Exhibit A

City of Fishers

Fishers Fire Department 97 (397)

HVAC Renovation

15109 E 136th St.
Fishers, IN 46037

100% FINAL REVIEW CONSTRUCTION DOCUMENTS

January 14, 2025

DRAWING LIST

TEAM

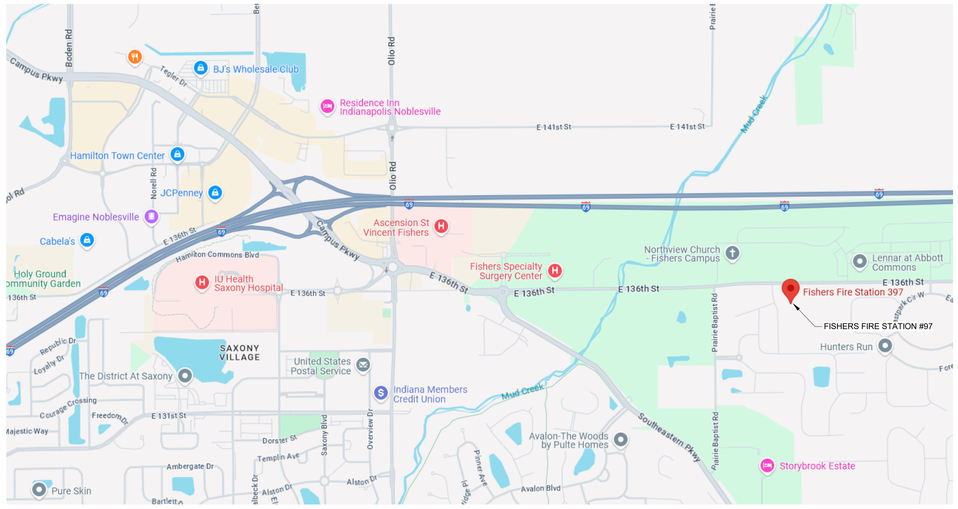
Owner - Fishers DPW
Client - Rachel Tudor

Design Team:
Firm - Applied Engineering
Project Manager - Dan James
Mechanical - Vincent Manzararres, Roy Wagner
Electrical - Jack Weinzapfel

SCOPE

Provide mechanical unit that will provide additional air into the building envelope shifting the building's pressure to a positive state instead of negative.

Site Plan
SCALE:NONE



Location Map
SCALE:NONE

Applied
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5975 Castle Creek Parkway N Drive, Suite 300 • Indianapolis, Indiana 46250
Tel: 317.810.4141 • Fax: 317.810.4140 • www.applied-e-s.com

NOTE: ALL SYMBOL DESCRIPTIONS ARE SUBJECT TO MODIFICATION ON THE DRAWINGS. ALL SYMBOLS NOT NECESSARILY USED ON THIS PROJECT.

VALVES & FITTINGS:

- GATE VALVE
- BALL VALVE
- BUTTERFLY VALVE
- CHECK VALVE
- GLOBE VALVE
- BALANCING VALVE
- PLUG VALVE
- CONTROL VALVE
- SOLENOID VALVE
- NEEDLE VALVE
- THERMAL EXPANSION VALVE
- AUTOMATIC BALANCE VALVE
- BACK FLOW PREVENTER
- PRESSURE REDUCING, SELF CONTAINED VALVE
- PRESSURE REDUCING, PILOT OPERATED VALVE
- RELIEF, PILOT OPERATED VALVE
- ANGLE GLOBE VALVE
- PRESSURE SAFETY, ANGLE TYPE VALVE
- THREE WAY BALL VALVE
- THREE WAY GLOBE VALVE
- THREE WAY PLUG VALVE
- MOTORIZED VALVE
- MOTORIZED VALVE
- THREE WAY CONTROL VALVE
- PIPE TURN 90°
- LINE BREAK
- PIPE ELBOW UP (RISER)
- PIPE ELBOW DOWN
- PIPE TEE DOWN
- CAP OR PLUG
- REDUCER, CONCENTRIC
- REDUCER, ECCENTRIC
- Y-STRAINER
- FLEXIBLE CONNECTION
- FLANGES
- UNION
- PIPE GUIDE
- PIPE ANCHOR
- FILTER (INLINE)
- GAUGE
- THERMOMETER
- STEAM TRAP
- PRESSURE SENSOR
- PUMP

VALVES & FITTINGS:

- MATERIAL CHANGE
- AUTOMATIC AIR VENT
- DRAIN
- FLOW METER

GENERAL SYMBOLS:

- POINT OF CONNECTION
- POINT OF REMOVAL
- PLAN NOTE
- DEMOLITION NOTE
- REVISION
- DETAIL BUBBLE
- SECTION BUBBLE

DIFFUSERS & REGISTERS

SUPPLY DIFFUSER:
SHADING INDICATES BLANKED-OFF QUADRANT OF DIFFUSION PATTERN
SEE SCHEDULE FOR RUNOUT SIZE
DIFFUSER TYPE
DIFFUSER SIZE
SDA 750
DIFFUSER CFM

SUPPLY DIFFUSER:
SHADING INDICATES BLANKED-OFF QUADRANT OF DIFFUSION PATTERN
SEE SCHEDULE FOR RUNOUT SIZE
DIFFUSER TYPE
DIFFUSER SIZE
SDA 750
DIFFUSER CFM

RETURN/EXHAUST GRILLE:
SEE SCHEDULE FOR RUNOUT SIZE
GRILLE TYPE
GRILLE SIZE
RGA 750
GRILLE CFM

RETURN/EXHAUST GRILLE:
SEE SCHEDULE FOR RUNOUT SIZE
GRILLE TYPE
GRILLE SIZE
RGA 750
GRILLE CFM

LINEAR BAR & SLOT DIFFUSER:
ARROW INDICATES DIRECTION OF AIR FLOW
SEE SCHEDULE FOR RUNOUT SIZE
DIFFUSER TYPE
DIFFUSER SIZE
LDA 220
DIFFUSER CFM

LINEAR BAR & SLOT DIFFUSER:
ARROW INDICATES DIRECTION OF AIR FLOW
SEE SCHEDULE FOR RUNOUT SIZE
DIFFUSER TYPE
DIFFUSER SIZE
LDA 220
DIFFUSER CFM

TERMINAL BOXES

SINGLE-DUCT TERMINAL BOX WITH REHEAT COIL
SEE SCHEDULE FOR RUNOUT SIZE
TYPE OF TERMINAL BOX
VAV-1
CONTROL PANEL
MAINTAIN CODE REQUIRED CLEARANCE IN FRONT OF CONTROL PANEL

DUAL DUCT TERMINAL BOX:
SEE SCHEDULE FOR RUNOUT SIZE
TYPE OF TERMINAL BOX
VAV-1
CONTROL PANEL(S)
MAINTAIN CODE REQUIRED CLEARANCE IN FRONT OF CONTROL PANEL

DUCTWORK:

- SUPPLY ARROW
- RETURN/EXHAUST ARROW
- THERMOSTAT
- T/RH — TEMPERATURE & RELATIVE HUMIDITY SENSOR
- P — PRESSURE SENSOR
- SUPPLY UP
- SUPPLY DOWN
- RETURN/EXHAUST UP
- RETURN/EXHAUST DOWN
- ROUND UP
- ROUND DOWN
- FLAT OVAL SUPPLY UP
- FLAT OVAL SUPPLY DOWN
- 16x12 — RECTANGULAR DUCT WIDTH x HEIGHT
- 16"ø — ROUND DUCT DIAMETER
- 16x12ø — FLAT OVAL DUCT WIDTH x HEIGHT
- 90° MITERED ELBOW WITH TURNING VANES
- W, r, (r=w) — ELBOW
- DUCT END CAP
- 15° MAX — DUCT TRANSITION - SLOPED BOTH SIDES
- 15° MAX — DUCT TRANSITION - FLAT ON ONE SIDE
- FLEXIBLE DUCT
- VOLUME DAMPER
- FD — FIRE DAMPER
- MOTORIZED DAMPER
- BDD — BACKDRAFT DAMPER
- AD — ACCESS DOOR
- FAN (OR PUMP)

DUCTWORK:

SINGLE LINE REPRESENTATION:

- SUPPLY UP
- SUPPLY DOWN
- RETURN/EXHAUST UP
- RETURN/EXHAUST DOWN
- ROUND UP
- ROUND DOWN
- FLAT OVAL SUPPLY UP
- FLAT OVAL SUPPLY DOWN
- 16x12 — RECTANGULAR DUCT WIDTH x HEIGHT
- 16"ø — ROUND DUCT DIAMETER
- 16x12ø — FLAT OVAL DUCT WIDTH x HEIGHT
- DUCT TURN 90°
- DUCT END CAP
- DUCT TRANSITION - SLOPED ON BOTH SIDES
- DUCT TRANSITION - FLAT ON ONE SIDE
- FLEXIBLE DUCT
- VOLUME BALANCE DAMPER
- FD — FIRE DAMPER
- MOTORIZED DAMPER
- BDD — BACKDRAFT DAMPER

PIPING DESIGNATIONS:

- NEW
- EXISTING TO REMAIN
- DEMOLITION
- FUTURE
- PIPE SLOPES IN DIRECTION OF ARROW

FLOW/CONTROL SYMBOLS:

- AI — ANALOG INPUT
- AO — ANALOG OUTPUT
- BI — BINARY INPUT
- BO — BINARY OUTPUT
- CO2 — CARBON DIOXIDE SENSOR
- CS — CURRENT SENSOR
- ΔP — DIFFERENTIAL PRESSURE SENSOR
- S — DUCT SMOKE DETECTOR
- ES — END SWITCH
- H — HUMIDITY SENSOR
- LL — LOW LIMIT TEMPERATURE SENSOR
- M — DAMPER MOTOR
- P — PRESSURE SENSOR
- T — TEMPERATURE SENSOR
- AIR FLOW MEASURING STATION
- AIR HANDLER FAN
- CONTROL VALVE
- HYDRONIC PUMP
- MS — MOTOR STARTER
- VFD — VARIABLE FREQUENCY DRIVE
- FM — FLOW METER

MECHANICAL ABBREVIATIONS:

AFF	ABOVE FINISHED FLOOR
AH	(PARAMETER) ALARM HIGH
AHJ	AUTHORITY HAVING JURISDICTION
AHU	AIR HANDLING UNIT
AL	(PARAMETER) ALARM LOW
AS	AIR SEPARATOR
ASD	ADJUSTABLE SPEED DRIVE (ALSO VFD)
BDD	BACK DRAFT DAMPER
BHP	BRAKE HORSEPOWER
BLDG	BUILDING
BOD	BOTTOM OF DUCT
BOP	BOTTOM OF PIPE
BOS	BOTTOM OF STEEL
BTU	BRITISH THERMAL UNIT
CA	COMPRESSED AIR
CH	CHILLER
CHWR	CHILLED WATER RETURN
CHWS	CHILLED WATER SUPPLY
℄	CENTERLINE
CO	CLEANOUT
CP	CONDENSATE PUMP
CTF	COOLING TOWER FAN
CTWR	COOLING TOWER WATER RETURN
CTWS	COOLING TOWER WATER SUPPLY
CU	COPPER
CS	CARBON STEEL
CV	CONTROL VALVE
CW	DOMESTIC COLD WATER
D	DRAIN
DB	DRY BULB
DCV	DOUBLE CHECK VALVE
DIA	DIAMETER
DN	DOWN
DOAS	DEDICATED OUTDOOR AIR SYSTEM
DPI	DIFFERENTIAL PRESSURE INDICATOR
DPS	DIFFERENTIAL PRESSURE SENSOR
DPT	DIFFERENTIAL PRESSURE TRANSMITTER
EF	EXHAUST FAN
EG	EXHAUST GRILLE
EL	ELEVATION
ET	EXPANSION TANK
EX	EXISTING
F	FILTER
FCU	FAN COIL UNIT
FCV	FLOW CONTROL VALVE
FD	FLOOR DRAIN
FE	FLOW ELEMENT
FLA	FULL LOAD AMPS
FT	FLOW TRANSMITTER
G	NATURAL GAS
HE	HEAT EXCHANGER
HW	DOMESTIC HOT WATER
HWR	DOMESTIC HOT WATER RETURN
HWRP	HOT WATER RECIRCULATION PUMP
HHWR	HEATING HOT WATER RETURN
HHWS	HEATING HOT WATER SUPPLY
HV	HAND VALVE
LI	LEVEL INDICATOR
LSH	LEVEL SENSOR HIGH
LSL	LEVEL SENSOR LOW
LSLL	LEVEL SENSOR LOW LOW
N2	NITROGEN
NC	NORMALLY CLOSED
NG	NATURAL GAS
NO	NORMALLY OPEN
P	PRESSURE
PH	PHASE
PI	PRESSURE INDICATOR
PIT	PRESSURE INDICATING TRANSMITTER
PRV	PRESSURE REGULATING VALVE
PS	PRESSURE SWITCH
PSV	PRESSURE SAFETY VALVE
PSIA	POUNDS PER SQUARE INCH ABSOLUTE
PSIG	POUNDS PER SQUARE INCH GAUGE
PT	PRESSURE TRANSMITTER
PWR	PURIFIED WATER RETURN
PWS	PURIFIED WATER SUPPLY
RF	RETURN FAN
RG	RETURN GRILLE
RO	REVERSE OSMOSIS
RPBP	REDUCED PRESSURE BACKFLOW PREVENTER
RH	RELATIVE HUMIDITY
S	STEAM
SC	STEAM CONDENSATE OR SPEED CONTROLLER
SAN	SANITARY
SD	SUPPLY DIFFUSER
SF	SUPPLY FAN
SFT	SOFT WATER
STR	STRAINER
TI	TEMPERATURE INDICATOR
TT	TEMPERATURE TRANSMITTER
V	VENT
VD	VOLUME DAMPER
VFD	VARIABLE FREQUENCY DRIVE (ALSO ASD)
VTR	VENT THROUGH ROOF
WB	WET BULB
WH	WALL HYDRANT
ZS	LIMIT SWITCH

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OWNER
FISHERS FIRE DEPARTMENT
15109 E 136th St.
Fishers, IN 46037

PROJECT
STATION 97 HVAC RENOVATION

100% FRCD
01/14/2025

REVISIONS
NO. DATE DESCRIPTION

DESIGNED BY: VAM
CHECKED BY: DTM
APPROVED BY: Approver
PROJECT NO.: 24-156

CERTIFICATION
PRELIMINARY NOT FOR CONSTRUCTION

SHEET TITLE
MECHANICAL SYMBOLS AND ABBREVIATIONS

SHEET NUMBER
M001

THIS CONSTRUCTION DOCUMENT IS A COLOR DELIVERABLE. IF THIS NOTE IS NOT IN RED, PLEASE REPRINT IN COLOR TO VIEW THE DOCUMENT AS INTENDED.

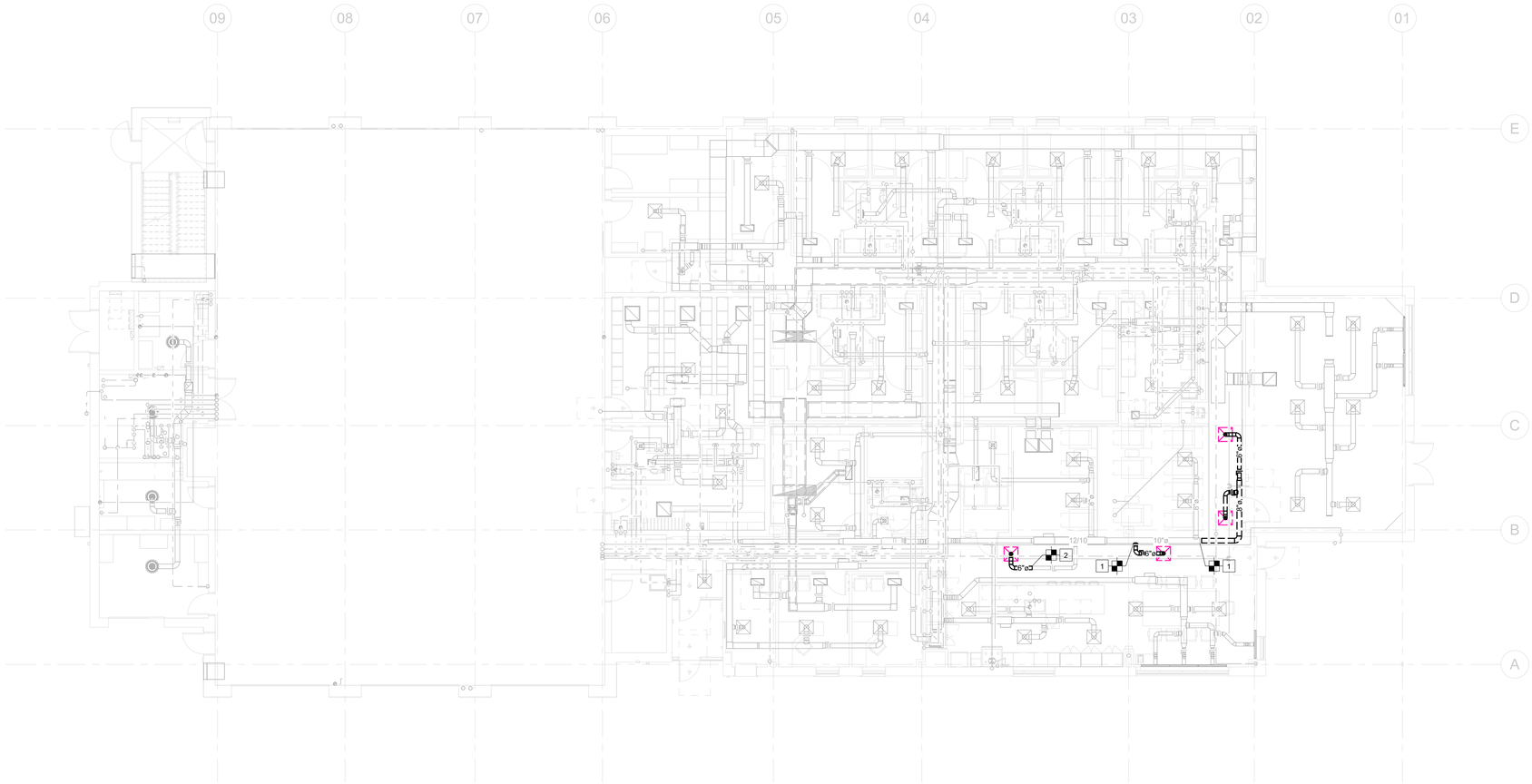
0 1/2" 1" 2"
ORIGINAL SHEET SIZE IS 30" X 42" (ARCH E1)
1/14/2025 1:36:50 PM AESI Proj. No: 24-156

GENERAL NOTES:

A. ALL WORK SHALL CONFORM TO STATE AND LOCAL REGULATIONS.
B. ALL RECTANGULAR SHEET METAL DUCT SIZES ARE INSIDE DIMENSIONS. ALL ROUND DUCT SIZES SHOWN ARE INSIDE DIAMETERS.
C. REPAIR AND PATCH ANY DAMAGE TO EXISTING OR NEW FACILITIES, INCLUDING SURFACES, ROOF AREAS, FLOORS, WALLS, ROOFS, AND CEILING. REPAIRS SHALL MATCH EXISTING INSTALLATION.
D. PROVIDE ROOF PROTECTION FOR EXISTING ROOF. PROVIDE WALK-OFF PROTECTION OVER EXISTING ROOF SURFACES WHERE WORK IS OCCURING.

DEMOLITION NOTES:

1. DISCONNECT SUPPLY AIR DUCT FROM THE EXTENTS SHOWN. REMOVE COMPLETE INCLUDING DUCTWORK,FITTINGS, APPURTENANCES, AND DIFFUSERS. PROVIDE DUCT CAP ON REMAINING OPENINGS. PROVIDE ACCOUSTIC CEILING TILE TO MATCH EXISTING WHERE DIFFUSERS ARE NOT BEING REPLACED.
2. DISCONNECT SUPPLY AIR DUCT AT THE LOCATION SHOWN. DIFFUSER TO BE SALVAGED AND RELOCATED. MODIFY EXISTING DUCTWORK TO ACCOMODATE NEW LOCATION. REFER TO SHEET M303 FOR MECHANICAL PLAN.



FIRST FLOOR DEMOLITION HVAC PLAN
SCALE: 1/8" = 1'-0"

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PROJECT NO.: 24-156	

SHEET TITLE

FIRST FLOOR DEMOLITION HVAC PLAN

SHEET NUMBER

M101

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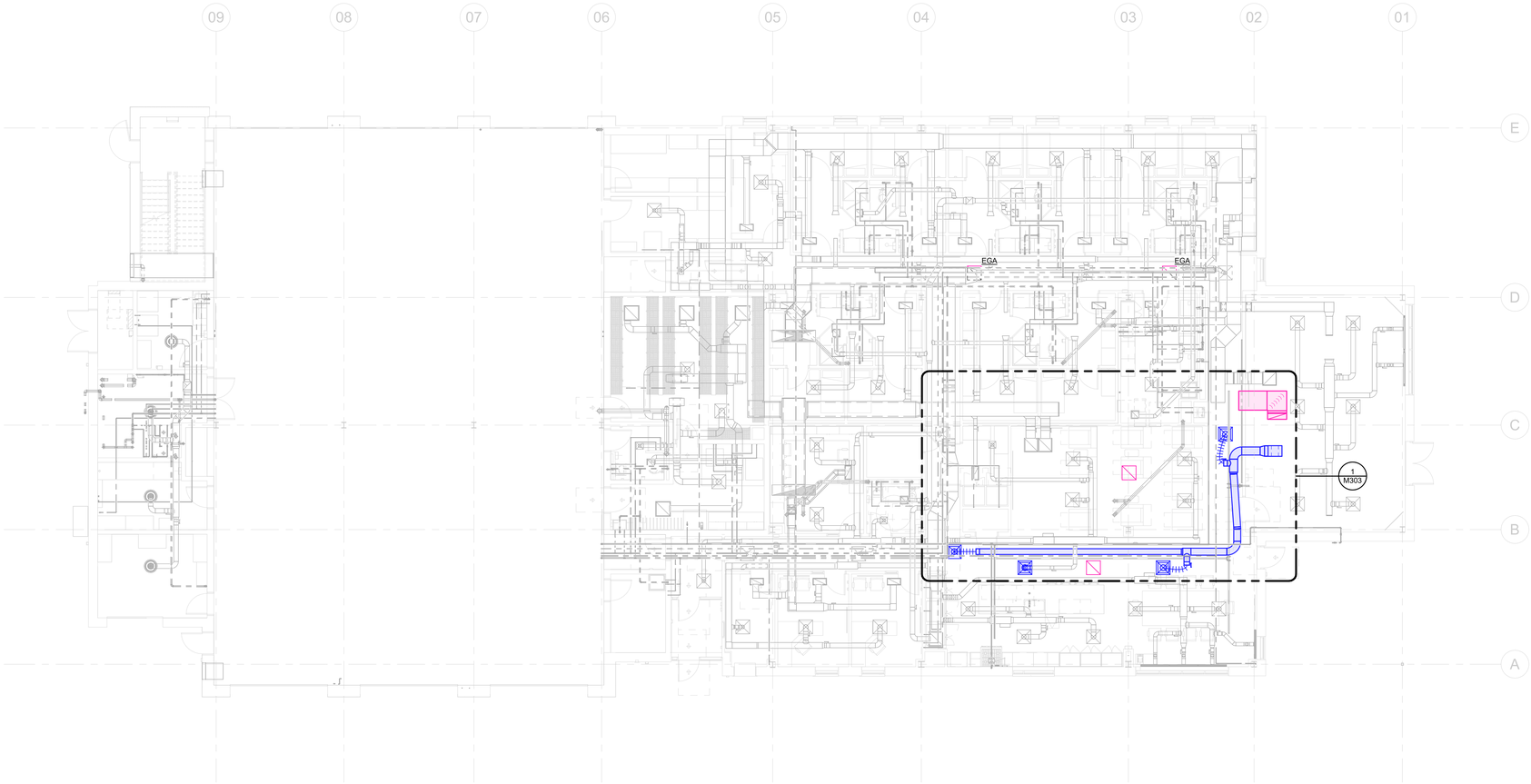
GENERAL NOTES:

A. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS IN THE FIELD PRIOR TO STARTING CONSTRUCTION. IF ANY DISCREPANCIES ARE FOUND IN THESE PLANS FROM THE ACTUAL FIELD CONDITIONS, THE CONTRACTOR SHALL NOTIFY THE ENGINEER IMMEDIATELY.
B. ALL WORK SHALL CONFORM TO STATE AND LOCAL REGULATIONS.
C. PROVIDE AND INSTALL ALL EQUIPMENT, PIPING, DUCTWORK AND APPURTENANCES AS DESCRIBED BY THESE DRAWINGS AND AS REQUIRED TO PROVIDE COMPLETE AND OPERATIONAL SYSTEMS TO THE OWNER UNDER THIS CONTRACT.
D. REFER TO THE DIVISION 23 SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS RELATING TO THE QUALITY, CONSTRUCTION AND FINISH OF MATERIALS.
E. ALL RECTANGULAR SHEET METAL DUCT SIZES ARE INSIDE DIMENSIONS. ALL ROUND DUCT SIZES SHOWN ARE INSIDE DIAMETERS.
F. INSTALL VOLUME DAMPER AT EACH BRANCH TAKE-OFF FROM MAIN SUPPLY DUCTS.
G. ALL WALL THERMOSTATS, SENSORS, AND/OR HUMIDISTATS SHALL BE 4'-0" ABOVE FINISHED FLOOR TO BOTTOM AND LINED UP VERTICALLY WITH LIGHT SWITCHES UNLESS OTHERWISE NOTED OR DIRECTED BY THE ARCHITECT/ENGINEER.
H. REPAIR AND PATCH ANY DAMAGE TO EXISTING OR NEW FACILITIES, INCLUDING SURFACES, FLOORS, WALLS, ROOFS, AND CEILING. REPAIRS SHALL MATCH EXISTING INSTALLATION.



