
3. Comply with UL 399.
4. Comply with ASME A112.19.3/CSA B45.4.
5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Comply with NSF 42 and NSF 53 for water filters for water coolers and bottle filling stations.
7. Comply with ICC A117.1 for accessible water coolers and bottle filling stations.

2.2 PRESSURE WATER COOLERS

A. Pressure Water Coolers - Surface Wall-Mounted, Stainless Steel: EWC-1and EWC-2.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkay; Model #EZS8WSLK or owner approved product by one of the following:
   a. Halsey Taylor.
   b. Oasis International.
2. Source Limitations: Obtain surface wall-mounted, stainless steel, pressure water coolers from single source from single manufacturer.
3. Bubbler: One, with adjustable stream regulator, located on cabinet deck.
4. Control: Front and side Push bar Activation.
5. Bottle Filler: Sensor activation automatic shutoff timer: Fill rate 0.5 to 1.5 gpm .
6. Drain: Grid with NPS 1-1/4 tailpiece.
7. Supply: NPS 3/8 with shutoff valve.
8. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
9. Filter: One or more water filters with capacity sized for unit peak flow rate.
10. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
11. Support: Water-cooler carrier.
12. Water-Cooler Mounting Height: Standard Accessible in accordance with ICC A117.1
13. Capacities and Characteristics:
    a. Cooled Water: 8 gph
    b. Ambient-Air Temperature: 90 deg F.
    c. Inlet-Water Temperature: 80 deg F.
    d. Cooled-Water Temperature: 50 deg F.
    e. Electrical Characteristics:
       1) Volts: 120 V ac.
       2) Phase: Single.
       3) Hertz: 60 Hz.
       4) Full-Load Amperes: 6 A.

2.3 SUPPORTS

A. Water-Cooler Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. MIFAB, Inc.
   d. Wade Drains.
   e. Zurn Industries, LLC.
2. Standard: ASME A112.6.1M.

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 and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.

B. Set freestanding, pressure water coolers on floor.

C. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

D. Install mounting frames, affixed to building construction, and attach recessed, pressure water coolers, and bottle filling stations to mounting frames.

E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping"

F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

H. Seal joints between fixtures 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."

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 water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Install ball shutoff valve on water supply to each fixture. Install valve upstream from filter for water cooler. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping"

D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ELECTRICAL CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

C. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplates to be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

3.5 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust pressure water-cooler temperature settings.

3.6 CLEANING

A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224716

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

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. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. HVAC demolition.
8. Equipment installation requirements common to equipment sections.
9. Concrete bases.
10. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

D. Coordinate systems shutdown (water, fire protection, hot water heating, steam, chilled water, etc.) with the Project Manager/Project Representative. Activation and shut down of existing systems shall be conducted by personnel only.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, 95/5 lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

a. Perfection Corp.; Clearflow Dielectric Waterway.
b. Victaulic Co. of America.

2.5 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

a. Link-Seal.
b. Metraflex Co.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.6 SLEEVES

A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

2.7 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

D. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.8 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, 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. Piping shall not project beyond walls or steel lines nor shall it hang below slabs more than is absolutely necessary. Particular attention shall be paid to the required clearances.

F. Offset piping where required to avoid interference with other work, to provide greater headroom or clearance, or to conceal pipe more readily. Offsets shall be properly drained or trapped where necessary.

G. Provide swing joints and expansion bends wherever required to allow the piping to expand without undue stress to connections or equipment.

H. Exposed piping around fixtures or in other conspicuous places shall not show tool marks at fittings.

I. Isolate pipe from the building construction to prevent transmission of vibration to the structure and to eliminate noise.

J. Install piping such that any equipment connected to piping may be removed by disconnecting two (2) flanges or unions and removing only one or two pipe sections. All equipment shall have bolted or screwed flanges or unions at pipe connections.

K. Install fittings for changes in direction and branch connections. T-drill system for mechanically formed tee connections and couplings, and Victaulic hole cut piping system are not allowed.

L. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

M. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

N. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

O. Install piping to permit valve servicing.

P. Install piping at indicated slopes.

Q. Install piping free of sags and bends.

R. Install piping to allow application of insulation.

S. Eccentric reducing couplings shall be provided in all cases where air or water pockets would otherwise occur due to a reduction in pipe size.

T. Cap and plug all openings in pipes during construction with suitable metal plugs or cap to keep out dirt and rubbish until equipment is connected.

U. Install drains, consisting of a tee fitting, NPS 3/4 full port-ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

V. Select system components with pressure rating equal to or greater than system operating pressure.

W. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

    a. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    b. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
    c. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
    d. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
    e. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

2. Existing Piping: Use the following:

    a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
    b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and spring clips.
    c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.

d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

X. All pipes extending through the roof shall be flashed with six pound lead flashing extending 6 inches beyond the pipe, welded to a lead sleeve extended up around the vent pipes, and rolled over into the pipe.

Y. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

1. Sleeves placed in floors shall be flush with the ceiling and shall have planed, square ends, extending 2 inches above the finished floor, unless otherwise specified or detailed.
2. Where sleeves pass through reinforced concrete floors, they shall be properly set in position before the concrete is poured, and shall be maintained in position by the Contractor until the concrete is set.
3. Sleeves placed in concrete beams shall be flush with the side of the beam and large enough to accommodate the bare pipe only. All other sleeves shall be of adequate size to accommodate pipe insulation undiminished in size.
4. Pipes passing through below grade perimeter walls or slabs on grade shall have the space between the pipe and sleeve sealed watertight.
5. Pipes passing through above grade floor slabs and masonry walls shall have the space between the pipe or insulation and the sleeve packed with non-asbestos wicking or other suitable, approved, non-combustible material.
6. Pipes passing through walls of Mechanical Equipment Rooms shall be made gas-tight by caulking the space between the pipe and sleeve with a fiber saturated with an approved type of plastic material.
7. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

Z. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

AA. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

BB. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

CC. Verify final equipment locations for roughing-in.

DD. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Install dielectric fittings to connect piping materials of dissimilar metals.

B. Unions shall be used in preference to couplings where their use will facilitate dismantling the pipe for maintenance.

C. Pipe sizes indicated shall be carried full size to equipment served. Any change of size to match equipment connection shall be made within one foot of the equipment. At temperature control valves with sizes smaller than connected lines, reduction shall be made immediately adjacent to valves.

D. No Uni-flange pipe adapters will be allowed.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 CONCRETE BASES

E. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

F. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

G. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

H. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

END OF SECTION 230500

SECTION 230513 – COMMON MOTOR REQUIREMENTS FOR HVAC 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. This Section specifies the motors for HVAC equipment for buildings and structures.

2. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein for a complete operating system.

3. Applicable sections of Division 26 - Electrical

1.3 SUBMITTALS

A. Shop Drawings

1. Motors

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70, “National Electrical Code”

PART 2 - PRODUCTS

2.1 Motors

A. Motors 1/3 HP and smaller shall be 120 volts, single phase. Motors 1/2 HP and larger shall be 208, 230, or 460 volts, 3 phase. Motors shall be size and rating as indicated on the drawing. Motors that are an integral part of special equipment may vary from above to meet manufacturing standards.

B. Motors shall be NEMA Design B, Class B, 1.15 S.F. at 40 deg. C ambient or 1.00 S.F. at 65 deg. C ambient.

C. Motors 1-1/2 HP and larger shall be cast iron heavy duty premium efficiency inverted rated T Frame.

D. Motors shall be grounded with manufacturer's supplied grounding kit.

E. All motors shall be ball bearing type. Ball bearings shall be sealed on both sides, manufactured be Fafnir, FAG, or SKF.

F. Motors served by variable frequency drives shall have an AEGIS SGR bearing protection ring.

G. Motor enclosure shall be suitable for the service conditions.

H. Motors shall be Super-E manufactured by Baldor, EQP manufactured by Toshiba, or approved equal.

PART 3 - EXECUTION

Not Used

END OF SECTION 220513

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. Bimetallic-actuated thermometers
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test plugs.
6. Sight flow indicators.
7. Flow Sensors.

B. Related Sections:

1. Division 23 Section "Steam and Condensate Heating Piping" for steam and condensate meters.

1.3 SUBMITTALS

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

B. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

D. Warranties: Submit written special warranty as specified in this Section. Include contact information, description of coverage, and start date for each special warranty.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

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

1. Ashcroft Inc.
2. Trerice, H. O. Co., EI Series

3. Weiss Instruments, Inc.

B. Standard: ASME B40.200.

C. Case: Sealed types; stainless steel with 3-inch (76-mm) nominal diameter.

D. External adjustment.

E. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.

F. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.

G. Connector Size: 1/2 inch (13 mm), with ASME B1.1 screw threads.

H. Stem: 0.25 or 0.375 inch (6.4 or 9.4 mm) in diameter; stainless steel.

I. Window: Plain glass or plastic.

J. Ring: Stainless steel.

K. Element: Bimetal coil.

L. Pointer: Dark-colored metal.

M. Accuracy: Plus or minus 1 percent of scale range.

2.2 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

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

   a. AMETEK, Inc.; U.S. Gauge.
   b. Ashcroft Inc.
   c. Trerice, H. O. Co.
   d. Weiss Instruments, Inc.

2. Standard: ASME B40.100.
3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch (114-mm) nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of brass pipe with NPS 1/4 or NPS 1/2 (DN 8 or DN 15) pipe threads.

C. Valves: Brass ball, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads.

2.6 TEST PLUGS

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

1. Flow Design, Inc.
2. Peterson Equipment Co., Inc.
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 (DN 8) or NPS 1/2 (DN 15), ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F (3450 kPa at 93 deg C).

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.7 SIGHT FLOW INDICATORS

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

1. Dwyer Instruments, Inc.
2. Emerson Process Management; Brooks Instrument.
3. Ernst Co., John C., Inc.
4. Ernst Flow Industries.
5. Penberthy; A Brand of Tyco Valves & Controls - Prophetstown.

B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

D. Minimum Pressure Rating: 125 psig (860 kPa).

E. Minimum Temperature Rating: 200 deg F (93 deg C).

F. End Connections for NPS 2 (DN 50) and Smaller: Threaded.

G. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

2.8 HYDRONIC FLOW METERS – Standard Use

A. General

1. Certification: A certified calculation, for the maximum and minimum volume flow rates at working conditions of temperature, pressure, additive concentration, if present, and pressure shall be supplied.
2. Calibration: Calibration of the transmitter(s) shall be accomplished following NIST standards. A certification of conformance shall be submitted.
3. Where applicable, shall be able to measure and report bi-directional flow.
4. Range: selected and calibrated for operations between 0 and 110-125% of the maximum operating flow.
5. Accuracy including linearity, hysteresis and repeatability of the transmitter shall be better than 0.5% of the span.

6. Turndown: minimum of 15:1 or as specified for the expected operating range of the system.
7. Pressure limits: 150 psi minimum.
8. Temperature limits: 250 degrees minimum for heating and chilled water.
9. Meter enclosure classification: NEMA 4.
10. Junction Box Enclosure: NEMA 4.
11. Identification tag: rust-proof metal identification tag on a chain showing design flow rates, meter readings or differential pressure outputs at designed flow rates, metered fluid and line size.

B. NPS 12" and Smaller: Use Magnetic inductive flowmeter and amplifier for measuring the flow of conductive liquids, with flanged ends, suitable for in-line installation.

1. Meter Housing material: Carbon steel, welded.
2. Flanges: Carbon steel, ANSI B16.5 Class 150 raised face.
3. Pipe spool material: Type 316 stainless steel.
4. Electrode Material: Type 316 stainless steel.
5. Flowmeter liner:
   a. Heating/Domestic Hot water: Teflon.
   b. Chilled/Domestic Cold Water: Polyurethane.
   c. Steam Condensate: Teflon to 300 degF, Ceramic over 300 degF as suitable for expected conditions.

C. NSP larger than 12": Use Annular flow sensors.

1. Annular flow sensor: Type 316 stainless steel.

D. Amplifier: Microprocessor based with back-lit LCD display in enclosure suitable for remote wall mounting and with the following:

1. Digital and analog outputs.
2. Bi-directional flow sensing/totalization.
3. Automatic zero point stability.
4. Empty pipe detection.
5. 115VAC, 60HZ power supply.

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

1. Flow Meter - Standard Use
   a. Siemens
   b. Rosemount Division of Emerson Process Management
   c. Yokogawa AXF
   d. ABB
   e. Onicon
2. BTU Metering when specified:
   a. Yokogawa AXF

F. BTU (Energy) Calculator (when required)

1. Acceptable Manufacturer:

a. Onicon System-10

2. Communication requirements: Modbus TCP.
3. Additional output: Analog output 4-20mA signal for water flow in gallons per minute.
4. Temperature sensors: water supply and return sensor with stainless steel thermo wells.

G. Warranty

1. The supplier/manufacturer of the above specified equipment shall guarantee for twenty-four (24) months from equipment startup or thirty (30) months from date of shipment, whichever occurs first, that the equipment shall be free from defects in design, workmanship, or materials.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install remote-mounted pressure gages on panel.

I. Install valve and snubber in piping for each pressure gage for fluids (except steam).

J. Install rising stem gate valve and syphon fitting in piping for each pressure gage for steam.

K. Install a pressure gauge, with a pulsation damper and rising stem gate valve, in the condensate pump discharge piping.

L. Install a single pressure gauge for each chilled water pump, condenser water pump, and hot water heating pump. Each gauge shall be installed with two minimum ½" sensor lines complete with thread-o-lets or soc-o-lets, nipples, brass body ball valves and reducers. One sensor line shall be connected to the pump discharge piping and the other to the suction piping.

M. Install test plugs in piping tees.

N. Install flow indicators in piping systems in accessible positions for easy viewing.

O. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

P. Install flowmeter elements in accessible positions in piping systems.

Q. Install wafer-orifice flowmeter elements between pipe flanges.

R. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.

S. Install permanent indicators on walls or brackets in accessible and readable positions.

T. Install connection fittings in accessible locations for attachment to portable indicators.

U. Install thermometers in the following locations:

1. Inlet and outlet of each hydronic boiler.
2. Two inlets and two outlets of each chiller.
3. Inlet and outlet of each hydronic coil in air-handling units.
4. Two inlets and two outlets of each hydronic heat exchanger.
5. Inlet and outlet of each thermal-storage tank.
6. Outside-, return-, supply-, and mixed-air ducts.
7. Entering and leaving sides of each heating and cooling coil in the air handling units.
8. Hot deck and cold deck.

V. Install pressure gages in the following locations:

1. Inlet and discharge of each pressure-reducing valve.
2. Inlet and outlet of each chiller chilled-water and condenser-water connection.
3. Suction and discharge of each pump.

W. Install flow sensors in the following locations:
1. Chilled water and condenser water lines at chillers.
2. Hot water heating lines at convertors.
3. As indicated on the drawings.

X. Flow Meter Installation

1. The location of the components of the hydronic flow meter shall comply with the straight-run pipe upstream and downstream requirements recommended by the manufacturer(s).
2. The contractor shall comply with all erection and installation methods, techniques, sequence, and procedures requested by the manufacturer’s representative.
3. All meters and ancillary equipment shall be installed in such a manner as to provide access for routine inspections, maintenance, and a means of removal.
4. Structural steel supports and miscellaneous steel required for supporting and/or anchoring meters and piping furnished under this standard shall be provided and installed in accordance with Division 5.

5. Inline flow meters shall be installed with upstream and downstream shutoff valves at each end of the metering run.
6. If the flow meter size is smaller than line size (if approved by Mechanical Engineer), the reducers must be on the meter sides of the shutoff valves such that the shutoff valves are line size. Eccentric reducers shall not be used at meter locations on the hydronic systems.
7. For BTU (Energy) meters, install manufacturer supplied temperature sensors according the manufacturer recommendations.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers for hydronic application shall be the following:

1. Bimetallic-actuated thermometers.

B. Thermometers for air-duct application shall be the following:

1. Bimetallic-actuated thermometers.

C. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 deg F (Minus 20 to plus 50 deg C).

B. Scale Range for Condenser-Water Piping: 0 to 150 deg F (Minus 20 to plus 70 deg C).

C. Scale Range for Heating, Hot-Water Piping: 30 to 240 deg F (0 to plus 115 deg C).

D. Scale Range for Steam and Steam-Condensate Piping: 50 to 400 deg F (0 to 200 deg C).

E. Scale Range for Air Ducts: Minus 40 to plus 110 deg F (Minus 40 to plus 45 deg C).

3.6 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Chilled Water, Condenser Water, and Heating Hot Water Systems: 0 to twice the maximum service-fluid pressure expected.

B. Scale Range for LP Steam System: 0 to 30 psi.

C. Scale Range for MP Steam System: 0 to 60 psi.

D. Scale Range for HP Steam System: 0 to 125 psi.

E. Scale Range for Steam Condensate Return System: 0 to 50 psi.

3.7 FLOWMETER SCHEDULE

Meter Application	Provided by	Installed By	Wired By	Line Size in Inch	Flow Range in lbs/hr	Notes
Steam		Contractor				
Chilled Water	Contractor	Contractor	Contractor			
Domestic Water		Contractor				
Heating Hot Water	Contractor	Contractor	Contractor			
BTU Calculator	Contractor	Contractor	Contractor			to wire network card
Condensate		Contractor		N/A	N/A	

END OF SECTION 230519

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC 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. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Equipment supports.

B. Related Sections:

1. Division 23 Section "Vibration Controls for HVAC Piping and Equipment" for vibration isolation devices.
2. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to 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.

C. Provide all necessary hangers, rods, supports, concrete inserts, etc., and proper size angles, channels, or unistruts to support all piping in a manner allowing movement during expansion

and contraction. These supporting structures shall not be overstressed. All piping shall be supported with approved hangers designed for vertical adjustment and capable of carrying normal loads in all conditions of operation.

1.5 SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

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

1. Clevis.
2. Fee and Mason.
3. Anvil.
4. PHD Manufacturing, Inc.

B. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
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 washer made of hot dip galvanized or cadmium plated.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, 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.

2.3 THERMAL-HANGER SHIELD INSERTS

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

1. PHS Industries, Inc.
2. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa) ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.4 EQUIPMENT SUPPORTS

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

2.5 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. 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 from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

E. Install hangers and supports to allow controlled thermal 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.

F. Install lateral bracing with pipe hangers and supports to prevent swaying.

G. 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 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

H. Holes shall not be drilled or punched in beams and supporting members. Do not support piping from roof deck, other piping, ducts or equipment.

I. Hangers and supports shall also be provided at every change of direction and within 1' of any pipe fittings and valves.

J. Pipe hangers in fan rooms and in mechanical equipment rooms shall be provided with suitable vibration isolation units to eliminate noise transmission between the piping and the building structure.

K. Hanger components shall not be used for purposes other than for which they were designed.

L. Vertical runs of piping not subject to appreciable expansion shall be supported by approved wrought steel clamps or collars, securely clamped to the risers. Where required, spring supports and guides shall be provided.

M. Where negligible movement of pipe occurs at hanger locations, rod hangers may be used for suspended lines. For piping supported from below, bases, brackets or structural cross members may be used.

N. If the vertical angle of the hanger is greater than 4 degrees, a traveling device shall be provided for horizontal movement. For piping supported from below, rollers or roller carriages shall be used.

O. Where significant vertical movement of the pipe occurs at the hanger location, a resilient support shall be used. Spring Cushion Hangers may be used where vertical movement does not exceed 1/4".

P. On a riser subject to expansion, only one support of the rigid type shall be used.

Q. Riser clamps shall have a positive means of engagement between the pipe and the clamp.

R. Provide anchors, guides and restraints wherever necessary to support risers, to maintain pipe in position, and to properly distribute expansion.

S. Provide supplemental framing, angles, channels and beams where the anchor locations do not align with the building structure or where the intended loads exceed the structural framing maximum load carrying capacity.

T. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

U. 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.

V. 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. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) 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 (305 mm) long and 0.048 inch (1.22 mm) thick.
b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.

5. Pipes NPS 8 (DN 200) and Larger: Reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 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 (40 mm).

3.4 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use only circular cross-section rod hangers to connect to building structural attachments to pipe support devices. Rod couplings are not acceptable.

D. Use of "C" clamps and beam clamps of "C" pattern and any modifications thereof is prohibited.

E. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

F. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

G. Use carbon-steel pipe hangers and supports and attachments for general service applications.

H. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

I. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

J. Use padded hangers for piping that is subject to scratching.

K. Use thermal-hanger shield inserts for insulated piping and tubing.

L. 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 (DN 15 to DN 750).
2. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
3. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
4. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
5. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
6. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction might occur.
7. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
8. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
9. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

M. 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 (DN 24 to DN 600).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

N. 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 (150 mm) for heavy loads.
2. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

O. 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. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
4. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
5. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
6. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

P. 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.

Q. 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 (32 mm).
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.

R. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

S. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

END OF SECTION 230529

SECTION 230553 - IDENTIFICATION FOR HVAC 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. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

1.3 SUBMITTALS

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

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Valve numbering scheme.

D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Emed.
2. Marking Services Inc.
3. Seton Name Plate Co.

2.2 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
2. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
4. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Stainless-steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.3 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.

B. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

D. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

E. Fasteners: Stainless-steel rivets or self-tapping screws.

F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

G. Label Content: Include caution and warning information, plus emergency notification instructions.

2.4 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.5 DUCT LABELS

D. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

G. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

H. Fasteners: Stainless-steel rivets or self-tapping screws self-tapping screws.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.6 STENCILS

K. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches (32 mm) for ducts; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Aluminum.
2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

2.7 VALVE TAGS

L. Valve Tags: 1-1/2” diameter round with 3/16” top hole, stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.

1. Tag Material: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain.
3. No painted tags will be accepted.

M. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

N. Number sequences shall be from 1 thru 999 with top line legends as follow:

1.	Chilled Water Supply	CHWS
2.	Chilled Water Return	CHWR
3.	Condenser Water Supply	CS
4.	Condenser Water Return	CR
5.	High Pressure Steam	HPS
6.	Medium Pressure Steam	MPS
7.	Low Pressure Steam	LPS
8.	High Pressure Condensate	HPC
9.	Medium Pressure Condensate	MPC

10.	Low Pressure Condensate	LPC
11.	Pumped Condensate	PC
12.	Hot Water Heating Supply	HWHS
13.	Hot Water Heating Return	HWHR

2.8 WARNING TAGS

O. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

B. Install or permanently fasten labels on each major item of mechanical equipment.

1. Motor Driven Equipment
2. Starters and Disconnect Switches
3. Booster Coils
4. Terminal Boxes
5. Control Devices

C. Locate equipment labels where accessible and visible.

D. Label exhaust fans with fan number and room number or numbers served.

3.2 PIPE LABEL INSTALLATION

A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Legends:

1. Heating and Air Conditioning

a. Chilled Water Supply
b. Chilled Water Return
c. Condenser Water Supply
d. Condenser Water Return
e. Energy Recovery
f. High Pressure Condensate
g. Medium Pressure Condensate
h. Low Pressure Condensate
i. High Pressure Steam (80 PSI and above)
j. Medium Pressure Steam (16 PSI to 79 PSI)
k. Low Pressure Steam (15 PSI and below)
l. Heating Water Supply
m. Heating Water Return
n. Condensate Drain

2. Refrigeration

a. Refrigeration – Hot Gas
b. Refrigeration – Liquid
c. Refrigeration - Suction

3.3 DUCT LABEL INSTALLATION

A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch (25 mm) high is needed for proper identification because of distance from normal location of required identification.

