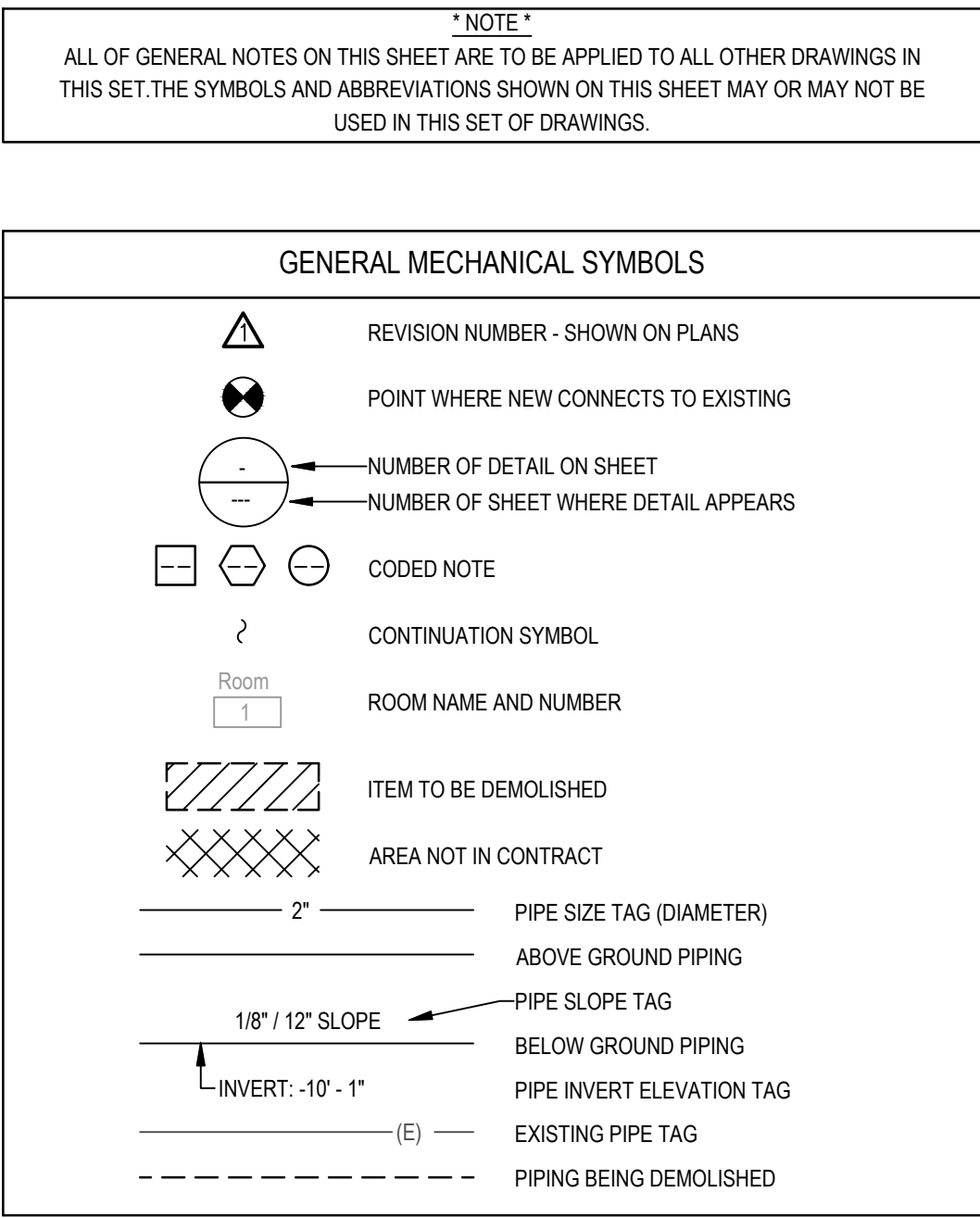
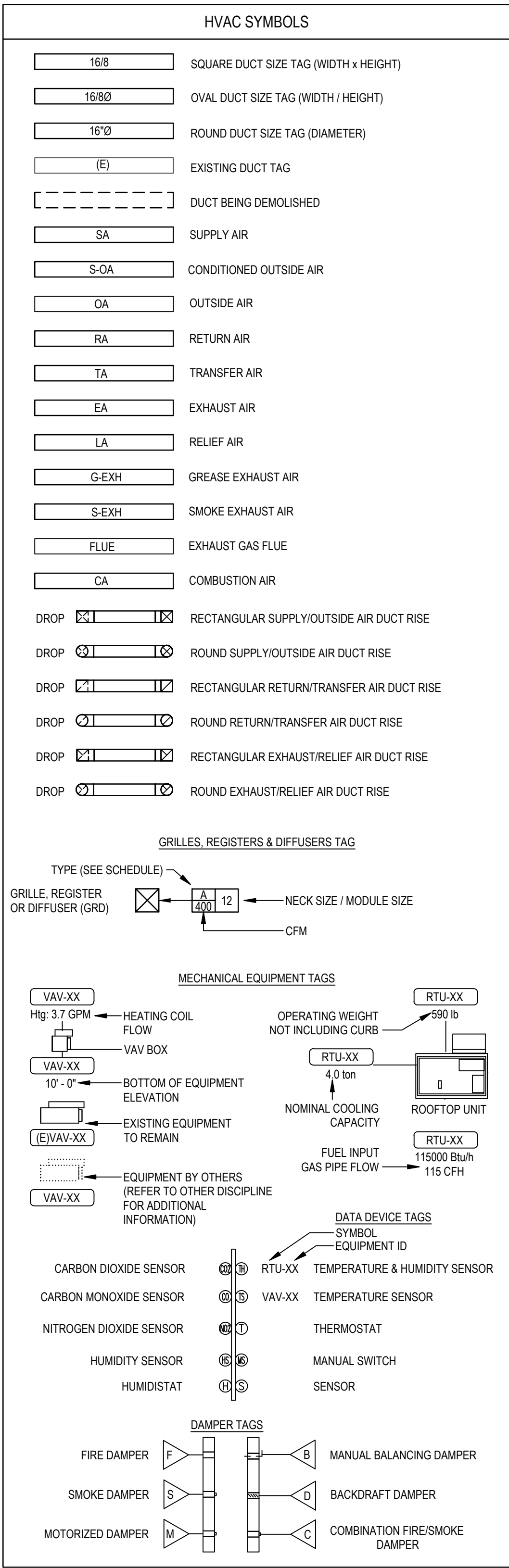
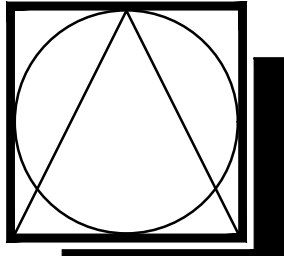




EQUIPMENT ABBREVIATIONS			
AC	AIR CONDITIONING UNIT	ET	EXPANSION TANK
ABD	AUTOMATIC BALANCE DAMPER	EW	ELECTRIC WATER HEATER
ACC	AIR COOLED CONDENSER	FCU	FAN COIL UNIT
ACCU	AIR COOLING CONDENSING UNIT	FP	FIRE PUMP
AHU	AIR HANDLING UNIT	GI	GREASE INTERCEPTOR
AS	AIR SEPARATOR	GRV	GRAVITY ROOF VENTILATOR
B	BOILER	HWP	HEATING WATER PUMP
CH	CHILLER	HX	HEAT EXCHANGER
CT	COOLING TOWER	HRU	HEAT RECOVERY UNIT
CUH	CABINET UNIT HEATER	HRV	POWER ROOF VENTILATOR
CWP	CONDENSER WATER PUMP	RE	RETURN/EXHAUST FAN
CHWP	CHILLED WATER PUMP	RTU	ROOFTOP UNIT
DBP	DOMESTIC WATER BOOSTER PUMP	SEP	SEWAGE EJECTOR PUMP
DC	DUCT MOUNTED COIL	SF	SUPPLY FAN
DCP	DOMESTIC WATER CIRCULATING PUMP	SP	SUMP PUMP
EF	EXHAUST FAN	UH	UNIT HEATER