FIRST FLOOR HVAC PLAN
SCALE: 1/8" = 1'-0"

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PROJECT

STATION 97 HVAC RENOVATION

100% FRCD
01/14/2025

REVISIONS

NO.	DATE	DESCRIPTION

DESIGNED BY: VAM	CERTIFICATION: PRELIMINARY NOT FOR CONSTRUCTION
CHECKED BY: DTM	
APPROVED BY: DTM	
PROJECT NO.: 24-156	

SHEET TITLE

FIRST FLOOR HVAC PLAN

SHEET NUMBER

M301

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0 1/2" 1" 2"

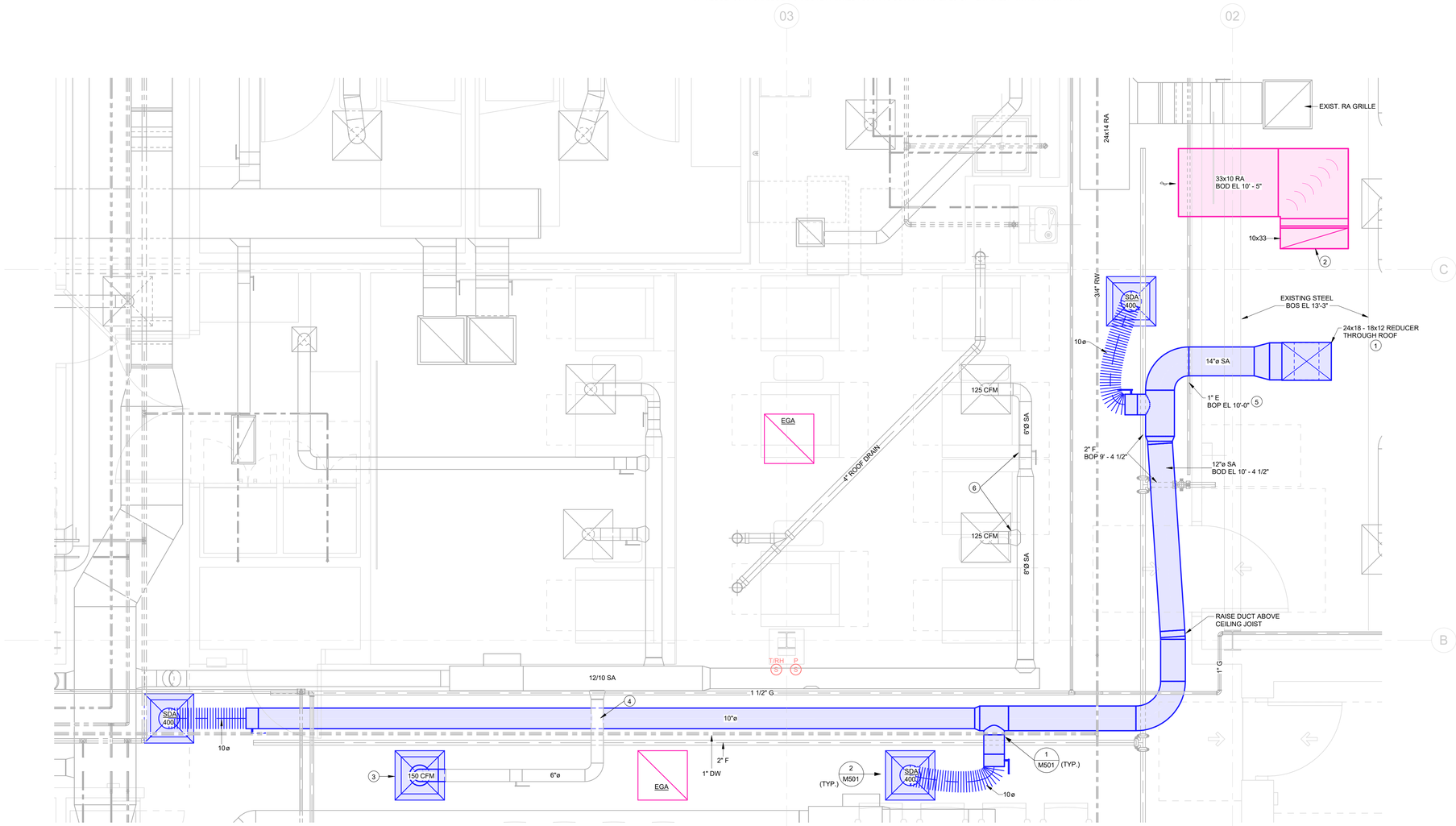
ORIGINAL SHEET SIZE IS 30" X 42" (ARCH E1)
1/14/2025 1:37:06 PM AESI Proj No: 24-156

GENERAL NOTES:

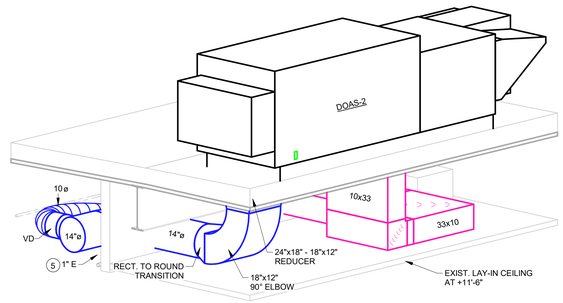
A. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS IN THE FIELD PRIOR TO STARTING CONSTRUCTION. IF ANY DISCREPANCIES ARE FOUND IN THESE PLANS FROM THE ACTUAL FIELD CONDITIONS, THE CONTRACTOR SHALL NOTIFY THE ENGINEER IMMEDIATELY.
B. ALL WORK SHALL CONFORM TO STATE AND LOCAL REGULATIONS.
C. PROVIDE AND INSTALL ALL EQUIPMENT, PIPING, DUCTWORK AND APPURTENANCES AS DESCRIBED BY THESE DRAWINGS AND AS REQUIRED TO PROVIDE COMPLETE AND OPERATIONAL SYSTEMS TO THE OWNER UNDER THIS CONTRACT.
D. REFER TO THE DIVISION 23 SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS RELATING TO THE QUALITY, CONSTRUCTION AND FINISH OF MATERIALS.
E. DUCT OR PIPING PENETRATING FLOOR SLABS AND/OR WALLS SHALL BE SEALED WEATHERTIGHT AND/OR MATCH EXISTING CONSTRUCTION.
F. ALL RECTANGULAR SHEET METAL DUCT SIZES ARE INSIDE DIMENSIONS. ALL ROUND DUCT SIZES SHOWN ARE INSIDE DIAMETERS.
G. INSTALL VOLUME DAMPER AT EACH BRANCH TAKE-OFF FROM MAIN SUPPLY DUCTS.
H. ALL WALL THERMOSTATS, SENSORS, AND/OR HUMIDISTATS SHALL BE 4'-0" ABOVE FINISHED FLOOR TO BOTTOM AND LINED UP VERTICALLY WITH LIGHT SWITCHES UNLESS OTHERWISE NOTED OR DIRECTED BY THE ARCHITECT/ENGINEER.
I. REPAIR AND PATCH ANY DAMAGE TO EXISTING OR NEW FACILITIES, INCLUDING SURFACES, FLOORS, WALLS, ROOFS, AND CEILING. REPAIRS SHALL MATCH EXISTING INSTALLATION.
J. ALL SENSORS SHALL BE 4'-0" ABOVE FINISHED FLOOR TO BOTTOM AND LINED UP VERTICALLY WITH LIGHT SWITCHES.

(#) PLAN NOTES:

1. ROUTE 24"x18" REDUCER VERTICALLY FROM DOAS-2. TRANSITION TO ROUND 14"Ø DUCT PRIOR TO WALL PENETRATION.
2. ROUTE 10"x33" RA DUCT VERTICALLY FROM DOAS-2. PROVIDE MOTORIZED RECIRCULATING AIR DAMPER.
3. RELOCATE SALVAGED DIFFUSER AND ADJUST VOLUME BALANCE DAMPER.
4. RAISE EXISTING 6" DIA. SA DUCT AS NEEDED TO ALLOW NEW 10" DIA. DUCT BELOW.
5. ADJUST 1" ELECTRICAL CONDUIT SUPPORTS AS NEEDED TO ALLOW 14" DIA. SA DUCT THROUGH WALL.
6. ADJUST VOLUME BALANCE DAMPER TO PROVIDE NEW SUPPLY AIR FLOW. EXISTING SUPPLY DIFFUSER TO REMAIN.



1 FIRST FLOOR HVAC ENLARGED PLAN
SCALE: 1/2" = 1'-0"



2 DOAS 3D VIEW - LOOKING NORTHWEST
SCALE: NONE

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PROJECT

STATION 97 HVAC RENOVATION

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01/14/2025

REVISIONS
NO. DATE DESCRIPTION

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CHECKED BY: DTM	PRELIMINARY NOT FOR CONSTRUCTION
APPROVED BY: DTM	
PROJECT NO.: 24-156	

SHEET TITLE

FIRST FLOOR HVAC ENLARGED PLAN & 3D VIEW

SHEET NUMBER

M303

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1/14/2025 1:37:07 PM AESI Proj No: 24-156
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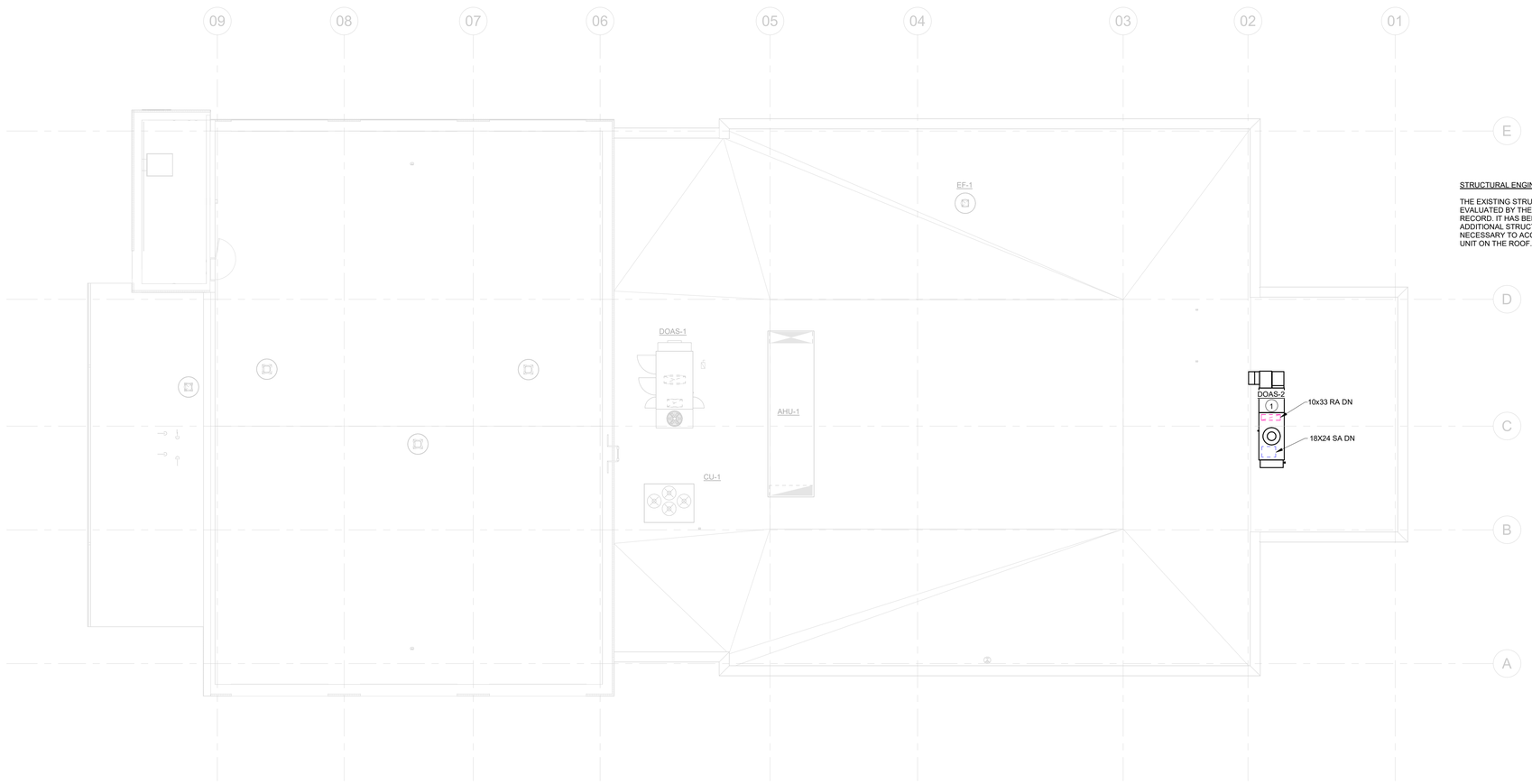
GENERAL NOTES:

A. PROVIDE ROOF PROTECTION FOR ALL AREAS WHERE WORK IS REQURIED. CONTRACTOR SHALL BE RESPONSIBLE FOR REPAIRING ANY DAMAGED AREAS OF THE ROOF.
B. PROVIDE WALK OFF PROTECTION FROM POINT OF ROOF ACCES TO THE LOCATION OF THE NEW UNIT.
C. REFER TO PLUMBING DRAWINGS FOR ROUTING OF NEW NATURAL GAS PIPING AND CONDENSATE DRAIN FROM THE NEW DOAS UNIT.

(#) PLAN NOTES:

1. PROVIDE NEW ROOF MOUNTED DOAS-2 UNIT. REFER TO DETAIL 3/M501.



STRUCTURAL ENGINEERING NOTE:

THE EXISTING STRUCTURAL STEEL HAS BEEN EVALUATED BY THE STRUCTURAL ENGINEER OF RECORD. IT HAS BEEN DETERMINED THERE IS NO ADDITIONAL STRUCTURAL REINFORCEMENT NECESSARY TO ACCOMODATE THE NEW DOAS UNIT ON THE ROOF.

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

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PROJECT

STATION 97 HVAC RENOVATION

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REVISIONS

NO.	DATE	DESCRIPTION

DESIGNED BY: VAM	CERTIFICATION: PRELIMINARY NOT FOR CONSTRUCTION
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APPROVED BY: DTM	
PROJECT NO.: 24-156	

SHEET TITLE

ROOF MECHANICAL PLAN

SHEET NUMBER

M320

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0 1/2" 1" 2"

ORIGINAL SHEET SIZE IS 30" X 42" (ARCH E1)
1/14/2025 1:37:08 PM AES Proj No: 24-156

DEDICATED OUTDOOR AIR SYSTEM

NOTES:

1. PROVIDE UNIT WITH MODEL GKD (120.5"x39.7"x14") ROOF CURB. CONSTRUCTION TO BE ENTIRELY 18 GAUGE GALVANIZED STEEL. CURB INSULATION TO BE FIELD INSTALLED.
2. FURNISH UNIT WITH: 2" DOUBLE WALL CONSTRUCTION, SS DRAIN PAN DOUBLE SLOPED, ACCESS DOORS, FACTORY WIRED DISCONNECT, ENERGY WHEEL, BACNETMSTP, CONTROL PANEL FACTORY WIRED MOUNTED ON UNIT (NEMA 4x ENCLOSURE), 24V CONTROL TRANSFORMER, SERVICE OUTLET ON UNIT FACTORY WIRED, FACTORY MOUNTED AND WIRED VFD (SUPPLY & EXHAUST FANS), DAMPER CONTROL 100% OA TO 100% RECIRCULATION, FROST CONTROL ON WHEEL, LOW LEAK DAMPERS, ROOF CURB FULLY INSULATED, SERVICE LIGHTS, CONDENSATE OVERFLOW SWITCH, EXHAUST GRAVITY BACKDRAFT DAMPER, MODULATING GAS VALVE, POWER VENTING, HAIL GUARDS, PHASE REVERSAL AND BROWNOUT PROTECTION, INDOOR PRESSURE SENSOR, INDOOR THERMOSTAT WITH TEMP/RH READOUT, UNIT MOUNTED DUCT SMOKE DETECTOR, HX WARRANTY OF 25 YEARS, COMPRESSOR WARRANTY 5 YEAR PARTS AND ONE YEAR FULL UNIT PARTS AND LABOR WARRANTY.

UNIT DATA				SUPPLY FAN DATA			EXHAUST FAN DATA			COOLING COIL DATA						GAS-FIRED HEATING DATA					ELECTRICAL DATA			
												EAT °F		LAT °F										
UNIT TAG	MANUFACTURER	MODEL	WEIGHT	SA/OA CFM	E.S.P.	BHP	EXHAUST CFM	E.S.P.	BHP	TOTAL MBH	SENSIBLE MBH	DB	WB	DB	WB	INPUT MBH	OUTPUT MBH	GAS PRESSURE	EAT DB	LAT DB	MCA	MOCP	VOLTS/HZ/PH	NOTES
DOAS-2	GREENHECK	RVE-20	1426 LB	1200	1"	0.75	650	0.5	0.5	63.3	39.8	85.6	70.1	52.7	52.6	100	81	6"	24.6	87.1	30.9	45	208/60/3	SEE...

SUPPLY DIFFUSER SCHEDULE

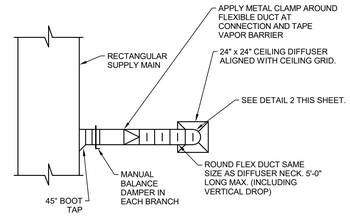
NOTES:
1. SUPPLY DIFFUSER SHALL BE CENTERED IN CEILING TILE.
2. RADIUS OF DIFFUSION BASED ON TERMINAL HORIZONTAL VELOCITIES OF 150-100-50 FPM
3. PAINT INSIDE OF DUCT FLAT BLACK WHERE VISIBLE.

TAG NO.	TYPE	DESCRIPTION	NOMINAL FACE SIZE (IN.)	NOMINAL RD. NECK SIZE (IN.)	BRANCH DUCT SIZE TO DIFFUSER...	CFM	MAX. NC LEVEL	THROW (FT) 150-100-50	MAX. NECK VELOCITY (FPM)	MAX. VELOCITY PRESSURE...	MAX. TOTAL PRESSURE (IN. W.C)	MFR.	MODEL NO.	REMARKS
SDA	CEILING	ALUM. CONSTRUCTION FOR LAY-IN CEILING	24 X 24	10	PER PLANS	400	21	4-6-11	800	0.04	0.078	PRICE	ASCD	1,2,3

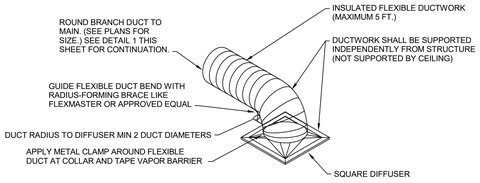
GRILLE SCHEDULE

NOTES:
1. ALL RETURN GRILLES SHALL BE CENTERED IN THE CEILING TILE.
2. PAINT INSIDE OF DUCT FLAT BLACK WHERE VISIBLE
3. ALUMINUM CONSTRUCTION. WHITE FINISH.

TAG NO.	NOMINAL FACE SIZE (IN.)	MIN. CORE AREA (SQ. FT.)	BRANCH DUCT SIZE TO GRILLE (IN.)	CFM RANGE	MAX. NC LEVEL	MAX. CORE VELOCITY (FPM)	MAX. VELOCITY PRESS...	MAX. TOTAL PRESSURE (IN. W. C.)	MFR.	MODEL NO.	REMARKS
EGA	24X24	N/A	PER PLANS	0-1000	21	300	0.006	0.013	PRICE	80	SEE NOTES



1 DIFFUSER DETAIL
SCALE: N/A

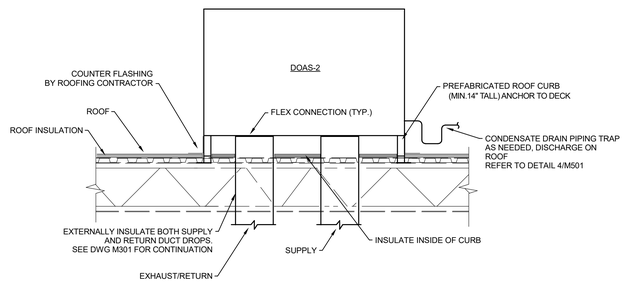


2 SUPPLY DIFFUSER DETAIL
SCALE: N/A

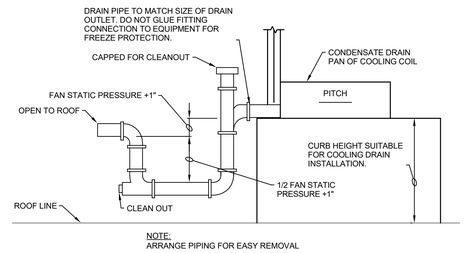
DOAS UNIT SEQUENCE OF OPERATION

1. THE UNIT SHALL RUN CONTINUOUSLY AS THE FIRE STATION IS OCCUPIED 24 HOURS A DAY.
2. THE UNIT CAN BE MANUALLY STARTED OR STOPPED FROM THE OWNER'S BMS WORKSTATION
3. THE UNIT SHALL MAINTAIN A DISCHARGE TEMPERATURE OF 72 DEGREES (ADJUSTABLE).
4. THE GAS FIRED HEAT, DX COOLING AND HOT GAS REHEAT SHALL MODULATE IN SEQUENCE TO MAINTAIN THE DISCHARGE AIR TEMPERATURE.
5. WHEN IN COOLING MODE, THE GAS HEAT SHALL BE LOCKED OUT. THE DX COOLING COIL SHALL MAINTAIN A DISCHARGE AIR TEMPERATURE OF 52 DEGREES OR LESS FOR DEHUMIDIFICATION. THE HOT GAS REHEAT COIL SHALL MODULATE TO REHEAT THE AIR TO THE DISCHARGE AIR TEMPERATURE SET POINT.
6. WHEN IN HEATING MODE, THE DX COOLING AND HOT GAS REHEAT SHALL BE DISABLED TO PREVENT SIMULTANEOUSLY HEATING AND COOLING. THE MODULATING GAS BURNER SHALL DISCHARGE THE SAME TEMPERATURE TO MAINTAIN THE DISCHARGE TEMPERATURE SET POINT.
7. THE INDOOR MOUNTED THERMOSTAT FURNISHED BY THE DOAS UNIT MANUFACTURER SHALL MODULATE THE GAS HEAT OR DX COOLING DEPENDING ON THE SEASON AND BASED OFF OF INDOOR AIR TEMPERATURE.
8. THE COMBINATION THERMOSTAT/RH SENSOR SHALL AUTOMATICALLY PUT THE UNIT INTO DX COOLING MODE IF THE INDOOR RELATIVE HUMIDITY RISES ABOVE 60% (ADJUSTABLE). THE UNIT WILL CONTINUE TO RUN IN COOLING MODE UNTIL THE INDOOR RELATIVE HUMIDITY FALLS BELOW 50%.
9. DX COOLING SHALL BE LOCKED OUT BELOW 55 DEGREES F OUTDOORS.
10. WHEN THE UNIT IS OPERATIONAL, THE OUTSIDE AIR DAMPER SHALL OPEN AND BRING IN A FIXED AMOUNT OF OUTSIDE AIR AS SCHEDULED ON THE DRAWINGS.
11. WHEN THE UNIT IS DISABLED THE OUTSIDE AIR DAMPER SHALL FULLY CLOSE AND THE RETURN/EXHAUST DAMPER SHALL FULLY OPEN.
12. AN INDOOR PRESSURE SENSOR FURNISHED BY THE DOAS UNIT MANUFACTURER SHALL MODULATE THE RETURN/EXHAUST DAMPER TO MAINTAIN A POSITIVE INDOOR PRESSURE SET POINT OF +0.05"WC.
13. A MINIMUM OF 650 CFM SHALL BE EXHAUSTED THRU THE ENERGY WHEEL AT ALL TIMES. SHOULD THE INDOOR PRESSURE EXCEED THE INDOOR PRESSURE SET POINT, THE EXHAUST FAN VFD SHALL INCREASE THE FAN SPEED AND MORE AIR SHALL BE EXHAUSTED IN ORDER TO NOT OVER PRESSURIZE THE BUILDING. THE EXHAUST FAN VFD SHALL CONSTANTLY MODULATE TO MAINTAIN THE INDOOR PRESSURE SET POINT.
14. THE TEMPERATURE CONTROL CONTRACTOR SHALL INTEGRATE THE FACTORY MOUNTED AND WIRED CONTROLLER INTO THE EXISTING BMS. ALL OF THE UNIT SET POINTS SHALL BE PULLED INTO THE EXISTING SOFTWARE FOR MONITORING BY THE OWNER.
15. CRITICAL ALARMS SHALL INCLUDE THE FOLLOWING:
    a. SUPPLY FAN FAILURE
    b. EXHAUST FAN FAILURE
    c. ENERGY WHEEL FAILURE
    d. LOW DISCHARGE AIR TEMPERATURE (BELOW 70 DEGREES ADJUSTABLE)
    e. HIGH DISCHARGE AIR TEMPERATURE (ABOVE 80 DEGREES ADJUSTABLE)
    f. COOLING SYSTEM FAILURE
    g. GAS HEAT FAILURE
16. UNIT SHALL AUTOMATICALLY SHUT DOWN IF THE DISCHARGE TEMPERATURE FALLS BELOW 45 DEGREES.
17. ANYTIME THE DUCT MOUNTED SMOKE DETECTOR HAS AN ALARM, THE UNIT SHALL SHUT-DOWN AND FULLY STOP AND AN ALARM SHALL BE SENT TO THE BMS.