C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

D. All valves and regulators (except those directly serving equipment) shall be provided with a brass tag securely wired in place on the valve stem below the packing gland nut. Tags shall clearly indicate the part of system, or room name and/or number controlled by the valve.

E. Furnish four (4) hot-press laminated typewritten copies of valve schedule, giving valve number controlled by the valve and location of valve. One copy will be mounted on a directory board in the main mechanical room, and one copy will be placed in each of the three mechanical brochures.

F. Prepare separate directories and drawings for the plumbing, heating, and air conditioning systems showing system layout as installed, and giving the number, location, and purpose of each component. The Contractor shall contact the A/E before starting the directory to insure proper tagging and listing.

G. Where it is necessary to operate more than one valve to control a section of piping, this fact and the numbers of the secondary valves shall be noted on the directory.

H. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

I. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape: 1-1/2 inches (38 mm), round.
2. Valve-Tag Color: Natural.
3. Letter Color: Black.

3.6 WARNING-TAG INSTALLATION

J. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

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. This Section includes testing, adjusting and balancing HVAC systems to provide design conditions as indicated by the associated drawings. This Section includes, but is not limited to the following:

1. Testing, adjusting and balancing of air and hydronic system fluid flow rates at the system and distribution system level to the indicated quantities according to tolerances specified herein. The following systems to be included:

   a. Air Systems:
      1) Constant-volume air systems.
      2) Variable-air-volume systems.
      3) Multizone systems.
      4) Induction-unit systems.

   b. Hydronic Piping Systems:
      1) Constant-flow hydronic systems.
      2) Variable-flow hydronic systems.
      3) Primary-secondary hydronic systems.

2. Measuring the electrical performance of HVAC equipment.
3. Verification that automatic control devices are functioning properly.
4. Measurement of sound levels as related to rotating mechanical equipment.
5. Vibration testing and analysis of all rotating equipment greater than or equal to 10 hp.
6. Measurement of duct leakage.
7. Reporting results of the activities and procedures specified in this Section.

B. The testing, adjusting and balancing of the air and hydronic systems shall be performed by an independent TAB contractor contracted directly by the Owner.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. Adjust: To regulate fluid flow rates and air patterns at the system or terminal level. At the system level an example would be reducing fan speed; at the terminal level an example would be changing a damper position.

C. Balance: To proportion air or water flows within the distribution system, including submains, branches and terminals with respect to design quantities.

D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

E. Independent: Not affiliated with or in employment of any Contractor.

F. NEBB: National Environmental Balancing Bureau.

G. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

H. Report Forms: Test data sheets for recording test data in logical order.

I. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

J. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

K. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

L. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

M. TAB: Testing, adjusting, and balancing.

N. TABB: Testing, Adjusting, and Balancing Bureau.

O. TAB Specialist: An entity engaged to perform TAB Work.

P. Testing, Adjusting and Balancing (TAB) Agent: The entity responsible for performing and reporting the TAB procedures.

Q. Terminal: A point where the controlled medium (fluid or energy) enters or leaves the distribution system.

1.4 ACTION SUBMITTALS

A. LEED Submittal:

1. Air-Balance Report for LEED Prerequisite IEQ 1: Documentation of work performed for ASHRAE 62.1, Section 7.2.2, "Air Balancing."
2. TAB Report for Prerequisite EA 2: Documentation of work performed for ASHRAE/IESNA 90.1, Section 6.7.2.3 – "System Balancing."

1.5 INFORMATIONAL SUBMITTALS

A. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

B. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed and prior to commencing work, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

C. Certified TAB reports.

D. Sample report forms, other than those standard forms from AABC, NEBB or TABB.

E. List of instruments and associated calibration reports to be used on project; at a minimum, this shall include the following information:

1. Instrument type and make (manufacturer and model number).
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.6 QUALITY ASSURANCE

A. Agent shall be an independent testing, adjusting and balancing professional services provider certified by AABC or NEBB and have a minimum of five years experience on projects of similar scope and complexity (unless waived by Infrastructure Planning and Facilities / Planning, Design and Construction). Approved TAB Agent shall be considered from the following:

1. Absolut Balancing Company – South Lyon, MI.
2. Aerodynamics Inspecting Company – Dearborne, MI.
3. Air Flow Testing, Inc. – Lincoln Park, MI.
4. Enviro-Aire/Total Balance, Inc. – St. Clair Shores, MI.
5. Ener-Tech Testing, Holly, MI.
6. Hi-Tech Test and Balance – Freeland, MI.
7. International Test and Balance – Southfield, MI.
8. Mechanical Testing Services, Inc. – Grandville, MI.
9. Quality Air Service – Kalamazoo, MI.

B. TAB Conference: Meet with Commissioning Services / Commissioning Authority / Planning, Design and Construction] on approval of the TAB strategies and procedures plan. This will be

carried out to develop a mutual understanding of the requirements for system configuration and scheduling. Require the participation of the TAB field supervisor, TAB technicians mechanical contractor, electrical contractor and controls contractor. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:

   a. The Contract Documents examination report.
   b. The TAB plan.
   c. Coordination and cooperation of trades and subcontractors.
   d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard TAB contractor's forms approved by Commissioning Authority.

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 – “Air Balancing.”

G. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 – “System Balancing.”

1.7 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with [PDC Project Representative / Owner] during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with [PDC Project Representative / Owner] during TAB operations to minimize conflicts with Owner's operations.

1.8 COORDINATION

A. Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

C. Systems shall be fully operational prior to system balancing. If a commissioning program is in place, all startup, testing and verification (STV) procedures shall be complete prior to initiation of TAB activities.

D. Test, adjust, and balance the air systems before hydronic systems.

E. Design Review: Provide one design review at final construction document review phase in order to point out monitoring and instrumentation requirements for proper system balance.

F. Construction Review: Provide onsite visit upon either completion of a commissioning program start-up phase or 100% controls completion and full system operability. Submit a "Systems Ready To TAB" checklist for completion by the appropriate installing contractors.

G. The mechanical contractor shall complete the installation and start all HVAC systems to ensure they are working properly, and shall perform all other items to assist the TAB contractor in performing the testing, adjusting, and balancing of the HVAC systems. Completion of a Systems Ready To TAB" checklist is required by the appropriate installing contractor prior to the beginning of TAB.

H. The mechanical contractor shall make any necessary changes to the impellers, motors, sheaves, belts, dampers as required by the TAB contractor at no additional cost to the owner. Adjustable pitch sheaves shall be replaced with fixed pitch sheaves after completing system balancing. Replaced sheaves and belts shall be disposed of by mechanical contractor.

I. The temperature control contractor shall complete the installation, and operate and test all control systems to ensure they are functioning properly as designed. The temperature control contractor shall assist the TAB contractor as needed to verify the operation and calibration of all temperature control systems. Completion of a Systems Ready To TAB" checklist is required by the appropriate installing contractor prior to the beginning of TAB.

J. Demonstration of mechanical equipment shall be performed by the mechanical contractor, or by factory trained manufacturer's representative as specified.

K. Provide instruments and technicians as required to verify readings under direction of [Commissioning Services / Commissioning Authority]

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TEST EQUIPMENT

A. Instrumentation shall be provided as necessary and appropriate to perform the work. The instrument shall be factory calibrated, and shall be used with the factory-determined application factors. When reasonable doubt of accuracy exists, recalibration of any or all instrumentation shall be performed as requested by the Commissioning Authority.

B. Proprietary test equipment shall be provided by the manufacturer of the equipment. The manufacturer's representative shall provide the equipment, demonstrate use of the equipment, and assist the TAB contractor or Commissioning Authority in the testing process.

C. Make instruments available to facilitate TAB data verification during testing.

D. Test pressure taps, pressure gages, thermometers and wells shall be installed by the mechanical contractor as indicated or specified.

E. Flow measuring stations, flow-limiting devices and balancing valves shall be installed by the mechanical contractor as indicated or specified.

F. All manual volume dampers located above ceilings shall be outfitted with a ribbon of consistent color and type and installed by mechanical contractor for facilitation of locating dampers during TAB.

G. Any additional required pressure and flow taps, and thermometer wells in locations where permanent installation devices are not indicated or specified shall be provided by the mechanical contractor.

3.2 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in

AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that mechanical contractor has replaced startup screens with permanent screens having indicated perforations.

L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping; mechanical contractor to assist as necessary.

O. Temperature controls contractor shall aid in the examination of operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures to [Commissioning Services / PDC / the Commissioning Authority]. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Procedure shall include a project specific approach which integrates general methods as set forth by the AABC as per National Standards for Total System Balance and/or NEBB as per Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

C. Verify completion of the “Systems Ready to TAB” report. It shall include the following items:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.

7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

1. Comply with requirements in ASHRAE 62.1, Section 7.2.2, "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, the mechanical contractor shall install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Note in report, as applicable, all final settings of variable frequency drives for specified design conditions, the associated static pressures/differential pressures observed and the conditions under which the system was tested, adjusted and balanced.

E. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity as applicable. This plan shall be discussed and agreed upon with [Commissioning Services / PDC / the Commissioning Authority]. The final plan for diversity shall be reflected in the report by which it pertains.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

    a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    b. Measure static pressure directly at the fan outlet or through the flexible connection.
    c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

    a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.

5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Fan speed shall not be increased in access of manufacturer's maximum recommended RPM. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

    a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal

units equals the indicated airflow of the fan. Discuss plan to simulate diversity with [CxS/CxA and PDC] and document agreed upon procedure prior to beginning work.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Coordinate with temperature control contractor to calibrate any airflow measuring devices installed in the air-handling systems. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

6. Re-measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

    a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

7. Upon completion of the above scope of work, place all variable air terminal units to full cooling mode, measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit. At this time, coordinate with the temperature controls contractor to verify that all variable air terminal unit dampers, namely the critical terminal unit damper, are near but less than 100% open. Adjust system to achieve this condition therefore optimizing energy consumption and validating design airflow conditions during requirements for full load.
8. Record final fan-performance data.

C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Balance variable-air-volume systems the same as described for constant-volume air systems.
2. Set terminal units and supply fan at full-airflow condition.

3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
4. Readjust fan airflow for final maximum readings.
5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.

8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

    a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
3. Set terminal units at full-airflow condition.
4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Adjust terminal units for minimum airflow.
6. Measure static pressure at the sensor.
7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.8 PROCEDURES FOR MULTIZONE SYSTEMS

A. Set unit at maximum airflow through the cooling coil.

B. The outside air (OA) and return air (RA) dampers should be postured prior to balancing. If the air handling unit (AHU) has a fixed OA damper it should be set to the appropriate position as a starting point.

C. The OA damper for air handling units using mechanical cooling should be adjusted to a position estimated to equal the design minimum airflow.

D. The OA damper for units using only ventilation air for cooling should be positioned 100% open, with the RA dampers closed.

E. If the cooling coil is sized for the full fan airflow, put all zones into full cooling by setting each zone thermostat to the lowest point.

F. Measure airflow of each zone and total the results.

G. Make any required fan speed adjustments to obtain the design total airflow.

H. Adjust each zone's balancing damper to achieve indicated airflow within the zone. This type of system cannot be properly balanced without manual zone balancing dampers. If the dampers are not provided, the TAB Supervisor should notify [CxS / PDC / CxA] to have them installed.

I. Once each zone has the correct airflow, the outlets can be balanced by using the previously described methods.

J. At the conclusion of all inlet and outlet balancing, re-adjust the AHU minimum OA ventilation rate, if required.

K. Record final unit data, prepare the report forms, and submit as required.

3.9 PROCEDURES FOR INDUCTION-UNIT SYSTEMS

A. Balance primary-air risers by measuring static pressure at the nozzles of the top and bottom units of each riser to determine which risers must be throttled. Adjust risers to indicated airflow within specified tolerances.

B. Adjust each induction unit.

3.10 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check liquid level in expansion tank.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.

4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.11 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:

1. Verify impeller size by operating the pump at maximum RPM with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

    a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Architect and comply with requirements in Division 23 Section "Hydronic Pumps."

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.

    a. Monitor motor performance during procedures and do not operate motors in overload conditions.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 10 percent of design.

B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

D. Set calibrated balancing valves, if installed, at calculated presettings.

E. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
3. Record settings and mark balancing devices.

H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

J. Check settings and operation of each safety valve. Record settings.

3.12 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems. Once TAB is complete per the specified procedures above, note the final differential pressure output which indicates the design flow condition. Fully open the metering valve located at the pump discharge. Decrease speed at variable frequency drive until differential pressure matches that originally attained at design conditions.

3.13 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first and then balance the secondary circuits.

3.14 PROCEDURES FOR STEAM SYSTEMS

A. Measure and record upstream and downstream pressure of each piece of equipment.

B. Measure and record upstream and downstream steam pressure of pressure-reducing valves.

C. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

D. Check settings and operation of each safety valve. Record settings.

E. Verify the operation of each steam trap.

3.15 PROCEDURES FOR HEAT EXCHANGERS

A. Measure water flow through all circuits.

B. Adjust water flow to within specified tolerances.

C. Measure inlet and outlet water temperatures.

D. Measure inlet steam pressure.

E. Check settings and operation of safety and relief valves. Record settings.

3.16 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.17 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
6. Capacity: Calculate in tons of cooling.
7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.18 PROCEDURES FOR COOLING TOWERS

A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:

1. Measure condenser-water flow to each cell of the cooling tower.
2. Measure entering- and leaving-water temperatures.
3. Measure wet- and dry-bulb temperatures of entering air.
4. Measure wet- and dry-bulb temperatures of leaving air.
5. Measure condenser-water flow rate recirculating through the cooling tower.
6. Measure cooling-tower spray pump discharge pressure.
7. Adjust water level and feed rate of makeup water system.
8. Measure flow through bypass.

3.19 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.20 PROCEDURES FOR BOILERS

A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

B. Steam Boilers: Measure and record entering-water temperature and flow and leaving-steam pressure, temperature, and flow.

3.21 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.

2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Air pressure drop.
4. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.22 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the condition of dampers.
7. Verify appropriate location of balancing devices such that accurate measurements can be attained and final TAB can be completed.
8. Check the operation of the drain pan and condensate-drain trap.
9. Check bearings and other lubricated parts for proper lubrication.
10. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Dampers functioning properly.

6. Verify correct operation of existing measurement/balancing devices (eg, dampers, gauges, valves, etc.)
7. Bearings and other parts are properly lubricated.
8. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.23 VIBRATION ANALYSIS [ACCEPTANCE TESTING]

A. Measurements shall be taken on the bearing caps of the machine in the vertical, horizontal and axial directions or at the equipment mounting feet if bearings are concealed.

B. For all equipment 10 horsepower and above, the contractor shall provide printed FFT signatures of vibration amplitude versus frequency. The frequency range should be broad enough to include all frequencies characteristic of the equipment, and the frequency filter should not be greater than 10% of band width. At least one signature should be taken on each bearing cap in the radial axis with the highest velocity amplitude. Signatures are to include velocity (inches per second peak to peak) and a bearing condition analysis (acceleration in g's, inches per second squared, under a high band pass filter).

C. If the self-excited vibration velocity exceeds the allowable maximum, the source of the vibration shall be determined by a qualified vibration consultant. After the source of vibration is determined, corrections shall be made by the Contractor to reduce the self-excited vibration velocity to a level below the allowable maximum.

D. All vibration measurements and analysis shall be made with instruments traceable to the National Bureau of Standards Criteria such as International Research and Development Corporation (IRD) Microprocessor Analyzer Balancer – Model 880, or approved equal.

E. Factory certification of vibration velocity of totally assembled unit will be acceptable in lieu of field measurements for packaged air conditioners, including through wall or window air conditioners, and equipment employing fractional horsepower electric motors.

F. The mechanical contractor shall complete the installation and start of all mechanical systems to ensure they are working properly prior to scheduling the vibration analysis provider.

G. The mechanical contractor shall be responsible for any necessary changes to fans, fan housings, pumps, pump bases, motors, pipe/duct hanger assemblies as required by the vibration analysis provider at no additional cost to the owner.

H. Approved vibration testing and analysis provider shall be considered from the following:

1. Reliability Concepts, LLC – Coldwater, MI
2. PMSI – Kalamazoo, MI
3. Zeluff Associates – Kalamazoo, MI

3.24 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

B. Adjust pumps to within 10% of design GPM at design temperature. Excess pump pressure shall be eliminated by trimming the pump impeller by the Mechanical Contractor (this shall be carried out by the mechanical contractor).

C. General rotating equipment maximum allowable self-excited, total unfiltered vibration velocity shall not exceed 0.15 inches per second peak to peak. Individual velocity amplitude peaks of filtered readings are not to exceed 0.10 inches per second peak to peak.

D. Direct drive pump maximum allowable self-excited, total unfiltered vibration velocity shall not exceed 0.10 inches per second peak to peak. Individual velocity amplitude peaks of filtered readings are not to exceed 0.05 inches per second peak to peak.

3.25 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices. Also, include system schematic diagrams consistently referenced with all equipment and test points, and preliminary test data.

B. Status Reports: Prepare [weekly] monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.26 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Upon verification and approval of draft reports, submit 1 complete set of final reports certified by the TAB contractor for the Architect and 2 sets for inclusion in operating and maintenance manuals. Bind report forms complete with schematic diagrams and data in reinforced, vinyl, 3-ring binder manuals.
2. As-built system schematic diagrams consistently referenced with all equipment and test points, and final test data.
3. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
4. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

a. Settings for outdoor-, return-, and exhaust-air dampers.
b. Conditions of filters.
c. Cooling coil, wet- and dry-bulb conditions.
d. Face and bypass damper settings at coils.
e. Fan drive settings including settings and percentage of maximum pitch diameter.
f. Inlet vane settings for variable-air-volume systems.
g. Settings for supply-air, static-pressure controller.
h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Unit arrangement and class.
g. Discharge arrangement.
h. Sheave make, size in inches (mm), and bore.
i. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
j. Number, make, and size of belts.
k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches (mm), and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

3. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm (L/s).
b. Total system static pressure in inches wg (Pa).

c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).
e. Filter static-pressure differential in inches wg (Pa).
f. Preheat-coil static-pressure differential in inches wg (Pa).
g. Cooling-coil static-pressure differential in inches wg (Pa).
h. Heating-coil static-pressure differential in inches wg (Pa).
i. Outdoor airflow in cfm (L/s); this should be tested in both maximum and minimum conditions.
j. Return airflow in cfm (L/s); this should be tested in both maximum and minimum outdoor air conditions.
k. Relief airflow in cfm (L/s); this should be tested in both maximum and minimum outdoor air conditions.
l. Outdoor-air damper position.
m. Return-air damper position.
n. Vortex damper position.
o. VFD frequency setting (Hz) and final static pressure set point; clearly indicate system configuration during testing.
p. Calibration of airflow stations (any that exist on the air-handling unit).

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch (mm) o.c.
f. Make and model number.
g. Face area in sq. ft. (sq. m).
h. Tube size in NPS (DN).
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm (L/s).
b. Average face velocity in fpm (m/s).
c. Air pressure drop in inches wg (Pa).
d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
h. Water flow rate in gpm (L/s).
i. Water pressure differential in feet of head or psig (kPa).
j. Entering-water temperature in deg F (deg C).
k. Leaving-water temperature in deg F (deg C).
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig (kPa).

n. Refrigerant suction temperature in deg F (deg C).
o. Inlet steam pressure in psig (kPa).

G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btu/h (kW).
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and rpm.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches (mm), and bore.
n. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

2. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm (L/s).
b. Entering-air temperature in deg F (deg C).
c. Leaving-air temperature in deg F (deg C).
d. Air temperature differential in deg F (deg C).
e. Entering-air static pressure in inches wg (Pa).
f. Leaving-air static pressure in inches wg (Pa).
g. Air static-pressure differential in inches wg (Pa).
h. Low-fire fuel input in Btu/h (kW).
i. High-fire fuel input in Btu/h (kW).
j. Manifold pressure in psig (kPa).
k. High-temperature-limit setting in deg F (deg C).
l. Operating set point in Btu/h (kW).
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btu/h (kW).

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.

e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches (mm), and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches (mm), and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm (L/s).
b. Total system static pressure in inches wg (Pa).
c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).
e. Suction static pressure in inches wg (Pa).
f. VFD frequency setting (Hz) and associated 2/3 static pressure reading in inches wg corresponding to design airflow.

I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F (deg C).
d. Duct static pressure in inches wg (Pa).
e. Duct size in inches (mm).
f. Duct area in sq. ft. (sq. m).
g. Indicated air flow rate in cfm (L/s).
h. Indicated velocity in fpm (m/s).
i. Actual air flow rate in cfm (L/s).
j. Actual average velocity in fpm (m/s).
k. Barometric pressure in psig (Pa).
l. Percent of design achieved.

J. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.

c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft. (sq. m).

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm (L/s).
b. Air velocity in fpm (m/s).
c. Preliminary air flow rate as needed in cfm (L/s).
d. Preliminary velocity as needed in fpm (m/s).
e. Final air flow rate in cfm (L/s).
f. Final velocity in fpm (m/s).
g. Space temperature in deg F (deg C).
h. Indicate final flow coefficient.
i. Percent of design achieved.

K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm (L/s).
b. Entering-water temperature in deg F (deg C).
c. Leaving-water temperature in deg F (deg C).
d. Water pressure drop in feet of head or psig (kPa).
e. Entering-air temperature in deg F (deg C).
f. Leaving-air temperature in deg F (deg C).
g. Terminal flow measuring device (circuit setter, flow meter, etc.) make/model/size.
h. Terminal flow measuring device water pressure drop (as required to determine terminal unit flow).
i. Final setting of flow measuring device valve handle indicator.
j. Percent of design achieved.