5 DOAS-2 SEQUENCE OF OPERATION
SCALE: N/A



3 DEDICATED OUTSIDE AIR SYSTEM UNIT DETAIL
SCALE: N/A



4 CONDENSATE DRAIN DETAIL
SCALE: N/A

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OWNER

FISHERS FIRE DEPARTMENT
15109 E 136th St.
Fishers, IN 46037

PROJECT

STATION 97 HVAC RENOVATION

100% FRCD
01/14/2025

REVISIONS

NO.	DATE	DESCRIPTION

DESIGNED BY: VAM	CERTIFICATION: PRELIMINARY NOT FOR CONSTRUCTION
CHECKED BY: DTM	
APPROVED BY: Approver	
PROJECT NO.: 24-156	

SHEET TITLE

MECHANICAL DETAILS & SCHEDULE

SHEET NUMBER

M501

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ORIGINAL SHEET SIZE IS 30" X 42" (ARCH E1)
1/14/2025 1:37:08 PM AESI Proj. No: 24-156
0 1/2" 1" 2"

NOTE: ALL SYMBOL DESCRIPTIONS ARE SUBJECT TO MODIFICATION ON THE DRAWINGS. ALL SYMBOLS NOT NECESSARILY USED ON THIS PROJECT.

GENERAL SYMBOLS:

- POINT OF CONNECTION
- POINT OF REMOVAL
- PLAN NOTE
- DEMOLITION NOTE
- REVISION
- DETAIL BUBBLE
- SECTION BUBBLE

VALVES & FITTINGS:

- GATE VALVE
- BALANCING VALVE
- BALL VALVE
- BUTTERFLY VALVE
- CHECK VALVE
- GLOBE VALVE
- CONTROL VALVE
- PRESSURE RELIEF, ANGLE TYPE VALVE
- REDUCED PRESSURE BACK FLOW PREVENTER
- INDICATED FLOW DIRECTION
- PIPE TURN 90°
- LINE BREAK
- PIPE ELBOW UP (RISE)
- PIPE ELBOW DOWN (DROP)
- PIPE TEE DOWN
- CAP OR PLUG
- REDUCER, CONCENTRIC
- REDUCER, ECCENTRIC
- FLANGES
- UNION
- METER
- FD FLOOR DRAIN
- CO FLOOR CLEANOUT
- GAUGE
- THERMOMETER
- T STEAM TRAP
- P PRESSURE SENSOR
- INLINE PUMP

PIPING DESIGNATIONS:

- NEW
- EXISTING TO REMAIN
- DEMOLITION
- FUTURE
- PIPE SLOPES IN DIRECTION OF ARROW
- DOMESTIC COLD WATER
- DOMESTIC HOT WATER
- DOMESTIC HOT WATER RETURN
- 140°F DOMESTIC HOT WATER 140°F
- 140°F DOMESTIC HOT WATER 140°F RETURN
- W WASTE PIPING
- ST STORM PIPING
- V SANITARY VENT
- D INDIRECT DRAIN
- AW ACID WASTE
- AV ACID VENT
- DI DEIONIZED WATER
- RODI REVERSE OSMOSIS DEIONIZED WATER
- LS LAWN SPRINKLER
- G GAS
- FOS FUEL OIL SUPPLY
- FOR FUEL OIL RETURN
- FOV FUEL OIL VENT
- VAC VACUUM
- CA COMPRESSED AIR

SPECIALTY PIPING

- MV MEDICAL VACUUM
- SV SURGICAL VACUUM
- LV LAB VACUUM
- N2 NITROGEN
- N2O NITROUS OXIDE
- CO2 CARBON DIOXIDE
- AG ARGON
- MA MEDICAL AIR
- LA LAB AIR

PLUMBING ABBREVIATIONS:

AD	ACCESS DOOR
ADA	AMERICANS WITH DISABILITIES ACT
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AHJ	AUTHORITY HAVING JURISDICTION
AHU	AIR HANDLING UNIT
AV	ACID VENT
AW	ACID WASTE
BDD	BACK DRAFT DAMPER
BF	BOTTLE FILLER
BHP	BRAKE HORSEPOWER
BLDG	BUILDING
BOD	BOTTOM OF DUCT
BOP	BOTTOM OF PIPE
BOS	BOTTOM OF STEEL
BTU	BRITISH THERMAL UNIT
CA	COMPRESSED AIR
℄	CENTERLINE
CO	CLEANOUT
CS	CUP SINK
CSS	CLINIC SERVICE SINK
CW	DOMESTIC COLD WATER
D	CONDENSATE/DRAIN
DB	DRY BULB
DCV	DOUBLE CHECK VALVE
DIA	DIAMETER
DN	DOWN
DOAS	DEDICATED OUTDOOR AIR SYSTEM
DWH	DOMESTIC WATER HEATER
ESEW	EMERGENCY SHOWER AND FACE/EYE WASH
EW	EMERGENCY EYE/FACE WASH
EWC	ELECTRIC WATER COOLER
EL	ELEVATION
ES	EMERGENCY SHOWER
EX	EXISTING
FCO	FLOOR CLEANOUT
FD	FLOOR DRAIN
FLA	FULL LOAD AMPS
G	NATURAL GAS
GI	GREASE INTERCEPTOR
HB	HOSE BIBB
HKSP	HOUSEKEEPING
HW	DOMESTIC HOT WATER
HWR	DOMESTIC HOT WATER RETURN
HWCP	HOT WATER RECIRCULATION PUMP
IE	INVERT ELEVATION
JS	JANITOR SINK
L	LAVATORY
MB	MOP BASIN
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
PH	PHASE
PIV	POST INDICATING VALVE
PSIA	POUNDS PER SQUARE INCH ABSOLUTE
PSIG	POUNDS PER SQUARE INCH GAUGE
RO	REVERSE OSMOSIS
RPBP	REDUCED PRESSURE BACKFLOW PREVENTER
SAN	SANITARY
SCW	DOMESTIC SOFT COLD WATER
SH	SHOWER
SI	SEDIMENT INTERCEPTOR
S	SINK
SS	STAINLESS STEEL
ST	STORM WATER
TD	TRENCH DRAIN
UR	URINAL
V	SANITARY VENT
VTR	VENT THROUGH ROOF
W	WASTE
WC	WATER CLOSET
WCO	WALL CLEANOUT
WH	WALL HYDRANT

GENERAL NOTES:

A. VERIFY EXISTING CONDITIONS IN THE FIELD PRIOR TO BIDDING AND BEFORE BEGINNING WORK.
B. REVIEW THE WORK OF OTHER TRADES, COORDINATE AND -PLAN WORK WITH THE OTHER TRADES AND OWNER, ADJUST AS A RESULT OF COORDINATION.
C. STORE EQUIPMENT AND COMPONENTS IN A CLEAN, DRY LOCATION UNTIL READY FOR INSTALLATION. PROTECT FROM WEATHER, DIRT, WATER, AND CONSTRUCTION DEBRIS, ETC. AT ALL TIMES. ANY DAMAGED EQUIPMENT OR COMPONENTS SHALL BE RESTORED AS NEW OR REPLACED.
D. ALL MATERIALS REMOVED AND NOT RELOCATED BECOME THE PROPERTY OF THE CONTRACTOR. REMOVE MATERIALS FROM THE PROJECT SITE UNLESS NOTED OTHERWISE.
E. PATCH WALLS, FLOORS, CEILINGS, COLUMNS, ROOF PENETRATIONS, ETC. WHERE ITEMS ARE REMOVED TO MATCH ADJACENT SURFACES.
F. DRAWINGS SHOW THE INTENDED ARRANGEMENT AND ROUTING OF ALL PIPING, EQUIPMENT, AND APPURTENANCES. THEY SHALL BE FOLLOWED AS CLOSELY AS ACTUAL BUILDING CONSTRUCTION AND WORK OF OTHER TRADES WILL PERMIT.
G. CLEAN ALL EQUIPMENT TO PRESENT A "LIKE NEW" CONDITION AT PROJECT COMPLETION.
H. OFFSET PIPING AROUND ELECTRICAL PANELS TO PROVIDE CLEARANCES AS REQUIRED BY THE NATIONAL ELECTRICAL CODE.

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OWNER

FISHERS FIRE DEPARTMENT
15109 E 136th St.
Fishers, IN 46037

PROJECT

STATION 97 HVAC RENOVATION

100% FRCD
01/14/2025

REVISIONS

NO.	DATE	DESCRIPTION

DESIGNED BY: VAM	CERTIFICATION: PRELIMINARY NOT FOR CONSTRUCTION
CHECKED BY: DTM	
APPROVED BY: Approver	
PROJECT NO.: 24-156	

SHEET TITLE

PLUMBING SYMBOLS AND ABBREVIATIONS

SHEET NUMBER

P001

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0 1/2" 1" 2"

ORIGINAL SHEET SIZE IS 30" X 42" (ARCH E1)
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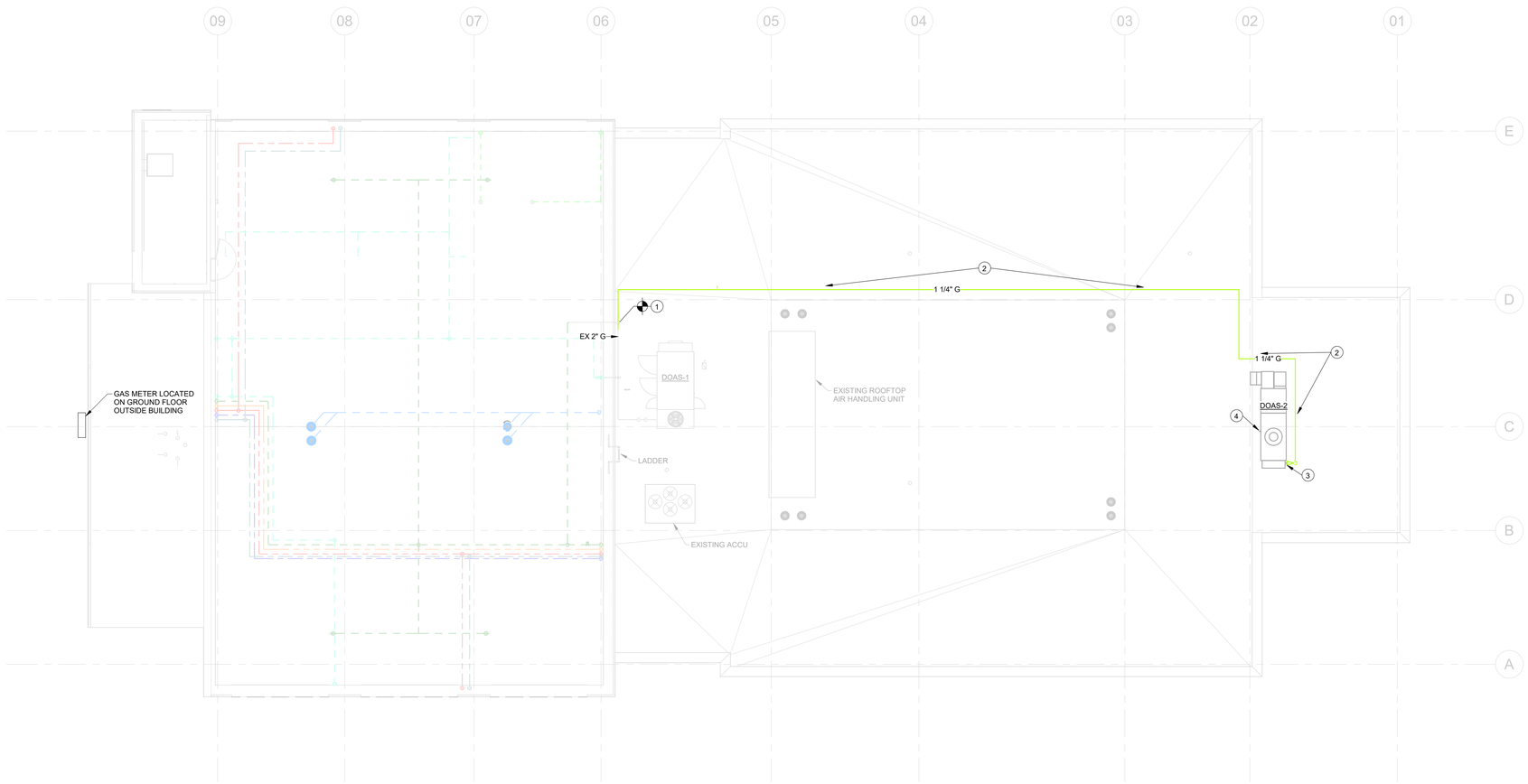
GENERAL NOTES:

A. REFER TO SHEET P001 FOR GENERAL NOTES.

(#) PLAN NOTES:

1. TIE-INTO EXISTING 2" GAS LINE WITH NEW 2"x2" TEE.
2. ROUTE NEW 1-1/4" G PIPING AS SHOWN. SUPPORT PIPING IN ACCORDANCE TO SPECIFICATION SECTION 220529.
3. CONNECT GAS LINE TO 3/4" CONNECTION AT DOAS-2 (100,000 BTUH). PROVIDE GAS SHUT-OFF VALVE, DIRT LEG AND UNION BEFORE CONNECTION TO UNIT.
4. TERMINATE CONDENSATE DRAIN PIPING TO ROOF. REFER TO DETAIL 4/M501.



ROOF PLUMBING PLAN

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

GAS EQUIPMENT LOAD SCHEDULE

EQUIPMENT MARK	EQUIPMENT NAME	QUANITY...	BTUH EACH	BTUH TOTAL	EQUIPMENT REQUIRED...
DOAS-2	Dedicated Outdoor Air System	1	100,000	100000	6" W.C.
TOTAL BTUH =				100,000.00	
TOTAL MBH =				100.00	

Total Length/Developed Lengt... 276 x 1.15 = 317'; USE 350'
Gas Pressure = 14"w.c. Required downstream of gas meter set. Requesting 2 PSI from Gas Company
Pipe Sizes = 1-1/4" Black iron

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SHEET TITLE

ROOF PLUMBING PLAN & GAS LOAD SCHEDULE

SHEET NUMBER

P320

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NOTE: ALL SYMBOL DESCRIPTIONS ARE SUBJECT TO MODIFICATION ON THE DRAWINGS. ALL SYMBOLS NOT NECESSARILY USED ON THIS PROJECT.

RACEWAY SYMBOLS:

- CONDUIT
- CONDUIT CONCEALED UNDER FLOOR OR BELOW GRADE
- UNDERGROUND CONDUIT STUBBED OUT 5'-0" FROM BUILDING OR WALKWAY LINE, CAPPED AND MARKED
- B#5,7 — HOME RUN TO PANEL "B" FOR CIRCUITS #5 & 7 WITH COMMON NEUTRAL AND GROUND
- CONDUIT UP/DOWN
- JUNCTION BOX CONCEALED ABOVE ACCESSIBLE CEILING AREA

RECEPTACLE SYMBOLS:

WALL RECEPTACLES 18" TO CENTER AFF UNLESS OTHERWISE NOTED EXCEPT FOR ABOVE COUNTER RECEPTACLES WHICH ARE +6" TO CENTER ABOVE COUNTER OR BLACKSPLASH COORDINATED WITH APPROVED SHOP DRAWINGS

- 20 AMP SIMPLEX GROUNDING RECEPTACLE - WALL, HORIZONTAL, ABOVE COUNTER, EMERGENCY POWER
- 20 AMP DUPLEX GROUNDING RECEPTACLE - WALL, HORIZONTAL, ABOVE COUNTER, EMERGENCY POWER, SPLIT WIRED
- 20 AMP DUPLEX GROUNDING RECEPTACLE, GROUND FAULT INTERRUPTING CIRCUIT - WALL, HORIZONTAL, ABOVE COUNTER, EMERGENCY POWER
- 20 AMP DOUBLE DUPLEX GROUNDING RECEPTACLE IN TWO GANG OUTLET BOX - WALL, ABOVE COUNTER, EMERGENCY POWER, SPLIT WIRED
- 20 AMP DOUBLE DUPLEX GROUNDING RECEPTACLE IN TWO GANG OUTLET BOX, GROUND FAULT INTERRUPTING CIRCUIT - WALL, ABOVE COUNTER, EMERGENCY POWER
- 20 AMP SIMPLEX GROUNDING RECEPTACLE, FLOOR MOUNTED - FLOOR, EMERGENCY POWER
- 20 AMP DUPLEX GROUNDING RECEPTACLE, FLOOR MOUNTED - FLOOR, EMERGENCY POWER, SPLIT WIRED
- 20 AMP DOUBLE DUPLEX GROUNDING RECEPTACLE, FLOOR MOUNTED - FLOOR, EMERGENCY POWER, SPLIT WIRED
- 20 AMP GROUNDING RECEPTACLE, CEILING MOUNTED - SIMPLEX, DUPLEX, DOUBLE DUPLEX
- SPECIAL RECEPTACLE - SEE DRAWING FOR NEMA TYPE
- OPTIONS - CONTROLLED, HALF-CONTROLLED, TAMPER RESISTANT USB, WEATHERPROOF
- SURFACE MULTI-OUTLET RACEWAY WITH RECEPTACLES 24" ON CENTER UNLESS OTHERWISE NOTED

LIGHTING CONTROL SYMBOLS:

- S^3 — 20 AMP POLE TOGGLE SWITCH 48" TO CENTER AFF. INSTALL MULTIPLE SWITCHES UNDER COMMON COVER PLATE. SUBSCRIPT AT SWITCH SYMBOL INDICATES THE FOLLOWING:
  TOP: 2 - DOUBLE POLE, 3 - THREE WAY, D - DIMMER, 4 - FOUR WAY, P - PILOT LIGHT, LC - LIGHT CONTROLLER, M - MOMENTARY, K - KEY OPERATED, BLANK - SINGLE POLE, LV - LOW-VOLTAGE PUSH BUTTON TYPE TOGGLE SWITCH
  BOTTOM: a,b,c,d, ETC. - IDENTIFICATION OF CONTROLLED DEVICE
- OCCUPANCY SENSOR SWITCH, CEILING MOUNTED
- OCCUPANCY SENSOR SWITCH, WALL MOUNTED
- DAYLIGHT SENSOR SWITCH, CEILING MOUNTED
- DAYLIGHT SENSOR SWITCH, WALL MOUNTED
- RC — LIGHTING ROOM CONTROLLER
- R — LIGHTING ISOLATED RELAY

POWER/MOTOR CONTROL SYMBOLS:

- PANELBOARD OR EQUIPMENT CABINET AS INDICATED
- MOTOR, NUMBER INDICATES HP
- S^F — MANUAL MOTOR STARTER WITH THERMAL OVERLOADS AND PILOT LIGHT, 48" AFF
- X — SAFETY (DISCONNECT) SWITCH, INSTALL AT 60" AFF, "F" INDICATES FUSE SIZE, BLANK INDICATES NON-FUSED, "X" INDICATES AMPERAGE RATING
- COMBINATION STARTER: SEE SCHEDULE.

LIGHTING SYMBOLS:

- a/b / F# — LIGHTING FIXTURE, "a/b" INDICATES SWITCHING, "F#" INDICATES TYPE
- LIGHTING FIXTURE WITH LAMPS ON NORMAL AND EMERGENCY CIRCUIT, PROVIDE SEPARATE EMERGENCY LAMP BALLASTS AS SPECIFIED
- ALWAYS ON NIGHT LIGHT
- a / F# — ROUND LIGHTING FIXTURE, "a" INDICATES SWITCHING, "F#" INDICATES TYPE
- a / F# — WALL MOUNTED LIGHTING FIXTURE, "a" INDICATES SWITCHING, "F#" INDICATES TYPE
- SINGLE ARM LIGHTING STANDARD, POLE MOUNTED LUMINAIRE AND POLE SUPPORT BASE
- DOUBLE ARM LIGHTING STANDARD, POLE MOUNTED LUMINAIRE AND POLE SUPPORT BASE
- LIGHTING FIXTURE ON LIGHTING TRACK, CEILING MOUNTED
- SINGLE FACE EXIT SIGN. ARROW INDICATES DIRECTIONAL ARROW ON EXIT SIGN FACE
- EXIT SIGN, WALL MOUNTED 8'-0" AFF UNLESS OTHERWISE NOTED
- EMERGENCY BATTERY UNIT WITH TWO HEADS, WALL MOUNTED 8'-0" AFF UNLESS OTHERWISE NOTED

FIRE ALARM SYMBOLS:

- FACP — FIRE ALARM CONTROL PANEL
- FAAP — FIRE ALARM ANNUNCIATOR PANEL
- NAC — NOTIFICATION ALARM CIRCUIT
- F — FIRE ALARM MANUAL PULL STATION, 48" AFF
- F — FIRE ALARM MANUAL PULL STATION, AUDIO-VISUAL INDICATING DEVICE CENTERED ABOVE THE PULL STATION, 48" AFF AND +80" AFF. LIGHT OUTPUT 75 cd UNLESS OTHERWISE NOTED
- V — FIRE ALARM VISUAL ONLY INDICATING DEVICE, +80" AFF. LIGHT OUTPUT 75 cd UNLESS OTHERWISE NOTED

CEILING	WALL	
AV	AV	FIRE ALARM AUDIO/VISUAL INDICATING DEVICE, WALL MOUNT +80" AFF. LIGHT OUTPUT 75 cd UNLESS OTHERWISE NOTED
SV	SV	FIRE ALARM SPEAKER/VISUAL INDICATING DEVICE, WALL MOUNT +80" AFF. LIGHT OUTPUT 75 cd UNLESS OTHERWISE NOTED
S	S	FIRE ALARM SPEAKER ONLY INDICATING DEVICE, WALL MOUNT +80" AFF
V	V	FIRE ALARM VISUAL ONLY INDICATING DEVICE, WALL MOUNT +80" AFF. LIGHT OUTPUT 75 cd UNLESS OTHERWISE NOTED
C	C	FIRE ALARM CHIME ONLY INDICATING DEVICE, WALL MOUNT +80" AFF
A	A	FIRE ALARM AUDIO HORN INDICATING DEVICE, WALL MOUNT +80" AFF

- BELL
- SD — AREA SMOKE DETECTOR
- HD — AREA HEAT DETECTOR
- FS — FLOW SWITCH, FIRE ALARM
- TS — TAMPER SWITCH, FIRE ALARM
- DS — DOOR SWITCH, FIRE ALARM
- AS — AIR DUCT SMOKE DETECTOR MOUNTED ON AIR DUCT
- LA — LOW AIR
- PS — PRESSURE SWITCH
- DOOR HOLD

TELECOMMUNICATION SYMBOLS:

- X — DATA OUTLET IN TWO GANG BOX WITH SINGLE GANG OPENING, "X" INDICATES NUMBER OF DATA JACKS
- X/X — VOICE/DATA OUTLET IN TWO GANG BOX WITH SINGLE GANG OPENING, "X/X" INDICATES NUMBER OF VOICE/DATA JACKS
- X — VOICE OUTLET IN TWO GANG BOX WITH SINGLE GANG OPENING, "X" INDICATES NUMBER OF VOICE JACKS
- X/X — FLUSH FLOOR VOICE/DATA OUTLET, "X/X" INDICATES NUMBER OF VOICE/DATA JACKS
- X — FLOOR OUTLET, DATA OUTLET CONSISTS OF (2) DATA OUTLETS UNLESS OTHERWISE NOTED, EACH ALPHA CHARACTER "X" INDICATES NUMBER OF UNIQUE DATA JACKS
- AC-X — CEILING MOUNTED OUTLET, DATA OUTLET CONSISTS OF (2) DATA OUTLETS, UNLESS OTHERWISE NOTED, EACH ALPHA CHARACTER "X" INDICATES NUMBER OF UNIQUE DATA JACKS
- AP-X — CEILING MOUNTED WIRELESS ACCESS POINT OUTLET, DATA OUTLET CONSISTS OF (2) DATA OUTLETS, UNLESS OTHERWISE NOTED, EACH ALPHA CHARACTER "X" INDICATES NUMBER OF UNIQUE DATA JACKS
- SURFACE DATA/TELECOM RACEWAY
- S — CEILING MOUNTED SPEAKER
- PAGING HORN TYPE SPEAKER
- TV — TELEVISION/VIDEO OUTLET IN TWO GANG BOX WITH SINGLE GANG OPENING

SECURITY/ACCESS CONTROL SYMBOLS

- CR — CARD READER, WALL MOUNT +48" AFF
- KP — KEYPAD
- PB — PANIC BUTTON
- RX — REQUEST TO EXIT
- DS — DOOR STATUS
- ES — ELECTRIC STRIKE
- ML — MAG LOCK
- AA — AUDIBLE ALARM

NURSE CALL SYMBOLS

- DC — CORRIDOR CONTROLLER
- NB — BED RECEPTACLE
- NA — DUAL AUXILIARY JACK STATION
- DS — DUTY STATION
- V — FOCUS RING
- PC — PULL CORD
- PC / A — PULL CORD WITH AUDIO STATION
- EC — EMERGENCY BUTTON/CODE BLUE
- SP — SINGLE BED/PATIENT STATION
- NM — VOIP NURSE CONSOLE
- LC — XL SENSOR
- AD / X — AUXILIARY DEVICE
- N — NURSE CALL DOME LIGHT
- RF SENSOR

DIAGRAM SYMBOLS:

- GROUND ROD (SINGLE LINE DIAGRAM)
- GROUND ROD (PLAN DRAWING)
- LIGHTNING ROD
- EXOTHERMIC WELDED CONNECTION
- T — TRANSFORMER, 480V PRIMARY, 120/208 VOLT SECONDARY, 3 PHASE, 4 WIRE UNLESS OTHERWISE NOTED
- CURRENT & VOLTAGE TRANSFORMERS AS REQUIRED (REFER TO SPECIFICATIONS)
- AM — AMMETER, (REFER TO SPECIFICATIONS)
- VM — VOLTMETER, (REFER TO SPECIFICATIONS)
- FUSE
- 30A 3P — CIRCUIT BREAKER (C.B.)
- PUSHBUTTON, NORMALLY OPEN
- PUSHBUTTON, NORMALLY CLOSED
- LEVEL SWITCH, NORMALLY OPEN
- LEVEL SWITCH, NORMALLY CLOSED
- LIMIT SWITCH, NORMALLY OPEN
- LIMIT SWITCH, NORMALLY CLOSED
- PRESSURE SWITCH, NORMALLY OPEN
- PRESSURE SWITCH, NORMALLY CLOSED
- FLOW SWITCH, NORMALLY OPEN
- FLOW SWITCH, NORMALLY CLOSED
- ON-DELAY TIMING CONTACT, NORMALLY OPEN
- ON-DELAY TIMING CONTACT, NORMALLY CLOSED
- OFF-DELAY TIMING CONTACT, NORMALLY OPEN
- OFF-DELAY TIMING CONTACT, NORMALLY CLOSED
- TEMPERATURE SWITCH, NORMALLY OPEN
- TEMPERATURE SWITCH, NORMALLY CLOSED
- RELAY CONTACT, NORMALLY OPEN
- RELAY CONTACT, NORMALLY CLOSED
- SOLENOID VALVE (WIRING DIAGRAM)
- R — PUSH-TO-TEST PILOT LIGHT
- XXXX / XXXX, x — 2-POSITION SELECTOR SWITCH
- OFF, HAND, AUTO, x — 3-POSITION SELECTOR SWITCH
- TERMINAL BLOCK
- CONTROL TRANSFORMER
- CONTROL TRANSFORMER

GENERAL SYMBOLS:

- NEW
- EXISTING TO REMAIN
- DEMOLITION
- FUTURE
- POINT OF CONNECTION
- POINT OF REMOVAL
- # — PLAN NOTE
- # — DEMOLITION NOTE
- # — REVISION
- X / X — DETAIL OR SECTION MARKER

ELECTRICAL ABBREVIATIONS:

#/C	MULTI-CONDUCTOR CABLE
1/C	SINGLE CONDUCTOR CABLE
20AF	20 AMP FUSES
3P	3 POLE
A, AMP	AMPERE
ACCU	AIR COOLED CONDENSING UNIT
AFF	ABOVE FINISHED FLOOR. MOUNTING HEIGHTS FROM FINISHED FLOOR TO TOP OF BOX
AHJ	AUTHORITY HAVING JURISDICTION
AHU	AIR HANDLING UNIT
CH	CABINET HEATER
℄	CENTERLINE
E	EXISTING EQUIPMENT TO BE REUSED
EF	EXHAUST FAN
EX	EXISTING
FCU	FAN COIL UNIT
GFI	GROUND FAULT INTERRUPTER
GND	GROUND
HP	HORSEPOWER
IG	ISOLATED GROUND
KVA	KILOVOLT AMPERES
KW	KILOWATT
NL	NIGHT LIGHT ON UNSWITCHED CIRCUIT
OL	OVERLOAD
PROVIDE	FURNISH, INSTALL AND CONNECT
RTU	ROOF TOP UNIT
UH	UNIT HEATER
UON	UNLESS OTHERWISE NOTED
V	VOLTS
WC	WATER COOLER
WG	WIRE GUARD
WP	WEATHERPROOF

GENERAL FIRE ALARM NOTES:

A. MANUAL PULL STATIONS AT EXIT DOORS SHALL BE INSTALLED WITHIN 5'-0" OF THE DOOR. OPERABLE PART OF EACH MANUAL PULL STATION SHALL BE INSTALLED BETWEEN 42" AND 48" ABOVE FINISHED FLOOR TO MEET ADA REQUIREMENTS.
B. FIRE RATED DOORS WITH HOLDS SHALL RELEASE UPON AN ALARM FROM SMOKE DETECTOR ON EITHER SIDE OF THE DOOR, OR OTHER ALARM INITIATION.
C. SMOKE DETECTOR SHALL BE INSTALLED 5'-0" OR LESS IN FRONT OF FACP AND CENTER OF THE DOORS WHICH CONTAIN HOLDERS.
D. SMOKE DETECTORS SHALL NOT BE INSTALLED WITHIN 3'-0" OF AN AIR DIFFUSER OR RETURN GRILL.
E. SMOKE DETECTORS IN ELEVATOR LOBBIES MUST BE INSTALLED WITHIN 21'-0" OF THE CENTERLINE OF THE ELEVATOR.
F. FIRE ALARM DESIGN SHALL CONTAIN NO MORE THAN 70% LOAD ON EACH PANEL AND LOOP LEAVING 30% AVAILABLE FOR FUTURE CAPACITY PER CIRCUIT.
G. CONTRACTOR MAY UTILIZE OPEN FIRE ALARM CABLING OR ARMORED FIRE ALARM CABLING WHEN INSTALLING CONDUCTORS ABOVE ACCESSIBLE CEILINGS AND BEHIND ACCESSIBLE CHASES. FIRE ALARM CABLING SHALL BE INSTALLED IN RACEWAY ABOVE INACCESSIBLE CEILINGS AND BEHIND INACCESSIBLE CHASES AND WALLS. IN ALL OPEN PUBLIC SPACES, FIRE ALARM CABLING SHALL BE INSTALLED IN RACEWAY (SURFACE RACEWAY) AND RACEWAY SHALL BE PAINTED TO MATCH WALLS/CEILING SURFACE ON WHICH THE RACEWAY IS INSTALLED.
H. OPEN FIRE ALARM CABLING NOT INSTALLED IN RACEWAY SHALL BE PLENUM RATED, NO EXCEPTION.
I. CONTRACTOR SHALL ADJUST DEVICE LOCATIONS BY UP TO 30" FROM WHAT IS SHOWN TO AVOID OBSTRUCTIONS.
J. CONTRACTOR SHALL PROVIDE "SURFACE MOUNT ADAPTER SKIRTS" FOR ALL SURFACE MOUNTED DEVICES. "SKIRTS" ARE NOT REQUIRED FOR SURFACE MOUNTED DEVICES INSTALLED IN MECHANICAL OR ELECTRICAL ROOMS.

GENERAL ELECTRICAL NOTES:

A. ALL WORK SHOWN IS NEW AND BY THE ELECTRICAL TRADES, UNLESS OTHERWISE NOTED.
B. ALL WORK SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE NATIONAL ELECTRICAL CODE (NFPA 70) AND NATIONAL FIRE ALARM CODE (NFPA 72) AS ADOPTED BY THE STATE INCLUDING ALL AMENDMENTS.
C. THIS CONTRACTOR SHALL REVIEW THE COMPLETE SET OF DRAWINGS AND SPECIFICATIONS AND INCLUDE WORK FROM OTHER DIVISIONS THAT AFFECT HIS WORK IN HIS BID.
D. CONTRACTOR SHALL VISIT PROJECT SITE, PRIOR TO BIDDING, TO REVIEW EXISTING ELECTRICAL, SECURITY, AND FIRE ALARM CONDITIONS. NOT ALL EXISTING ELECTRICAL EQUIPMENT, WIRING DEVICES AND RACEWAYS ARE SHOWN.
E. EACH CONTRACTOR SHALL FIELD VERIFY ALL EXISTING APPLICABLE CONDITIONS AND DIMENSIONS SHOWN ON THE DRAWINGS, AS PERTAINS TO THE INTENT OF THESE DRAWINGS. CONTRACTOR SHALL BRING TO THE ATTENTION OF THE ENGINEER AND DESIGNER ANY DISCREPANCIES PRIOR TO THE COMMENCEMENT OF ANY WORK AFFECTED BY OR RELATED TO SUCH DISCREPANCY. EACH CONTRACTOR SHALL BE RESPONSIBLE FOR ALL COSTS ASSOCIATED WITH OR CAUSED BY THAT CONTRACTOR'S FAILURE TO COMPLY WITH THIS REQUIREMENT.
F. COORDINATE ALL WORK WITH OWNER, SO AS TO NOT CAUSE DISRUPTION OF OWNER'S STAFF.
G. ALL LOUD NOISE MUST BE LIMITED TO BEFORE 8 AM OR AS DIRECTED BY OWNER.
H. WORK IN OFFICES, LABS, ETC., WILL REQUIRE THE PROTECTION (COVERING) OF FURNISHINGS AND ELECTRICAL/ELECTRONIC EQUIPMENT. DO NOT USE PLASTIC TO COVER COMPUTERS AND ELECTRONIC EQUIPMENT AT ANY TIME. CLOTH COVERS ARE ACCEPTABLE.
I. POWER, SECURITY, AND FIRE ALARM INTERRUPTIONS MUST BE PROPERLY PURSUED TO REDUCE INCONVENIENCE TO THE NORMAL BUILDING ACTIVITY TO A MINIMUM. ARRANGEMENTS FOR INTERRUPTION OF ELECTRICAL SERVICE TO AREAS MUST BE MADE IN WRITING WITH THE SUPERINTENDENT AND PROJECT MANAGER AT LEAST ONE WEEK BEFORE THE PROPOSED INTERRUPTIONS.
J. INTERRUPTIONS OF SERVICE IN AREAS WHERE PERSONNEL ARE WORKING WILL BE MADE BETWEEN THE HOURS OF 11:00 P.M. AND 6:00 A.M. UNLESS APPROVED BY SUPERINTENDENT, OWNER'S SECURITY PERSONNEL, AND OWNER'S FIRE ALARM PERSONNEL.
K. DEMOLITION SHALL BE PERFORMED TO MINIMIZE DAMAGE TO ADJACENT RETAINED WORK. WHERE SUCH DAMAGE OCCURS, PATCH, REPAIR OR OTHERWISE RESTORE TO ITS ORIGINAL CONDITION.
L. WHERE DEMOLITION WORK LEAVES HOLES AND DAMAGED SURFACE THAT WILL BE EXPOSED IN FINISHED WORK OR THROUGH A FIRE SEPARATION, THESE HOLES AND DAMAGED SURFACES SHALL BE PATCHED AND REPAIRED TO MATCH ADJACENT FINISHED SURFACE.
M. CONTRACTOR SHALL INCLUDE IN HIS BID THE REMOVAL AND PROPER DISPOSAL OF ALL EXISTING ELECTRICAL EQUIPMENT INDICATED TO BE REMOVED. HOWEVER, THE OWNER HAS THE FIRST RIGHT TO REFUSAL OF ALL EXISTING ELECTRICAL EQUIPMENT.
N. FOR ALL REMOVED OUTLETS, EQUIPMENT, SECURITY, AND FIRE ALARM, REMOVE ALL EXISTING RACEWAY AND WIRING TO SOURCE OR FIRST ACTIVE TO REMAIN JUNCTION BOX.
O. MAINTAIN SERVICE CONTINUITY TO ALL EXISTING LOADS THAT ARE TO REMAIN BY MODIFYING AND/OR EXTENDING CONDUIT AND WIRING AS REQUIRED. FIELD VERIFICATION OF EXISTING CONDUIT RUNS AND CIRCUITRY IS TO BE DONE AS REQUIRED. THIS INCLUDES, BUT IS NOT LIMITED TO RECEPTACLES, OVERHEAD POWER DROPS, DISCONNECTS, LIGHTING, AND WIRING TO FUME HOODS AND MECHANICAL EQUIPMENT.
P. UNLESS OTHERWISE NOTED ON THE DRAWINGS, ALL CUTTING AND PATCHING REQUIRED FOR THE ELECTRICAL, SECURITY, AND FIRE ALARM INSTALLATION SHALL BE PERFORMED BY THE APPROPRIATE TRADE AND PAID FOR BY THIS CONTRACTOR. ALL CUTTING AND PATCHING SHALL BE IN ACCORDANCE WITH THE APPLICABLE ARCHITECTURAL DETAILS/NOTES.
Q. RELOCATED/REINSTALLED ITEMS SHALL BE CLEANED AND PLACED IN STORAGE UNTIL ITEMS ARE READY TO BE REINSTALLED. IF ITEM IS DAMAGED, IT SHALL BE REPAIRED OR REPLACED WITH NEW ITEM AS APPROVED.
R. ALL FIRESTOPPING SHALL BE PROVIDED UNDER DIVISION 07 OR DIVISION 26, "FIRESTOPPING".
S. VERIFY EXACT LOCATION OF OUTLETS ABOVE COUNTERS, IN CASEWORK OR EQUIPMENT PRIOR TO ROUGH IN.
T. COORDINATE INSTALLATION OF DEVICES AND WIRING WITH LIGHTING, HVAC, PIPING, AND STRUCTURAL MEMBERS.
U. EMERGENCY LIGHTING FIXTURES - TEST SWITCH AND INDICATOR LAMP ARE TO BE LOCATED IN A READILY VISIBLE LOCATION. IF INSTALLATION INSTRUCTIONS BY MANUFACTURER DO NOT ALLOW FOR THIS, MOUNT SWITCH AND LAMP IN SINGLE GANG BOX FLUSH MOUNTED IN CEILING TILE ADJACENT TO FIXTURE. BODINE SELLS A COVER-PLATE FOR THIS PURPOSE. FLEX CONDUIT CAN BE USED BETWEEN FIXTURE AND BOX.
V. GFCI CIRCUIT SHALL BE INSTALLED SUCH THAT GFCI RECEPTACLE SHALL ONLY TRIP ITSELF AND DOES NOT TRIP OR DISCONNECT POWER ON ANY OTHER RECEPTACLE.
W. LOW-VOLTAGE CONDUIT (NOT INCLUDING TELECOMMUNICATIONS, "T" SERIES DRAWINGS) SHALL NOT CONTAIN MORE THAN 270° IN BENDS BETWEEN FLOOR BOXES, PROJECTOR BOXES, CAMERA BOXES, A/V EQUIPMENT RACKS, FIRE ALARM DEVICE BOXES, FIRE ALARM PANELS, SECURITY DEVICE BOXES, AND SECURITY PANELS. PROVIDE PULL BOXES IN RACEWAYS THAT CONTAIN MORE THAN 270° IN BENDS. PROVIDE A MINIMUM OF ONE (1) PULL BOX FOR EVERY 100 FEET OF RACEWAY.
X. CONTRACTOR SHALL PROVIDE MINIMUM 200 LB TENSION PULL STRING IN ALL EMPTY/FUTURE USE RACEWAYS.
Y. ALL CONDUIT ROUTED IN AND THROUGH CONCRETE AND/OR BUILDING STRUCTURAL WALLS SHALL BE RIGID METAL CONDUIT, UNLESS OTHERWISE NOTED.
Z. SURFACE RACEWAY USED SHALL BE PAINTED TO MATCH THE WALLS.
AA. WHEN NEW WALL AND FLOOR FINISHES ARE SHOWN, REMOVE ALL COVERPLATES AND REINSTALL AFTER NEW FINISHES HAVE BEEN COMPLETED.
BB. TURN OVER ALL KEYS TO OWNER AT COMPLETION OF PROJECT.
CC. FIRE STOP ALL WALL AND FLOOR PENETRATIONS WHETHER SURFACE IS RATED OR NOT.
DD. DEVICE LOCATIONS AND RACEWAY ROUTING SHOWN IS DIAGRAMMATIC. CONTRACTOR SHALL VERIFY ALL CONDITIONS PRIOR TO STARTING CONSTRUCTION.
EE. ALL CIRCUITS SHALL CONSIST OF 3/4"C, 2-#12 & #12 GND UNLESS OTHERWISE NOTED.

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OWNER

FISHERS FIRE DEPARTMENT
15109 E 136th St.
Fishers, IN 46037

PROJECT

STATION 97 HVAC RENOVATION

100% FRCD
01/14/2025

REVISIONS

NO.	DATE	DESCRIPTION

DESIGNED BY: JKW	CERTIFICATION: PRELIMINARY NOT FOR CONSTRUCTION
CHECKED BY: DJJ	
APPROVED BY: Approver	
PROJECT NO.: 24-156	

SHEET TITLE

ELECTRICAL SYMBOLS AND ABBREVIATIONS

SHEET NUMBER

E001

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0 1/2" 1" 2"

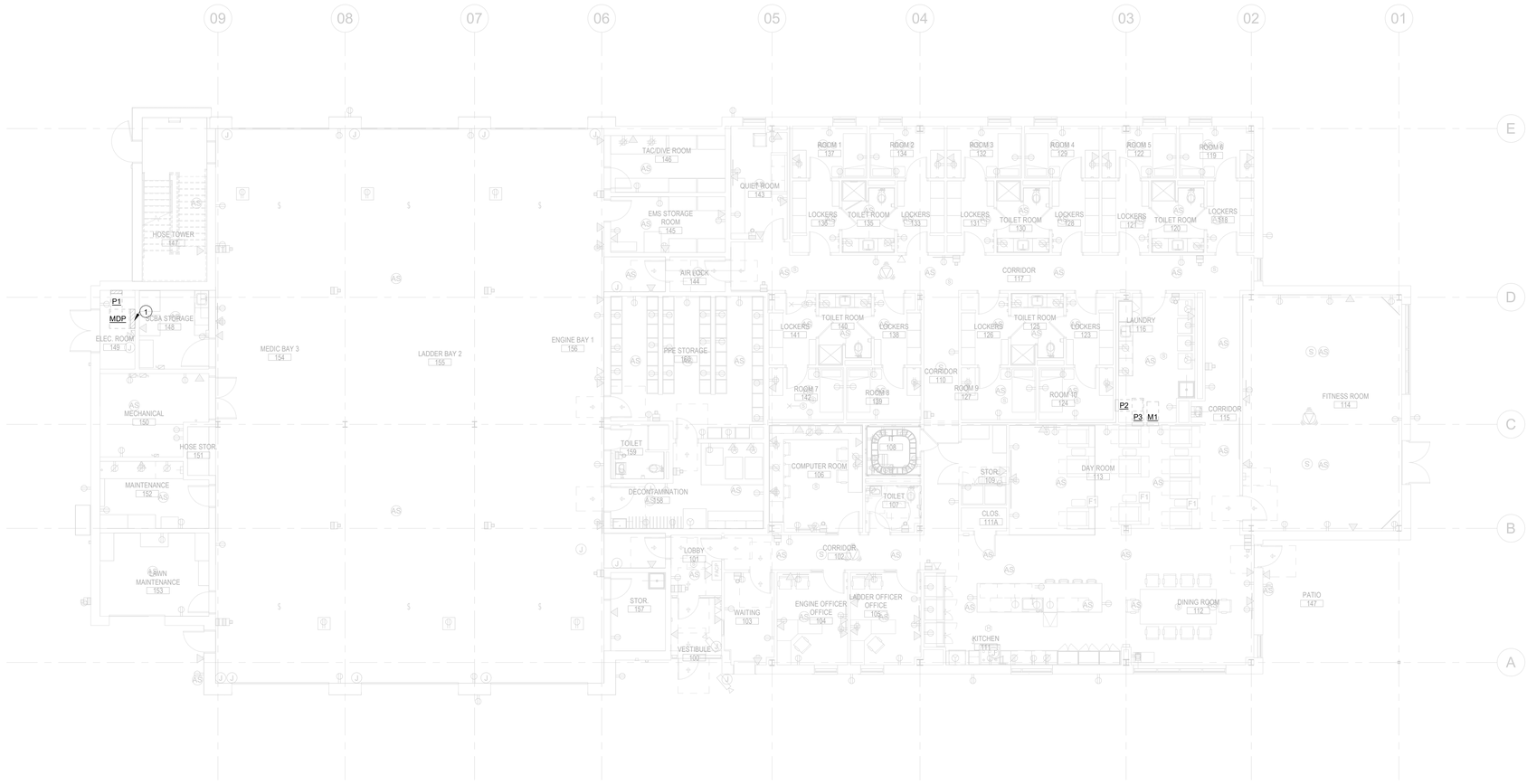
ORIGINAL SHEET SIZE IS 30" X 42" (ARCH E1)
1/14/2025 1:37:11 PM AESI Proj. No: 24-156

GENERAL NOTES:

A. REFER TO DRAWING E001 FOR ADDITIONAL GENERAL NOTES.

(#) PLAN NOTES:

1. OVER CURRENT PROTECTION: PROVIDE OVER CURRENT PROTECTION (OCP) DEVICE IN PANEL MDP FOR DOAS-2. REFER TO PANEL SCHEDULE ON E501 FOR OCP DEVICE SIZE.