L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm (L/s).
g. Water pressure differential in feet of head or psig (kPa).
h. Required net positive suction head in feet of head or psig (kPa).
i. Pump rpm.
j. Impeller diameter in inches (mm).
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig (kPa).
b. Pump shutoff pressure in feet of head or psig (kPa).
c. Actual impeller size in inches (mm).
d. Full-open flow rate in gpm (L/s).
e. Full-open pressure in feet of head or psig (kPa).
f. Final discharge pressure in feet of head or psig (kPa).
g. Final suction pressure in feet of head or psig (kPa).
h. Final total pressure in feet of head or psig (kPa).
i. Final water flow rate in gpm (L/s).
j. Voltage at each connection.
k. Amperage for each phase.
l. Final design flow rate using discharge metering valve (ie triple duty valve, multi-purpose valve) at maximum VFD frequency (Hz); indicate differential pressure in feet of head at design conditions.
m. Final VFD frequency setting (Hz) and associated 2/3 differential pressure (psig) measurement/set point required to achieve design conditions; clearly indicate system configuration during testing.
n. Calibration of hydronic flow station(s).

M. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.27 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:

a. Measure airflow of at least 10 percent of air outlets.
b. Measure water flow of at least 5 percent of terminals.
c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
d. Verify that balancing devices are marked with final balance position.
e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.28 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

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. Insulation Materials:

a. Calcium silicate.
b. Cellular glass.
c. Flexible elastomeric.
d. Mineral fiber.
e. Phenolic.
f. Polyolefin.

2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Lagging adhesives.
7. Sealants.
8. Factory-applied jackets.
9. Field-applied fabric-reinforcing mesh.
10. Field-applied cloths.
11. Field-applied jackets.
12. Tapes.
13. Securements.
14. Corner angles.

B. Related Sections:

1. Division 22 Section "Plumbing Insulation."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. LEED Submittal:

1. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.

C. Qualification Data: For qualified Installer.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork 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.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Calcium Silicate:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Industrial Insulation Group (The); Thermo-12 Gold.

2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Pittsburgh Corning Corporation; Foamglas Super K.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
6. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
7. Factory fabricated shapes according to ASTM C 450 and ASTM C 585.

H. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.

I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Duct Wrap.
d. Owens Corning; All-Service Duct Wrap.

J. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied ASJ jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; Commercial Board.
b. Johns Manville; 800 Series Spin-Glas.
c. Knauf Insulation; Insulation Board.
d. Owens Corning; Fiberglas 700 Series.

A. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; 1000 Series Spin-Glas.
b. Owens Corning; High Temperature Industrial Board Insulations.

B. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; Micro-Lok.
b. Knauf Insulation; 1000 Pipe Insulation.
c. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

3. Type II, 1200 deg F (649 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, without factory-applied jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

C. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semi-rigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. CertainTeed Corp.; CrimpWrap.
   b. Johns Manville; MicroFlex.
   c. Knauf Insulation; Pipe and Tank Insulation.
   d. Owens Corning; Fiberglas Pipe and Tank Insulation.

D. Phenolic:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Kingspan Corp.; Koolphen K.

2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
4. Factory fabricated shapes according to ASTM C 450 and ASTM C 585.

E. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Armacell LLC; Tubolit.
   b. Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.

2.2 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F (927 deg C). Comply with ASTM C 656, Type II, Grade 6. tested and certified to provide a [**1**] [**2**]-hour fire rating by a NRTL acceptable to authority having jurisdiction.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Johns Manville; Super Firetemp M.

B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a [**1**] [**2**]-hour fire rating by a NRTL acceptable to authority having jurisdiction.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; FlameChek.
b. Johns Manville; Firetemp Wrap.

2.3 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.4 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F (10 to 427 deg C).

1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA Inc.; Aeroseal.
b. Armacell LCC; 520 Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Chemical Company (The); 739, Dow Silicone.
b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

2.6 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

2.7 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
4. Color: White or gray.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
4. Color: Aluminum.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
4. Color: White.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, 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. Products: Subject to compliance with requirements, provide one of the following:

   a. Johns Manville; Zeston.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. 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.

5. Factory-fabricated tank heads and tank side panels.

D. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Products, Division of ITW; Metal Jacketing Systems.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.

   a. Factory cut and rolled to size.
   b. Finish and thickness are indicated in field-applied jacket schedules.
   c. Moisture Barrier for Indoor Applications: 1-mil thick, heat-bonded polyethylene and kraft paper.
   d. Moisture Barrier for Outdoor Applications: 3-mil thick, heat-bonded polyethylene and kraft paper.
   e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

a. Factory cut and rolled to size.
b. Material, finish, and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil thick, heat-bonded polyethylene and kraft paper.
e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricated fitting covers only if factory-fabricated fitting covers are not available.

E. Underground Direct-Buried Jacket: 125-mil thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Pittsburgh Corning Corporation; Pittwrap.
b. Polyguard; Insulrap No Torch 125.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: 3 inches (75 mm).
2. Thickness: 11.5 mils (0.29 mm).
3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.

6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Width: 3 inches (75 mm).
2. Thickness: 6.5 mils (0.16 mm).
3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Width: 2 inches (50 mm).
2. Thickness: 6 mils (0.15 mm).
3. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Width: 2 inches (50 mm).
2. Thickness: 3.7 mils (0.093 mm).
3. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.10 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, wide with wing or closed seal.
2. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing or closed seal.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length

to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

    a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
    b. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
    c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

    a. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
    b. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
    c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

    a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
    b. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
    c. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

    a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

2.11 CORNER ANGLES

A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

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 equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and 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, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom 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 application and finishing.

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 at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install 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.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). 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 2 inches (50 mm) o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

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 (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar 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. Manholes.
5. Handholes.
6. Cleanouts.

Q. Continue insulation vapor barrier through penetrations except where prohibited by code. It is essential that the integrity of the vapor barrier is maintained. Fasteners or other securing devices that may unintentionally penetrate or otherwise damage the vapor barrier are prohibited. Where fasteners must penetrate the vapor barrier, the vapor barrier shall be repaired with a patch or tape of the same materials.

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 (50 mm) 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 (50 mm).
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. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).

1. Comply with requirements in Division 07 Section "Penetration Firestopping"irestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
2. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) o.c. in both directions.
    d. Do not overcompress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.

f. Impale insulation over anchor pins and attach speed washers.
g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches (75 mm).
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch (150-mm) centers, starting at corners. Install 3/8-inch- (10-mm-) diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from aluminum, at least 0.040 inch (1.0 mm) thick.

3.6 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.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be 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 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 used for adjacent pipe. Overlap adjoining pipe insulation by not less than two 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 two 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 and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
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.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. 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 shall conform 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 adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two 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 (50 mm) 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.

E. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

F. All sectional pipe covering shall be neatly and tightly applied with unbroken lengths and with the ends of the sections firmly butted together. Longitudinal joints shall be on the least conspicuous side of the pipe and slightly staggered. Fiberglass cloth or other coating shall be lapped over all joints and well pasted or cemented down in a neat and inconspicuous manner.

G. Extend insulation through all sleeves in order to produce a continuous application.

H. Secure calcium silicate pipe insulation with stainless steel bands.

I. Insulation for piping shall be continuous through hangers and supports.

J. Provide insulation inserts and insulation protection shields at hanger or support locations.

K. Where a vapor barrier is not required on insulated piping in size less than 4" inch, hangers and supports may be attached directly to piping with insulation completely covering hanger or support and jacket sealed at support rod penetration. Do not use ring hangers on cold piping.

L. Where riser clamps are required to be attached directly to piping requiring vapor barrier, extend insulation and vapor barrier jacketing/coating around riser clamps.

M. Insulate all drip pockets, end caps, etc. on all lines, except where otherwise noted. Thickness of insulation, vapor barriers, jackets and finishes shall match adjacent piping.

3.7 CALCIUM SILICATE INSULATION INSTALLATION

A. Insulation Installation on Boiler Breechings and Ducts:

1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation material.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.
3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch (25 mm).

Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch (25 mm). Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

C. Insulation Installation on Pipe Flanges:

1. Install preformed 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 block insulation of same material and thickness as pipe insulation.
4. Finish flange insulation same as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

3.8 CELLULAR-GLASS INSULATION INSTALLATION

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 factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but 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 preformed 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 pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as 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 sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed 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.

3.9 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install 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 sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. 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.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.10 MINERAL-FIBER INSULATION INSTALLATION

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 factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but 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 preformed 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 mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed 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 preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered 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.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).

5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.

6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.11 PHENOLIC INSULATION INSTALLATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with 0.062-inch (1.6-mm) wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.

B. 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 factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets with vapor retarders on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:

1. Install preformed 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 block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

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

E. Insulation Installation on Valves and Pipe Specialties:

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

3.12 POLYOLEFIN INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install 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 polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet 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.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.13 FIELD-APPLIED JACKET INSTALLATION

A. 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 (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. 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.

C. Where metal jackets are indicated, install with 2-inch (50-mm) 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 (300 mm) o.c. and at end joints.

3.14 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

3.15 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.16 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in nonconditioned space.

4. Indoor, exposed return located in nonconditioned space.
5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
7. Indoor, concealed oven and warewash exhaust.
8. Indoor, exposed oven and warewash exhaust.
9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
11. Outdoor, concealed supply and return.
12. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.17 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

B. Concealed, return-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

C. Concealed, outdoor-air duct insulation shall be one of the following:

1. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (48-kg/cu. m) nominal density.

D. Concealed, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be one of the following:

1. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (48-kg/cu. m) nominal density.

E. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

F. Exposed, supply-air duct insulation shall be one of] the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

G. Exposed in unconditioned spaces, return-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

H. Exposed, outdoor-air duct insulation shall be one of the following:

1. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

I. Exposed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

J. Exposed, supply-air plenum insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

K. Exposed in unconditioned spaces, return-air plenum insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

L. Exposed, outdoor-air plenum insulation shall be one of the following:

1. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

3.18 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

B. Concealed, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 3 inches (75 mm) and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 3 inches (75 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

C. Concealed, return-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 3 inches (75 mm) and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 3 inches (75 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

D. Concealed, outdoor-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches (50 mm) and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

E. Concealed, supply-air plenum insulation shall be one of the following:

1. Mineral-Fiber Board: 3 inches (75 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

F. Concealed, return-air plenum insulation shall be one of the following:

1. Mineral-Fiber Board: 3 inches (75 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

G. Exposed, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 3 inches (75 mm) and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 3 inches (75 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

H. Exposed, return-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 3 inches (75 mm) and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 3 inches (75 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

I. Exposed, supply-air plenum insulation shall be one of the following:

1. Mineral-Fiber Board: 3 inches (75 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

J. Exposed, return-air plenum insulation shall be one of the following:

1. Mineral-Fiber Board: 3 inches (75 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

3.19 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

1. Provide insulated equipment containing fluids below ambient temperature with vapor retarding jackets.
2. Provide insulated equipment containing fluids above ambient temperature with jackets.

B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

C. Steam Pressure Reducing Station: Insulate for a distance of minimum 5 pipe diameters upstream and downstream of the steam pressure reducing station with calcium silicate insulation. Insulation thickness shall be not less than 4 inches.

D. Steam Humidifiers: Insulate with a 1-1/2 inch thick calcium-silicate block insulation.

E. Pressure-Powered Pumps: Insulate with removable insulation covers. The cover shall enclose pump surfaces and flanges, and shall be fabricated with galvanized box frame and 1-1/2" thick calcium silicate.

F. Hot Water Pumps: Insulate with removable insulation covers. The cover shall enclose pump surfaces and flanges, and shall be fabricated with galvanized box frame and 1-1/2" thick calcium silicate.

G. Absorption Chillers: Insulate generator section including heads with a 1-1/2 inch thick calcium-silicate block insulation. Insulate evaporator and condenser sections with foam insulation not less than 3/4 inch thick. Refer to manufacturer’s recommendations.

H. Electric Chillers: Insulate cold surfaces on chillers, including, but not limited to, evaporator bundles, suction piping, compressor inlets, tube sheets, water boxes, and nozzles with one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Polyolefin: 1 inch thick.

I. Heat-exchanger (water-to-water for cooling service) insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Polyolefin: 1 inch thick.

J. Heat-exchanger (water-to-water for heating service) insulation shall be one of the following:

1. Calcium Silicate: 3 inches thick.

2. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
3. Mineral-Fiber Pipe and Tank: 2 inches thick.

K. Steam-to-hot-water converter insulation shall be one of the following:

1. Calcium Silicate: 3 inches thick.
2. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
3. Mineral-Fiber Pipe and Tank: 2 inches thick.

L. Chilled-water air-separator, expansion/compression tank insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Polyolefin: 1 inch thick.

M. Heating-hot-water air-separator, expansion/compression tank insulation shall be one of the following:

1. Calcium Silicate: 2 inches thick.
2. Mineral-Fiber Board: 2 inch thick and 3-lb/cu. ft. nominal density.
3. Mineral-Fiber Pipe and Tank: 2 inch thick.

N. Thermal storage tank (brine, water, ice) insulation shall be one of the following:

1. Cellular Glass: 4 inches thick.
2. Phenolic: 3 inches thick.
3. Mineral-Fiber Board: 3 inches thick.
4. Mineral-Fiber Pipe and Tank. 3 inches thick.

O. Steam flash-tank, flash-separator, and blow-off-tank insulation shall be one of the following:

1. Calcium Silicate: 3 inches thick.
2. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
3. Mineral-Fiber Pipe and Tank: 2 inches thick.

3.20 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. Hot water heating piping inside radiation, convectors, or cabinet heater enclosures.
2. Steam traps.
3. Control valves except for chilled water.
4. Condenser water piping.
5. Cooling tower water piping.
6. Fire protection piping.
7. Underground piping.

8. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

C. Insulate cold pipes conveying fluids below ambient temperature with vapor retardant jackets with self sealing laps.

1. Chilled Water.
2. Condensate Drain.
3. Refrigerant Suction.

D. PVC jackets shall be installed on insulated piping in conjunction with fitting covers to provide a total sealed system as required by USDA and FDA for applications in food and pharmaceutical facilities.

3.21 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
c. Polyolefin: 1 inch thick.

B. Chilled Water and Brine, 40 Deg F (5 Deg C) and below:

1. NPS 6 and Smaller: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches (38 mm) thick.
b. Mineral-Fiber, Preformed Pipe, Type I: 1 inch (25 mm) thick.
c. Phenolic: 1 inch (25 mm) thick.

2. NPS 8 and Larger: Insulation shall be one of the following:

a. Cellular Glass: 3 inches thick.
b. Mineral-Fiber, Preformed Pipe, Type I: 3 inches thick.
c. Phenolic: 3 inches thick.

C. Chilled Water and Brine, above 40 Deg F (5 Deg C):

1. All sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch (25 mm) thick.
b. Mineral-Fiber, Preformed Pipe, Type I: 1 inch (25 mm) thick.
c. Polyolefin: 1 inch (25 mm) thick.

D. Heating-Hot-Water Supply and Return, 200 Deg F (93 Deg C) and below:

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.

E. Steam and Steam Condensate and Pumped Condensate, Low Pressure:

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe, Type I or II: 2-1/2 inches thick.

2. NPS 1-1/2 and Larger: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe, Type I or II: 3 inches (75 mm) thick.

F. Steam and Steam Condensate, Medium/High Pressure:

1. NPS 3/4 and Smaller: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe, Type I or II: 3 inches thick.

2. NPS 1 thru NPS 1-1/4: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe, Type I or II: 4 inches thick.

3. NPS 1-1/2 and Larger: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe, Type I or II: 4.5 inches thick.

G. Refrigerant Suction and Hot-Gas Piping:

1. NPS 6 and smaller: Insulation shall be one of the following:

a. Cellular Glass: 1 inches thick.
b. Flexible Elastomeric: 1 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
d. Phenolic: 1 inch thick.
e. Polyolefin: 1 inch thick.

2. For NPS 8 and larger: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1-1/2 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.
d. Phenolic: 1-1/2 inch thick.

H. Heat-Recovery Piping:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

I. Hot Service Drains:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Calcium Silicate: 1-1/2 inches (38 mm) thick.
b. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch (25 mm) thick.

J. Hot Service Vents:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Calcium Silicate: 1-1/2 inches (38 mm) thick.
b. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch (25 mm) thick.

3.22 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Chilled Water and Brine:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 3 inches (75 mm) thick.
b. Flexible Elastomeric: 3 inches (75 mm) thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 3 inches (75 mm) thick.
d. Phenolic: 2 inches (50 mm) thick.
e. Polyolefin: 3 inches (75 mm) thick.

B. Heating-Hot-Water Supply and Return, 200 Deg F (93 Deg C) and below:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 3 inches thick.

C. Steam and Steam Condensate, 350 Deg F (177 Deg C) and below:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Calcium Silicate: 4 inches (100 mm) thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I or II: 4 inches thick.

D. Steam and Steam Condensate, above 350 Deg F (177 Deg C):

1. All Pipe Sizes: Insulation shall be one of the following:

a. Calcium Silicate: 5.5 inches (125 mm) thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I or II: 5.5 inches (100 mm) thick.

E. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be one of the following:

    a. Cellular Glass: 2.5 inches (50 mm) thick.
    b. Flexible Elastomeric: 2.5 inches (50 mm) thick.
    c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2.5 inches (50 mm) thick.
    d. Phenolic: 2.5 inches (50 mm) thick.
    e. Polyolefin: 2.5 inches (50 mm) thick.

F. Heat-Recovery Piping:

1. All Pipe Sizes: Insulation shall be one of the following:

    a. Flexible Elastomeric: 2 inches (50 mm) thick.
    b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50 mm) thick.
    c. Polyolefin: 2 inches (50 mm) thick.

G. Hot Service Drains:

1. All Pipe Sizes: Insulation shall be one of the following:

    a. Calcium Silicate: 1-1/2 inches (38 mm) thick.
    b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

H. Hot Service Vents:

1. All Pipe Sizes: Insulation shall be one of the following:

    a. Calcium Silicate: 1-1/2 inches (38 mm) thick.
    b. Mineral-Fiber, Preformed Pipe Insulation, Type II: 1 inch (25 mm) thick.

3.23 INDOOR, FIELD-APPLIED JACKET SCHEDULE

I. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

J. If more than one material is listed, selection from materials listed is Contractor's option.

K. Ducts and Plenums, Concealed:

1. None.

L. Ducts and Plenums, Exposed: Vertical ductwork and plenums in mechanical equipment rooms and in finished spaces shall be provided with a jacket to a height of 10' above finished floor. Horizontal ductwork and plenums within 10’ above finished floor in mechanical equipment rooms and in finished spaces shall be completely provided with a jacket.

1. PVC: 20 mils (0.5 mm) thick.
2. Aluminum, Smooth: 0.016 inch (0.41 mm) thick.

M. Piping, Concealed:

1. None.

N. Piping, Exposed: Vertical piping in mechanical equipment rooms and in finished spaces shall be provided with a jacket to a height of 10' above finished floor. Horizontal piping within 10’ above finished spaces shall be completely provided with a jacket.

1. PVC: 20 mils (0.5 mm) thick.
2. Aluminum, Smooth: 0.016 inch (0.41 mm) thick.

3.24 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

O. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

P. If more than one material is listed, selection from materials listed is Contractor's option.

Q. Ducts and Plenums, Concealed:

1. None.

R. Ducts and Plenums, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):

1. Aluminum, Smooth: 0.024 inch (0.61 mm) thick.
2. Stainless Steel, Type 304 or 316, Smooth 2B Finish: 0.016 inch (0.41 mm) thick.

S. Ducts and Plenums, Exposed, Larger Than 48 Inches (1200 mm) in Diameter or with Flat Surfaces Larger Than 72 Inches (1800 mm):

1. Aluminum, Smooth with 1-1/4-Inch- (32-mm-) Deep Corrugations: 0.032 inch (0.81 mm) thick.
2. Stainless Steel, Type 304 or 316, Smooth, with 1-1/4-Inch- (32-mm-) Deep Corrugations: 0.020 inch (0.51 mm) thick.

T. Piping, Concealed:

1. None.

U. Piping, Exposed:

1. Aluminum, Smooth with Z-Shaped Locking Seam: 0.024 inch (0.61 mm) thick.
2. Stainless Steel, Type 304 or 316, Smooth 2B Finish with Z-Shaped Locking Seam: 0.016 inch (0.41 mm) thick.

END OF SECTION 230700

SECTION 230713 - DUCT INSULATION

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 insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Outdoor, exposed supply and return.

B. Related Sections:

1. Section 230716 "HVAC Equipment Insulation."
2. Section 230719 "HVAC Piping Insulation."
3. Section 233113 "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. 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 insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having

jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 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.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type II with factory-applied vinyl jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corporation; SoftTouch Duct Wrap.
b. Johns Manville; a Berkshire Hathaway company; Microlite.
c. Knauf Insulation; Atmosphere Duct Wrap with ECOSE Technology.
d. Manson Insulation Inc; Alley Wrap.
e. Owens Corning; SOFTR All-Service Duct Wrap.

F. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.."

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corporation; Commercial Board.
b. Johns Manville; a Berkshire Hathaway company; 800 Series Spin-Glas.
c. Knauf Insulation; Earthwool Insulation Board with ECOSE Technology.
d. Manson Insulation Inc; AK Board.
e. Owens Corning; Fiberglas 700 Series.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand; H. B. Fuller Construction Products; CP-127.
b. Eagle Bridges - Marathon Industries; CP-127.Eagle Bridges - Marathon Industries; 225..
c. Foster Brand; H. B. Fuller Construction Products; 85-60/85-70.
d. Mon-Eco Industries, Inc; 22-25.

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand; H. B. Fuller Construction Products; CP-82.
b. Eagle Bridges - Marathon Industries.
c. Foster Brand; H. B. Fuller Construction Products; 85-50.
d. Mon-Eco Industries, Inc; 22-25.

2.3 MASTICS

A. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Brand; H. B. Fuller Construction Products; CP-38 Chil-Low.
    b. Foster Brand; H. B. Fuller Construction Products; 30-80.
    c. Knauf Insulation; EXPERT Mastics - KI-900 ASJ.
    d. Vimasco Corporation.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

B. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Brand; H. B. Fuller Construction Products; CP-30.
    b. Eagle Bridges - Marathon Industries.
    c. Foster Brand; H. B. Fuller Construction Products; 30-35.
    d. Mon-Eco Industries, Inc; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Brand; H. B. Fuller Construction Products; Encacel.
    b. Eagle Bridges - Marathon Industries.
    c. Foster Brand; H. B. Fuller Construction Products; 60-95/60-96.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Brand; H. B. Fuller Construction Products; CP-10.
    b. Eagle Bridges - Marathon Industries.
    c. Foster Brand; H. B. Fuller Construction Products; 46-50.
    d. Knauf Insulation; EXPERT Mastics - KI-700 ASJ.
    e. Mon-Eco Industries, Inc; 55-50.
    f. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.4 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand; H. B. Fuller Construction Products; CP-76.
   b. Eagle Bridges - Marathon Industries; CP-76.Eagle Bridges - Marathon Industries; 405..
   c. Foster Brand; H. B. Fuller Construction Products; 95-44.
   d. Mon-Eco Industries, Inc; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand; H. B. Fuller Construction Products; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.