FIRST FLOOR POWER AND SYSTEMS PLAN

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

0 1/2" 1" 2"

ORIGINAL SHEET SIZE IS 30" X 42" (ARCH E1)
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SHEET TITLE

FIRST FLOOR POWER AND SYSTEMS PLAN

SHEET NUMBER

E310

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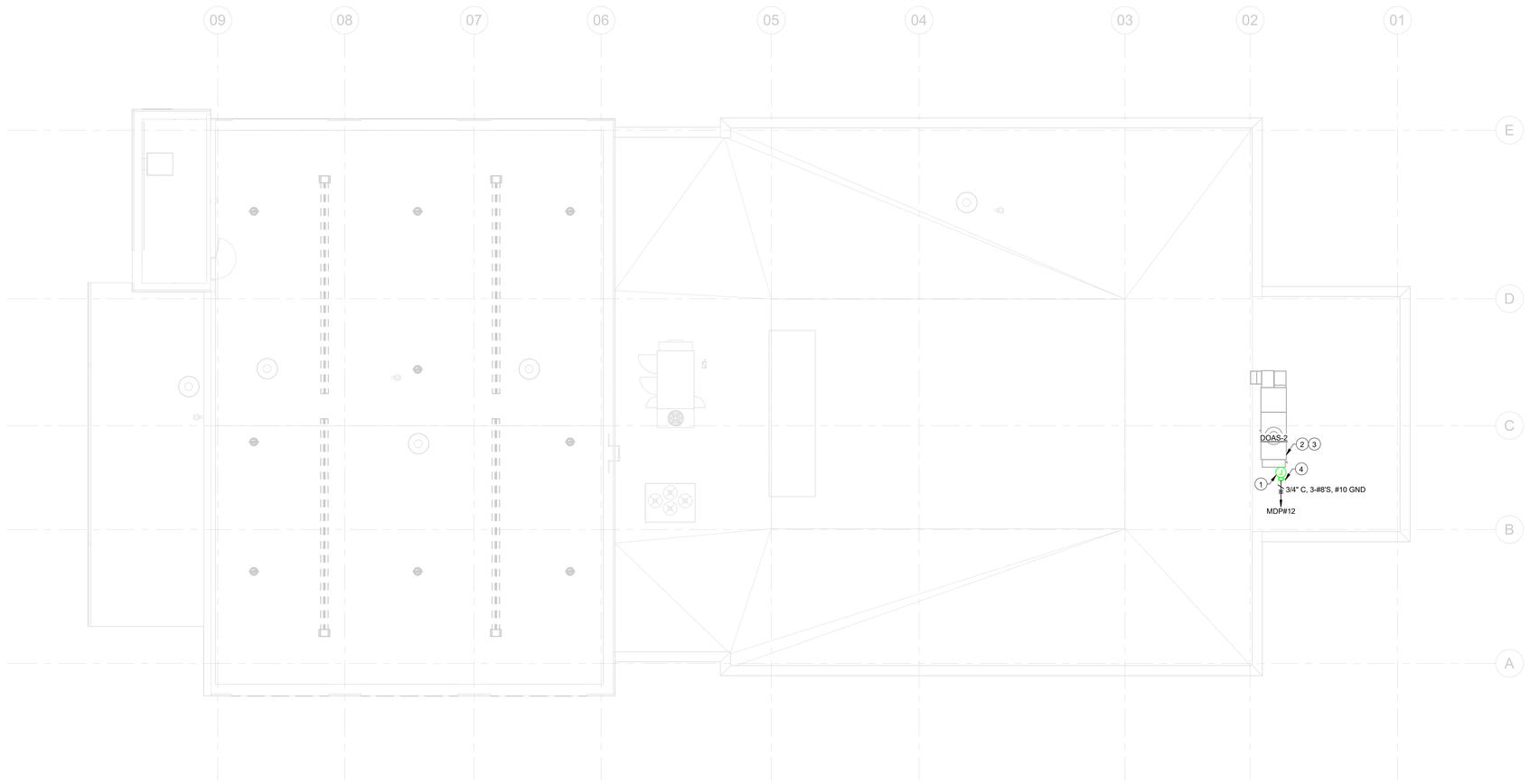
GENERAL NOTES:

A. REFER TO DRAWING E001 FOR ADDITIONAL GENERAL NOTES.

(#) PLAN NOTES:

1. CIRCUIT ROUTE: POWER SHALL BE ROUTED UP INSIDE THE CURB. REFER TO MECHANICAL UNIT SPECIFICATION SHEET FOR PROVIDED WIRING LOCATION.
2. SERVICE OUTLET: SERVICE OUTLET PROVIDED BY MECHANICAL EQUIPMENT.
3. DUCT DETECTOR: DETECTOR TO BE PROVIDED BY MECHANICAL EQUIPMENT.
4. FUSED DISCONNECT: PROVIDE NEMA 3R 60A FUSIBLE DISCONNECT SWITCH. EC TO PROVIDE AND INSTALL 40A FUSE.



ROOF ELECTRICAL PLAN

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

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PROJECT

STATION 97 HVAC RENOVATION

100% FRCD
01/14/2025

REVISIONS

NO.	DATE	DESCRIPTION

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SHEET TITLE

ROOF ELECTRICAL PLAN

SHEET NUMBER

E320

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0 1/2" 1" 2"

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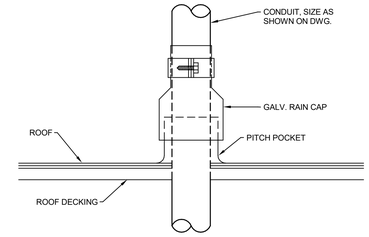
SWITCHBOARD SCHEDULE

	Panel Name:	MDP			Main:	MCB				Location:	ELEC ROOM 149		Project	FIRE STATION 97									
	SPD	YES			Amp	800				Mounting:	FLOOR												
	Voltage:	208Y/120			Nema	1				Kaic Rating:	42KAIC		Project No.	24-156									
	Feed From:	ATS1			Feed...	SEE ONE LINE								Applied Engineering Services (317-810-4141)									

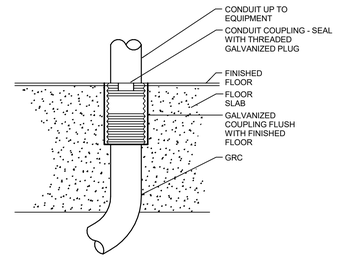
Ckt	Description	Breaker			Load In KVA			"A"	"B"	"C"	Load In KVA			Breaker			Description	Ckt
		Pole	Trip	Type	LTS	RECP	MISC				LTS	RECP	MISC	Pole	Trip	Type		
1	EXISTING M1	3	225		0.00	0.00	28.00	52.75			1.61	5.64	17.50					2
					0.00	0.00	24.58		49.33		1.61	5.64	17.50	3	400		EXISTING P1	
					0.00	0.00	21.77			46.52	1.61	5.64	17.50					
3	EXISTING P2	3	100		0.00	10.89	0.29	20.75			1.30	7.91	0.36					4
					0.00	10.89	0.29		20.75		1.30	7.91	0.36	3	125		EXISTING P3	
					0.00	10.89	0.29			20.75	1.30	7.91	0.36					
5	EXISTING CU-1	3	100		0.00	0.00	7.66	15.11			0.00	0.00	7.45					6
					0.00	0.00	7.66		15.11		0.00	0.00	7.45	3	100		EXIST SCBA COMPRESSOR	
					0.00	0.00	7.66			15.11	0.00	0.00	7.45					
7	EXISTING SNOW MELT N.	2	50		0.00	0.00	3.95	4.95			0.00	0.00	1.00					8
					0.00	0.00	3.95		4.95		0.00	0.00	1.00	2	60		EXIST GEN. CNTRL PNL	
9	EXISTING SNOW MELT S.	2	50		0.00	0.00	3.95			3.95	0.00	0.00	0.00					10
					0.00	0.00	3.95	3.9			0.00	0.00	0.00	3	100		EXISTING SPARE	
11	EXISTING SPARE	3	100		0.00	0.00	0.00		0.0		0.00	0.00	0.00					
					0.00	0.00	0.00			3.2	0.00	0.00	3.19					12
					0.00	0.00	0.00	3.2			0.00	0.00	3.19	3	45		**DOAS-2**	
	SPACE								3.2		0.00	0.00	3.19					
	SPACE									0.0							SPACE	
	SPACE							0.0			0.0	0.0	0.0					14
	SPACE								0.0		0.0	0.0	0.0		60		EXISTING SPD	
	SPACE									0.0	0.0	0.0	0.0					
								88.61	**85.19**	**82.38**								

	Connected KVA	Demand Factor	Demand KVA
Lighting Load (KVA)	8.72	1.0	**8.72**
Receptacle Load (KVA)	73.32	NEC	**41.66**
Misc. Load (KVA)	201.51	0.9	**179.35**
Total Load (KVA)	283.56	DF	**229.73**

TRIP TYPE	TRIP UNIT DESCRIPTION	Notes:



1 ROOF PENETRATION DETAIL
SCALE: NONE



2 CONDUIT STUB UP
SCALE: NONE

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PROJECT

STATION 97 HVAC RENOVATION

100% FRCD
01/14/2025

REVISIONS
NO. DATE DESCRIPTION

DESIGNED BY	CERTIFICATION
JKW	PRELIMINARY NOT FOR CONSTRUCTION
CHECKED BY: DJJ	
APPROVED BY: Approver	
PROJECT NO.: 24-156	

SHEET TITLE

ELECTRICAL DETAILS AND SCHEDULES

SHEET NUMBER

E501

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Table of Contents:1/14/2025

Table of Contents

END OF TABLE OF CONTENTS

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. Pipe stands.
   2. Equipment supports.

B. Related Requirements:

   1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
   1. Pipe stands.
   2. Equipment supports.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. 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.

2.2 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Support for Gas Piping:

1. Description: Single base unit suitable for outdoor installation and support of service indicated on the drawings without membrane penetration.
2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
3. Hardware: Galvanized steel or polycarbonate to secure pipe to support.
4. Accessories: Protection pads.

PART 3 - EXECUTION

3.1 APPLICATION

A. 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. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 PIPE SUPPORT INSTALLATION

A. Pipe Support Installation:

1. Pipe Support Types: Assemble components and mount on existing smooth roof surface. Do not penetrate roof membrane.
2. Support piping on roof a minimum of every 8’-0” on center and at all elbows.
3. Pipe support shall be capable of securing supported pipe to the support via means of a strap to secure piping to the support.

B. Install lateral bracing as needed near parapet wall with pipe hangers and supports to prevent swaying. Supporting piping against existing masonry parapet walls is permitted if needed and required.

C. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

D. 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.

3.3 ADJUSTING

A. Adjust long piping runs to insure piping has been installed straight and parallel or perpendicular to building walls and appurtances.

END OF SECTION 220529

SECTION 221123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Joining materials.
4. Manual gas shutoff valves.
5. Dielectric fittings.

1.2 DEFINITIONS

A. CWP: Cold working pressure.

B. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. An example includes rooftop locations.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Piping specialties.
2. Corrugated, stainless steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Roof supports for gas piping.
6. Dielectric fittings.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1. Shop Drawing Scale: 1/8 inch per foot minimum.
2. Detail mounting, supports, and valve arrangements.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

B. Certificates:

1. Welding certificates.

C. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

D. Field Quality-Control Submittals:

1. Field quality-control reports.

E. Qualification Statements: For professional engineer.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Steel Support Welding: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. Pipe Welding: Qualify procedures and operators in accordance with the ASME Boiler and Pressure Vessel Code.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping in accordance with requirements of authorities having jurisdiction.

B. 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.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

1.7 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide purging and startup of natural-gas supply in accordance with requirements indicated:

1. Notify Owner's representative no fewer than 5 days in advance of proposed interruption of natural-gas service. This facility is a fire station that is occupied 24 hours a day. Outages must be scheduled to not interrupt any of the activities needed or required to maintain the ability of the staff to provide public safety.
2. For the tie-in to the existing system, have all new gas piping installed to minimize the downtime for the interruption of service. Provide the Owner's representative with an estimated time of outage in order to make the tie-in of the new gas piping.

1.8 COORDINATION

A. Coordinate with the Owner's Representative and the local utility as required for modifications made to the existing natural gas distribution system. It shall be the Contractor's responsibility to coordinate required outages, develop a work plan to be approved by the owner for length of time of the outage required for modifications to the system.

B. Coordinate requirements for piping identification for natural-gas piping. Comply with requirements in Section 220553 "Identification of Plumbing Piping and Equipment."

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each product type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Comply with the International Fuel Gas Code.

B. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Minimum Operating Pressure of Service Meter: 14" w.c.

2.3 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.

2. Wrought-Steel Welding Fittings: ASTM A234/A234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

    a. Material Group: 1.1.
    b. End Connections: Threaded or butt welding to match pipe.
    c. Lapped Face: Not permitted underground.
    d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum O-rings, and spiral-wound metal gaskets.
    e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

2.4 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.5 MANUAL GAS SHUTOFF VALVES

A. See "Aboveground, Manual Gas Shutoff Valve Schedule" articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves NPS 1-1/4 to NPS 2 having initials "WOG" permanently marked on valve body.

C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.

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

    a. A.Y. McDonald Mfg. Co.
    b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    c. BrassCraft Manufacturing Co.; a Masco company.
    d. Perfection Corporation.
    e. R.W. Lyall; brand of Hubbell Utility Solutions; Hubbell Incorporated.

2. Body: Bronze, complying with ASTM B584.
3. Ball: Chrome plated brass.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Separate packnut with adjustable stem packing threaded ends.
7. Ends: Threaded, flared, or socket as indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller are to be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural gas service with "WOG" indicated on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

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

    a. A.Y. McDonald Mfg. Co.
    b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    c. BrassCraft Manufacturing Co.; a Masco company.
    d. Perfection Corporation.
    e. R.W. Lyall; brand of Hubbell Utility Solutions; Hubbell Incorporated.

2. Body: Bronze, complying with ASTM B584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller are to be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Two-Piece, Regular Port Bronze Ball Valves with Bronze Trim: MSS SP-110.

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

a. A.Y. McDonald Mfg. Co.
b. Apollo Valves; Conbraco Industries, Inc.
c. BrassCraft Manufacturing Co.; a Masco company.
d. Lyall, R. W. & Company, Inc.
e. Perfection Corporation.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE.
6. Packing: Threaded body packnut design with adjustable stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural gas service with "WOG" indicated on valve body.

F. Bronze Plug Valves: MSS SP-78.

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

a. A.Y. McDonald Mfg. Co.
b. Lee Brass Company.

2. Body: Bronze, complying with ASTM B584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller are to be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Cast-Iron, Lubricated Plug Valves: MSS SP-78.

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

a. A.Y. McDonald Mfg. Co.
b. Flowserve Corporation.
c. Homestead Valve: a division of Olson Technologies, Inc.
d. Milliken Valve Company; a Mueller brand.
e. Mueller Co. LLC; Mueller Water Products, Inc.
f. R & M Energy Systems; Robbins & Myers.

2. Body: Cast iron, complying with ASTM A126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1 and smaller are to be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

H. Cast Iron, Nonlubricated Plug Valves: MSS SP-78.

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

    a. A.Y. McDonald Mfg. Co.
    b. Mueller Co.
    c. Xomox Corporation.

2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural gas service with "WOG" indicated on valve body.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

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

    a. A.Y. McDonald Mfg. Co.
    b. Capitol Manufacturing Company.
    c. GF Piping Systems: Georg Fischer LLC.

d. HART Industrial Unions, LLC.
e. Jomar Valve.
f. Matco-Norca.
g. WATTS; A Watts Water Technologies Company.
h. Wilkins.
i. Zurn Industries, LLC.

2. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: 125 psig minimum at 180 deg F.
c. End Connections: Solder-joint copper alloy and threaded ferrous.

2.7 LABELING, PAINTING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description and rated pressure of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

B. Prime and paint all new and modified gas piping with corrosion resistant paint to match existing to prevent corrosion. Provide protection to not get overspray onto the roof or adjacent equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in and routing for the new natural-gas piping to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section. Coordinate temporary shut-down of the gas system with the Owner’s representative.

B. Inspect natural-gas piping in accordance with the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with the International Fuel Gas Code requirements for preventing accidental ignition.

D. Provide protection for existing roof surfaces. Provide walk-off mats and other protection to prevent any damage to the existing roof. Any damage due to work being performed shall be the responsibility of the Contractor to repair to the satisfaction of the Owner's Representative.

3.3 INSTALLATION OF OUTDOOR PIPING

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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. Locate valves for easy access. Minimize the number of elbows.

D. Provide pre-manufactured pipe supports for piping installed on the roof. Support piping no less than every 8 feet on center. Piping supports shall be designed to sit on an existing membrane type of roof. Secure piping to each support.

E. Support gas piping at all change in direction, at all elbows to insure piping is not affected by wind or weather.

F. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Verify final equipment locations for roughing-in.

J. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

K. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
2. Install sediment trap on both sides of regulators for gas reduction to 2 psig with valve and capped.

L. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

M. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

N. Connect branch piping from top or side of horizontal piping.

O. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

P. Do not use natural-gas piping as grounding electrode.

Q. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

R. Install pressure gauge downstream from each line regulator.

3.4 INSTALLATION OF VALVES

A. Install manual gas shutoff valve for each gas appliance.

3.5 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. 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.

D. Welded Joints:

1. Construct joints in accordance with AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.6 PIPING CONNECTIONS

A. Connect to existing natural gas piping where indicated on the drawings. Utilize existing shut-off valves to minimize disruption to service to other appliances inside the building.

B. Provide a complete work plan to the Owner's representative of date of outage needed, existing appliances that will be affected and a length of time of the outage. Do not proceed with work until the plan has been approved by the Owner.

C. Install natural-gas piping electrically continuous, and bonded to gas-appliance equipment grounding conductor of the circuit powering the appliance in accordance with NFPA 70.

D. Where installing piping adjacent to appliances, allow space for service and maintenance of appliances.

E. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

3.7 LABELING AND IDENTIFICATION

A. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.8 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Test, inspect, and purge natural gas in accordance with NFPA 54 the International Fuel Gas Code and authorities having jurisdiction.

2. Leak test all gas piping after pressure has been applied to the system.
3. Natural-gas piping will be considered defective if it does not pass tests and inspections.

B. Prepare test and inspection reports.

3.9 PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

A. Aboveground, branch piping NPS 1 and smaller is to be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping is to be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

3.10 ABOVEGROUND, MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller are to be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

B. Valves for pipe sizes NPS 2-1/2 and larger are to be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.
3. Cast-iron, nonlubricated plug valve.

C. Valves in branch piping for single appliance are to be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

END OF SECTION 231123

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Duct labels.
3. Valve tags.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Continue Existing Valve-numbering scheme.

D. Valve Schedules: Provide for the gas piping system. Include in operation and maintenance manuals. Continue numbering scheme as the original project.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
2. Letter and Background Color: As indicated for specific application under Part 3.
3. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1-1/2” inch for name of new DOAS Unit. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

E. Fasteners: Stainless steel rivets or self-tapping screws.

F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

G. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings. Also include the following:

1. Duct size.
2. Flow-Direction Arrows: Include flow-direction arrows on distribution ducts. Arrows may be either integral with label or may be applied separately.
3. Lettering Size: At least 1-1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

2.3 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.04-inch or anodized aluminum, 0.031-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire link chain or beaded chain or S-hook.

B. Valve Schedules: Continue existing numbering scheme as existing valves.

1. Include valve-tag schedule in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

A. Coordinate installation of identifying piping and ductwork.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices above existing acoustical ceilings and similar concealment.

D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS

A. Permanently fasten labels on each item of mechanical equipment.

B. Sign and Label Colors: Black lettering on white background.

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C. Locate equipment labels where accessible and visible.

3.4 INSTALLATION OF DUCT LABELS

A. Install self-adhesive duct labels showing service and flow direction with permanent adhesive on air ducts.

1. Provide labels in the following color codes:

a. For air supply ducts from new DOAS Unit: White letters on blue background.
b. For exhaust/return ducts from new DOAS Unit: White letters on green background.

B. Locate label near each point where ducts enter into and exit from concealed spaces and at maximum intervals of 15 ft. where exposed or are concealed by removable ceiling system.

3.5 INSTALLATION OF VALVE TAGS

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, gas shutoff valves, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.

B. Modify existing valve tag schedule as necessary to include any new valve tags.

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. Section Includes:

1. Testing, Adjusting, and Balancing of Air Systems:

a. Constant-volume air systems (DOAS unit fans).

2. Testing, adjusting, and balancing of equipment.

1.3 DEFINITIONS

A. NEBB: National Environmental Balancing Bureau.

B. TAB: Testing, adjusting, and balancing.

C. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Certified TAB reports.

C. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Specialists Qualifications, Certified by NEBB:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB.
2. TAB Technician: Employee of the TAB specialist and certified by NEBB.

1.6 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations. The Fire Station is a 24/7/365 operation and all testing and balancing shall be coordinated with the Owner's representative and Commanding Officer at the Fire Station.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 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 installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for equipment.

D. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

E. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

F. Examine operating safety interlocks and controls on HVAC equipment.

G. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.

H. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:
   a. Duct systems are complete with terminals installed.
   b. Volume dampers are open and functional.
   c. Clean filters are installed.
   d. Fans are operating, free of vibration, and rotating in correct direction.
   e. Ceilings are installed.
   f. Windows and doors are installed.
   g. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system in accordance with the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with applicable Sections.

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.

3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

A. Test, adjust, and balance HVAC equipment indicated on Drawings, including the following:
1. DOAS Unit

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for 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' Record drawings duct layouts.

C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

D. Check airflow patterns from the outdoor-air dampers and the return/exhaust-air dampers as well as the supply-fan discharge and proper rotation of the energy wheel.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check gas valves for proper operation.

K. Check for proper sealing of air-handling-unit components.

L. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Set outside-air, return/exhaust-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
    c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

2. Measure fan static pressures as follows:

    a. Measure static pressure directly at the supply air fan outlet or through the flexible connection.
    b. Measure static pressure directly at the supply fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system including the energy wheel.

3. Do not make fan-speed adjustments that result in motor overload.

M. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

N. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

O. Verify final system conditions.

1. Coordinate operation of the new DOAS unit with the Temperature Control Contractor. Request assistance of the TCC to insure the sequence of operation has been implemented and that the TAB Contractor fully understands the unique operating conditions of the DOAS unit so proper testing and balancing can be performed.

2. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
3. Re-measure and confirm that total airflow is within design.
4. Re-measure all final fan operating data, speed, volts, amps, and static profile.
5. Mark all final settings.
6. Test system in economizer mode. Verify proper operation and adjust if necessary.
7. Measure and record all operating data.
8. Record final fan-performance data.

3.6 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. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

3.7 HVAC CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify HVAC control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.8 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:
1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. 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 specialist.
3. Project name.
4. Project location.
5. Engineer's name and address.
6. Contractor's name and address.
7. Temperature Control Contractors 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.

D. DOAS-Unit Test Reports: 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, and bore.
    i. Center-to-center dimensions of sheave and amount of adjustments in inches.
    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 speed.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

    a. Total airflow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan speed.
    d. Inlet and discharge static pressure in inches wg.
    e. For each filter bank, filter static-pressure differential in inches wg.
    f. Cooling-coil static-pressure differential in inches wg.
    g. Gas Heat Exchanger static-pressure differential in inches wg.

h. Hot Gas Reheat Coil static-pressure differential in inches.
i. List for each internal component with pressure-drop, static-pressure differential in inches wg.
j. Outdoor airflow in cfm.
k. Return/Exhaust airflow in cfm.
l. Outdoor-air damper position.
m. Return/Exhaust-air damper position.

E. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Air pressure drop in inches wg.
c. Entering-air, wet- and dry-bulb temperatures in deg F.
d. Leaving-air, wet- and dry-bulb temperatures in deg F.

F. Gas-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.

2. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.
d. Low-fire fuel input in Btu/h.
e. High-fire fuel input in Btu/h.

G. Fan Test Reports: For supply, return/exhaust 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.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and speed.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan speed.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

H. Round 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 fan and unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Indicated airflow rate in cfm.
g. Indicated velocity in fpm.
h. Actual airflow rate in cfm.
i. Actual average velocity in fpm.

I. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

END OF SECTION 230593

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 air.
   2. Indoor, concealed return/exhaust located above ceilings.

B. Related Sections:
   1. Section 23 31 13 "Metal Ducts".

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:
   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. 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 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.

C. 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.

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 23 05 29 "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.

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.

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. 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. 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 . 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.; SoftTouch Duct Wrap.
      b. Johns Manville; Microlite.
      c. Knauf Insulation; Friendly Feel Duct Wrap.
      d. Owens Corning; SOFTR All-Service Duct Wrap.

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.
   1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
   1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.

2.4 SEALANTS

A. 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.

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- 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. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches 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 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 into roof curb and up connecting to new DOAS Unit.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

3.5 DUCT INSULATION SCHEDULE, GENERAL

A. Ducts Requiring Insulation:
1. Indoor, concealed supply air.
2. Indoor, concealed return/exhaust located above lay-in ceilings.

B. Items Not Insulated:
1. Factory-insulated flexible ducts.
2. Flexible connectors.
3. Vibration-control devices.
4. Factory-insulated access panels and doors.

3.6 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed supply-air and return/exhaust duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

END OF SECTION 230713

SECTION 230923 - DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Miscellaneous sensors and controllers for HVAC:
      a. DDC temperature controllers the new DOAS unit.
      b. Control wire.
      c. Control raceways.

B. Section is intended to be an extension of the existing Jackson Systems Building Automation System.

C. Contact Joe Jackson at Jackson Systems 317-222-7204

D. Related Requirements:
   1. 237433 – Packaged Air to Air Make-up Air Units

1.2 ACTION SUBMITTALS

A. Product Data:

   1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
   3. Product description with complete technical data, performance curves, and product specification sheets.
   4. Installation, operation, and maintenance instructions including factors effecting performance.

PART 2 - PRODUCTS

2.1 Indoor pressure controls shall be furnished by the DOAS Manufacturer and installed by the Temperature Control Contractor.

2.2 Indoor temperature and humidity sensor furnished by the DOAS Manufacturer and installed by the Temperature Control Contractor.

2.3 Standalone DDC temperature controllers for DOAS unit furnished and installed by the DOAS Unit Manufacturer. Coordinate interface format with the Temperature Control Contractor.

2.4 Discharge air temperature sensor provided by the Temperature Control Contractor.

2.5 CONTROL WIRE AND CABLE

A. Wire: Single conductor control wiring above 24 V.

1. Wire Size: Minimum 18 AWG.
2. Conductors: 7/24 soft annealed copper strand with 2- to 2.5-inch lay.
3. Conductor Insulation: 600 V, Type THWN or Type THHN, and 90 deg C in accordance with UL 83.
4. Conductor Insulation Colors: Black (hot), white (neutral), and green (ground).
5. Furnish on spools.

B. Single, Twisted-Shielded, Instrumentation Cable above 24 V:

1. Wire Size: Minimum 18 AWG.
2. Conductors: Twisted, 7/24 soft annealed copper strand with a 2- to 2.5-inch lay.
3. Conductor Insulation: Type THHN/THWN or Type TFN rating.
4. Conductor Insulation Colors:

    a. Twisted Pair: Black and white.
    b. Twisted Triad: Black, red, and white.

5. Shielding: 100 percent type, 0.35/0.5-mil aluminum/Mylar tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
6. Outer Jacket Insulation: 600 V, 90 deg C rating, and Type TC cable.
7. Furnish on spools.

C. Single, Twisted-Shielded, Instrumentation Cable 24 V and Less:

1. Wire Size: Minimum 22 AWG.
2. Conductors: Twisted, 7/24 soft annealed copper stranding with a 2- to 2.5-inch lay.

3. Conductor Insulation: Nominal 15-mil thickness, constructed from flame-retardant PVC.
4. Conductor Insulation Colors:

    a. Twisted Pair: Black and white.
    b. Twisted Triad: Black, red, and white.

5. Shielding: 100 percent type, 1.35-mil aluminum/polymer tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
6. Outer Jacket Insulation: 300 V, 105 deg C rating, and Type PLTC cable.
7. Furnish on spools.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

B. Examine walls, floors, roofs, and ceilings for suitable conditions where the DOAS unit will be installed.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install products level, plumb, parallel, and perpendicular with building construction.
1. Install wall mounted control devices furnished by others at 48 inches above floor in accessible locations.
2. Connect new DOAS unit to the existing Jackson Systems Building Management System. The Owner shall be able to see status, alarms, set points, etc. from the existing Owner Software.
3. Add the new DOAS unit to the existing graphics of the existing BMS. The graphics should display key temperatures such as, but not limited to the following:
    a. Outside air intake temperature entering the energy wheel
    b. Exhaust air temperature leaving the unit
    c. Exhaust air entering the energy wheel.
    d. Supply air temperature leaving the energy wheel.
    e. Energy Wheel Status
    f. Supply Fan Status
    g. Exhaust Fan Status
    h. Discharge air temperature (Low and High discharge temp alarm)

B. Support products, tubing, piping wiring, and raceways.

C. Fabricate openings and install sleeves in ceilings, floors, roof, and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for

concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

D. Firestop Penetrations Made in Fire-Rated Assemblies.

3.3 INSTALLATION OF CONTROL WIRE, CABLE, AND RACEWAY

A. Wire and Cable Installation:
1. Install cables with protective sheathing that is waterproof and capable of withstanding continuous temperatures of 90 deg C with no measurable effect on physical and electrical properties of cable.

a. Provide shielding to prevent interference and distortion from adjacent cables and equipment.

2. Terminate wiring in a junction box.

a. Clamp cable over jacket in a junction box.
b. Individual conductors in the stripped section of cable is to be slack between the clamping point and terminal block.

3. Terminate field wiring and cable not directly connected to instruments and control devices having integral wiring terminals using terminal blocks.

B. Conduit Installation:

1. Comply with Section 260533 "Conduits for Electrical Systems".

C. Low Voltage Wiring Installation:
1. Comply with Section 260519 “Low Voltage Electrical Power Conductors and Cables.”

3.4 SEQUENCE OF OPERATION

A. Refer to the Drawings for the Sequence of Operation for the New DOAS Unit.

3.5 DEMONSTRATION

A. On-Site Training:
1. Include on-site training as required, to observe each unique product type installed with hands-on review of operation, calibration, and service requirements.

B. Training Content for Daily Operators:

1. Basic operation of system modifications and additions to the existing BMS.

2. Understanding each unique product type installed including performance and service requirements for each.
3. Understanding operation of the new DOAS system and equipment including sequences of operation, each unique control algorithm.
4. Understanding physical location and placement of controllers and hardware.
5. Demonstrating the following for the new DOAS Unit:
    a. Operation of the DOAS unit in the normal-off, normal-on, and failed conditions while observing individual equipment, dampers, and valves for correct position under each condition.
    b. Hardware interlocks and safeties function properly and system performs correct sequence of operation after electrical power interruption and resumption after power is restored.
6. The Temperature Control Contractor shall make any adjustments as needed in the system for a period of 12 months from substantial completion that includes a full year of seasonal changes as needed for proper operation of the unit as intended.

END OF SECTION 230923

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Hangers and supports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

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

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.

B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.

C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible. All longitudinal seams shall be Pittsburgh lock seams unless otherwise specified for specific application.

2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. For ducts exposed to car wash chemicals, construct of Type 316 stainless steel.

B. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and

duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

2.5 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 in accordance with UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

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

C. Water-Based Joint and Seam Sealant:

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

D. Flanged Joint Sealant: Comply with ASTM C920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.

5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-inch wg static-pressure class, positive or negative.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods: Galvanized-steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.

D. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.

B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install ducts in maximum practical lengths with fewest possible joints.

D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Coordinate installation of duct mounted sensors by the Temperature Control Contractor. Do impede access to duct mounted devices and label location under insulation.

H. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

I. Elbows: Use long-radius elbows wherever they fit.

1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.

J. Branch Connections: Use lateral or conical branch connections.

3.2 DUCT SEALING

A. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. All Air Ducts: Seal Class A.

3.3 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Do not use powder-actuated fasteners.
2. Do not use supports shot into the underside of the existing metal roof deck.
3. Support all duct from existing structural steel members. Provide cross bracing as needed is supporting duct between existing steel bar joists.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers

and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets.

E. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.5 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.

3.6 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.

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

3.7 DUCT SCHEDULE

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

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

B. Supply and Return/Exhaust Ducts:

1. Ducts Connected to the new DOAS Unit:

a. Pressure Class: Positive . 1 to 2 inch wg.
b. Minimum SMACNA Seal Class: A
c. SMACNA Leakage Class for Rectangular: 8
d. SMACNA Leakage Class for Round and Flat Oval: 4

C. Elbow Configuration:

1. 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."

2. 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) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

D. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Conical spin in.

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

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Manual volume dampers.
   2. Flange connectors.
   3. Turning vanes.
   4. Flexible connectors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 90A and NFPA 90B.

B. 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.

2.2 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Greenheck Fan Corporation.
      b. Nailor Industries Inc.
      c. Pottorff.
      d. Price
      e. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
      f. Titus.

   2. Performance:

a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg differential static pressure.

3. Construction:

a. Linkage out of airstream.
b. Suitable for horizontal or vertical airflow applications.

4. Frames:

a. Hat-shaped, 16-gauge-thick, galvanized sheet steel.
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; 16 gauge thick.

6. Locking device to hold damper blades in a fixed position without vibration.

2.3 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc; a DMI company.
3. DynAir; a Carlisle Company.
4. Elgen Manufacturing.
5. Ward Industries; a brand of Hart & Cooley, LLC.

B. Description: Add-on or roll-formed, factory fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gauge and Shape: Match connecting ductwork.

2.4 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Aero-Dyne Sound Control Co.
2. CL WARD & Family Inc.
3. Ductmate Industries, Inc; a DMI company.
4. Duro Dyne Inc.
5. DynAir; a Carlisle Company.
6. Elgen Manufacturing.
7. Ward Industries; a brand of Hart & Cooley, LLC.

B. Manufactured Turning Vanes for Metal Ducts: Fabricate 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. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply 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."

E. Vane Construction:

1. Single wall.

2.5 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Ductmate Industries, Inc; a DMI company.
2. Duro Dyne Inc.
3. DynAir; a Carlisle Company.
4. Elgen Manufacturing.
5. Ward Industries; a brand of Hart & Cooley, LLC.

B. Fire-Performance Characteristics: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Materials: Flame-retardant or noncombustible fabrics.

E. Coatings and Adhesives: Comply with UL 181, Class 1.

F. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

2.6 ACCESS DOORS

A. Manufacturers:
1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Pottorff.
4. Price
5. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
6. Titus.

B. Construction: Galvanized Double Wall insulated with a minimum of 2 fastening devices. Hinged piano type. No access window. Minimum access door size of 12”x12”

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.

B. Set dampers to fully open position before testing, adjusting, and balancing.

C. Install flexible connectors to connect ducts to equipment.

D. Install access doors at all locations of duct mounted control devices.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.

END OF SECTION 233300

SECTION 233346 - FLEXIBLE DUCTS

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. Insulated flexible ducts.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For flexible ducts.

   1. Include plans showing locations and mounting and attachment details.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

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 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.

C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."

D. Comply with ASTM E96/E96M, "Test Methods for Water Vapor Transmission of Materials."

2.2 INSULATED FLEXIBLE DUCTS

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

1. Flexmaster U.S.A., Inc.
2. JP Lamborn Co.
3. McGill AirFlow LLC.
4. Thermaflex; a Flex-Tek Group company.
5. Ward Industries; a brand of Hart & Cooley, LLC.

B. Insulated, Flexible Duct: UL 181, Class 1, two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.
4. Insulation R-Value: Comply with ASHRAE/IES 90.1.

2.3 FLEXIBLE DUCT CONNECTORS

A. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

B. Non-Clamp Connectors: Adhesive.

C. Provide flexible, duct radius forming brace, like Flexmaster or approved equal, for all connections to diffusers. Adjust flex duct to only bend down from supply duct to diffuser connection. No additional bends will be permitted.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.

B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.

C. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped and adhered in place.

D. Connect flexible ducts to metal ducts with adhesive and metal clamps.

E. Installation:

1. Install ducts fully extended.

2. Do not bend ducts across sharp corners.
3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
5. Install flexible ducts in a direct line, without sags, twists, or turns.
6. Maximum length of flexible ducts shall not exceed 5’-0” in length.

F. Supporting Flexible Ducts:

1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
3. Ducts shall not be supported by ceiling.

END OF SECTION 233346

SECTION 233713.13 - AIR DIFFUSERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Square ceiling diffusers.

B. Related Requirements:

   1. Section 233300 "Air Duct Accessories" for volume-control dampers not integral to diffusers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.

PART 2 - PRODUCTS

2.1 SQUARE CEILING DIFFUSERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Nailor Industries Inc.
   2. Price Industries Limited.
   3. Titus.

B. Plaque Type Diffuser [SDA]:
   1. Material: Steel.
   2. Finish: Baked enamel, white.
   3. Face Size: 24 by 24 inches.
   4. Face Style: Plaque
   5. Mounting: T-bar.
   6. Pattern: Fixed.

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers 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 are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

3.2 INSTALLATION

A. Install diffusers 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.

END OF SECTION 233713.13

SECTION 233713.23 - REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adjustable blade face grilles.

2. Fixed blade face grilles.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
2. Section 233713.13 "Air Diffusers" for various types of air diffusers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.

PART 2 - PRODUCTS

2.1 GRILLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Krueger.
2. Metalaire.
3. Nailor Industries Inc.
4. Price Industries Limited.
5. Titus.
6. Tuttle & Bailey.

B. Fixed Face Grille [EGA]:

1. Material: Aluminum.
2. Finish: Baked enamel, white.
3. Face Arrangement: Perforated ½” x ½” x ½” grid core.

4. Core Construction: Integral or removable.
5. Frame: 1-1/4 inches wide.
6. Mounting: Lay-in.

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate 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 grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

3.2 INSTALLATION

A. Install grilles level and plumb.

B. Outlets and Inlets Locations: 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.

3.3 ADJUSTING

A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.23

SECTION 237433 –PACKAGED AIR-TO-AIR MAKE-UP AIR UNIT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. 100% outside air packaged make-up air unit .

B. Related Requirements:

1.2 ACTION SUBMITTALS

A. Product Data: For each dedicated outdoor-air unit.

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.
3. Include unit dimensions and weight.
4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
5. Fans:

    a. Certified fan-performance curves with system operating conditions indicated.
    b. Certified fan-sound power ratings.
    c. Fan construction and accessories.
    d. Motor ratings, electrical characteristics, and motor accessories.

6. Include certified coil-performance ratings with system operating conditions indicated.
7. Include filters with performance characteristics.
8. Include heat exchangers with performance characteristics.
9. Include dampers, including housings, linkages, and operators.

B. Shop Drawings: For each dedicated outdoor-air unit.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Roof curb sizing.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For dedicated outdoor-air units to include in emergency, operation, and maintenance manuals.

1.4 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. Filters: One set for each unit.

1.5 WARRANTY

A. Warranty: Manufacturer agrees to replace components of dedicated outdoor-air units that fail in materials or workmanship within specified warranty period.

   1. Warranty Period for Dedicated Outdoor-Air-Handling Units: 18 months from substantial completion parts and labor.

   2. Warranty Period for Compressor: 5 year parts only warranty.
   3. Warranty Period for Heat Exchangers: 25 years parts only from substantial completion.
   4. Warranty Period for Energy Wheel: Five years parts only from substantial completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70. ETL listed.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of units and components.

C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE 15 and ASHRAE 34 Compliance: For refrigeration system safety.

E. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

F. ASHRAE 84 Compliance: Comply with capacity ratings for energy-recovery equipment.

2.2 CAPACITIES AND CHARACTERISTICS

A. See drawing schedules for capacities and characteristics.

2.3 DEDICATED OUTDOOR-AIR UNITS

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

1. AAON.
2. Captive Aire
3. Greenheck

B. Source Limitations: Obtain dedicated outdoor-air units from single manufacturer.

C. Unit Casing:

1. General Fabrication Requirements for Casings: Formed and reinforced 2 inch double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed. Double wall construction shall be thermally broken.

2. Insulation shall be rigid urethane injected foam or similar material to meet the same insulating values and meet UL94HF-1 flame requirements. Insulation shall be full coverage including all walls, doors, roof and floor of unit.

3. Unit shall be finished primed and painted unit with standard factory color to resist a salt spray test per ASTM-B117

4. Access panels shall be hinged or removable panels to provide easy access to all the major components including filters. Access doors or panels shall be constructed of a minimum of G90 galvanized steel painted the same as other sections of the unit.
5. Configuration: Horizontal unit with bottom discharge for roof-mounting installation.
6. Double-Wall Configuration:
   a. Casing Insulation:

      1) Materials: Polyurethane foam insulation.
      2) Casing Panel R-Value: Minimum R-13.
      3) Insulation Thickness: 2 inches.

7. Condensate Drain:

   a. Pan: Stainless steel pan and connection.

   b. Condensate drain trap.

   c. Double sloped to prevent any standing water in the pan.

8. Fasteners: Corrosion Resistant.

D. Fans, Drives, And Motors:

1. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
2. Supply-Air Fan and Exhaust-Air Fan: Direct Drive Centrifugal; Painted steel; mounted on solid-steel shaft.

    a. Shafts: With field-adjustable alignment.

        1) Turned, ground, and polished hot-

3. Drive: Factory-mounted variable frequency drives.
4. Motors:

    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency.
    b. 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.
    c. Enclosure Type: Open, drip-proof with shaft grounding.
5. Condenser Fans:
    a. Direct Drive
    b. Propeller type of aluminum construction
    c. EC Motor on lead condenser fan

E. Coils:

1. General Requirements for Coils:

    a. Comply with AHRI 410.
    b. Fabricate coils section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
    c. Coils are not to act as structural component of unit.

2. Supply-Air Refrigerant Coils:

    a. Tubes: Copper>.
    b. Fins:

        1) Material: Aluminum.
        2) Fin Spacing: Maximum 12 fins per inch.

    c. Fin and Tube Joints: Mechanical bond.
    d. Headers: Seamless-copper headers with brazed connections.
    e. Frames: Galvanized steel.
    f. Coatings: None.
    g. Ratings: Designed, tested, and rated in accordance with ASHRAE 33 and AHRI 410.

        1) Working Pressure: Minimum 300 psig.

3. Condenser Refrigerant Coils:

    a. Tube Material: Copper.
    b. Fin Material: Aluminum.
    c. Fin and Tube Joint: Mechanical bond.
    d. Hail guards for coil protection
    e. Coating: None.

4. Hot Gas Reheat Coils:
    a. Tube Material: Copper.
    b. Fin Material: Aluminum.
    c. Fin and Tube Joint: Mechanical bond.
    d. Coating: None.

F. Refrigeration Circuit Components: R-454B refrigerant.

G. Rotary Heat Exchanger: Polymer wheel with silica gel desiccant

H. Dampers: Low leakage outdoor air damper, return/recirc air damper, and exhaust discharge gravity backdraft damper,
1. Electronic Damper Operators:

    a. Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
    b. Electronic damper position indicator shall have visual scale indicating percentage of travel and 2 to 10 V dc feedback signal.
    c. Operator Motors:
        1) Size to operate with sufficient reserve power to provide smooth modulating action.
        2) Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
    d. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
    e. Fail-Safe Operation: Mechanical, spring-return mechanism with external, manual gear release on non-spring-return actuators.

I. Electrical Power Connections:

1. Single-Point Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power connection to unit.
2. Enclosure: NEMA 250, Type 4X, mounted in unit with hinged access door in unit cabinet having a lock and key or padlock and key.
3. Wiring: Numbered and color-coded to match wiring diagram.
4. Wiring Location: Install factory wiring outside an enclosure in a raceway.
5. Power Interface: Field power interface to be NEMA KS 1, heavy-duty, non-fused disconnect switch.

6. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:

    a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection in accordance with IEC 60947-4-1.
    b. NEMA KS 1, heavy-duty, non-fusible switch.
    c. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

7. Factory-Mounted, Overcurrent-Protection Service: For each motor.
8. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity for use with a factory mounted and wired convenience outlet.
9. Controls: Factory wire unit-mounted controls where indicated.

    a. Service Lights: LED type, vaporproof luminaire with individual switched junction box located outside, adjacent to each access door and panel.

    b. Convenience Outlets: One 20 A duplex GFCI receptacle per location with junction box located on outside casing wall.

10. Control Relays: Auxiliary and adjustable time-delay relays.

J. Controls:
1. Control Wiring: Factory wire connection for controls' power supply.
2. Control Devices: Sensors, transmitters, relays, switches, detectors, operators, actuators, and valves shall be manufacturer's standard items to accomplish indicated control functions.
3. Status Panel: Unit mounted.

    a. Cooling/Off/Heating Controls: Control operational mode.
    b. Damper Position: Indicate position of outdoor-air dampers in terms of percentage of outdoor air.
    c. Internally mounted control center with 24VAC control transformers.
    d. BMS Protocol BACNet MSTP
    e. Supply Fan Control
    f. Exhaust Fan Control
    g. Web based user interface
    h. Energy Wheel economizer control
    i. Energy Wheel rotation sensor
    j. Damper Control – 100% OA-Recirculation
    k. Indoor pressure controls (remote mounted devices)
    l. Room thermostat with space temp and RH
    m. Phase and brown-out protection
    n. Status Lights:

        1) Filter dirty.
        2) Fan operating.
        3) Cooling operating.
        4) Heating operating.

5) Smoke alarm.
6) General alarm.

o. Digital Numeric Display:

1) Outdoor airflow.
2) Supply airflow.
3) Outdoor dry-bulb temperature.
4) Outdoor dew point temperature.
5) Space temperature.
6) Supply temperature.
7) Space relative humidity.
8) Space carbon dioxide level.

4. Refrigeration System Controls:

a. Unit-mounted enthalpy controller shall lock out refrigerant system when outdoor-air enthalpy is less than 28 Btu/lb of dry air or outdoor-air temperature is less than 60 deg F.
b. Outdoor-air sensor de-energizes dehumidifier operation when outdoor-air temperature is less than 60 deg F.
c. Relative-humidity sensor energizes dehumidifier operation when relative humidity is more than 50 percent.

d. Factory-mounted sensor in unit discharge with sensor adjustment located in control panel to control electric coil to maintain temperature.

5. Damper Controls: Space-pressure sensor modulates outdoor- and exhaust-air dampers to maintain a positive pressure in space at a minimum of 0.05 inch wg with respect to outdoor reference.
6. DDC Temperature Control: Standalone control module for link between unit controls and DDC temperature-control system. Control module shall be compatible with control system specified in Section 230923 "Direct Digital Control (DDC) System for HVAC." Links shall include the following:

a. Start/stop interface relay and relay to notify DDC temperature-control system alarm condition.
b. Hardware interface or additional sensors for the following:

1) Room temperature.
2) Discharge-air temperature.
3) Refrigeration system operation.
4) Furnace operation.

7. Interface with DDC System for HVAC: Factory-installed hardware and software to enable the DDC system for HVAC to monitor, control, and display unit status and alarms. Refer to Specification Section 230593 Direct Digital Control (DDC) Systems for HVAC.

a. Hardwired Points:

1) Monitoring: On-off status, common trouble alarm.

2) Discharge air temperature
3) Control: On-off operation, supply temperature set-point adjustment, space pressure set-point adjustment.

K. Roof Curbs:
1. Materials: Minimum of 18-gauge galvanized steel with corrosion-resistant coating, watertight gaskets, and factory-installed wood nailer; complying with National Roofing Contractors Association manuals for the specific type of roofing applicable to the Project.

a. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

1) Materials: ASTM C1071, Type I or II.
2) Thickness: 2 inches.

b. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.

1) Liner Adhesive: Comply with ASTM C916, Type I.
2) Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
3) Liner materials applied in this location shall have airstream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric, depending on service air velocity.

2. Curb Dimensions: Height of 24 inches.
3. Wind and Seismic Restraints: Metal brackets compatible with the curb and casing, painted to match unit, used to anchor unit to the curb, and designed for loads at Project site.

L. Intake And Relief Openings:

1. Type: Manufacturer's standard hood or louver, including moisture eliminator, at all unit intake and relief openings.
2. Materials: Match material and finish of casing exterior.
3. Bird Screen: Comply with requirements in ASHRAE 62.1.
4. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

M. Furnace:
1. 409 Stainless steel heat exchanger.
2. Indirect gas fired
3. 16:1 turn down ratio.
4. Fully modulating control.
5. Integral combustion gas blower

N. Compressor:
1. Hermetic Scroll type compressor with inverter
2. Internally isolated
3. All refrigeration accessories and controls

4. Crankcase heater
5. R454-B refrigerant

O. Filters
1. Supply filters MERV-13
2. Outdoor air and exhaust filters: MERV-8

2.4 MATERIALS

A. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for steel sheet.

B. Stainless Steel:

1. Manufacturer's standard grade for casing.
2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.

C. Galvanized Steel: ASTM A653/A653M.

D. Aluminum: ASTM B209.

2.5 SOURCE QUALITY CONTROL

A. AHRI 920: Manufacturer to certify that performance ratings are in accordance with AHRI 920 if AHRI 920 certification program is not in place. Provide AHRI 920 certification if AHRI 920 certification program is in place.