2.5 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 C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

a. ITW Insulation Systems; Illinois Tool Works, Inc; Aluminum and Stainless Steel Jacketing.
b. RPR Products, Inc; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.

a. Sheet and roll stock ready for shop or field sizing.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil-(0.025-mm-)thick, heat-bonded polyethylene and kraft paper
d. Moisture Barrier for Outdoor Applications: 3-mil-(0.075-mm-)thick, heat-bonded polyethylene and kraft paper.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
b. Compac Corporation; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; Ideal Tape Cold Seal 728 ASJ.
d. Knauf Insulation; EXPERT Tapes - ASJ Tape.
e. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
b. Compac Corporation; 110 and 111.
c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK][Ideal Tape Cold Seal 791 FSK.
d. Knauf Insulation; EXPERT Tapes - FSK Tape.
e. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Compac Corporation.
    b. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
    c. Venture Tape; 1506 CW NS.

2. Width: 2 inches (50 mm).
3. Thickness: 6 mils (0.15 mm).
4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    b. Compac Corporation.
    c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    d. Knauf Insulation; EXPERT Tapes - 2 Mil Foil Tape.
    e. Venture Tape; 3520 CW.

2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.8 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated.

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; CD.
3) Midwest Fasteners, Inc.; CD.
4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; CHP-1.
2) GEMCO; Cupped Head Weld Pin.
3) Midwest Fasteners, Inc.; Cupped Head.
4) Nelson Stud Welding; CHP.

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. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

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 ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct 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, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. 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 at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-(75-mm-)wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.

a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to 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 duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

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 (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. 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 (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).

5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-(150-mm-)wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-(150-mm-)wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

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 (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-(1.6-mm-)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 (38-mm) laps at longitudinal seams and 3-inch-(75-mm-)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 (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. 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 (50-mm) 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 (300 mm) o.c. and at end joints.

3.8 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.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each duct system defined in the "Duct Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.

3.11 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

B. Concealed, round and flat-oval, return-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

C. Concealed, round and flat-oval, outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.

2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

D. Concealed, rectangular, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

E. Concealed, rectangular, return-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density..

F. Concealed, rectangular, outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

G. Exposed, round and flat-oval, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

H. Exposed, round and flat-oval, return-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m)nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

I. Exposed, round and flat-oval, outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m)nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

J. Exposed, rectangular, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m)nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

K. Exposed, rectangular, return-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m)nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

L. Exposed, rectangular, outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m)nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

3.12 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

B. Exposed, round and flat-oval, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

C. Exposed, rectangular, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

3.13 OUTDOOR, 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. Ducts and Plenums, Concealed:
1. Aluminum, Smooth: 0.020 inch (0.51 mm) thick.

D. Ducts and Plenums, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):

1. Aluminum, Smooth 0.020 inch (0.51 mm) thick.

END OF SECTION 230713

SECTION 230923 – DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

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. This Section includes a complete and functional direct digital Energy Management Control System (EMCS) as specified herein. The EMCS Contractor shall have total system responsibility for the installation including the following:

1. Non-BACnet Installations: Furnish and install all software, hardware, data base, conduit, wire, cable, building level network control units, floor level network control units and required connections for a complete and functional system to monitor and control points as specified, including software and data base generation, loading, debugging, and start-up.
2. BACnet Installations: Furnish and install a totally native BACnet-based system including applicable software to be installed on an Owner provided operator workstation (OWS) in accordance with this specification. All building controllers, application controllers, and input/output devices shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135-2001, BACnet. Provide all software, hardware, database, conduit, wire, cable, building level controller units, floor level controller units and required connections for a complete and functional system to monitor and control points as specified, including software and database generation, loading, debugging and startup. Provide all necessary BACnet-compliant hardware and software to meet the systems functional specifications. Provide Protocol Implementation Conformance Statements (PICS) for windows-based control software and every controller in the system.
    a. Operator Workstation Software:
        1) All applicable software to facilitate direct connection to the building EMCS.
        2) Any necessary software/hardware “keys” required for EMCS communication software.
        3) Any additional hardware cabling or equipment that may be required to facilitate direct connection to EMCS field devices (Serial Communication adapters, etc)

3. Furnish and install all network cabling, conduits, network switches, routers for a complete and functional network system, ending at the facility’s top-level building network switch, or at the nearest existing building level controllers as determined by Owner. Standard mode of connection shall be Ethernet or BACnet over IP unless approved otherwise by Owner.

4. Generation of color graphic displays at the native existing graphic terminal in Central Control for each mechanical system connected to the system. Graphics to include all dynamic point data information associated with each major mechanical system and setpoints.
5. Provide complete hardware and software documents, shop drawings, operating and maintenance manuals and classroom training of operators and maintenance personnel at the site. Provide as-built control drawings in CAD format to Owner.
6. Provide a dedicated power supply to each controller cabinet and communications interface. Provide manufacturers recommended grounding to each controller cabinet, and dedicated 120V, 20A circuit with locking clip on breaker. Clearly label circuit in panel.
7. Provide an uninterruptable power supply (UPS) for all direct digital control systems supporting laboratory and/or animal systems. UPS to be manufactured by SOLA HD, series DIN RAIL AC UPS, model SDU 850-5, or approved equal.
8. Accomplish acceptance tests, including point-to-point verification, with alarming verification including messages for all critical alarm and life safety points. Typical points requiring messaged alarming include but are not limited to:
    a. Control air compressor
    b. 24 hour fans and pumps (i.e. Freeze Protection)
    c. Critical temperature and humidity control areas (i.e. Archiving/Museum)
    d. Critical pressure control areas and systems (i.e. Laboratories and Lab Systems)
    e. Critical systems (i.e. Fire and Security)
    f. State/Federally regulated areas (i.e. Animal Areas)
9. Provide connections for all electrical devices provided by the EMCS contractor to the controllers.
    a. Provide proper marking and identification of all devices, wiring, and controls. Equipment labels should indicate device name, address, room location, etc.
    b. Controllers and panel enclosures marked with panel number/instance number and IP address.
    c. Layout/as-built wiring diagram of control panel put inside a protective sleeve and secure inside the control panel.
    d. Control wires labeled to indicate which I/O terminals they are connected to.
10. Schedule all non-24 hour equipment in accordance with generally approved University guidelines for energy usage and in accordance with the Owner. Non-24 hour equipment shall be scheduled as soon as practical to avoid excessive use of University resources prior to turnover to the University.
11. Provide any additional support that may be required to facilitate full integration of all control devices, including hardware communication troubleshooting with 3rd party devices (Variable Frequency Drives, packaged controllers, etc).
12. Demolition Requirements: Demolition shall include removal of all associated control components (sensors, switches, etc.), wiring, and database at the front end (point definitions, programming, etc.)
13. Guarantee.

B. The EMCS Contractor shall bid directly to and be contracted directly by the General Contractor or Construction Manager.

C. Related Sections include the following:

1. Division 23 Section "Meters and Gages for HVAC Piping" for measuring equipment that relates to this Section.

1.3 DEFINITIONS

A. DDC: Direct digital control.

B. I/O: Input/output.

C. RTD: Resistance temperature detector.

1.4 SYSTEM DESCRIPTION

A. The temperature control system shall be of the DDC type, connected to the University's present Energy Monitoring and Control System.

B. BACnet implementations shall be functionally verified on BOTH the Siemens Apogee EMCS and the Delta Controls Orcaview EMCS located in the University's Central Control Office.

C. BACnet implementation shall be completely based on ANSI/ASHRAE Standard 135-2001, BACnet, and is to control all listed equipment using native BACnet-compliant components. Non BACnet-compliant or proprietary equipment or systems (including gateways) shall not be acceptable and are specifically prohibited. Any device designated to act as a BACnet Broadcast Management Device (BBMD) shall be designed for and dedicated to that purpose and shall not be utilized to control any other aspect of the building system.

D. System controllers connected to floor level (BACnet MS/TP) devices shall perform all necessary MS/TP network routing to facilitate network efficiency and reduce communication and control lag. When system controllers cannot perform this function, dedicated BACnet MS/TP routing hardware shall be provided.

E. All materials and equipment used shall be standard components, regularly manufactured for Siemens Building Control Systems or Delta Controls and shall not be custom designed especially for this project. All components shall have been thoroughly tested and proven in actual use, and shall include, but not be limited to:

1. Controller cabinets with all electronics and transducers, including on-board communications capability and database memory battery back-up. Provide latest revision firmware and largest available memory board.
2. Communications interface devices.
3. Printed circuit assemblies, point modules.
4. Auxiliary device enclosures.
5. Control and status relays.
6. Current transformers.
7. Thermowells (Mechanical Contractor shall install wells furnished by the EMCS contractor)
8. Temperature and pressure transmitters.
9. Water flow sensors and transmitters.

10. Electric to pneumatic transducers.
11. Pneumatic to electric transducers, standard shall be 0 to 20 psi unless noted otherwise, include brass fittings on all pneumatic devices.
12. Power supplies to controller cabinets, transducers, and other control devices.

1.5 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

B. Shop Drawings:

1. Submit complete shop drawings of the proposed EMCS for approval including sequence of operation, valve ranges, DDC logical points and physical addresses, typical system information such as fan CFM, voltage, FLA, HP, GPM, etc.
2. Submit complete shop drawings of the proposed EMCS system for approval including, but not be limited to the following:

    a. I/O point summary with recommended set points, start/stop times, time delays, etc.
    b. Operator and hardware point numbers, logical names and user names.
    c. Controller unit schematic wiring, layout sheet including logical point names, valve ranges, etc.
    d. Fan and mechanical system schematic diagrams showing EMCS sensor locations, including valve ranges, CFM, voltage, FLA, GPM and areas served.
    e. One-line diagrams for sensors, control points, and terminations, including labeling to controller cabinets, with all components, signal values, and cables.
    f. Terminal cabinets, including labeled terminal blocks.
    g. Connections to existing loops, controls, and panels.
    h. Internal and external wiring of relays and contacts.
    i. Schematic of all major equipment provided.
    j. Operator, maintenance, and software programming manuals.
    k. Spare parts list and prices.
    l. Complete sequence of operation, description, control logic flow diagrams, and completed programming sheets in manual form for each mechanical system controlled.

3. All manufacturer's drawings, catalog cuts, and specifications shall be properly identified with the Engineer's project number and title. Each piece of equipment shall be properly identified as to its location and equipment number. Verify Equipment numbering with the Owner.
4. SUBMITTALS data relevant to panel schedules and other pertinent equipment information requiring approval prior to field installation shall be forwarded from the EMCS Contractor. Upon receipt of approval, the EMCS Contractor shall proceed with installation, set-up, calibration and check out of the various control and monitoring systems. At the completion of components and systems installation the Contractor shall request in writing that the Owner inspect and approve satisfactory operation as specified under "Acceptance Procedure".

C. As-built Drawings:

1. At the completion of the project as-built drawings shall be submitted to the Owner, showing conduit size and location, cable and wire identification, panel and sensor locations, and device layouts with panels, branch circuit numbers, and wiring diagrams for each type of typical field point wiring and for each specific variation, and data trunk riser diagram.
2. Furnish 3 sets of neatly drawn as-built diagrams of the temperature control systems, complete with sequence of operations, valve ranges, cabinet layout sheets, point logical names and physical addresses. One set to be mounted in plastic covers located in control cabinets in the field, two sets to be delivered to Construction Representative for Archives and records. One set of AutoCAD as-built drawings on CDROM shall be furnished to Design Representative to be delivered to Engineering and Architectural Services. File naming convention shall be as determined by Owner.
3. EMCS Contractor is to keep a current marked-up copy of as-built drawings on site at all times once installation started.

D. Operations and Maintenance Manuals:

1. The system shall be provided with complete maintenance and operation instructions including, but not limited to the following:

   a. Complete electronic schematic wiring diagrams for printed circuit boards, DDC Controller cabinets and other equipment included in these Specifications.
   b. Complete instruction set in manual form for operation of the system.
   c. Complete instruction set in manual form for adding and deleting of points and interface device panels including all relevant parameters such as descriptor inputs, point types, change-of-state type, functions, etc.
   d. Complete diagnostic and trouble shooting procedures set in manual form.
   e. Complete instruction set in manual form for all software and firmware.

2. Any updates to firmware, software, and hardware shall be fully documented at or before the time of delivery.

E. Warranties: Submit written special warranty as specified in this Section. Include contact information, description of coverage, and start date for each special warranty.

1.6 INPUT/OUTPUT SUMMARY FORM

A. The following I/O Summary Form is a sample form illustrating the typical information required of the various building systems. Any device connected to the EMS that is also controlled by some local device (e.g.: light switch, P.E., high limit stat, twist timer, etc.) must be defined as an DI point. Provide dry contact from local device to digital input at controller and programming necessary to accomplish sequence of operation.

B. Typical control points connected to the EMCS system are as follows:

1. HVAC/H&V Systems:

a. Supply fan (status and control).
b. Return fan (status and control where fan is not interlocked w/supply).
c. Mixed air temperature.
d. Heating coil temperature.
e. Cooling coil temperature.
f. Discharge air temperature.
g. Return air temperature.
h. Return air relative humidity.
i. Damper control.
j. Cooling coil control.
k. Space humidity sensor (where humidity control is critical).
l. At least one space temperature sensor per system or zone.

2. Miscellaneous Building Systems:

a. Outdoor air temperature.
b. Temperature control air compressor low pressure alarm.
c. Fire (trouble circuit).
d. Fire (fire alarm circuit).
e. Exhaust fans (status and control) including:

1) Toilet exhaust.
2) General exhaust.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with ASHRAE Standard 135 for DDC system components.

C. Comply with ASHRAE Standard 135-2001, BACnet where applicable.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

C. Salvaged Materials and Components: Existing control components (Building Controllers, Application Specific / Advanced Application Controllers, Point Expansion Components, etc)

when removed from the field as part of a controls replacement or upgrade shall be returned to the owner for reuse or recycling at the owner's discretion.

1.9 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate supply of conditioned electrical branch circuits for control units.

C. Coordinate final room numbers with PDC and equipment numbers with Maintenance Services.

D. Coordinate controller addresses with Maintenance Services/Central Control.

1.10 WARRANTY

A. The EMCS system shall be guaranteed for a period of two years after final approval by the Owner. The guarantee shall be provided for a completely installed system, including all components, parts, and assemblies of the EMCS. The guarantee shall cover parts, materials, and labor to locate and correct any defects in materials or workmanship.

B. The Contractor shall initiate the warranty period by formally transmitting to the Owner commencement notification of the period for the system and devices accepted. The warranty period begins when these devices are formally accepted by the Owner (refer to ACCEPTANCE PROCEDURE below).

C. Contact information shall be provided for quick service engineering assistance concerning hardware and software problems. There shall be provisions made for getting manufacturer certified diagnostic and repair personnel on the scene quickly should the need arise. There shall also be a software expert familiar with the software of this machine who can be easily contacted.

D. This system shall be inspected by the EMCS Contractor for a four hour period once each month during the warranty period to run diagnostic tests and also provide maintenance instructions to the operating personnel.

E. The EMCS Contractor shall give the Owner 24 hours prior notification of each maintenance trip during the contract guarantee period. In addition, the Contractor shall furnish the Owner and Engineer a written record of each maintenance trip, number of employees present, time involved, and work accomplished.

F. Owner shall be able to make changes to data base, when prior data base is stored on disk in case of error in change, without affecting or voiding warranty.

1.11 MAINTENANCE

A. The EMCS Contractor shall provide and maintain on site working spare parts for the EMCS system during the warranty period including DDC Controllers, communication boards,

networking components, modules, sensors, floor level (subnet) devices, transformers, etc. ___ will be custodian of these spare parts and shall be authorized to utilize them in performing first level maintenance. The EMCS Contractor shall refurbish/replace spare parts in exchange for failed items.

PART 2 - PRODUCTS

2.1 CURRENT SENSORS (TRANSFORMERS)

A. Current sensors used for monitoring motor operation shall be sized according to motor horsepower. The output shall be compatible with the EMCS field device with necessary interfacing transducers provided.

B. The current sensors shall have mounting brackets for attachment to the motor starter enclosure.

C. Manufacturers: Veris model 921, or approved equal.

2.2 CURRENT SENSING RELAYS

A. Current sensing relays shall be used for monitoring motor operation, and sized according to motor HP.

B. Manufacturers: Veris model 908 or RIB Model RIBXGTA.

2.3 TEMPERATURE DETECTORS

A. Temperature detectors shall be wire wound or thin film platinum resistance type sensors, or 10K Ohm thermistor type, referenced at 77 degree F, either having a minimum accuracy of $\pm$ 0.5° F over the noted range. All sensors of a particular category shall be of the same type and manufacturer.
   1. 10K Ohm thermistors shall only be allowed as point type sensors at the zone/room level control.

B. Resistance Temperature Detectors (RTD) shall be two-wire type Platinum RTD and shall be provided with local 4-20 MA signal conditioning tranducers shall be provided. The sensing bulb shall be copper or stainless steel. The minimum temperature range for all sensors will be 20 °F. to 120 °F with an accuracy of $\pm$ 0.6° F for a single point duct and immersion sensor and +/-2 °F for continuous averaging sensors in air when matched to the 4-20mA trasmitter. Sensors shall have a maximum time constant of three seconds per degree change. Sensors shall not require recalibration at any time. Where required, linearizing, ranging, and resistance change versus temperature curve interpretations shall be made by software programming at the CPU or Controller. Minimum room temperature sensor range is 40-90 degree F. Wider range may be required for special applications.

C. Temperature detectors shall be either stem or tip sensitive types. Sensors installed outdoors, in piping systems, and in corrosive environments shall be hermetically sealed in type 316 stainless

steel enclosures, with all joints and closures Heliarc welded. Soldering or brazing is not approved. Entire assembly, including external trim, shall be a watertight, vibration proof, heat resistant unit.

D. Sensing elements installed in piping systems shall be provided with separable wells constructed of type 316 stainless steel. Elements shall be inserted into the wells with appropriate heat transfer compound.

E. Sensors installed outdoors shall be of weatherproof construction, protected from sunlight and wind effects with a stainless steel protective shield.

F. All air handler and duct mounted temperature sensors shall be of the averaging type, with 8', 12', 16', 24', 50' 80' or 100' long sensing elements. The averaging element shall have a continuous element sensor along the entire length. Averaging elements shall be installed across the full air flow area in a serpentine fashion, on rigid supports designed specifically for mounting of such elements. The averaging element shall be protected against vibration and wear at each point of contact with the element supports. Strain on the element shall be relieved at the junction box to prevent tension on the internal electrical connections. A minimum sensor density of 1' per 1 sq. ft. of coil is required.
   1. If more than 100' of sensor is required for coil coverage, then multiple, non-overlapping sensors of the same length shall be permitted and wired as separate inputs to the controller.

G. Rigid stem 304 stainless steel averaging sensors will be allowed where duct size is smaller than 3' square.

2.4 STATIC PRESSURE TRANSMITTERS

A. Static pressure transmitters shall be industrial quality, capable of transmitting 4-20mA analog output signal proportional to differential (static) pressure input signals. Transmitter shall have a minimum 1% accuracy rating over the range of the device, zero and span adjustment, and stainless steel case.

B. Manufacturers: Setra Model C264, or approved equal.

2.5 ELECTRONIC TO PNEUMATIC TRANSDUCERS

A. Accessories: In-line filter, dual valve and gauge.

B. Manufacturers: Model EPC2GFS style by Advanced Control Technologies, Inc, or approved equal.

2.6 DAMPER END SWITCHES

A. Damper end switches shall be two position, encapsulated non-mercury style mounted on the shaft arm, SPDT, unless noted otherwise. Where electronic actuators are used end switches provided with actuator will be allowed upon prior approval by owner.

2.7 EMCS CABLE

A. All EMCS cable shall be installed in conduit except as listed below when approved by Owner prior to award of contract. EMCS cable shall comply with manufacturer's recommendations. Separate raceway systems shall be supplied for Class I and Class II circuits.
   1. The following may use cable tray, j-hook, or other wire management device in lieu of conduit.
      a. RS-485 network cabling on non-life safety devices.
      b. Low voltage control wiring outside of mechanical rooms on non-life safety devices.

B. Data transmission trunk cables and equipment grounding procedures shall meet the latest FCC guidelines (FCC rules, part 15, subpart J) for electromagnetic field generation.

C. No splicing of RS-485 or RS-232 data cabling shall be allowed. Communication trunk shall be installed per manufacturers recommendation for operation at 19,200 baud or higher, continuous daisy chain with no tees and trunk terminators installed where appropriate. All communication and analog input wiring shall be AWG size as recommended by manufacturer with teflon jacket.

D. Splicing of temperature sensor cable is not allowed.

E. Splicing of binary status or command cable shall take place at the field cabinet or motor starter only.

2.8 DDC CONTROLLERS

A. Controllers shall be complete assemblies consisting of modular hardware including power supply, microcomputer, input/output modules, termination modules, and battery (where applicable). Battery (if applicable) shall be non-rechargeable lithium with 10 year life, and be capable of supporting all memory within the control unit if the house power to the unit is interrupted or lost for a minimum of 60 days total down time.

B. Controllers shall be furnished as newest revision level with largest available memory configuration unless prior approval by Owner. Verify controller type to be used in design with Owner. Most recent revision firmware shall be supplied unless otherwise noted. Point extension/slave devices shall NOT be utilized in the design without prior approval by the Owner. Each controller shall be provided with 10% spare point capacity. All controllers shall be provided with floor level (subnet) network capability and H-O-A switches at the output points unless approved otherwise by the Owner.

C. All points from a given mechanical system shall reside in the same controller.

D. Each Controller cabinet shall be able to monitor the following types of inputs:

Analog Inputs	Digital [Binary] Inputs
4-20 mA	Dry contact closure
0-10 VDC	Pulse accumulator
1000 ohm [10K Ohm]	

E. Controller cabinets shall directly control pneumatic and electronic actuators and control devices. Each control unit shall be capable of providing the following control outputs:

Analog Outputs	Digital [Binary] Outputs
4-20 mA	Motor starters, sizes 1 to 4
0-10 VDC	

F. All temperature control functions shall be executed within the same DDC Controller. Loop control shall be executed via direct digital control algorithms. The user shall be able to customize control strategies and sequences of control, and shall be able to define appropriate control loop algorithms and choose the optimum loop parameters for loop control. Upon Owner request the EMCS shall demonstrate stable loop control by utilizing test cabinet simulation program and trending the data. Control loops shall support any of the following control modes:

1. Two position (on-off, slow-fast, etc.)
2. Proportional (P)
3. Proportional plus integral (PI)
4. Proportional, integral, plus derivative (PID)

G. It shall be possible to fully create, modify, or remove control algorithms within a specific DDC Controller while it is operating and performing other control functions. Input for these changes may be made directly into the DDC Controller or via the network. Each control loop shall be fully user definable in terms of:

1. Sensors/actuators that are part of the control strategy.
2. Control mode.
3. Gain.
4. Control action.
5. Sampling time.

H. DDC Controllers shall be able to share point information such that control sequences or control loops executed at one control unit may receive input signals from sensors connected to other DDC Controllers within the network. If the network communication link fails or the other DDC Controller malfunctions, the control loop shall continue to function using the last value received from the Controller.

I. The system shall permit the generation of job-specific control strategies that can be activated in any of the following ways:

1. Continuously.
2. At a particular time of day.
3. On a pre defined date.
4. When a specific measured or controlled variable reads a selected value or state.
5. When a piece of equipment has run for a certain period of time.

J. Upon a loss of commercial power to any DDC Controller, the other units within the network shall not be affected and the loss of operation of that unit shall be reported at the designated operator's terminal. All control strategies and energy management routines defined for the DDC Controller shall be retained during power failure via the internal battery for a minimum of eight (8) hours.

Upon resumption of commercial power the control unit shall resume full operation without operator intervention. The unit shall also automatically reset its clock such that proper operation of timed sequences is possible without the need for manual reset of the clock.

K. Location of DDC Controller cabinets shall be approved by the Owner prior to installation.
   1. DDC controller cabinets and controller accessory cabinets are not to be used as a conduit path or electrical raceway. This includes packaged equipment controller cabinets, custom installed controller cabinets and zone level controller cabinets.
   2. Provide electrical trough enclosure above all DDC system level controller cabinets and controller accessory cabinets.

L. Enclose and install control devices and equipment such that they will not be subject to vibration, excessive temperature, dirt, moisture, or other harmful effects or conditions beyond their rated limitations. If devices must be located so as to be subjected to conditions beyond their recommended or rated limitations, provide the necessary protective enclosures or furnish the equipment constructed of materials and features capable of withstanding the adverse conditions. Controls and devices subject to wetting or to the weather shall be corrosion resistant weather tight enclosures.

M. DDC programs shall follow DSD standard form and shall include discrete sections of code that are not intermingled with other sections of control, per the following:

   1. Increment line numbers by 10 or more. First line number shall be greater than or equal to 10, last line number shall be less than or equal to 32000.
   2. Place all time-based commands (e.g. WAIT, TOD, SAMPLE, LOOP) such that they are evaluated each pass through the program.
   3. Include comments describing each section of code.
   4. Section A shall include all diagnostic, power return, emergency point and other related code.
   5. Section B shall include all equipment schedules.
   6. Section C shall include all DDC and other equipment control.
   7. Section D shall include all two-speed sequencing, alarm delays, alarm limits and miscellaneous code, and odd month determination.
   8. Each DDC program shall include the alarm indicators code in Section A. Each DDC program shall include code in Section E that initialize the run time totals on all equipment defined for totalization.
   9. Any air handling unit with a heating coil controlled through DDC shall include programming which places the unit in special operation on discharge sensor failure to prevent freezing of the heating and cooling coils.
   10. Each controller cabinet shall include only as many programs as is necessary for programming modularity and ease of troubleshooting. If device operation is such that the existence of multiple programs within a single control has an effect on system performance or control timing, the presence of these multiple programs must receive prior approval by the Owner. Multiple programs , if present, shall be independent in functionality and shall not perform similar or identical functions (i.e. Start/Stop, Time of Day, etc). Each program shall be tested utilizing a test cabinet simulation to verify program functions properly, prior to loading in field cabinet.

2.9 ADVANCED APPLICATION CONTROLLERS

A. Each DDC controller shall be able to extend its performance and capacity through the Use of floor level (subnet), advanced application controllers (AAC).

B. Each AAC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each AAC shall be a microprocessor-based, multi-tasking, real-time digital control processor, and fully programmable.

C. Terminal Box Controllers - Provide control of individual pieces of equipment including, but not limited to, the following:
   1. Unit Conditioners.
   2. Unit Ventilators.

D. Controllers shall include all point inputs and outputs necessary to perform the specified control sequences.

E. Each controller performing space temperature control shall be provided with a matching room temperature sensor. Each room temperature sensor shall be provided with a terminal jack to be used to connect a portable operator's terminal to control and monitor AAC points, setpoint adjustment dial, temperature indicator, and override switch.

F. A dedicated power source and separate isolation transformer for each AAC Power Trunk shall be provided. Transformer shall be mounted in a separate auxiliary enclosure.

2.10 APPLICATION SPECIFIC CONTROLLERS

A. Application specific controllers (ASCs) shall NOT be utilized unless approved by the Owner prior to project bid.

2.11 ELECTRONIC ACTUATORS

A. Unless approved otherwise by the Owner, all actuation shall be electronic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install engraved laminated plastic nameplates under each instrument in the control panel to designate its function.

B. All devices connecting to EMCS such as contactors, motor starters, electric pneumatic transducers, pressure electric transducers, resistance temperature detectors, relays, terminal box controllers, etc., shall be marked with the same point number used on the shop drawing SUBMITTALS for the system so as to identify the point and its function for University field

service personnel. Marking shall be done with gummed paper tags installed on the surfaces that have been steel wool cleaned and sprayed with clear enamel for waterproofing.

C. Wire shall be color coded according to the Construction Representative's directions.

D. Dedicated circuits shall be installed in branch lighting panels to serve controller cabinets. Circuit breakers shall be equipped with locking clips, and shall be clearly identified.

E. All Controller Cabinets and auxiliary enclosures shall be supplied with engraved phenolic nameplates permanently attached identifying their field cabinet number, area, fan systems controlled, etc.

F. Special equipment shall be installed in accordance with manufacturer's instructions and recommendations of Service Engineer where specified or required. All control instruments, valves, etc., shall be carefully adjusted and set for proper operating of the equipment served as noted herein or as required by the equipment manufacturer's instructions and recommendations.

3.2 FIELD QUALITY CONTROL

A. Upon completion of the work, the EMCS Contractor shall instruct the Owner's Operating Engineer and acquaint him with all of the operating characteristics of all equipment installed by him including the EMCS and all other systems, at the same time operating each and every system individually for a period of two days, unless otherwise specified. During this two day period the building's Operations Manual shall be used for reference.

B. During system commissioning and at such time acceptable performance of the installed system hardware and software has been established, the Contractor shall provide on-site operator instruction to the Owner's operating personnel. Operator instruction during normal working hours will be performed by competent contractor representatives familiar with the computer's software, hardware, and accessories.

C. At a time mutually agreed upon during system commissioning as stated above, the EMCS Contractor shall give an absolute minimum 24 hours of instruction to the Owner's designated personnel on the operation of all equipment included in the project. Operator orientation of the automation system will include, but not be limited to equipment functions, commands, advisories, appropriate operator intervention required in responding to the system's operation, and any other training needed in the operation of the system. An Owner's manual prepared for this project by the Contractor will be used in addition to the instruction. Six (6) manuals shall be provided.

D. Additional instruction time as deemed necessary by the Owner shall be provided by the Contractor as an extra service, and will be paid for in accordance with the State Prevailing Wage Rates for Engineers and Technicians.

3.3 ACCEPTANCE PROCEDURE

A. SUBMITTALS data relevant to point index, functions limits, sequences, interlocks, power fail/restarts, logs, software routines and associated parameters, and other pertinent information

for the operating system and data base shall be forwarded from the EMCS contractor to the Owner.

B. Approved data base will be entered into the central computer, debugged, and down line loaded to Controllers. Prior to on-line operation a complete demonstration and readout of the computer command shall be performed in the presence of the Owner. In addition, a printout of the data base generated for all points shall be reviewed with the Owner by the EMCS contractor. Modification to the data base shall be made by the EMCS contractor as directed by the Owner.

C. All points shall be verified prior to "punch-out" for correct and accurate correspondence between the CRT data display and actual field location and equipment operation.

D. The Contractor shall maintain dated and initialed calibration and verification sheets and provide a copy to the Owner. Include verification of enhanced alarming with messages for all points selected by the Owner. Typical points with messages include control air compressors, 24 hour fans and pumps, critical systems and animal areas. Point verification sheets can be obtained in Central Control.

E. Upon successful completion of system generation the Owner shall be requested in writing to inspect and approve the satisfactory operation of the EMCS, sub-systems, and accessories.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls.

END OF SECTION 230923

SECTION 232300 - REFRIGERANT PIPING

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.

B. Refrigerant piping and systems are to follow current code requirements and refrigerant system regulations.

1.2 SUMMARY

A. This Section includes refrigerant piping used for food preservation and air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-134a:

1. Suction Lines for Air-Conditioning Applications: 115 psig (793 kPa).
2. Suction Lines for Heat-Pump Applications: 225 psig (1551 kPa).
3. Hot-Gas and Liquid Lines: 225 psig (1551 kPa).

B. Line Test Pressure for Refrigerant R-404A:

1. Suction Lines for Air-Conditioning Applications: 240 psig.
2. Suction Lines for Heat-Pump Applications: 400 psig.
3. Hot-Gas and Liquid Lines: 400 psig.

C. Line Test Pressure for Refrigerant R-407C:

1. Suction Lines for Air-Conditioning Applications: 230 psig (1586 kPa).
2. Suction Lines for Heat-Pump Applications: 380 psig (2620 kPa).
3. Hot-Gas and Liquid Lines: 380 psig (2620 kPa).

D. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).
2. Suction Lines for Heat-Pump Applications: 535 psig (3689 kPa).
3. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:

1. Thermostatic expansion valves.
2. Solenoid valves.
3. Hot-gas bypass valves.
4. Filter dryers.
5. Strainers.
6. Pressure-regulating valves.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.8 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.9 COORDINATION

A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) or ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Silver Solder: Cadmium-free high-silver alloy consisting of at least 45% silver.

E. Brazing Filler Metals: Phosphorus/copper/silver alloy consisting of 15% silver.

F. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
4. Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

2.2 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 275 deg F (135 deg C).

B. Packed-Angle Valves:

1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.

5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig (3450 kPa).
8. Maximum Operating Temperature: 275 deg F (135 deg C).

C. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
8. Working Pressure Rating: 500 psig (3450 kPa).
9. Maximum Operating Temperature: 275 deg F (135 deg C).

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig (3450 kPa).

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and [**24**] [**115**] [**208**]-V ac coil.
6. Working Pressure Rating: 400 psig (2760 kPa).
7. Maximum Operating Temperature: 240 deg F (116 deg C).
8. Manual operator.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig (2760 kPa).
6. Maximum Operating Temperature: 240 deg F (116 deg C).

G. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.

2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Superheat: Adjustable.
6. Reverse-flow option (for heat-pump applications).
7. End Connections: Socket, flare, or threaded union.

H. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.

1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
5. Seat: Polytetrafluoroethylene.
6. Equalizer: Internal.
7. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and [**24**] [**115**] [**208**]-V ac coil.
8. End Connections: Socket.
9. Throttling Range: Maximum 5 psig (34 kPa).
10. Working Pressure Rating: 500 psig (3450 kPa).
11. Maximum Operating Temperature: 240 deg F (116 deg C).

I. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig (3450 kPa).
5. Maximum Operating Temperature: 275 deg F (135 deg C).

J. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig (3450 kPa).
6. Maximum Operating Temperature: 275 deg F (135 deg C).

K. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 240 deg F (116 deg C).

L. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated charcoal.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig (14 kPa).
8. Working Pressure Rating: 500 psig (3450 kPa).
9. Maximum Operating Temperature: 240 deg F (116 deg C).

M. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated charcoal.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig (14 kPa).
8. Working Pressure Rating: 500 psig (3450 kPa).
9. Maximum Operating Temperature: 240 deg F (116 deg C).

N. Mufflers:

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or flare.
3. Working Pressure Rating: 500 psig (3450 kPa).
4. Maximum Operating Temperature: 275 deg F (135 deg C).

O. Receivers: Comply with ARI 495.

1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
2. Comply with UL 207; listed and labeled by an NRTL.
3. Body: Welded steel with corrosion-resistant coating.
4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
5. End Connections: Socket or threaded.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 275 deg F (135 deg C).

P. Liquid Accumulators: Comply with ARI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig (3450 kPa).
4. Maximum Operating Temperature: 275 deg F (135 deg C).

2.3 REFRIGERANTS

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

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

B. ASHRAE 34, R-134a: Tetrafluoroethane.

C. ASHRAE 34, R-404A.

D. ASHRAE 34, R-407C: Difluoromethane/Pentafluoroethane/1,1,1,2-Tetrafluoroethane.

E. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Suction Lines for Conventional Air-Conditioning Applications: Copper, Type L (B) or ACR, drawn-temper tubing and wrought-copper fittings with brazed or silver soldered joints.

B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type L (B) or ACR, drawn-temper tubing and wrought-copper fittings with brazed or silver soldered joints.

C. Safety-Relief-Valve Discharge Piping: Copper, Type L (B) or ACR, drawn-temper tubing and wrought-copper fittings with brazed or silver soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.

E. Install a full-sized, three-valve bypass around filter dryers.

F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

G. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

I. Install moisture/liquid indicators in liquid line in close proximity of the receiver outlet and at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Hot-gas bypass valves.
4. Compressor.

K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

L. Install receivers sized to accommodate pump-down charge.

M. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

A. Refer to Division 23 Section “Common Work Results for HVAC” for basic installation requirements.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

C. Install refrigerant piping according to ASHRAE 15.

D. Refer to Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls" for solenoid valve controllers, control wiring, and sequence of operation.

E. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

F. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

G. Install refrigerant piping in protective conduit where installed belowground.

H. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

I. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

J. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

K. Prior to brazing and soldering, fill piping with dry grade nitrogen. Continue to flow nitrogen through piping at a rate of 20 fpm while piping is being heated to prevent oxidation of inside of piping and fittings.

L. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

M. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

N. Install sleeves for piping penetrations of walls, ceilings, and floors.

O. Install sleeve seals for piping penetrations of concrete walls and slabs.

P. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.4 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Cushioned-clamp hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod size, 1/4 inch (6.4 mm).
4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
6. NPS 2 (DN 50): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
7. NPS 2-1/2 (DN 65): Maximum span, 108 inches (2700 mm); minimum rod size, 3/8 inch (9.5 mm).
8. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (9.5 mm).
9. NPS 4 (DN 100): Maximum span, 12 feet (3.7 m); minimum rod size, 1/2 inch (13 mm).

D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.

2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.

    a. Fill system with nitrogen to the required test pressure.
    b. System shall maintain test pressure within 2% at the manifold gage throughout duration of test. Pressure test duration shall not be less than 4 hours.
    c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.
    e. At the request of the Owner’s Representative, the Contractor shall cut open the refrigerant piping for inspection during site visits to verify the use of dry nitrogen as indicated in Section 3.3 above. Up to 4 locations may be selected at random by the Owner’s Representative. If evidence of non-compliance is discovered the affected piping shall be removed until clean piping is confirmed. If significant contamination is encountered at more than 4 locations the entire system will be considered to be contaminated. All affected piping shall be replaced and/or repaired at the Contractor’s expense.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.

4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

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. Single-wall rectangular ducts and fittings.
2. Double-wall rectangular ducts and fittings.
3. Single-wall round and flat-oval ducts and fittings.
4. Double-wall round and flat-oval ducts and fittings.
5. Sheet metal materials.
6. Sealants and gaskets.
7. Hangers and supports.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article unless otherwise indicated.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity 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 the airstream shall comply with requirements in ASHRAE 62.1.

1.4 SUBMITTALS

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

1. Sealants and gaskets.

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 of ducts.
5. Dimensions of main 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 and vibration isolation.

C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Perimeter moldings.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 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.

B. Transverse Joints: Select joint types and fabricate according to 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. Standing seams T-15, angle reinforced standing seams T-16, welded flange T-21, reinforced welded flange T-21a, companion angles T-22, and formed-on flanges T-25a (TDC) and T-25b (TDF)
2. Use of drives slip seams on sides is acceptable for unreinforced ducts.
3. Use of tie rodded reinforcement alternative is not acceptable.

C. Longitudinal Seams: Select seam types and fabricate according to 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."

1. All longitudinal seams on flat sides shall be of the grooved seam L-3.
2. All longitudinal corner seams shall be of the Pittsburgh lock L-1.

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 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."

1. Smooth radius with at least one splitter vane and square throat R/W equal to 0.5 or higher.
2. Mitered and Tee-shape elbows with turning vanes are acceptable where space restrictions dictate.
3. Select 45 degree entry tees, conical or bell mouth tees, or wyes. Straight tap connections will not be accepted.

E. As an option, Ductmate proprietary duct connection systems may be used with permission of the Architect/Engineer. Refer to the manufacturer guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.

2.2 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

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

1. McGill AirFlow LLC.

B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

D. Transverse Joints: Select joint types and fabricate according to 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."

E. Longitudinal Seams: Select seam types and fabricate according to 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."

F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 degree C) mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F (0.034 W/m x K) at 75 deg F (24 degree C) mean temperature.

H. Inner Duct: Minimum 0.028-inch (0.7 mm) solid sheet steel.

I. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse 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."

J. Longitudinal Seams: Select seam types and fabricate according to 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."

2.3 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

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

    a. Lindab Inc.
    b. McGill AirFlow LLC.
    c. SEMCO Incorporated.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate according to 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 (1524 mm) in Diameter: Flanged.
2. Lap at least 2 inches in direction of air flow and securely fastened with screws through the lap on center spacing not to exceed 2 ½ inches.

D. Longitudinal Seams: Select seam types and fabricate according to 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 (2286 mm) inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to 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."

F. Elbows: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," unless otherwise indicated.

1. Smooth radius stamped elbows for 8" ducts and smaller. 5-piece segmented elbows for 9" duct and larger.
2. Elbows shall have a centerline radius at least equal to 1.0 times the duct diameter. Mitered elbow will not be accepted.

2.4 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

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

1. Lindab Inc.
2. McGill AirFlow LLC.
3. SEMCO Incorporated.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. Transverse Joints: Select joint types and fabricate according to 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."

    a. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.

2. Longitudinal Seams: Select seam types and fabricate according to 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."

    a. Fabricate round ducts larger than 90 (2286 mm) inches in diameter with butt-welded longitudinal seams.
    b. Fabricate flat-oval ducts larger than 72 (1830 mm) inches in width (major dimension) with butt-welded longitudinal seams.

3. Tees and Laterals: Select types and fabricate according to 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."

D. Inner Duct: Minimum 0.028-inch (0.7 mm) solid sheet steel.

E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 degree C) mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

F. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F (0.034 W/m x K) at 75 deg F (24 degree C) mean temperature.

2.5 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 shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90 (Z275).
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90 (Z275).
2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils (0.10 mm) thick on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 1 mil (0.025 mm) thick on opposite surface.
3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.

D. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

E. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

F. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

G. 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 shall be applied to the exterior surface.
2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
5. Shop-Applied Coating Color: Black.
6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

H. Reinforcement Shapes and Plates: ASTM A 36/A 36M, 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.

I. Tie Rods: Galvanized steel, 1/4-inch (6 mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10 mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.6 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to 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 (76 mm).
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 degree C).
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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 (2500 Pa), 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. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Hot-dipped 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 (Table 5-1M), "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 A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated 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 according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round and flat-oval ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. 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 (38 mm).

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

M. Use fabricated fittings for all changes in directions, sizes, shapes and connections.

N. Locate ducts parallel and perpendicular to building lines; avoid diagonal runs except as otherwise indicated.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

A. Construction: Conform to Michigan Department of Public Health, except as noted otherwise.

B. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

C. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet (6 m) in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches (38 mm) from bottom of duct.

D. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

E. Provide openings at the sides or at the top of the duct, at changes of directions to permit inspection and cleaning. Access panels shall be of the same material and thickness as the duct, shall have a gasket or sealant, and shall be grease-tight. Do not install turning vanes or baffles in exhaust ducts.

F. Exhaust fans with ductwork connected to both sides shall have access for cleaning and inspection within 3' on each side of the fan.

3.4 ADDITIONAL INSTALLATION REQUIREMENTS FOR DISHWASHER EXHAUST DUCT

A. Construction: Conform to Michigan Department of Public Health, except as noted otherwise.

3.5 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to 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 (500 Pa) and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): 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 (500 Pa) and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.6 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.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing.

1. Install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
2. Install hangers at duct joints on either 8 or 10 foot centers, and at every change of direction.
3. Support ductwork directly from the building structure; not from the other ducts, piping, equipment, or roof deck.
4. Holes shall not be drilled or punched in beams and supporting members.

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 (5 m).

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.

3.7 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 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 (750 Pa): Test representative duct sections, selected by Architect from sections installed, totaling no less than 25 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. Test for leaks before applying external insulation.
5. 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.
6. Give seven days' advance notice for testing.

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 according to "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 shall 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.

3.9 DUCT CLEANING

A. Clean new and existing duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "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.

C. 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.

D. 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.

E. 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 according to NADCA 1992. 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 according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

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

1. Underground Ducts: Concrete-encased, PVC-coated, galvanized sheet steel with thicker coating on duct exterior.

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: C.

2. Ducts Connected to Constant-Volume Air-Handling Units:

   a. Pressure Class: Positive 3-inch wg (750 Pa).
   b. Minimum SMACNA Seal Class: B.

3. Ducts Connected to Variable-Air-Volume Air-Handling Units:

   a. Pressure Class: Positive 4-inch wg (1000 Pa).
   b. Minimum SMACNA Seal Class: A.

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 (500 Pa).
   b. Minimum SMACNA Seal Class: C.

2. Ducts Connected to Air-Handling Units:

   a. Pressure Class: Positive or negative 3-inch wg (750 Pa).
   b. Minimum SMACNA Seal Class: B.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

   a. Pressure Class: Negative 3-inch wg (750 Pa).
   b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.

2. Ducts Connected to Air-Handling Units:

   a. Pressure Class: Positive or negative 3-inch wg (750 Pa).
   b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.