B. Fan Energy Index (FEI): Test in accordance with AMCA 210 and rate in accordance with AMCA 99, AMCA 207, and AMCA 208.

C. Fan Operating Limits: Classify fans in accordance with AMCA 99, Section 14.

D. Damper Leakage and Air Performance:

1. Damper Rating: Test and rate dampers for leakage and air performance in accordance with AMCA 510.

E. Refrigerant Coils: Factory tested to minimum 450 psig internal pressure and to minimum 300 psig internal pressure while under water, in accordance with AHRI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF DEDICATED OUTDOOR-AIR UNITS

A. Roof Curb: Install on roof structure or concrete base, level and secure, in accordance with NRCA's "The NRCA Roofing Manual: Membrane Roof Systems". Install units on curbs and coordinate roof penetrations and flashing with roof construction. Secure units to upper curb rail, and secure curb base to roof framing with anchor bolts. Coordinate sizes and locations of roof curbs with actual equipment provided.

B. Coordinate all roofing work with the Contractor holding the current warranty on the roof. Contact the Owner’s representative for information on the current roof warranty.

C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

D. Install filter-gauge, static-pressure taps upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum in accessible position. Provide filter gauges on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

E. Connect duct to unit with flexible connections on underside where ducts penetrate the roof. Comply with requirements in Section 233300 "Air Duct Accessories."

F. Wall- and duct-mounted sensors furnished by manufacturer for field installation to be wired and installed by the Temperature Control Contractor. Install control wiring and make final connections to control devices and unit control panel. Coordinate all controls with the Temperature Control Contractor.

G. Comply with requirements for gas-fired furnace installation in NFPA 54.

H. Install separate devices furnished by manufacturer and not factory installed.

I. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

3.3 PIPING AND DUCT CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing natural gas piping adjacent to units, allow space for service and maintenance. Do not block access doors or access panels.

C. Provide a condensate drain trap assembly sized specific for the static pressure requirements of the make-up air unit to insure there is a positive water seal. Terminate the condensate drain from the trap assembly onto the roof in a manner where the water is directed away from the unit and does not pond or pool on the existing membrane roof.

D. Duct Connections:

1. Comply with requirements in Section 233113 "Metal Ducts."
2. Drawings indicate the general arrangement of ducts.
3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 233300 "Air Duct Accessories."

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 with a black background and engraved white letters at least 1/2 inch high.

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

C. Refer to Specification Section 230923, Direct Digital Control (DDC) System for HVAC.

D. All control devices supplied by the DOAS unit manufacturer shall be wired and installed by the TCC. Coordinate any control devices furnished by the unit manufacturer with the TCC. All control devices shipped loose with the unit shall be wired and installed by

the Temperature Control Contractor. Turn all control devices over to the TCC so that there is a single source of all controls.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.

2. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans. Make all repairs required.
3. Start refrigeration system when outdoor-air temperature is within normal operating limits. and measure and record the following:

    a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
    b. Cooling coil entering-air, dry- and wet-bulb temperatures.
    c. Condenser coil entering-air dry-bulb temperature.
    d. Condenser coil leaving-air dry-bulb temperature.

4. Simulate maximum cooling demand and inspect the following:

    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.
5. Verify operation of the gas fired furnace.
    a. Check burners and heat exchangers are clean and free of debris and packing material.
    b. Verify the burner fully modulates from maximum to minimum positions.
    c. Inspect gas flue and combustion air intakes to insure there are not obstructions.
6. Verify operation of the hot gas reheat coil.
    a. Simulate a low discharge temperature to allow the hot gas reheat coil to operate.
    b. Make adjustments to the hot gas refrigerant circuit as needed for proper operation. (This should be done only by the manufacturer’s start-up technican)

7. Inspect casing insulation for integrity, moisture content, and adhesion.
8. Verify that clearances have been provided for servicing.
9. Verify that controls are connected and operable.
    a. The Temperature Control Contractor shall work with the installing Contractor to verify the unit operates per the Sequence of Operation noted on the drawings.
10. Verify that filters are installed. Install clean filters at the time of substantial completion and instruct the owner of all filter locations, how to access and sizes and types of filters required for ongoing maintenance.
11. Clean coils and inspect for construction debris.
12. Verify bearing lubrication.

13. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
14. Adjust fan belts to proper alignment and tension.
15. Start unit.
16. Inspect and record performance of interlocks and protective devices.
17. Operate unit for run-in period.
18. Calibrate controls.
19. Adjust and inspect high-temperature limits.
20. Verify operational sequence of controls.
21. Measure and record the following airflows. Plot fan volumes on fan curve.

    a. Supply-air/Outdoor-air volume

    b. Exhaust air volume at 100% outside air.

B. After startup, change filters, verify bearing lubrication, and adjust belt tension.

C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.

D. Prepare written report of the results of startup services.

E. Prepare and present the Owner with a Operation and Maintenance Manual. Manual shall include contact information of the prime Contractor.

3.7 ADJUSTING

A. Adjust initial discharge temperature set point. Coordinate discharge temperature set point in the existing BMS and how to reset it if desired.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 CLEANING

A. After completing system installation; testing, adjusting, and balancing dedicated outdoor-air unit and air-distribution systems; and completing startup service, clean the unit internally to remove foreign material and construction dirt and dust. Clean fan wheels, casings, dampers, coils, and filter housings, and install new, clean filters.

B. Insure all packing materials are removed from the inlet and discharge of each coil.

3.9 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.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

B. The Temperature Control Contractor shall demonstrate the operation of the units control features to the Owner. The TCC shall make any adjustments as needed in the system for a period of 12 months from substantial completion that includes a full year of seasonal changes as needed for proper operation of the unit as intended.

END OF SECTION 237433

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Definitions.
2. General electrical requirements.
3. Electrical coordination and installation.
4. Temporary electricity.
5. Submittals.
6. Delivery, storage, and handling.
7. Cutting, patching, damage, and mutilation.
8. System startup.
9. Warranty.
10. Firestopping.

1.3 LEED REQUIREMENTS

A. There is no LEED requirements for this project.

1.4 DEFINITIONS

A. Furnish: Supply but do not install the specific item, component, equipment, system, etc.

B. Install: Place in position, make connections and adjust for use of the specific item, component, equipment, system, etc.

C. Provide: Furnish and install the specific item, component, equipment, system, etc.

D. Equipment: A general term, including material, fittings, devices, appliances, luminaires, apparatus, machinery, etc. used as part of or in the connection with an electrical installation, per NEC.

E. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces, immediately below roof, space above ceilings, unexcavated spaces, crawlspaces, and tunnels.

F. Concealed, Inaccessible, Interior Installations: Concealed from view and protected from physical contact by building occupants. Rendered inaccessible by the structure of finish of the building, per NEC. Examples include above hard ceilings and in chases not behind an access panel.

G. Concealed, Accessible, Interior Installations: Concealed from view and protected from physical contact by building occupants. Accessible via the structure of the finish of the building, per NEC. Examples include above lay-in ceilings and behind access panels in chases.

H. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and from physical contact by building occupants but subject to outdoor ambient temperatures. Examples include duct banks and equipment within an underground vault or manhole.

I. Exposed, Interior Installations: Exposed to view indoors, and accessible Examples include mechanical equipment rooms.

J. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

K. Rough-In: Suitable raceway terminated at each end in a suitable box or with a bushing and containing a pull string.

L. Work: Labor, installation, materials, equipment, systems, etc. required to complete a portion of the project scope.

M. NFPA 70 (National Electrical Code - NEC): Currently adopted NFPA 70 code with all amendments as adopted by the state or local authority having jurisdiction.

1.5 GENERAL ELECTRICAL REQUIREMENTS

A. Provide all required labor, material, equipment, and Contractor's services necessary to complete the electrical installation required in full conformity with the Contract Documents and as required to meet all current codes and ordinances including all requirements of the Occupational Safety and Health Act latest edition.

B. This Contractor shall review the complete set of drawings and specifications and include work from other divisions that affect his work.

C. Perform all work to conform to or exceed the minimum requirements of the current edition of the National Electrical Code, NECA and all federal, state, local and municipal codes and ordinances. Work shown on the drawings or in the specifications that exceed the minimum requirements of the NFPA 70 or other regulations shall be installed as indicated. Comply with the directions of all properly appointed authorities having jurisdiction.

D. OSHA: Contractor, Sub-Contractor, and all those working at the job site shall adhere to all requirements of the Occupational Safety and Health Act latest edition.

E. Drawings are diagrammatical in nature and do not show every required miscellaneous detail, support, fitting, etc. Drawings shall not be scaled for purposes of equipment installation. All measurements shall be verified to ensure equipment, raceways, devices, luminaires, etc. are installed in a neat and workmanlike manner. Furnish and install all materials required for a complete and operational electrical system.

F. Obtain all permits, licenses, certificates and pay for all fees necessary to complete the electrical installation unless otherwise noted in the front-end specifications or Division 01.

G. Field verify all conditions and dimensions as they pertain to the intent of the drawings and specifications. Contractor shall bring to the attention of the Engineer any discrepancies discovered prior to the commencement of any work affected by or related to such discrepancy. Contractor shall be responsible for all costs associated with or caused by that contractor's failure to comply with this requirement.

H. Provide all disconnects, starters, outlets, receptacles, wiring, raceway, pathways, etc. required to properly connect all equipment indicated in the Construction Documents to be furnished and installed by other Trades and/or by the Owner or furnished by other Trades and/or the Owner for installation by this Contractor. Verify all requirements with approved submittals prior to rough-in and installation.

I. Rough-in requirements for all equipment to be connected may not be shown on the drawings. Contractor shall verify all electrical requirements with the other Trades and/or the Owner furnishing the equipment, and with the manufacturer of the equipment.

J. The Engineer reserves the right to make changes of the locations of all receptacles, switches, equipment, etc. up to the time of rough-in or setting of equipment without additional cost to the project.

K. Field verifies exact location of electrical equipment including lighting fixtures, fire alarm devices, security system devices, receptacles, etc. in rooms containing exposed ductwork, piping, etc. and rearrange as required by the Engineer.

L. All materials shall be new and shall be Underwriters Laboratories (UL) labeled conforming to NEMA Standards and all applicable codes unless otherwise noted.

M. Manufacturer Qualifications: Company specializing in manufacturing products with not less than three years of documented experience.

N. Workmanship: As a minimum requirement, NECA ”Good Workmanship in Electrical Construction” shall be followed along with any additional requirements as described in the specifications and on the drawings.

O. To help prevent sound transmission from one space to another, do not install recessed equipment and devices back-to-back in the same wall.

P. Provide all cutting, patching, and replacement of materials for electrical work in accordance with all appropriate Divisions of Specifications.

Q. Paint surface mounted or otherwise exposed conduit, raceway, boxes, and other unfinished electrical materials in finished spaces. Paint to match surfaces to which they are attached to, or color as selected by Architect.

R. All finish painting shall be in accordance with and provided under Division 09 and paid for by this Contractor.

S. Provide access panels and doors for electrical items that are required to remain accessible that are installed in non-accessible spaces. Access doors and panels are specified in Division 08."

T. Contractor shall examine architectural drawings to verify wall thickness for proper recessing depth for all flush installed equipment, devices, etc. Any instance of inadequate depth shall be brought to the attention of the architect and engineer prior to Bids or provided for by this contractor.

U. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements (drawings, specifications, submittals, addendums, etc.).

1.6 VERIFICATION

A. Contractor shall visit the project site to verify existing conditions relative to the project scope.

B. Work shown on the drawings as "existing" is assumed to be in place and suitable for modifications and additions as indicated on the drawings. This contractor shall field verify these items prior to installation and shall make all necessary provisions required for proper installation as required by the drawings and specifications. Contractor shall submit questions about existing conditions in writing to the architect/engineer.

1.7 COORDINATION

A. Contractor shall coordinate with all other Trades to assure proper timing and installation of materials and equipment to meet the sequence of construction. Contractor shall also coordinate with other trades to ensure installation is within intended space requirements, meets code requirements, and does not result in any conflicts. Minor field installation deviations from the drawings are acceptable to ensure proper installation and that all code requirements are met.

B. Before performing any work, review the drawings and confirm that the electrical work does not interfere with clearance required for beams, foundations, columns, pilasters, partitions, ductwork, plumbing, fire protection, etc. Where interferences develop after installation of equipment, this contractor shall make changes requested by the Engineer as required to provide proper clearances at the expense of this Contractor.

C. All interruptions of a system or a service shut-down of any duration shall be approved by the Owner and Engineer in writing not less than fourteen (14) days in advance of the

interruption or shut-down. Submit duration and nature of an interruption or shut-down at time of request.

D. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping installed at required slope.
4. To allow raceways, cables, wireways, cable trays, busways, etc. to be clear of obstructions and of the working and access space of other equipment.
5. To maintain mechanical access, especially the 24”x24” space required in front of VAV/CAV box control locations

E. Coordinate location of access panels and doors for electrical items that are behind finished surfaces concealed in locations that will remain inaccessible in the future.

F. For equipment requiring connections by other trades, provide approved submittals to the appropriate trade. Approved submittals are to include all information required by the other trade.

G. Coordinate all training sessions with the Owner and Engineer. All training sessions shall be performed and scheduled at the Owner’s convenience. Quantity of training sessions and length of each session shall be as specified in the technical specification sections.

1.8 TEMPORARY ELECTRICITY

A. Provide temporary power and lighting for the progression of work by all Trades as required by Division 01.

1.9 SERVICE CONTINUITY

A. Continuity:

1. Service continuity to existing equipment shall be addressed in the following manner:

a. Maintain service continuity to all existing loads that are to remain by modifying and/or extending conduit and wiring as required. Field verification of existing conduit runs, and circuitry is to be done as required. This is applicable to receptacles, overhead power drops, disconnects, lighting, and wiring to fume hoods and mechanical equipment.

B. Inconvenience to Occupants:

1. Power interruptions must be properly pursued to reduce inconvenience to the normal building activity to a minimum.

C. Interruption Arrangements:

1. Arrangements for interruption of electrical service to Project areas must be made in writing with the Owner representative\Project Manager at least two weeks before the proposed interruptions.

D. Interruption Hours:

1. Interruptions of service in areas where Owner's personnel are working and possibly sleeping, should be coordinated 1 week in advance and scheduled during hours of 2pm and 8pm unless otherwise requested by the building manager and approved by Owner's representative.

1.10 SUBMITTALS

A. Refer to Division 01 Shop Drawings, for submittal procedures.

B. Provide submittals for products in Division 26, 27, and 28.

C. Shop drawing submittals shall comply with the following:

1. Organize each submittal by specification section and it shall include all manufactured items.
2. Include wiring diagrams, riser diagrams, etc. showing the quantity and types of cables, raceway required for systems such as Lighting Control, Sound Systems, Access Control, etc. Drawings will be returned for completion if the locations and routing of the devices and cables are not shown. Delays in the construction schedules due to incomplete drawings shall be the responsibility of this Contractor.

D. Submit record drawings in accordance with Division 01

E. Where new electrical equipment, devices, cabling, etc. specified or noted on the drawings are obsolete, provide replacements that meet or exceed all options and accessories necessary for its function. Submit replacement for approval.

F. Contractor shall verify recessed depths for luminaires against catalog reference material prior to providing submittals for review.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle all material and equipment in accordance with the manufacturer's recommendation unless specifically otherwise noted.

B. Store all materials and equipment off-site unless approved by the Engineer. Materials and equipment stored on-site shall be stored in a climate controlled indoor space and so as not to interfere with construction or facilities in use by Owner.

C. Damaged material and equipment shall not be furnished or installed.

1.12 CUTTING, PATCHING, DAMAGE, AND MUTILATION

A. The General Contractor is responsible for all cutting and patching indicated on the Architectural Drawings related to installation or removal of work by the Electrical Contractor. All required cutting and patching may not be shown. Any additional cutting and patching required for electrical work, which is not indicated on the Architectural Drawings, is the responsibility of the Electrical Contractor.

B. Properly patch and repair cuts made into, or penetration made through fire rated walls, floors, and ceilings to maintain their proper fire rating.

C. Roof openings required by this Contractor that are not shown on the Architectural or Structural Drawings shall be provided by the Division 07 Contractor and paid for by this Contractor.

D. All undue or untimely damage or mutilation of masonry, plaster and other finished surfaces around conduit, equipment, etc., created by this Contractor shall be repaired by the proper Contractor and paid for by this Contractor.

E. This Contractor shall be responsible for damage to or mutilation of the work of the other Contractors or to the building and its contents caused by equipment installed or work performed by this Contractor.

F. The finish of any item that has been marred, scratched or damaged in any way by this Contractor shall be repaired and repainted at the expense of this Contractor, and to the satisfaction of the Engineer.

1.13 BASIC ELECTRICAL REQUIREMENTS

A. All electrical systems shall be designed and specified as “fully-rated” systems. “Series-rated” systems are not acceptable.

1.14 SYSTEM START-UP

A. Perform tests on all systems and each piece of equipment as required by applicable codes and/or as specified.

B. Clean all equipment of construction debris and dust prior to demonstration to Owner.

C. All work shall include start-up of all systems, demonstrating each system to the Owner, and training the Owner in the proper operation of each system. Furnish operational and maintenance instructions.

1.15 WARRANTY

A. In addition to the warranty required under the provisions of front end, Division 0 and 1 specification, provide additional warranty for work and materials for the time periods

indicated under individual Sections of the Specifications or for a duration of one (1) year from the date of final acceptance by the owner or substantial completion, whichever is longer. Manufacturer product Warranties and Guaranties that exceed the minimum requirements of the Contract Documents shall be adhered to.

B. Contractor shall correct, repair, and/or replace any deficiencies of any part of the installation to the satisfaction of the Owner and Engineer for the duration of the warranty/guarantee period.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to top of unit for wall-mounted items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with the project documents.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

3.2 FIRESTOPPING

A. Provide firestopping to raceway and cable penetrations of fire-rated floor, ceilings, partitions and wall assemblies for electrical installations to maintain fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07.

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire.
2. Aluminum building wire.
3. Nonmetallic underground conduit with conductors, Type NUCC.
4. Metal-clad cable, Type MC.
5. Armored cable, Type AC.
6. Photovoltaic cable, Type PV.
7. Mineral-insulated cable, Type MI.
8. Tray cable, Type TC.
9. Fire-alarm wire and cable.
10. Connectors and splices.

B. Wire and cable shall be color coded, with a separate color used for each phase and neutral used consistently through the system as specified in Identification section Green shall be used for all grounding conductors.

C. No material shall be used in the conductor system that cannot be identified under an approved material specification.

D. No material shall be installed that is corrosive, breeds or sustains mold growth, is moisture absorbing or whose properties exceed the following:

1. Flame spread 25 Max
2. Smoke developed 50 Max
3. Fuel contributed 50 Max

E. All wires and cables shall be delivered to the work site in complete coils with an approved tag containing manufacturer's name, wire size and type of insulation.

1.2 SUBMITTALS

A. Product Data:

1. Copper building wire.
2. Aluminum building wire.
3. Nonmetallic underground conduit with conductors, Type NUCC.

4. Metal-clad cable, Type MC.
5. Armored cable, Type AC.
6. Photovoltaic cable, Type PV.
7. Mineral-insulated cable, Type MI.
8. Tray cable, Type TC.
9. Connectors and splices.

B. Product Schedule: Indicate type, use, location, and termination locations.

C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Alpha Wire; brand of Belden, Inc.
2. Cerro Wire LLC.
3. Encore Wire Corporation.
4. General Cable; Prysmian Group North America.
5. Okonite Company (The).
6. Service Wire Co.
7. Southwire Company, LLC.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 and for compact stranding & TC-ER ASTM B496 for stranded conductors.

E. Conductor Insulation:
1. Type THHN and Type THWN-2. Comply with UL 83.
2. Type THW and Type THW-2. Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
3. Type XHHW-2. Comply with UL 44.

F. Shield:

1. Type TC-ER: Cable designed for use with ASDs, with oversized crosslinked polyethylene insulation, dual spirally wrapped copper tape shields and three bare symmetrically applied ground wires, and sunlight- and oil-resistant outer PVC jacket.

2.2 ALUMINUM BUILDING WIRE

A. Aluminum wire is not permitted.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders:

1. Copper; Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits:

1. Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders above ground: Type THHN/THWN-2, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

C. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

3.3 INSTALLATION, GENERAL

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points in accordance with Section 260533.13 "Conduits for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.4 INSTALLATION OF FIRE-ALARM WIRE AND CABLE

A. Comply with NFPA 72.

B. Wiring Method: Install wiring in metal pathway according to Section 270528.29 "Hangers and Supports for Communications Systems."

1. Install plenum cable in environmental airspaces, including plenum ceilings.
2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system must be installed in a dedicated pathway system.
    a. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
3. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70, Types MI and CI, is not permitted.
4. Signaling Line Circuits: Power-limited fire-alarm cables must not be installed in the same cable or pathway as signaling line circuits.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.

F. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.

G. Wiring to Remote Alarm Transmitting Device: 1 inch (25 mm) conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inch (150 mm) of slack.

D. Comply with requirements in Section 284621.11 "Addressable Fire-Alarm Systems" for connecting, terminating, and identifying wires and cables.

3.6 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.8 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.9 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
2. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements:

3. Perform each of the following visual and electrical tests:
   a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
   b. Test bolted connections for high resistance using one of the following:

      1) A low-resistance ohmmeter.
      2) Calibrated torque wrench.
      3) Thermographic survey.

   c. Inspect compression-applied connectors for correct cable match and indentation.
   d. Inspect for correct identification.
   e. Inspect cable jacket and condition.
   f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable for a one-minute duration.
   g. Continuity test on each conductor and cable.
   h. Uniform resistance of parallel conductors.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports to record the following:
   1. Procedures used.
   2. Results that comply with requirements.
   3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL 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. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 07 84 13 "Penetration Firestopping" for firestopping at conduit and box entrances.
2. Section 26 05 43 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
3. Section 27 05 28 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. EMT: Electrical Metallic Tubing.

C. GRC: Galvanized rigid steel conduit.

D. IMC: Intermediate metal conduit.

E. LFMC: Liquid tight Flexible Metal Conduit.

F. RNC: Rigid Nonmetallic Conduit (Rigid Polyvinyl Chloride Conduit: Type PVC).

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:
1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. GRC: Comply with ANSI C80.1 and UL 6.
3. IMC: Comply with ANSI C80.6 and UL 1242.

4. EMT: Comply with ANSI C80.3 and UL 797.
5. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

1. Comply with NEMA FB 1 and UL 514B.
2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Fittings, General: Listed and labeled for type of conduit, location, and use.
4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
5. Fittings for EMT:

a. Material: Steel.
b. Comply with NEMA FB 2.10, Type: Setscrew, insulated throat, concrete tight type couplings and connectors similar to Appleton #TWXX-SI Series, OZ/Gedney #4000-ST/5000-ST Series, and meeting Federal Spec #WF408F. Other fittings shall not be acceptable.
c. Comply with NEMA FB 2.10, Type: Steel compression for 2” or smaller and steel setscrew for larger than 2”, insulated throat, concrete tight type couplings and connectors similar to Appleton #TWXX-SI Series, OZ/Gedney #4000-ST/5000-ST Series, and meeting Federal Spec #WF408F. Other fittings shall not be acceptable.

6. Fitting for GRC and IMC: Comply with NEMA FB 2.10, all threaded fittings (use of set screw or compression type not acceptable).
7. Liquid tight fittings: Comply with NEMA FB 2.20, shall be UL listed for grounding, ferrule, and sleeve type with insulated throat as O-Z Gedney “4Q” series, Appleton ‘ST” Carlon “Carflex” or approved equal.

8. Conduit Hubs shall have insulated throat and recessed O-Ring seal.
9. Conduit Bodies:

    a. “LB” and Mogul size for 1” and larger conduits.
    b. Cast ferrous material for exterior, watertight, and vapor tight locations with gaskets at covers.

10. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

D. GRC for underground or pour in concrete walls shall be conductive, waterproof joint compound equal to T&B “KOPR-SHIELD” or Sherwin Williams ‘ZINC-CLAD”.

2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

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

1. B-line, an Eaton business.
2. Hoffman; a brand of Pentair Equipment Protection.
3. MonoSystems, Inc.
4. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, 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 unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.3 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A; galvanized steel.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover and threaded hubs.

D. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

1. Through wall and Handy boxes are not permitted.
2. Four-inch octagon or square boxes for fixture outlets.

E. Gangable boxes are prohibited.

F. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, Type 3R, Type 4,and Type 12 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

G. Cabinets:

1. NEMA 250, Type 1, Type 3R, and Type 12 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.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
7. Backboard: Provide 3/4" thick plywood backboard for mounting terminal blocks and other electronics.

H. Terminal Blocks

1. Terminal Blocks: NEMA ICS 4.

2. Power Terminals: Unit construction type with closed back and tubular pressure screw connector, rated 600 volts minimum.
3. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts minimum.
4. Provide ground bus terminal block with each connector bonded to enclosure or cabinet.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
1. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
2. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
3. Cover Legend: Molded lettering, "ELECTRIC." or Custom legend as requested.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC.
3. All explosion proof work (rigid only): GRC.
4. "Vaportight" and "watertight" work: GRC.
5. In or above prefabricated concrete decking such as "FLEXICORE," "RAPIDEX," etc: GRC
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
7. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT, IMC, or GRC.
2. Below bottom of lowest slab in granular fill: GRC or PVC.
3. Concealed feeder conduit in Ceilings and Interior Walls and Partitions: EMT.
4. Concealed Branch Circuit in Ceilings and Interior Walls and Partitions: EMT.

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC. Six feet maximum length unless otherwise noted.
6. Damp or Wet Locations: GRC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 nonmetallic in institutional and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

1. See communications specifications for telecom raceway sizes.

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. Comply with NEMA FB 2.10.
2. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.
3. EMT: Use setscrew fitting for larger than 2” C and compression fitting for 2” and smaller conduit, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface raceways only were indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

C. Separate raceway systems shall be provided for:

1. Each lighting system.
2. Convenience outlets.
3. Each power system.
4. Each special or different system as further specified whether it is battery lighting, high or low voltage or any nature, such as telephone, fire alarm, emergency system, sound, control systems, Building Automation Control Systems, etc.
5. Except by special permission, separate conduits are required for each feeder, each equipment branch circuit, and for all special systems.

D. Common conduits will be acceptable for:
1. Motor branch circuits, or for a motor circuit and its associated control wiring.

2. Lighting and lighting control wiring can be in the same conduit provided the insulation on the control wiring is greater than the highest voltage in the raceway.

E. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.

F. Do not fasten conduits onto the bottom side of a metal deck roof.

G. 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.

H. Complete raceway installation before starting conductor installation.

I. Arrange stub-ups so curved portions of bends are not visible above finished slab.

J. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

K. Make bends in raceway using large radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

L. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines. Conduits located in mechanical and electrical spaces may be exposed.

M. Install conduit parallel and perpendicular to walls and building lines. Conduit under slab may be routed from point-to-point.

N. Arrange raceway to maintain headroom and present neat appearance. Install 1” or less below deck to avoid future conflicts when ceilings are installed or when additional work is added.

O. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.

P. Do not attach conduit to ceiling support wires.

Q. Install underground conduit within the building perimeter a minimum of 6 inches below the drainage fill under the concrete slab.

R. Install all branch circuit conduits within the building perimeter above the finished floor line except when serving floor boxes, outlets in partial height walls, or exterior connections were shown or unless otherwise noted on contract documents. Floor boxes, partial height walls, or exterior connections shall be served from the floor below.

S. Provide insulated throat metal grounding bushings with lay-in type lug for all feeder conduits.

T. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender to fabricate bends in metal conduit larger than 2-inch size.

U. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

V. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

W. Route conduit through same roof openings as piping and ductwork wherever possible. Where separate roofing penetration is required, coordinate location and installation method with roofing installation.

1. One conduit per sleeve.
2. Minimum height of sleeve not less than 8-inches above roof membrane.
3. Provide rain shield on conduit overlapping sleeve a minimum of 2-inches.
4. Secure rain shield to conduit with stainless steel pressure clamps.
5. Provide flashing as required.

X. Support conduit within 12 inches of enclosures to which attached.

Y. Raceway embedded in slab and under floor slab are not permitted unless otherwise indicated on the contract documents.

Z. Panelboards:

1. Branch Circuits: Six (6) spare 1-inch (27-mm) conduits up and two (2) spare 1-inch (27-mm) conduits down shall be installed from each flush mounted lighting and power panelboard, control cabinet, and electronic systems cabinet of all descriptions and terminated in space above or at respective ceilings in 4-inch spare boxes with blank covers, two conduits per box. None are required out bottom of panels of slab on grade.

AA. Stub-Ups to Above Recessed Ceilings:

1. Use EMT, IMC, or GRC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

BB. 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.

CC. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

DD. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

EE. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and

insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

FF. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

GG. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

HH. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. De-burr cut ends.

II. 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. Cap underground raceways designated as spare above grade alongside raceways in use.

JJ. GRC and IMC conduit installation as follow:

1. Coupled with Erickson Couplings in lieu of running threads.
2. Installed with joints sealed with conductive, waterproof conduit joint compound (where underground or in concrete), equal to T & B "KOPR-SHIELD" or Sherwin Williams "ZINC-CLAD".
3. Installed in accordance with Underwriters Laboratories Standard UL6 for Rigid and UL/242 for IMC.
4. Where GRC or IMC enters a box or other fitting through a knockout, an approved double locknut and bushing shall be provided. Not applicable for threaded hubs.
5. Used for sleeves except where sheet metal is approved elsewhere.
6. Installed with all threaded fittings (the use of set screw or compression type not acceptable).
7. Where exiting or entering a concrete slab, extend Rigid or IMC at least 36" before adapting to EMT.
8. Where Rigid or IMC enters a junction box or any enclosure within 60" of exiting or entering a concrete slab, the Rigid or IMC shall be continuous into the enclosure.
9. Conduit hubs shall be installed for all GRC or IMC terminations to sheet metal type enclosures and for installations requiring a watertight or dust tight seal.

KK. Rigid Non-Metallic Conduit (PVC):

1. Underground site lighting branch circuits only, no concrete encasement is required. Other types of installations may require concrete encasement as indicated on the drawings, other sections of these specifications, and as directed by the Owner or NEC.
2. Entire installation shall be watertight.

LL. Surface Raceways:

1. Install surface raceway with a minimum 2-inch radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway

section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
3. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
4. Close ends of wireway and unused conduit openings.
5. Where two-piece raceway covers pass through walls, floors, and/or ceilings, the cover shall be cut on both sides of the wall, floor, or ceiling (maximum of 6” from edge of penetration) to permit removal of the cover from each side of the obstruction.

MM. Install raceway sealing fittings at accessible locations according to NFPA 70 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 according to NFPA 70.

NN. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Conduit extending from interior to exterior of building.
4. Conduit extending into pressurized duct and equipment.
5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6. Where otherwise required by NFPA 70.

OO. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

PP. Expansion-Joint Fittings:

1. Install in each run of aboveground GRC, IMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    b. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.

3. 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 for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

QQ. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations not subject to severe physical damage.
2. Use LFMC in damp or wet locations not subject to severe physical damage.

RR. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

1. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
2. Align wall mounted outlet boxes for switches, thermostats, and similar devices.

SS. Install boxes in locations as shown on the drawings, as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70.

1. Electrical boxes shown on drawings are approximate locations unless otherwise indicated. Adjust box locations up to 10 feet if required to accommodate intended purpose.
2. Locate boxes to allow luminaries positioned as shown on reflected ceiling plan.
3. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel; provide a minimum 6” separation. Provide a minimum 24” separation in acoustic rated walls.
4. Coordinate installation of outlet boxes for equipment connected under Section “Wiring Devices”.

TT. 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. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

UU. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

VV. Locate boxes so that cover or plate will not span different building finishes.

WW. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose. Secure flush mounting box to interior wall partition studs. Accurately position to allow for surface finish thickness.

1. Use stamped steel bridges to fasten flush mounting outlet box between studs.
2. Adjust flush installed outlets to make front flush with finished wall material.

XX. Install boxes, enclosures, and cabinets plumb. Anchor securely to structural supports.

YY. Orient boxes vertically to accommodate wiring devices unless otherwise noted.

ZZ. Use flush mounting outlet box in finished areas.

AAA. Install knockout closures in unused box openings.

BBB. Install pull boxes and junction boxes above accessible ceiling and in unfinished areas only.

CCC. Inaccessible Ceiling Areas: Install outlet and junction boxes not more than 6 inches from ceiling access panel or from removable recessed luminaries.

DDD. Use cast outlet boxes in exterior locations exposed to weather and wet locations.

EEE. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in wet locations.

FFF. Clean interior of boxes and remove dust, debris and other material prior to wire or device installation. Clean exposed surfaces and restore finish. Touch up damage.

GGG. Contractor shall maintain J-Box accessibility. When an outlet, junction box, or pull box becomes inaccessible for any reason (i.e., new lab benches or cabinets) the outlet, junction box, or pull box shall be relocated and all associated conduit and wiring modified and re-routed as required maintaining accessibility.

HHH. Route conduit away from any equipment requiring maintenance access, minimum 24-inches clearance.

III. Comply with requirements in Division 26 "Identification for Electrical Systems" for raceway and Boxes identifications.

JJJ. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits and /or ceiling support wire.

KKK. Set metal floor boxes level and flush with finished floor surface. Provide junction box beneath for conduit routing as required.

LLL. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 31 20 00 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 31 20 00 "Earth Moving."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 31 20 00 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install handholes with bottom below frost line, below grade.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

1. Firestop cables in conduit penetrating rated wall/floor within the building.

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

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 for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Division 07 "Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 SUBMITTALS

A. See Division 01 for submittals procedures.

B. Product Data: For each type of product.

C. LEED Submittals:

1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit EQ 4: For sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: Through gyp board used EMT. Through concrete or block use galvanized rigid conduit (GRC).
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

    a. Thickness shall be minimum 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable for slabs-on-grade and below-grade-exterior walls.

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

    a. Link-Seal

2. Sealing Elements: EPDM rubber 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 or Stainless steel.
4. Connecting Bolts and Nuts: Match material of pressure plates, of length required to secure pressure plates to sealing elements.

2.3 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in this section and Division 07 "Joint Sealants."
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall, so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide minimum 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. On communications sleeves where a raceway will NOT be installed within the sleeve, provide protect bushings on sleeve terminations.
6. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe 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.

G. Underground, Exterior-Wall and Floor Penetrations: Install steel pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Labels.
2. Bands and tubes.
3. Tapes and stencils.
4. Tags.
5. Signs.
6. Miscellaneous identification products.

1.2 SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

2. Arc Flash label for electrical equipment.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.3 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, 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.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 for color identification of hazards; 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs and tags; and the following:

1. Fire-protection and fire-alarm equipment, including raceways, must be finished, painted, or suitably marked safety red.

D. Signs, labels, and tags required for personnel safety must comply with the following standards:

1. Safety Colors: NEMA Z535.1.
2. Facility Safety Signs: NEMA Z535.2.
3. Safety Symbols: NEMA Z535.3.
4. Product Safety Signs and Labels: NEMA Z535.4.
5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.

E. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.

G. Thermal Movements: Allow for thermal movements 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 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 1000 V or Less:
1. Black letters on white field for Utility Power and Red letters on white field for Standby Power. Label at every 25’.
2. Legend: Indicate voltage and system or service type.

B. Fire Alarm Conduit and Rough-ins Box
1. Junction boxes painted red. Device address will be red letters on white field on junction box cover.
2. Colored Raceway and boxes (Red).
3. Legend: FA System, and Device address.

C. Armored and Metal-Clad Cable.
   1. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
   2. Black letters on white field for Utility Power and Red letters on White field for Standby Power.
   3. Legend: Indicate voltage and system or service type.

D. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

   1. Color must be factory applied or field applied for sizes larger than 8 AWG if authorities having jurisdiction permit.
   2. Where two or more neutrals are included in same conduit, at each panel, junction box, etc. the proper neutral wire shall be permanently and effectively identified with its branch circuit conductor(s) taped together and labeled with circuit number(s). The neutrals shall have a colored strip that corresponds to the phase color of the non-grounded conductor.
   3. For branch circuit conductors, wiring shall be identified with wrap-on wire vinyl cloth wire markers. Number shall indicate associated terminal in motor controller, panel board, etc.
   4. Phase sequence shall be N-A-B-C, proceeding in direction of left to right, front to back, top to bottom. All phase and neutral shall be identified.
   5. All feeder to power distribution equipment and to all motors shall be completely phase out as to sequence and rotation and so labeled.
   6. For new construction color coding shall be as shown in the table below:

ITEM	120/208	277/480
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
“A” Phase Neutral	White with Black Tracer	Gray with Brown Tracer
“B” Phase Neutral	White with Red Tracer	Gray with Orange Tracer
“C” Phase Neutral	White with Blue Tracer	Gray with Yellow Tracer
Shared Neutral	White with No Tracer	Gray with No Tracer
Switch Leg Return	Yellow	Yellow
Three and Four Way “Travelers	Orange	Orange
Mechanical or Equipment Ground Only	Green	Green

E. Warning Label Colors:

1. Identify system voltage with black letters on orange background.

F. Warning labels and signs must include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 3 FEET MINIMUM."

G. Equipment Identification Labels:

1. Black letters on white field for Utility Power and Red letters on White field for Standby Power..

2.3 LABELS

A. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3 mil (0.08 mm) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
1. Minimum Nominal Size:

a. 1-1/2 by 6 inch (37 by 150 mm) for raceway and conductors.
b. 3-1/2 by 5 inch (76 by 127 mm) for equipment.
c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inch (50 mm) long, with diameters sized to suit diameters and that stay in place by gripping action.

2.5 TAPES AND STENCILS

A. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil (0.08 mm) thick by 1 to 2 inch (25 to 50 mm) wide; compounded for outdoor use.

B. Tape and Stencil: 4-inch (100 mm) wide black stripes on 10-inch (250 mm) centers placed diagonally over orange background and are 12 inch (300 mm) wide. Stop stripes at legends.

C. Underground-Line Warning Tape:
1. Tape:

a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and communications utility lines.

b. Printing on tape must be permanent and may not be damaged by burial operations.
c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

2. Color and Printing:

a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".
c. Inscriptions for Orange Tapes: "CAUTION BURIED COMMUNICATION LINE BELOW".
d. Multilayer laminate, consisting of high-density polyethylene scrim coated with pigmented polyolefin; bright colored, continuous-printed on one side with inscription of utility, compounded for direct-burial service.
e. Width: 3 inch (75 mm).
f. Thickness: 12 mil (0.3 mm).
g. Weight: 36.1 lb./1000 sq. ft (17.6 kg/100 sq. m).
h. Tensile in accordance with ASTM D882: 400 lbf (1780 N) and 11,500 psi (79.2 MPa).

D. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height must be 1 inch (25 mm).

2.6 TAGS

A. Nonmetallic Preprinted Tags: Polyethylene tags, 0.023 inch (0.58 mm) thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.

B. Write-on Tags:
1. Polyester Tags: 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment.
2. Marker for Tags:

a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
b. Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 SIGNS

A. Laminated Acrylic or Melamine Plastic Signs:
1. Engraved legend.
2. Thickness:

a. For signs up to 20 sq. inch (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.

b. For signs larger than 20 sq. inch (129 sq. cm), 1/8 inch (3.2 mm) thick.
c. Engraved legend with black letters on white face.
d. Self-adhesive.
e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 1000 V: Identification must completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

H. System Identification for Raceways and Cables over 1000 V: Identification must completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

J. Emergency Operating Instruction Signs: Install instruction signs with white legend on red background with minimum 3/8 inch (10 mm) high letters for emergency instructions at equipment used for power transfer.

K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.

L. Accessible Fittings for Raceways: Identify cover of junction and pull box of the following systems with wiring system legend and system voltage. System legends must be as follows:

1. "EMERGENCY POWER AND CIRCUIT ."
2. "UTILITY POWER AND CIRCUIT."
3. "UPS POWER AND CIRCUIT."
4. System legends shall be as follows: Examples: “LTS RM #213, Panel P-L-B.1, Cir. #3” and “EM RM #213, Panel P-E-B.1, Cir #1,3,5”

M. Self-Adhesive Labels:

1. Install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide single line of text with 1/2 inch (13 mm) high letters on 1-1/2 inch (38 mm) high label; where two lines of text are required, use labels 2 inch (50 mm) high.

N. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.

O. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.

P. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of 6 inch (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

Q. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

R. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inch (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in common trench or concrete envelope exceeds 16 inch (400 mm) overall.
2. Install underground-line warning tape for direct-buried cables and cables in raceways.

S. Nonmetallic Preprinted Tags:

1. Place in location with high visibility and accessibility.
2. Secure using UV-stabilized or plenum-rated cable ties.

T. Write-on Tags:

1. Place in location with high visibility and accessibility.
2. Secure using UV-stabilized or plenum-rated cable ties.

U. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch (13 mm) high letters on minimum 1-1/2 inch (38 mm) high sign; where two lines of text are required, use signs minimum 2 inch (50 mm) high.

V. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch (13 mm) high letters on 1-1/2 inch (38 mm) high sign; where two lines of text are required, use labels 2 inch (50 mm) high.

W. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 1000 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft (15 m) maximum intervals in straight runs, and at 25 ft (7.6 m) maximum intervals in congested areas.

D. Accessible Fittings for Raceways and Cables within Buildings: Identify cover of junction and pull box of the following systems with self-adhesive labels containing wiring system legend and system voltage. System legends must be as follows:

1. "EMERGENCY POWER."
2. "UTILITY POWER."
3. "UPS POWER."
4. “ FIRE ALARM SYSTEM”

E. Conductors to Be Extended in Future: Attach write-on tags to conductors and list source.

F. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

G. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

H. Instructional Signs: Self-adhesive labels, including color code for grounded and ungrounded conductors.

I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.

1. Apply to exterior of door, cover, or other access.
2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

a. Power-transfer switches.
b. Controls with external control power connections.
c. .

J. Arc Flash Warning Labeling: Self-adhesive labels.

K. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.

L. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on red background with minimum 3/8 inch (10 mm) high letters for emergency instructions at equipment used for power transfer.

M. Equipment Identification Labels:

1. Indoor Equipment: Self-adhesive label.
2. Outdoor Equipment: Laminated acrylic or melamine sign.
3. Equipment to Be Labeled:

a. Panelboards:
1) Typewritten directory of circuits in the location provided by panelboard manufacturer.
a) 5”x8” minimum size protected by plastic sleeve or guard, Example: “Room 204 – outlets – North wall”.
2) Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
a) 1/2" high letters on outside of panel doors identifying panel, voltage, phase, wire, and source of feed. Label Interior of panel using marker, Example: “LNP1, 208Y/120V, 3-Phase, 4W, LDP-1, Circuit #4”.
3) Arc-flash label comply with NFPA 70 E and /or specified.
b. Enclosures and electrical cabinets.
c. Access doors and panels for concealed electrical items.
d. Switchgear, Switchboard, Substation and Power Panel (Dist. Board):
1) Provide an engraved plastic label with 3/4" high letters, security attached, identifying the unit, voltage, phase, and wire, Example: “MDP-1, 208Y/120V, 3-Phase, 4W”.
2) Branch switches to be labeled with engraved plastic label with 3/16” high letters securely attached to exterior of device. Example “Pump HWP1”.
3) Label to include the name of the load it is feeding and with the source of the power, Example: “SD-P fed from MD-P, located in room #B64.”
4) Arc-flash label comply with NFPA 70 E and /or specified.
e. Transformers:
1) Provide an engraved plastic label with 3/4" high letters, security attached, identifying the unit, voltage, phase, and wire, Example: “TN1”, Feed from “MDP-1, and Feed to LDP-1”.
f. Emergency system boxes and enclosures.
g. Enclosed switches, Enclosed circuit breakers, Enclosed controllers, Variable-speed controllers, Contactors, Battery-inverter units, UPS equipment:
1) Label each Label each with engraved plastic label with 3/16” high letters securely attached to the exterior of device as follows: Equipment served, Source of feed and circuit number, Example: “ACP-20 fed from SD-P-1 located in room #B64”.
2) Arc-flash label comply with NFPA 70 E and /or specified.
h. Power-transfer equipment(ATS):
1) Label “Normal” and “Emergency” poles with engraved plastic tag.

2) Label transfer switches with source designations as “Normal Switchboard SD-P” or “Emergency-Source.”
3) Arc-flash label comply with NFPA 70 E and /or specified.

i. Remote-controlled switches, dimmer modules, control devices, and wiring devices:
   a) Utility (Normal) power device covers shall be marked with a clear label with black lettering indicating panel and circuit, Example: “Panel PR2-B4, Cir. # 3”

j. Battery-inverter units or other Secondary Source ie: Generator Power.
   1) Provide an engraved plastic label with ¾” high letters, securely attached, identifying the unit, voltage, phase, and wire:
      a) Example: Feed from “P-L-1.1, Cir#1”.

END OF SECTION 260553

SECTION 260580 - EQUIPMENT WIRING 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 providing electrical connections to equipment furnished under other Specification Sections and/or the Owner such as folding partitions, overhead doors, dock levelers, door access and control equipment, food service equipment, projection screens, modular furniture, elevators, HVAC equipment, plumbing equipment, etc.

1.3 GENERAL REQUIREMENTS

A. Provide all required labor, material, equipment, and Contractor’s services necessary to complete the electrical portion of the equipment installation.

B. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, manufacturer's instructions, etc., for equipment furnished under other sections or by the Owner. Coordinate with equipment suppliers to determine connection locations and all other electrical requirements.

C. All electrical requirements for equipment furnished under other Specification Sections and/or the Owner to be connected may not be shown on the electrical drawings. Review all project specifications and drawings for all such equipment requirements prior to bid.

D. Verify all equipment requirements with the Contractor and/or the Owner who is providing the equipment including approved submittals prior to rough-in. Make adjustments in any electrical equipment, devices, etc. shown on the drawings as required to properly connect equipment.

E. The Contractor supplying the equipment is responsible for the correct locations of all equipment provided by the Contractor. The Owner is responsible for the correct locations of all equipment provided by the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide electrical equipment, disconnects, devices, wiring, etc. as specified under other Division 26 specification sections unless otherwise noted.

2.2 CORDS, PLUGS AND RECEPTACLES

A. Cord Construction: Oil-resistant thermoset insulated Type SO multi-conductor flexible cord with identified equipment grounding conductor, suitable for extra hard usage.

B. Cord Size: Suitable for connected load of equipment and rating of branch circuit overcurrent protection.

C. Attachment Plug Configuration: Match receptacle configuration at outlet furnished for equipment.

D. Verify overcurrent protection requirements and verify the NEMA rating of plugs and receptacles.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that equipment is ready for electrical connection, wiring, and energizing.

3.2 PREPARATION

A. Review Equipment submittals prior to installation and Electric rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.

3.3 INSTALLATION

A. Provide all raceway, pathways, flexible conduit for movable equipment, wiring, circuit breakers, fuses, safety switches, motor starters, motor starter interlocks, push-button stations, remote stations, indicating lights, control devices such as limit switches, etc. as required to properly connect the equipment for complete and operational system.

B. Make electrical connections of all equipment, devices, circuits, wiring, etc. Make these connections in control panels or in wiring compartment of pre-wired equipment in accordance with manufacturer's instructions.

C. For electrical equipment and devices furnished by other contractors that is located in or on casework and built-in furniture: provide conduit, fittings, boxes and wiring ahead of the electrical equipment and devices to make the electrical connections.

D. Provide a minimum 1” conduit skeletal raceway system to house all card access and door hardware system low-voltage cabling. Refer to Section 26 05 33 for additional skeletal raceway requirements.

E. Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment.

F. Provide prefinished cord set and receptacle where connection with attachment plug is indicated or specified.

G. Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connections boxes.

H. The Contractors responsible for other Specification Sections and the Owner are to provide manufacturer's wiring diagrams to this Contractor for equipment furnished by them.

END OF SECTION 260580

SECTION 262813 - FUSES

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. Cartridge fuses rated 600 V ac and less for use in the following:

    a. Control circuits.
    b. Motor-control centers.
    c. Panelboards.
    d. Switchboards.
    e. Enclosed controllers.
    f. Enclosed switches.

2. Plug-fuse adapters for use in Edison-base, plug-fuse sockets.

3. Spare-fuse cabinets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

    a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
    b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.

4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in PDF format.
5. Coordination charts and tables and related data.
6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in PDF format.
4. Coordination charts and tables and related data.

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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 FIELD 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Bussmann, an Eaton business.
2. Littelfuse, Inc.
3. Mersen USA.

B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
2. Type RK-5: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, time delay.
4. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
5. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.

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. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

2.3 PLUG FUSES

A. Characteristics: UL 248-11, rejection base, nonrenewable plug fuses, dual-element, time-delay, 125-V ac.

2.4 PLUG FUSE ADAPTERS

A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuseholders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

2.5 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch-high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.

C. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Owner.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813