3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.

   a. Type 304, stainless-steel sheet.
   b. Welded seams and joints.
   c. Pressure Class: Positive or negative 3-inch wg (750 Pa).
   d. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
   e. SMACNA Leakage Class: 3.

4. Ducts Connected to Dishwasher Hoods:

   a. Type 304, stainless-steel sheet.
   b. Welded seams and flanged joints with watertight EPDM gaskets.
   c. Pressure Class: Positive or negative 3-inch wg (750 Pa).
   d. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.

e. SMACNA Leakage Class: 3.

5. Ducts Connected to Fans Exhausting Laboratory and Process (ASHRAE 62.1, Class 3 and 4) Air:

a. Type 316, stainless-steel sheet.
b. Seams: Factory machine formed spiral lock type.
c. Elbows and Fittings: Continuous-welded construction. Elbows shall have a centerline radius equal to 1.5 times the duct diameter.
d. Pressure Class: Positive or negative 6-inch wg (1500 Pa).
e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
SMACNA Leakage Class: 3.

6. Ducts Connected to Perchloric Acid Hoods:

a. Materials: Welded stainless steel type 316 or flame retardant polypropylene.
b. Provide complete washdown and drain system.
c. Sealants, Gaskets, and Lubricants: acid resistant and nonreactive with perchloric acid.

7. Ducts Connected to Radioisotope Hoods:

a. Materials: Stainless steel type 304.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: C.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: B.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 3.
SMACNA Leakage Class for Round and Flat Oval: 3.

F. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

2. PVC-Coated Ducts:

a. Exposed to Airstream: Match duct material.

b. Not Exposed to Airstream: Match duct material.

3. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Galvanized.

G. Double-Wall Duct Interstitial Insulation:

1. Supply Air Ducts: 2 inches (51 mm) thick.
2. Return Air Ducts: 1-1/2 inches (38 mm) thick.

H. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Velocity 1000 fpm (5 m/s) or Lower:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):

1) Radius Type RE 1 with minimum 1.0 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."

c. Velocity 1500 fpm (7.6 m/s) 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: 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 (5 m/s) or Lower: 1.0 radius-to-diameter ratio and three segments for 90-degree elbow.
        2) Velocity 1000 to 1500 fpm(5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
        3) Velocity 1500 fpm (7.6 m/s) 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 (305 mm) and Smaller in Diameter: Stamped or pleated.
    c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Standing seam or welded.

I. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connections."

    a. Rectangular Main to Rectangular Branch: 45-degree entry.
    b. Rectangular Main to Round Branch: 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 (5 m/s) or Lower: 90-degree tap.
    b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
    c. Velocity 1500 fpm (7.6 mm) or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

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. Backdraft and pressure relief dampers
2. Manual volume dampers
3. Fire dampers
4. Flange connectors
5. Turning vanes
6. Remote damper operators
7. Duct-mounted access doors
8. Duct access panel assemblies
9. Flexible connectors
10. Flexible ducts
11. Duct accessory hardware

B. Related Sections:

1. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

1.3 SUBMITTALS

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

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. LEED Submittal:

1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."
2. Product Data for Prerequisite EA 2: Documentation indicating that duct insulation R-values comply with tables in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air Conditioning."

C. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings
b. Manual volume damper installations
c. Control damper installations
d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators
e. Wiring Diagrams: For power, signal, and control wiring

D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

E. Source quality-control reports.

F. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

A. 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 shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90 (Z275)
2. Exposed-Surface Finish: Mill phosphatized

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304.

D. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: Comply with ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

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

1. Air Balance Inc.; a division of Mestek, Inc.
2. Louvers and Dampers; a division of Mestek, Inc.
3. Greenheck Fan Corporation
4. Ruskin Company; BD6 Heavy Duty Backdraft Damper

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2000 fpm (10 m/s).

D. Maximum System Pressure: 1-inch wg (0.25 kPa).

E. Frame: 0.063-inch- (1.6-mm-) thick extruded aluminum, with welded corners and mounting flange.

F. Blades: Multiple single-piece blades, maximum 6-inch (150-mm) width, 0.025-inch- (0.6-mm-) thick, roll-formed aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Extruded vinyl, mechanically locked.

I. Blade Axles: Aluminum.

J. Tie Bars and Brackets: Aluminum.

K. Return Spring: Adjustable tension.

L. Bearings: Synthetic pivot bushings.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.

4. Chain pulls.
5. Screen Mounting: Front or rear mounted in sleeve as indicated.
6. Screen Material: Galvanized.
7. Screen Type: Bird.
8. 90-degree stops.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

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

    a. Air Balance Inc.; a division of Mestek, Inc.
    b. Greenheck Fan Corporation
    c. Louvers and Dampers; a division of Mestek, Inc.
    d. McGill AirFlow LLC
    e. Nailor Industries Inc.
    f. Ruskin Company

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:

    a. Hat-shaped, galvanized-steel channels, 0.064-inch (1.62 mm) minimum thickness.
    b. Mitered and welded corners.
    c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Galvanized-steel, 0.064 (1.62 mm) inch thick.

6. Blade Axles: Galvanized steel.
7. Bearings:

    a. Oil-impregnated bronze or molded synthetic.
    b. Dampers in ducts with pressure classes of 3-inch (750 Pa) wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:

1. Size: 1-inch (25 mm) diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch (2.4 mm) thick zinc-plated steel, and a 3/4-inch (19 mm) hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.4 FIRE DAMPERS

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

1. Air Balance Inc.; a division of Mestek, Inc.
2. Louvers and Dampers; a division of Mestek, Inc.
3. Greenheck Fan Corporation
4. McGill AirFlow LLC
5. Ruskin Company

B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch (1 kPa) wg static pressure class and minimum 4000-fpm (20 m/s) velocity.

D. Fire Rating: 1-1/2 hours.

E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.052 or 0.138 inch (1.3 or 3.5 mm) thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch (0.85 mm) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034 (0.85 mm) inch- thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Fusible links.

2.5 FLANGE CONNECTORS

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

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.6 TURNING VANES

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

1. Ductmate Industries, Inc.
2. METALAIRE, Inc.
3. SEMCO Incorporated

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

D. Vane Construction: Double wall.

2.7 REMOTE DAMPER OPERATORS

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

1. Greenheck Fan Corporation
2. Ventfabrics, Inc.
3. Young Regulator Company

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Brass.

D. Cable: Stainless steel.

E. Wall-Box Mounting: Recessed, 3/4 inches (19 mm) deep.

F. Wall-Box Cover-Plate Material: Steel.

2.8 DUCT-MOUNTED ACCESS DOORS

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

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Ductmate Industries, Inc.
3. Flexmaster U.S.A., Inc.
4. Greenheck Fan Corporation
5. McGill AirFlow LLC
6. Nailor Industries Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; 7-2 (7-2M), "Duct Access Doors and Panels," and 7-3, "Access Panels - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Vision panel.
d. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches (300 mm) Square: No hinges and two sash locks.
b. Access Doors up to 18 Inches (460 mm) Square: Two hinges and two sash locks.
c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches with outside and inside handles.
d. Access Doors Larger than 24 by 48 Inches (600 by 1200 mm): Four hinges and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.

3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 10-inch wg (2500 Pa).
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.9 DUCT ACCESS PANEL ASSEMBLIES

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

1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. 3M

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch (1.3-mm) carbon steel.

D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F (1093 deg C).

F. Minimum Pressure Rating: 10-inch wg (2500 Pa), positive or negative.

2.10 FLEXIBLE CONNECTORS

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

1. Ductmate Industries, Inc.
2. Ventfabrics, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to 2 strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.

A. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

A. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd. (810 g/sq. m).
2. Minimum Tensile Strength: 530 lbf/inch (93 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).

A. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.

1. Minimum Weight: 14 oz./sq. yd. (474 g/sq. m).
2. Tensile Strength: 450 lbf/inch (79 N/mm) in the warp and 340 lbf/inch (60 N/mm) in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F (Minus 55 to plus 260 deg C).

A. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor 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.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch (6-mm) movement at start and stop.

2.11 FLEXIBLE DUCTS

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

1. Flexmaster U.S.A., Inc.; Type 8M
2. McGill AirFlow LLC

B. Acoustical, Insulated, Flexible Duct: UL 181, Class 1, CPE inner film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.

2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

C. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.

2.15 DUCT ACCESSORY HARDWARE

D. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

E. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.
3. Do not use extractors, splitter-type dampers, and register or diffuser dampers for volume control.
4. Locate volume dampers at least two diameters from a fitting and as far as possible from outlets.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire dampers according to UL listing.

H. Connect ducts to duct silencers rigidly.

I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot (15-m) spacing.
8. Upstream from turning vanes.
9. Upstream or downstream from duct silencers.
10. Control devices requiring inspection.
11. Upstream from flow measuring stations.
12. Upstream from steam humidifiers.
13. In duct below roof ventilators or fans to service dampers.
14. Elsewhere as indicated.

J. Install access doors with swing against duct static pressure.

K. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
5. Body Access: 25 by 14 inches (635 by 355 mm).
6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).

L. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

M. Install flexible connectors to connect ducts to equipment.

N. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

O. Connect diffusers or light troffer boots to ducts with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.

P. Connect flexible ducts to metal ducts with draw bands.

Q. Install duct test holes where required for testing and balancing purposes.

R. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

S. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233423 - HVAC POWER VENTILATORS

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. This Section includes the following:

1. Utility set fans.
2. Centrifugal roof ventilators.
3. Axial roof ventilators.
4. Upblast propeller roof exhaust fans.
5. Centrifugal wall ventilators.
6. In-line centrifugal fans.
7. Propeller fans.

1.3 PERFORMANCE REQUIREMENTS

A. Operating Limits: Classify according to AMCA 99.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Fan speed controllers.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Wiring Diagrams: Power, signal, and control wiring.

4. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set for each belt-driven unit.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. UL Standard: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.9 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases with actual equipment provided.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

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

1. Aerovent; a Twin City Fan Company
2. Carnes Company HVAC.
3. Greenheck.
4. Loren Cook Company.

B. Description: Direct-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Housing: Removable, spun-aluminum, dome top and outlet baffle; 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 and grease collector.
2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

E. Belt Drives:

1. Resiliently mounted to housing.
2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
5. Fan and motor isolated from exhaust airstream.

F. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

2.2 AXIAL ROOF VENTILATORS

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

1. Aerovent; a Twin City Fan Company.
2. Carnes Company HVAC.
3. Greenheck.
4. Loren Cook Company.
5. New York Blower Company (The).

B. Description: Direct-driven axial fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; square, one-piece, hinged, aluminum base.

1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

D. Fan Wheel: Aluminum or Steel hub and blades.

E. Belt Drives:

1. Resiliently mounted to housing.
2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
4. Pulleys: Cast-iron, adjustable-pitch motor pulley.

F. Accessories:

1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
2. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
4. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

B. Enclosure Type: Totally enclosed, fan cooled.

2.4 SOURCE QUALITY CONTROL

A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Support units using spring isolators having a static deflection of 1 inch (25 mm). Vibration- and seismic-control devices are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

D. Secure roof-mounting fans to roof curbs with cadmium-plated hardware.

E. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

F. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch (25 mm). Vibration-control devices are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

G. Install units with clearances for service and maintenance.

H. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. 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.
3. Verify that cleaning and adjusting are complete.
4. 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.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION 233423

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

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. Ceiling diffusers.
2. Registers and grilles.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Carnes.
2. Krueger.
3. Price Industries.
4. Titus.
5. Tuttle & Bailey.

2.2 GENERAL REQUIREMENTS

A. Air inlets and outlets shall be tested in accordance with ASHRAE 70.

B. Throw, horizontal distance from the diffuser to the point where the theoretical centerline velocity is 50 feet per minute, shall not exceed the horizontal distance between the diffuser and the nearest wall, or half the horizontal distance between ceiling diffusers.

2.3 CEILING DIFFUSERS

A. Round Ceiling Diffuser:

1. Devices shall be specifically designed for variable-air-volume flows.
2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Style: Three cone.
5. Mounting: Duct connection.
6. Pattern: Fully adjustable.
7. Dampers

B. Rectangular and Square Ceiling Diffusers:

1. Devices shall be specifically designed for variable-air-volume flows.
2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Style: Three cone.
5. Pattern: Adjustable Throw
6. Dampers

2.4 REGISTERS AND GRILLES

A. Supply Air Bar Grille:

1. Material: Steel.
2. Finish: Baked enamel, white.
3. Face Blade Arrangement: Adjustable. Vertical spaced 3/4 inch (19 mm) apart.
4. Rear Blade Arrangement: Adjustable. Horizontal spaced 3/4 inch (19 mm) apart.
5. Frame: 1-1/4 inches (32 mm) wide.
6. Mounting: Countersunk screw, concealed, or lay in as scheduled.

B. Return Air Bar Grille:

1. Material: Steel.
2. Finish: Baked enamel, white.
3. Face Blade Arrangement: 45 degree fixed horizontal spaced 3/4 inch (19 mm) apart.
4. Frame: 1-1/4 inches (32 mm) wide.
5. Mounting: Countersunk screw, concealed, or lay in as scheduled.

2.5 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Adjust the classroom grilles to prevent strong drafts.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 236313 - AIR-COOLED REFRIGERANT CONDENSERS

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. This Section includes packaged, air-cooled condensers.

1.3 SUBMITTALS

A. Product Data: For each air-cooled condenser, include rated capacities, operating characteristics, furnished specialties, and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For air-cooled condensers to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Code for Mechanical Refrigeration."

C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

C. Coordinate location of refrigerant piping and electrical roughins.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Bohn Refrigeration Products; Heatcraft, Inc.
2. Carrier Corporation; Carrier Air Conditioning Div.
3. Dunham-Bush, Inc.
4. McQuay International.
5. Trane Co. (The); Worldwide Applied Systems Group.
6. York International Corp.

2.2 PACKAGED, OUTDOOR AIR-COOLED CONDENSERS

A. Description: Factory assembled and tested; consisting of casing, condenser coils, condenser fans and motors, and unit controls.

B. Condenser Coil: Seamless copper-tube, finned coil; factory tested at 425 psig (2930 kPa).

1. Coil Fin: Aluminum.
2. Circuit: To match compressors with liquid subcooling coil.
3. Refrigerant Accessories: Provide receiver, pressure control, and solenoid valve for each circuit.

C. Condenser Fans and Drives: Propeller fans with aluminum or galvanized-steel fan blades, for vertical air discharge; directly driven with permanently lubricated ballbearing motors with integral current- and thermal-overload protection.

D. Operating and Safety Controls: Include condenser fan motor thermal and overload cutouts; 115-V control transformer, if required; magnetic contactors for condenser fan motors and a nonfused factory-mounted and -wired disconnect switch for single external electrical power connection.

A. Low Ambient Controller: Cycles condenser fans or controls condenser fan speed to permit operation down to 0 deg F (minus 18 deg C).

B. Unit Casings: Galvanized or zinc-coated steel treated and finished with manufacturer's standard paint coating, designed for outdoor installation with weather protection for components and controls, and with the following:

1. Removable panels for access to controls, condenser fans, motors, and drives.
2. Plated-steel fan guards.
3. Lifting eyes.

4. Removable legs.

2.3 PACKAGED, INDOOR AIR-COOLED CONDENSERS

A. Description: Factory assembled and tested; consisting of casing, condenser coils, condenser fans and motors, and unit controls.

B. Condenser Coil: Seamless copper-tube, finned coil; factory tested at 425 psig (2930 kPa).

1. Coil Fin: Aluminum.
2. Circuit: To match compressors with liquid subcooling coil.
3. Refrigerant Accessories: Provide receiver, pressure control, and solenoid valve for each circuit.

C. Condenser Fans and Drives: Forward-curved centrifugal fans for horizontal air discharge.

1. Fan on steel shaft with self-aligning ball bearings.
2. V-belt drive with minimum of two belts; variable pitch drive pulley.
3. Motor mounted on adjustable slide base.

D. Operating and Safety Controls: Include condenser fan motor thermal and overload cutouts; 115-V control transformer, if required; magnetic contactors for condenser fan motors and a nonfused factory-mounted and -wired disconnect switch for single external electrical power connection.

E. Low Ambient Controller: Cycles condenser fans or controls condenser fan speed to permit operation down to 0 deg F (minus 18 deg C).

F. Unit Casings: Galvanized or zinc-coated steel treated and finished with manufacturer's standard paint coating, designed for indoor installation, and with the following:

1. Removable panels for access to controls, condenser fans, motors, and drives.
2. 1-inch- (25-mm-) thick inlet filter.

2.4 MOTORS

A. General requirements for motors are specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

2.5 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate air-cooled condensers according to ARI 460.

B. Testing Requirements: Factory test sound-power-level ratings according to ARI 270.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of air-cooled condensers.

B. Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where air-cooled condensers will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.

B. Install air-cooled condensers on concrete base. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.

C. Install roof-mounting units on equipment supports specified in Division 07.

D. Vibration Isolation: Mount air-cooled condensers on rubber pads with a minimum deflection of 1/4 inch (6.35 mm). Vibration isolation devices and installation requirements are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

E. Maintain manufacturer's recommended clearances for service and maintenance.

F. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Refrigerant Piping: Connect piping to unit with pressure relief, service valve, filter-dryer, and moisture indicator on each refrigerant-circuit liquid line. Refrigerant piping and specialties are specified in Division 23 Section "Refrigerant Piping."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Perform electrical test and visual and mechanical inspection.
2. Leak Test: After installation, charge system 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. Complete manufacturer's starting checklist.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Verify proper airflow over coils.

B. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

C. Remove and replace malfunctioning air-cooled condensers and retest as specified above.

3.5 STARTUP SERVICE

A. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

1. Inspect for physical damage to unit casing.
2. Verify that access doors move freely and are weathertight.
3. Clean units and inspect for construction debris.
4. Verify that all bolts and screws are tight.
5. Adjust vibration isolation and flexible connections.
6. Verify that controls are connected and operational.

B. Lubricate bearings on fans.

C. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.

D. Start unit according to manufacturer's written instructions and complete manufacturer's startup checklist.

E. Measure and record airflow over coils.

F. Verify proper operation of capacity control device.

G. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

H. After startup and performance test, lubricate bearings.

3.6 DEMONSTRATION

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

END OF SECTION 236313

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

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 split-system air-conditioning units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. LEED Submittals:

1. Product Data for Credit EA 4: For refrigerants, documentation including printed statement that refrigerants are free of HCFCs.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

D. Samples for Initial Selection: For units with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-Up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Carrier Corporation; Home Comfort and HVAC Building & Industrial Systems.
2. Fujitsu General America, Inc.
3. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.
4. Mitsubishi Heavy Industries America, Inc.
5. SANYO North America Corporation; SANYO Fisher Company.
6. Trane; a business of American Standard companies.
7. YORK; a Johnson Controls company.
8. Daikin

2.2 INDOOR UNITS 5 TONS (18 kW) OR LESS

A. Concealed Evaporator-Fan Components:

1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
2. Insulation: Faced, glass-fiber duct liner.

3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
4. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
5. Fan Motors:

    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
    b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
    c. Wiring Terminations: Connect motor to chassis wiring with plug connection.

6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
7. Filters: Permanent, cleanable.
8. Condensate Drain Pans:

    a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

        1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
        2) Depth: A minimum of 2 inches (50 mm) deep.

    b. Double-wall, galvanized-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
    c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

        1) Minimum Connection Size: NPS 1 (DN 25).

    d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
    e. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

B. Floor-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect.

    a. Discharge Grille: Steel with surface-mounted frame.
    b. Insulation: Faced, glass-fiber duct liner.
    c. Drain Pans: Galvanized steel, with connection for drain; insulated.

2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
3. Fan: Direct drive, centrifugal, with power-induced outside air.
4. Fan Motors:

a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
b. Multitapped, multispeed with internal thermal protection and permanent lubrication.

5. Air Filtration Section:

a. General Requirements for Air Filtration Section:

1) Comply with NFPA 90A.
2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

b. Disposable Panel Filters:

1) Factory-fabricated, viscous-coated, flat-panel type.
2) Thickness: 1 inch (25 mm).
3) Arrestance according to ASHRAE 52.1: 80.
4) Merv according to ASHRAE 52.2: 5.
5) Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
6) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

C. Wall-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
3. Fan: Direct drive, centrifugal.
4. Fan Motors:

a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
c. Enclosure Type: Totally enclosed, fan cooled.
d. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
e. Mount unit-mounted disconnect switches on exterior of unit.

5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
6. Condensate Drain Pans:

a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
2) Depth: A minimum of 1 inch (25 mm) deep.

b. Double-wall, galvanized-steel sheet with space between walls filled with foam insulation and moisture-tight seal.

c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

1) Minimum Connection Size: NPS 1 (DN 25).

d. Pan-Top Surface Coating: Asphaltic waterproofing compound.

7. Air Filtration Section:

a. General Requirements for Air Filtration Section:

1) Comply with NFPA 90A.
2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

b. Disposable Panel Filters:

1) Factory-fabricated, viscous-coated, flat-panel type.
2) Thickness: 1 inch (25 mm).
3) Arrestance according to ASHRAE 52.1: 80.
4) Merv according to ASHRAE 52.2: 5.
5) Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
6) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

2.3 OUTDOOR UNITS (5 TONS (18 kW) OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

a. Compressor Type: Scroll.

b. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 210/240.

3. Fan: Aluminum-propeller type, directly connected to motor.
4. Motor: Permanently lubricated, with integral thermal-overload protection.
5. Low Ambient Kit: Permits operation down to 45 deg F (7 deg C).
6. Mounting Base: Polyethylene.

2.4 ACCESSORIES

A. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
4. Fan-speed selection including auto setting.

B. Automatic-reset timer to prevent rapid cycling of compressor.

C. Refrigerant Line Kits are not permitted except by special and specific approval of MSU Engineers and trades personnel. Refrigerant piping shall conform with all applicable MSU Standards in Division 23.

D. Drain Hose: For condensate.

E. Additional Monitoring:

1. Monitor constant and variable motor loads.
2. Monitor variable-frequency-drive operation.
3. Monitor economizer cycle.
4. Monitor cooling load.
5. Monitor air distribution static pressure and ventilation air volumes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install ground-mounted, compressor-condenser components on 4-inch- (100-mm-) thick, reinforced concrete base that is 4 inches (100 mm) larger, on each side, than unit. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.

D. Install roof-mounted, compressor-condenser components on equipment supports specified in Division 07 Section "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.

E. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 1 inch (25 mm). See Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

F. Install a check valve immediately off the drain pan to start the drain system with pumped drain off of an evaporator drain pan. The check valves shall be line size of pan drain. Install a float in the drain pan that shuts down the A/C unit in case of the pump malfunctioned.

3.2 CONNECTIONS

G. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

H. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

I. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

J. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

K. Remove and replace malfunctioning units and retest as specified above.

L. Prepare test and inspection reports.

3.4 STARTUP SERVICE

M. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

N. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 238219 - FAN COIL UNITS

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. This Section includes fan-coil units and accessories.

1.3 DEFINITIONS

A. BAS: Building automation system.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. LEED Submittals:

1. Product Data for Credit EA 4: Documentation required by Credit EA 4 indicating that equipment and refrigerants comply.
2. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of fan-coil unit indicated.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For fan-coil units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.

1.5 Warranties: Submit written special warranty as specified in this Section. Include contact information, description of coverage, and start date for each special warranty.QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 COORDINATION

A. Coordinate layout and installation of fan-coil units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan-Coil-Unit Filters: Furnish one spare filters for each filter installed.

PART 2 - PRODUCTS

2.1 FAN-COIL UNITS

A. Manufacturers:

1. Carrier Corporation.
2. Environmental Technologies, Inc.
3. Daikin.
4. Sterling Hydronic Products
5. Trane.
6. YORK International Corporation.
7. Price Industries
8. IEC International Environmental Corporation
9. ZehnderRittling

B. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.

C. Main and Auxiliary Drain Pans: Plastic. Fabricate pans and drain connections to comply with ASHRAE 62.1-2004. Drain pans shall be removable.

D. Chassis: Galvanized steel where exposed to moisture. Floor-mounting units shall have leveling screws.

E. Cabinet: Steel with baked-enamel finish in manufacturer's standard paint color as selected by Architect.

1. Vertical Unit Front Panels: Removable, steel, with steel discharge grille and channel-formed edges, cam fasteners, and insulation on back of panel.
2. Horizontal Unit Bottom Panels: Fastened to unit with cam fasteners and hinge and attached with safety chain; with integral stamped discharge grilles.
3. Steel recessing flanges for recessing fan-coil units into ceiling or wall.

F. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
1. Pleated Cotton-Polyester Media: 90 percent arrestance and 7 MERV.

G. Fan and Motor Board: Removable.

1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
3. Wiring Termination: Connect motor to chassis wiring with plug connection.

Basic Unit Controls:

4. Control voltage transformer.
5. Unit-mounted thermostat with the following features:

a. Heat-cool-off switch.
b. Fan on-auto switch.
c. Fan-speed switch.
d. Automatic changeover.
e. Adjustable deadband.
f. Concealed set point.
g. Concealed indication.
h. Degree F indication.

6. Unit-mounted temperature sensor.
7. Unoccupied-period-override push button.
8. Data entry and access port.

a. Input data includes room temperature, and humidity set points and occupied and unoccupied periods.
b. Output data includes room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status.

H. DDC Terminal Controller:

1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
2. Unoccupied Period Override Operation: Two hours.
3. Unit Supply-Air Fan Operation:

    a. Occupied Periods: Fan runs continuously.
    b. Unoccupied Periods: Fan cycles to maintain room setback temperature.

4. Hydronic-Cooling-Coil Operation:

    a. Occupied Periods: Modulate control valve to maintain room temperature.
    b. Unoccupied Periods: Close control valve.

5. Heating-Coil Operation:

    a. Occupied Periods: Modulate control valve to provide heating if room temperature falls below thermostat set point.
    b. Unoccupied Periods: Start fan and modulate control valve if room temperature falls below setback temperature.

6. Outdoor-Air Damper Operation:

    a. Occupied Periods: Open damper to fixed position for indicated percent outdoor air.
    b. Unoccupied periods: Close damper.

7. Outdoor-Air Damper Operation:

    a. Occupied Periods:

        1) Outdoor-Air Temperature below Room Temperature: If room temperature is above thermostat set point, modulate outdoor-air damper to maintain room temperature (outdoor-air economizer). If room temperature is below thermostat set point, position damper to fixed minimum position.
        2) Outdoor-Air Temperature above Room Temperature: Position damper to fixed minimum position for indicated percent outdoor air.

    b. Unoccupied Periods: Close damper.

8. Controller shall have volatile-memory backup.

I. Electrical Connection: Factory wire motors and controls for a single electrical connection.

J. Characteristics:

1. Filters: 1 inch (25 mm) thick.

2.2 DUCTED FAN-COIL UNITS

A. Manufacturers:

1. Carrier Corporation.
2. Environmental Technologies, Inc.
3. McQuay International.
4. Sterling Hydronic Products
5. Trane.
6. YORK International Corporation.
7. Zehnder Rittling

B. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.

C. Coil Section Insulation: 1/2-inch (13-mm) thick coated glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.

1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

D. Drain Pans: Plastic. Fabricate pans and drain connections to comply with ASHRAE 62.1-2004.

E. Chassis: Galvanized steel where exposed to moisture, with baked-enamel finish and removable access panels.

F. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.

1. Supply-Air Plenum: Sheet metal plenum finished and insulated to match the chassis.
2. Return-Air Plenum: Sheet metal plenum finished to match the chassis.
3. Dampers: Galvanized steel with extruded-vinyl blade seals, flexible-metal jamb seals, and interlocking linkage.

G. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Pleated Cotton-Polyester Media: 90 percent arrestance and 7 MERV.

H. Direct-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, multispeed motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.

1. Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

I. Basic Unit Controls:

1. Control voltage transformer.

2. Unit-mounted thermostat with the following features.

    a. Heat-cool-off switch.
    b. Fan on-auto switch.
    c. Fan-speed switch.
    d. Automatic changeover.
    e. Adjustable deadband.
    f. Concealed set point.
    g. Concealed indication.
    h. Degree F indication.

3. Unit-mounted temperature sensor.
4. Unoccupied-period-override push button.
5. Data entry and access port.

    a. Input data includes room temperature, and humidity set points and occupied and unoccupied periods.
    b. Output data includes room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status.

J. DDC Terminal Controller:

1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
2. Unoccupied Period Override Operation: Two hours.
3. Unit Supply-Air Fan Operation:

    a. Occupied Periods: Fan runs continuously.
    b. Unoccupied Periods: Fan cycles to maintain room setback temperature.

4. Outdoor-Air Damper Operation (where applicable):

    a. Occupied Periods: Open damper to fixed position for indicated percent outdoor air.
    b. Unoccupied Periods: Close damper.

5. Outdoor-Air Damper Operation:

    a. Occupied Periods:

        1) Outdoor-Air Temperature below Room Temperature: If room temperature is above room-temperature set point, modulate outdoor- and return-air dampers to maintain room-temperature set point (outdoor-air economizer). If room temperature is below set point, position damper to fixed minimum setting.
        2) Outdoor-Air Temperature above Room Temperature: Position damper to fixed minimum position for pre-determined, adjustable percent outdoor air.

    b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.

6. Controller shall have volatile-memory backup.

K. Electrical Connection: Factory wire motors and controls for a single electrical connection.

L. Capacities and Characteristics:

1. Filters: 1 inch (25 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive fan-coil units for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before fan-coil-unit installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fan-coil units level and plumb.

B. Install fan-coil units to comply with NFPA 90A.

C. Suspend fan-coil units from structure with elastomeric hangers. Vibration isolators are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

D. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 60 inches (1525 mm) above finished floor.

E. Install new filters in each fan-coil unit within two weeks after Substantial Completion.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Connect condensate drain to indirect waste.

a. Install condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.

B. Connect supply and return ducts to fan-coil units with flexible duct connectors specified in Division 23 Section "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan-coil units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 238219

SECTION 238233 - CONVECTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Finned-tube radiators.
2. Convectors.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Location and size of each field connection.
2. Location and arrangement of piping valves and specialties.
3. Enclosure joints, corner pieces, access doors, and other accessories.

C. Color Samples for Initial Selection: For units with factory-applied color finishes.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For convection heating units to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 HOT-WATER OR STEAM FINNED-TUBE RADIATORS

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

1. Slant/Fin.
2. Sterling.
3. Trane.
4. Vulcan Radiator; Style DS.
5. Airtex
6. ZehnderRittling

B. Performance Ratings: Rate finned-tube radiators according to Hydronics Institute's "I=B=R Testing and Rating Standard for Finned-Tube (Commercial) Radiation."

C. Heating Elements:

1. Steam: Steel tubing mechanically expanded into flanged collars of evenly spaced steel fins resting on element supports. Tube ends shall be threaded.
2. Hot-water: Copper tubing mechanically expanded into flanged collars of evenly spaced aluminum fins resting on element supports. Tube ends shall be expanded for soldering.

D. Element Supports: Ball-bearing cradle type to permit longitudinal movement on enclosure brackets.

E. Rust-Resistant Front Panel: Minimum 0.064-inch- (1.6-mm-) thick, ASTM A 653/A 653M, G60 galvanized steel.

F. Wall-Mounting Back Panel: Minimum 0.0329-inch- (0.85-mm-) thick steel, full height, with full-length channel support for front panel without exposed fasteners.

G. Floor-Mounting Pedestals: Conceal insulated piping at maximum 36-inch (914-mm) spacing. Pedestal-mounting back panel shall be solid panel matching front panel. Provide stainless-steel escutcheon for floor openings at pedestals.

H. Support Brackets: Locate at maximum 36-inch (914-mm) spacing to support front panel and element.

I. Finish: Baked-enamel finish in manufacturer's standard color as selected by Architect.

J. Damper: Knob-operated internal damper at enclosure outlet.

K. Access Doors: Factory made, permanently hinged with tamper-resistant fastener, minimum size 6 by 7 inches (150 by 175 mm), integral with enclosure.

L. Enclosure Style: Sloped top.
1. Top Outlet Grille: Punched louver; painted to match enclosure.

M. Accessories: Filler sections, corners, relay sections, and splice plates all matching the enclosure and grille finishes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive convection heating units for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for connections to verify actual locations before convection heating unit installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONVECTOR INSTALLATION

A. Install units level and plumb.

B. Install air-seal gasketing between wall and recessing flanges or front cover of fully recessed unit.

C. Install piping within pedestals for freestanding units.

3.3 CONNECTIONS

A. Install control valves as required by Division 23 Section "Instrumentation and Control for HVAC."

B. Install piping adjacent to convection heating units to allow service and maintenance.

C. Conceal piping behind the enclosure of the finned-tube radiations.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace convection heating units that do not pass tests and inspections and retest as specified above.

END OF SECTION 238233

SECTION 260100 - BASIC ELECTRICAL REQUIREMENTS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Basic Electrical Requirements specifically applicable to Divisions 26 Sections, in addition to General Conditions, Supplementary Conditions, Division 1 and Division 2.

B. Drawings and all electrical sections apply to each section of the electrical specifications.

1.02 SUMMARY

A. It is mandatory that all electrical trades work required for the complete installation must accommodate Owner's access to his daily operation. Coordinate work schedule with representative.

1.03 WORK INCLUDED

A. The work shall include, but shall not be limited to the following:

1. The provision of underground conduits.
2. The demolition necessary to accommodate new work and new construction.
3. The provision of underground feeders to existing distribution system and new distribution equipment.
4. The provision of a complete grounding system.
5. The provision of 120/208V distribution panelboards.
6. The provision of 120/208V, 3 phase, 4 wire panelboards.
7. The provision of all separate motor controls including disconnect switches, manual starters, magnetic starters, combination starters, as required for all mechanical equipment.
8. The provision of all required outlets, devices and wiring.
9. The provision of recessed floor boxes with adjustable cover assembly and receptacle outlets for power and data/voice system.
10. The provision of all interior.
11. The provision of a complete egress lighting system.
12. The provision of exit lights as shown and/or required.
13. The provision and/or replacement of new switches and/or breakers in existing panelboards as shown on drawings.
14. The removal and replacement of panelboards as shown.
15. The removal, replacing and updating the directory for all panelboards.
16. The provision, rework and/or replacement of outlets as indicated or required.

17. The provision of control devices, switches, motion devices for indoor lighting.
18. The provision of new fire alarm system, including main fire alarm panelboards, all devices, boxes, water sprinkler flow switches.
19. The rework and addition of data/voice system.
20. The provision of raceway, boxes, rough in, etc., including pull wire for all devices.
21. The provision of cable tray, raceways, boxes rough in for all data/voice, sound system devices.
22. The disconnect of mechanical equipment as shown on mechanical and electrical documents including the removal of conduits and wiring back to source as applicable.
23. The provision of complete sound system, complete with conduits, boxes, wiring, speakers, microphones, amplifier, and all devices for a complete system.
24. The removal and disposal of all empty conduits, switches, starters, and contactors that are no longer in usage.
25. All steel supports required for the installation of electrical equipment, conduits, metal raceways, cabinets and lighting fixtures and elsewhere as required for complete installation.
26. All cutting and patching work required for the electrical installation, unless noted otherwise.
27. Acceptance testing for all new electrical systems and equipment.
28. All incidental items required to complete the installation.
29. Electrical systems commissioning.
30. The provision of Overcurrent Protective Device Coordination Study.

1.04 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code 2002 Edition.

1.05 SUBMITTALS

A. Submit under provisions of Section 01700.

B. Proposed Products List: Include Products specified in the following sections:

Section	260100	Basic Electrical Requirements
Section	260519	Low-Voltage Electrical Power Conductors And Cables
Section	260526	Grounding And Bonding For Electrical Systems
Section	260529	Hangers And Supports For Electrical Systems
Section	260533	Raceway And Boxes For Electrical Systems
Section	260536	Cable Trays For Electrical Systems
Section	260553	Identification For Electrical Systems
Section	260573	Overcurrent Protective Device Coordination Study
Section	260923	Lighting Control Devices
Section	262416	Panelboards
Section	262726	Wiring Devices
Section	262813	Fuses
Section	262816	Enclosed Switches And Circuit Breakers
Section	262913	Enclosed Controllers

Section 265100 Interior Lighting
Section 270500 Common Work Results For Communications
Section 280500 Common Work Results For Electronic Safety And Security
Section 283111 Digital, Addressable Fire-Alarm System

C. Submit shop drawings and product data grouped to include complete submittals of related equipment and accessories in a single submittals.

D. Mark dimensions and values in units to match those specified.

E. Upon completion of project contractor shall provide Owner with one set of complete record drawings of the power, fire alarm, security, telecommunication and audio/visual systems.

1.06 REGULATORY REQUIREMENTS

A. All applicable ANSI, NFPA, State, County, City and local codes and ordinances.

B. Obtain and pay for all required permits.

C. Request inspections from authority having jurisdiction.

1.07 PROJECT/SITE CONDITIONS

A. Install work in locations shown on drawings, unless prevented by Project conditions.

B. Prepare drawings showing proposed rearrangement of exposed work to meet project conditions, including changes to work specified in other Sections. Obtain permission of Architect/Engineer before proceeding.

1.08 WIRING METHODS

A. Provide raceways for all wiring. Wiring shall not be run exposed or concealed without being enclosed in raceways.

B. Do not mix wiring systems. Provide separate raceways for different systems by Voltage, type or purpose.

1. 120/208 volt separate from 277/480 volts.
2. Exit and means of egress lighting separate.
3. Tele/comm/data/separate.
4. Fire alarm.

1.09 WORK NOT INCLUDED OR WITH OWNER TRADES

The following work will not be part of the electrical work:

A. Furnishing and installation of all building motors.

B. The Architectural and Mechanical Trades control system wiring except 120 volt line circuit wiring to equipment such as unit heaters and domestic hot water circulating pumps.

C. "Package Unit" equipment, and similar items, will be furnished with starters and control devices by the Mechanical Trades unless otherwise shown on M & E Coordination Schedule.

1.10 DEFINITIONS

A. In the Electrical sections of Specifications, the terms "Electrical Trades", "The Contractor", or "This Contractor" shall mean the Electrical Contractor. The term “Provide” shall mean “furnished and installed in place.”

1.11 INSPECTION OF SITE

A. Before submitting his proposal, this Contractor shall personally inspect the site of the proposed work to arrive at a clear understanding of the conditions under which work is to be done. He shall be held responsible to have compared the premises and site with the Drawings and Specifications and to have satisfied himself as to conditions of the premises, existing obstructions and any other conditions affecting the carrying out of this work, before the delivery of his proposal.

B. No allowances or extra consideration in behalf of the Contractor will subsequently be allowed because of error or failure on the part of the Contractor in making such inspection.

1.12 EXCAVATION AND BACKFILLING

A. All excavation and backfilling required to install work specified in the Electrical Division shall be done by the Contractor for excavation work but paid for by this Contractor.

1.13 DEMOLITION

A. As shown on plans, certain areas in the existing building shall be modified to suit the new requirements.

B. Work in the area includes the disconnection, removal relocation and complete reconnection of all items shown on plans and/or otherwise required to suit the design intent. It shall be the responsibility of the contractor to visit the job site to correctly ascertain the scope of work and to include all pertinent costs in his base bid.

C. Relocate and reroute equipment, devices and wiring as required in demolition areas.

D. All electrical work interfering with modification work for the new requirements shall be disconnected, removed, and/or rerouted to suit the final installation.

E. Removal shall mean complete disconnection and removal of electrical work and material, normally provided by electrical trades, including such items as disconnect switches, control devices, etc., conduit and wire to source.

F. Source shall mean panel or existing item to remain.

G. Relocation shall mean complete disconnection, relocation and reconnection of electrical work and material, normally provided by electrical trades, including such items as disconnect switches, control devices, etc., and extension of existing and/or provision of new conduit and wiring, from source.

H. All equipment and wiring not in renovation areas but affected by work in renovation areas shall be reconnected as necessary for the complete working system.

I. Abandoned and inactive conduits, wire, devices, equipment, etc., on walls shall be removed in their entirety. Existing interior lighting fixtures shall be removed. Conduit and boxes shall be removed. Conduit and wiring feeding devices, and equipment to be removed shall be also removed up to the next active pull box, junction box or panel, hangers, messenger cable, brackets, etc., supporting items to be removed shall also be unfastened and removed. Open holes in ducts, boxes, panels, and knockouts shall be closed with suitable snap plugs or blank-off steel plates.

J. The contractor shall legally remove demolished equipment from the project site.

1.16 CUTTING AND PATCHING

A. All cutting, patching, and refinishing work necessary for the project electrical installations shall be done by the Contractor for such work but paid for by this Contractor.

1.17 PAINTING

A. All factory finished electrical equipment shall be cleaned at completion of job. Equipment showing rust or mars shall be touched up with rust inhibiting primer and finished with enamel of color to match original finish. Paint fire alarm system junction boxes "red". Coordinate painting of fixture hanger rods and stems and auxiliary fixture supports with Painting Trades.

1.18 STRUCTURAL DIFFICULTIES

A. Should any construction conditions prevent the installation of switches, conduit, outlet boxes, junction boxes, conductors, lighting fixtures and/or other related equipment at locations shown on Drawings, minor deviations may be permitted and shall be directed by the Construction Manager and shall be made without any additional cost to Owner.

1.19 SLEEVES, CHASES AND RECESSES

A. Provide conduit sleeves where conduits pass through walls, beams and ceilings. Where specific sizes are not indicated on Drawings, sleeves shall be sized to provide one-half (1/2) inch clearance around the outside surface of the item for which they were installed. They shall be flush with wall surfaces. The space between conduit and sleeves shall be fire stopped using one of the methods detailed in the UL Fire Resistance Directory, Vol. 2, Through - Penetration Firestop Systems, latest Edition. Seal any openings between sleeves and concrete in an appropriate manner

B. The filler materials and methods used shall be rated at least equal to the fire resistance of the construction material being penetrated.

1.20 GRADE OF MATERIAL AND/OR EQUIPMENT

A. All items purchased for this project shall be new, unused material, and shall be manufacturer's first or specification grade and shall be UL listed for their intended use.

1.21 ASSEMBLY OF EQUIPMENT

A. The Drawings and Specifications make mention of numerous items to be purchased and installed and are noted by a manufacturer's name, catalog number and/or brief description. The catalog number as mentioned may not be complete to designate all the accessory parts and appurtenances required for the particular use of function.

B. Arrange with the manufacturer for the purchase of all items required for the complete installation and efficient operation of the equipment furnished.

1.22 USE OF EQUIPMENT

A. The use of any equipment, or any part thereof, for purposes other than testing, even with the Owner's consent, shall not be construed to be an acceptance of the work on the part of the Owner, nor shall it be construed to obligate the Owner in any way to accept improper work or defective materials.

1.23 PROTECTION, HANDLING AND CLEANING

A. Responsibility for care and protection of Electrical Work, including assigned equipment, rests with Electrical Trades until the installation has been accepted.

B. After delivery, before and after installation, store and protect equipment and materials against dampness, theft, injury, or damage from all causes.

C. Protect lighting fixtures, and other equipment with finished enamel or glazed surfaces, from damage by covering and/or coating in an approved manner

1.24 EQUIPMENT CONNECTIONS

A. Connection to equipment, motors, fixtures, etc., shall be made in accordance with the Shop Drawings and rough-in measurements furnished by the manufacturers of the particular equipment furnished. Any and all additional connections not shown on the plans but called for by the Shop Drawings or required for the proper operation shall be provided at no additional charge to Owner.

1.25 CONDUIT INSTALLATION

A. All work shall be concealed in finished areas unless otherwise noted. Exposed work shall be installed perpendicular or parallel to walls, ceilings, and structural members and coordinated with mechanical ducts, pipes, and equipment.

B. For work in finished rooms without ceilings, the conduit shall be run exposed except as noted hereinbefore. Conduit drops for outlets, switches, etc., shall be run concealed in the wall construction and such conduits shall be concealed up to a point at least 9'-6" above the floor.

C. Outlets shall not be installed back to back, maintain a minimum of 12” between adjacent outlets. Through-wall outlets are not permitted.

1.26 ACCESS DOORS

A. Provide all access doors where required by NEC for access to concealed features of the electrical installation. Doors shall be of suitable construction and insulating properties for the wall or ceiling in which they are installed. In the walls and ceilings, doors shall be as required to make all controls, electrical boxes and equipment accessible, minimum size 12" x 12". Provide inserts for access doors to provide similar appearance to the surrounding construction. Areas with lay-in or accessible ceilings will not require access doors.

B. Access doors shall have fire ratings equal to the wall or ceiling in which they are installed, and shall be Milcor, or approved equal. Door shall be provided by Architectural trade, but paid for by this Contractor.

1.27 DRAWINGS AND MEASUREMENTS

A. The Drawings show the general arrangement, general design and location of equipment. The Drawings are to be considered diagrammatic and are not intended to be scaled for roughing-in measurements, nor to serve as Shop Drawings.

B. Electrical Work is shown on Drawings by standard symbols. Special symbols, if used, are shown in a legend on Drawings.

C. Outlets connected by lines show switch control or circuiting only and are not actual runs of conductors. All light and receptacle outlets are lettered and numbered; the letter indicates the panel from which the circuit is to be controlled. All outlets bearing the same letter and number shall be connected to the same circuit.

D. Follow the Drawings in laying out the work. Consult Architectural, Structural and Mechanical Trades Construction Documents to become familiar with all conditions affecting the work, and verify all spaces in which work will be installed. Field measurements shall be taken where necessary, for ordering materials and fitting the installation to the building construction.

E. Where job conditions require reasonable changes in indicated locations or arrangements, such changes shall be made without extra cost to the Owner.

1.28 COORDINATION WITH OTHER TRADES

A. Install all work so as to avoid interference with the work of other Trades. Be responsible for removing and relocating any work, which, in the opinion of the Owner's Representative, causes an interference with the work of the trades.

1.29 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Division 1 General Requirements and Section 01700. In addition to the requirements specified in Division 1, indicate installed conditions for:

1. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.

2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.

3. Approved substitutions, contract modifications, and actual equipment and materials installed.

1.30 TESTING AND ACCEPTANCE

A. When the systems are completed, the Contractor shall operate equipment in accordance with Section 16950 and Section 16995 and as directed by Owner's Representative. Replace all faulty equipment. Make necessary adjustments before final acceptance.

B. Perform all tests required by State, City, County and/or other agencies having jurisdiction, with Architect/Engineer and Construction Manager present.

C. Provide all materials, equipment, etc., and labor required for tests.

D. Provide complete operating instructions, test results, manuals and repair parts lists for the Owner's personnel as specified above. Instruct Owner's personnel in the operation of all systems.

1.31 PARTS RECEIPT

A Retain all portable and detachable portions of the installation such as keys, tools, manuals, etc., until the completion of the work and then turn them over to the Owner and obtain itemized receipt. This receipt shall be attached to the "Final Application" for payment.

1.32 PERMITS AND FEES

A. Unless otherwise indicated, all required permits, licenses, inspections, and approvals shall be obtained, and fees shall be paid for, by this Contractor.

1.33 CERTIFICATE OF APPROVAL

A. Upon completion of the building, provide the Construction Manager with Certificate of Approval from electrical inspection authority.

1.34 MOUNTING HEIGHTS

A. Unless otherwise indicated, mounting heights shall be based on measurement from finished floor to centerline of outlet device junction box or where applicable, to top/bottom of equipment. Mounting heights shall be as follows:

Lighting Switches	4'-0"
Receptacles (General Areas)	1'-6"
Receptacles (Utility Areas)	4'-0"
Telecommunication Outlets	1'-6"
Fire Alarm Stations	4'-0"
Fire Alarm Signals	7'-6"
Alarm Bells	1'-6" Below Fin. Ceil.
Lighting/Receptacle Panels	6'-0" to Top
Distribution Panels	7'-0" to Top
Motor Starters, Safety Switches	5'-0" to Top

END OF SECTION 260100

SECTION 260519 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.
3. Sleeves and sleeve seals for specified cables.

PART 2 - PRODUCTS

A. Conductors & Cables Manufacturers – Basis of Design Product: Subject to compliance with requirements, provide product indicated on drawings or a comparable produce by one of the following:

1. Alcan Products Corporation; Alcan Cable Division.
2. American Insulated Wire Corp.; a Leviton Company.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.

B. Copper and Aluminum Conductors: Shall comply with NEMA WC 70. All conductor sizes indicated on plans are copper. Contractor to adjust conductor sizes accordingly for aluminum conductors.

C. Conductor Insulation: Shall Comply with NEMA WC 70.

D. Factory-fabricated connectors and splices shall be of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

A. CONDUCTOR MATERIAL APPLICATIONS

1. Feeders: Use Copper for feeders smaller than No. 4 AWG; use copper or aluminum for feeders No. 4 AWG and larger. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

2. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3. Feeders and breakers shall be Type THHN-THWN single conductors in required raceway.

4. Feeders Concealed in Ceilings, Walls, and Partitions, shall be Type THHN-THWN, single conductors in raceway.

5. Feeders Concealed in Concrete, below Slabs-on Grade, and Underground: Type THHN-THWN, single conductors in raceway.

6. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

7. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

8. Cord Drops and Portable Appliance Connection: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

9. Control Circuits: Type THHN-THWN, in raceway.

B. INSTALLATION OF CONDUCTORS AND CABLES

1. Concealed cables in finished walls, ceilings, and floors, unless otherwise indicated.

2. Use manufacturer-approved pulling compound or lubricant where necessary; Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

3. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

4. Support cables according to Division 26 Section “Hangers and Supports for Electrical Systems”.

5. Identify and color-code conductors and cables according to Division 26 Section “Identification for Electrical Systems”.

C. CONNECTIONS

1. Tighten electrical connectors and terminals according to manufacturer’s published torque-tightening values.

2. Make splices and taps that are compatible with conductor materials and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

3. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

D. SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

1. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section “Penetration Firestopping”.

2. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

3. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

4. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

5. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

6. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section “Joint Sealants”.

7. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section “Penetration Firestopping”.

8. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.

9. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals.

10. Underground Exterior-Wall Penetrations: Install cast-iron “wall pipes” for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

11. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section “Penetration Firestopping”.

END OF SECTION 260543

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

A. This Section includes the following:

1. Methods and materials for grounding systems and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

D. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

PART 3 - EXECUTION

A. Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 and larger, unless otherwise indicated.

B. Grounding Bus: Install in communication equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install 2 ft long bus on insulated spacers 1 inch, minimum, from wall and 6 inches above finished floor, unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.

C. Provide proper connector terminations and connectors

D. Secondary Neutral: Interconnect and connect to grounding conductor.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
9. Cable trays.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. .

B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

3.4 FIELD QUALITY CONTROL

A. Retain a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
2. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohms.

B. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRIC

PART 1 - GENERAL

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components as manufactured by:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch diameter holes at a maximum of 8 inches `o.c., in at least 1 surface. Support systems as manufactured by:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. Fabco Plastics Wholesale Limited.
d. Seasafe, Inc.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threased-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

2. Mechanical Expansion Anchors: Insert-wedge type stainless steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A325.

6. Toggle Bolts: All steel springhead type.

7. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.1 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits.

C. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

D. Use 3000-psi, 28-day compressive-strength concreteAnchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

A. This section includes the following:

1. Raceways, fittings, boxes, enclosures and cabinets for electrical wiring.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Manufacturers – Basis of Design Product: Subject to compliance with requirements, provide product indicated on drawings or a comparable product by one of the following:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1.

C. Aluminum Rigid Conduit: ANSI C80.5.

D. IMC: ANSI C80.6.

E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

F. EMT: ANSI C80.3.

G. LFMC: Flexible steel conduit with PVC jacket.

H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

I. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers – Basis of Design Product: Subject to compliance with requirements, provide product indicated on drawings or a comparable product by one of the following:

1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corp.; Pipe & Plastics Group.
6. Condux International, Inc.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.

D. LFNC: UL 1660.

E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

F. Fittings for LFNC: UL 514B.

2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

A. Manufacturers Basis of Design Product: Subject to compliance with requirements, provide product indicated on drawings or a comparable product by one of the following:

1. Arnco Corporation.
2. Endot Industries Inc.
3. IPEX Inc.
4. Lamson & Sessions; Carlon Electrical Products.

B. Description: Comply with UL 2024; flexible type, approved for plenum installation.

2.4 METAL WIREWAYS

A. Manufacturers Basis of Design Product: Subject to compliance with requirements, provide product indicated on drawings or a comparable product by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type [**1**] [**12**] [**3R**], unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type.

E. Finish: Manufacturer's standard enamel finish.

2.5 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect and as manufactured by:

a. Thomas & Betts Corporation.
b. Walker Systems, Inc.; Wiremold Company (The).
c. Wiremold Company (The); Electrical Sales Division.

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors and as manufactured by:

a. Butler Manufacturing Company; Walker Division.
b. Enduro Systems, Inc.; Composite Products Division.
c. Hubbell Incorporated; Wiring Device-Kellems Division.
d. Lamson & Sessions; Carlon Electrical Products.
e. Panduit Corp.
f. Walker Systems, Inc.; Wiremold Company (The).
g. Wiremold Company (The); Electrical Sales Division.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers Basis of Design Product: Subject to compliance with requirements, provide product indicated on drawings or a comparable product by one of the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Metal Floor Boxes: Cast metal, fully adjustable, rectangular.

F. Nonmetallic Floor Boxes: Nonadjustable, round.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

I. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

J. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.7 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.8 SLEEVE SEALS

A. Manufacturers Basis of Design Product: Subject to compliance with requirements, provide product indicated on drawings or a comparable product by one of the following:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.

2. Pressure Plates: Stainless steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit.
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: Rigid steel conduit.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

E. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

F. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

G. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

H. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

I. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

J. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch Trade Size: Install raceways in maximum lengths of 50 feet.
2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

K. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

L. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.

1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:

   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F temperature change.
   d. Attics: 135 deg F temperature change.

2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.
3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

M. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

N. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

O. Set metal floor boxes level and flush with finished floor surface.

P. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both surfaces of walls.

G. Extend sleeves installed in floors 2 inches above finished floor level.

H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.4 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.5 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.6 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

A. This section includes the following:

1. Cable trays and fittings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Cable Trays and Fittings shall be as manufactured by:

1. Chalfant Manufacturing Company.
2. Cooper B-Line, Inc.
3. Cope, T. J., Inc.; a subsidiary of Allied Tube & Conduit.
4. GS Metals Corp.; GLOBETRAY Products.
5. MONO-SYSTEMS, Inc.
6. MPHusky.
7. PW Industries.

2.2 MATERIALS AND FINISHES

A. Cable Trays, Fittings, and Accessories: Aluminum, complying with NEMA VE 1

B. Sizes and Configurations: Refer to the Cable Tray specified on Drawings for specific requirements for types, materials, sizes, and configurations.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

A. Comply with recommendations in NEMA VE 2. Install as a complete system, including all necessary fasteners, hold-down clips, splice-plate support systems, barrier strips, hinged horizontal and vertical splice plates, elbows, reducers, tees, and crosses.

B. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed dimensions recommended in NEMA FG 1.

C. Make changes in direction and elevation using standard fittings, as applicable.

D. Make cable tray connections using standard fittings.

E. Seal penetrations through fire and smoke barriers according to Division 07 Section

F. Workspace: Install cable trays with enough space to permit access for installing cables.

3.2 CABLE INSTALLATION

A. Install cables only when cable tray installation has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties as recommended by NEMA VE 2.

C. On vertical runs, fasten cables to tray every 18 inches

D. Install covers after installation of cable is completed.

3.3 CONNECTIONS

A. Ground cable trays according to manufacturer's written instructions.

B. Install an insulated equipment grounding conductor with cable tray, in addition to those required by NFPA 70.

3.4 FIELD QUALITY CONTROL

A. After installing cable trays and after electrical circuitry has been energized

1. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage.
2. Verify that the number, size, and voltage of cables in cable tray do not exceed that permitted by NFPA 70. Verify that communication or data-processing circuits are separated from power circuits by barriers.
3. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable tray.

B. Report results in writing.

END OF SECTION 260536

SECTION 260543 – UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

A. This Section includes the following:

1. Conduit, ducts, and duct accessories for direct-buried duct banks.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.

B. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Manufacturers Basis of Design Product: Subject to compliance with requirements, provide product indicated on drawings or a comparable product by one of the following:

1. ARNCO Corp.
2. Beck Manufacturing.
3. Cantex, Inc.
4. CertainTeed Corp.; Pipe & Plastics Group.
5. Condux International, Inc.
6. ElecSys, Inc.
7. Lamson & Sessions; Carlon Electrical Products.
8. Manhattan/CDT; a division of Cable Design Technologies.
9. Spiraduct/AFC Cable Systems, Inc.

B. Underground Plastic Utilities Duct: NEMA TC 6 & 8, Type EB-20-PVC, ASTM F 512, UL 651A, with matching fittings by the same manufacturer as the duct, complying with NEMA TC 9.

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

B. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

3.2 EARTHWORK

A. Excavation and Backfill: Comply with Division 31 Section “Earth Moving”, but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work.

D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section “Cutting and Patching”.

3.3 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down and away from buildings and equipment.

B. Curves and Bends: Use 5-degree angle couplings for small changes in direction.

C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer’s written instructions.

D. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line.

E. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations.

F. Pulling Cord: Install 100-lbf test nylon cord in ducts, including spares.

G. Direct-Buried Duct Banks:

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.

2. Provide space separators close enough to prevent sagging.

3. Install backfill as specified in Division 31 Section “Earth Moving”.

4. Backfilling with normal compaction as specified in Division 31 Section “Earth Moving”.

5. Trench bottom to provide firm and uniform support for duct banks.

6. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated.

7. Warning Tape: Bury warning tape approximately 12 inches above direct-buried ducts and duct banks, placing them 24 inches o.c.

3.4 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section “Grounding and Bonding for Electrical Systems”.

END OF SECTION 260543

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

A. This Section includes the following:

1. Identification for raceway and metal-clad cable.
2. Identification for conductors and communication and control cable.
3. Underground-line warning tape.
4. Warning labels and signs.
5. Equipment identification labels.
6. Miscellaneous identification products.

1.02 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

PART 2 - PRODUCTS

2.01 UNDERGROUND-LINE WARNING TAPE

A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.

1. Not less than 6 inches wide by 4 mils thick.
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend shall indicate type of underground line.

2.02 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

PART 3 - EXECUTION

3.01 APPLICATION

A. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.

B. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

C. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Equipment to Be Labeled:

a. Panelboards, electrical cabinets, and enclosures.
b. Disconnect switches.
c. Enclosed circuit breakers.
d. Motor starters.
e. Fire-alarm control panel and annunciators.

3.02 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
2. Colors for 208/120-V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.

END OF SECTION 260553

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

A. Section includes the following:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.2 SUBMITTALS

A. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.

1.3 PROJECT CONDITIONS

A. Do not deliver or install panelboards until spaces are enclosed and weathertight,
Do not interrupt electric service to facilities occupied by Owner or others unless permitted in wiring by the owner.

1.4 COORDINATION

A. Coordinate layout and installation of panelboards and components with other trades

1.5 EXTRA MATERIALS

A. Furnish

1. Two spares keys for each type of panelboard cabinet lock.
2. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Flush- and surface-mounted cabinets.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1

2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

3. Finishes:

   a. Panels and Trim: manufacturer's standard two-coat finish

4. Directory Card: Inside panelboard door, mounted in transparent card holder

B. Incoming Mains Location. As required

C. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
3. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

E. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Minimum 22,000 A.I.C.

2.2 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

E. Branch Overcurrent Protective Devices: Fused switches.

F. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

B. Mains: Circuit breaker or lugs only as shown.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits.
2. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
c. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.

B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.

2.5 ACCESSORY COMPONENTS AND FEATURES

A. Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NECA 407.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

3.2 INSTALLATION

A. Mount top of trim 90 inches above finished floor unless otherwise indicated.

B. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

C. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

D. Install filler plates in unused spaces.

E. Stub two (2) 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub two (2) 1-inch empty conduits into raised floor space or below slab not on grade.

3.3 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as required.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Wall-box motion sensors.
3. Snap switches and wall-box dimmers.
4. Communications outlets.
5. Floor service outlets, and multioutlet assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 5351 (single), 5352 (duplex).
b. Hubbell; HBL5351 (single), CR5352 (duplex).
c. Leviton; 5891 (single), 5352 (duplex).
d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed & non-feed-through type. Include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; GF20.
b. Pass & Seymour; 2084.

2.4 SNAP SWITCHES

A. Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

2.5 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover.

2.6 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type flap-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular, solid brass with satin finish.

D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Blank cover with bushed cable opening.

2.7 MULTIOUTLET ASSEMBLIES

A. Manufacturers Basis of Design Product: Subject to compliance with requirements, provide product indicated on drawings or a comparable product by one of the following:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Wiremold Company (The).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
3. Install wiring devices after all wall preparation, including painting, is complete.

B. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose.
3. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

C. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
3. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
4. Tighten unused terminal screws on the device.

D. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

E. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.

6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

A. Section includes the following:

1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, panelboards, switchboards, enclosed controllers, and motor-control centers.

1.2 SUBMITTALS

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

1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current curves, coordination charts and tables and related data.
4. Fuse sizes for elevator feeders and elevator disconnect switches.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses.

1.4 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.5 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.6 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

PART 2 - PRODUCTS

A. Manufacturers: Subject to compliance with requirements:

1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.

3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses: All fuses shall be dual element time delay type.

1. Feeders 200A to 600A: Class RK1, fast acting.
2. Feeders Less than 200A: Class RK5, fast acting.
3. Motor Branch Circuits: Class RK5, time delay.
4. Other Branch Circuits: 100A to 600A: Class RK1, less than 100A – RK5.
5. Control Circuits: Class CC, fast acting.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:

1. Fusible switches.
2. Nonfusible switches.

1.02 SUBMITTALS

A. For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, finishes and:

1. Short-circuit current rating.
2. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.03 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F.
2. Altitude: Not exceeding 1000 feet.

1.04 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces.

PART 2 - GENERAL

2.01 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Energy & Automation, Inc.
4. Square D/Group Schneider.

B. Fusible Switch, 600 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Nonfusible Switch, 600 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

PART 3 - GENERAL

3.01 INSTALLATION

A. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

3.02 FIELD QUALITY CONTROL

A. Prepare for acceptance testing as follows:

1. Inspect mechanical and electrical connections.
2. Verify switch and relay type and labeling verification.
3. Verify rating of installed fuses.

END OF SECTION 262816

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

A. This Section includes the following:

1. Interior lighting.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

1.02 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Energy-efficiency data.
3. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

1.03 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.04 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.01 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

2.02 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.

2.03 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls.

B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.

C. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

END OF SECTION 265100

SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Provisions of raceway, boxes for data system as described in the following Sections:

1. 260529 – Hangers and Supports for Electric.
2. 260533 – Raceway and Boxes for Electrical Systems.
3. 260543 – Underground Ducts and Raceways for Electrical Systems.
4. 260553 – Identification for Electrical Systems.

B. Specifications and drawings of low voltage systems to be provided by City of Ann Arbor. Contractor to include the purchase and installation of all new low voltage communication systems as required by the City of Ann Arbor including security, audio visual, and I.T. systems.

END OF SECTION 270500

SECTION 280500 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 SUMMARY

A. Provisions of raceway, boxes for data system as described in the following Sections:

1. 260529 – Hangers and Supports for Electric.
2. 260533 – Raceway and Boxes for Electrical Systems.
3. 260543 – Underground Ducts and Raceways for Electrical Systems.
4. 260553 – Identification for Electrical Systems.

B. Specifications and drawings of low voltage systems to be provided by City of Ann Arbor. Contractor to include the purchase and installation of all new low voltage communication systems as required by the City of Ann Arbor including security, audio visual, and I.T. systems.

END OF SECTION 280500

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Notification appliances.
5. Addressable interface device.
6. Digital alarm communicator transmitter.

1.2 SYSTEM DESCRIPTION

A. Noncoded, UL-certified addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

B. Noncoded addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.

1.3 SUBMITTALS

A. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:

a. Trained and certified by manufacturer in fire-alarm system design.
b. NICET-certified fire-alarm technician, Level III minimum.

B. Product Data: For each type of product indicated.

C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Include voltage drop calculations for notification appliance circuits.
3. Include battery-size calculations.
4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.

5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.

6. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

D. Field quality-control reports.

E. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:

    a. Frequency of testing of installed components.
    b. Frequency of inspection of installed components.
    c. Requirements and recommendations related to results of maintenance.
    d. Manufacturer's user training manuals.

5. Manufacturer's required maintenance related to system warranty requirements.
6. Abbreviated operating instructions for mounting at fire-alarm control unit.
7. Copy of NFPA 25.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.

C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system. Existing system is a National Time 2000 Series.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Construction Manager no fewer than ten (10) days in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without Construction Manager's written permission.

1.6 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.7 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
2. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
3. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
4. Keys and Tools: One extra set for access to locked and tamperproofed components.
5. Audible and Visual Notification Appliances: One of each type installed.
6. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements:

1. Simplex.
2. Federal Signal Corporation.
3. Gamewell; a Honeywell company.
4. GE Infrastructure; a unit of General Electric Company.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Smoke detectors.
3. Duct smoke detectors.
4. Automatic sprinkler system water flow.
5. Fire-extinguishing system operation.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the Detroit Fire Department.
4. Unlock electric door locks in designated egress paths.
5. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
6. Close smoke dampers in air ducts of designated air-conditioning duct systems.
7. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Low-air-pressure switch of a dry-pipe sprinkler system.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.
9. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.
10. Dirty smoke detector.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators.

2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.

a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
b. Include a real-time clock for time annotation of events on the event recorder and printer.

2. Addressable initiation devices that communicate device identity and status.

a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.

3. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 2 line(s) of 40 characters, minimum. 80 characters total.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Circuits:

1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.

a. Initiating Device Circuits: Style A.
b. Notification Appliance Circuits: Style W.
c. Signaling Line Circuits: Style 1.
d. Install no more than 126 addressable devices on each signaling line circuit.

D. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

E. Notification Appliance Circuit: Operation shall sound in a code 3 temporal pattern.

F. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and

sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

G. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to the Detroit Fire Department.

H. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

I. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed lead calcium.

J. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.
3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type indicating detector has operated.

7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

    a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
    b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
    c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.6 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling line circuit, equipped for mounting as indicated and with screw terminals for system connections.

B. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

C. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

D. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output:

   a. Comply with NFPA72.
   b. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.

2.7 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

B. Integral Relay: Capable of providing a direct signal for fan, damper or door control.

2.8 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the Detroit Fire Department and shall comply with UL 632 and be listed and labeled by an NRTL.

B. Secondary Power: Integral rechargeable battery and automatic charger.

C. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.9 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by manufacturer of device.
2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Equipment Mounting: Install fire-alarm control unit not more than 72 inches (1830 mm) above the finished floor.

C. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the supervising station.
3. Expand, modify, and supplement existing equipment as necessary to extend existing functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

D. Smoke Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet (9 m).
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix Ain NFPA 72.
5. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.

E. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

F. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

G. Visible Alarm-Indicating Devices: Install adjacent to each alarm horn and at least 6 inches (150 mm) below the ceiling.

3.2 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.3 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.4 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction and construction management.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111