EDC	ELECTRIC DUCT COIL	WH	WATER HEATER

ABBREVIATIONS			
Ø	ROUND	LVR	LOUVER
ABD	AUTOMATIC BALANCE DAMPER	LWT	LEAVING WATER TEMPERATURE
ABV	ABOVE	M/A	MIXED AIR
AC	AIR CONDITIONING	MAX	MAXIMUM
AD	AREA DRAIN	MBH	ONE THOUSAND BTU PER HOUR
ADD	ADDENDUM	MCF	ONE THOUSAND CUBIC FEET
AFF	ABOVE FINISHED FLOOR	MD	MOTORIZED DAMPER
AFUE	ANNUAL FUEL UTILIZATION EFFICIENCY	MECH	MECHANICAL
ALT	ALTERNATE	MFR	MANUFACTURER
AP	ACCESS PANEL	MIN	MINIMUM
ARCH	ARCHITECT/ARCHITECTURAL	MISC	MISCELLANEOUS
BFF	BELOW FINISHED FLOOR	MTR	MOTOR
BLW	BELOW	MUA	MAKE-UP/AIR
BTU	BRITISH THERMAL UNITS	NC	NOISE CRITERIA
BTUH	BRITISH THERMAL UNITS PER HOUR	NC	NORMALLY CLOSED
CAP	CAPACITY	NC	NOT IN CONTRACT
CB	CATCH BASIN	NO	NUMBER
CFM	CUBIC FEET PER MINUTE	NO	NORMALLY OPEN
CLG	CEILING	NTS	NOT TO SCALE
CO	CLEAN OUT	O	OXYGEN
CW	COLD WATER	O/A	OUTSIDE AIR
D	DEGREE	ORD	OVERFLOW ROOF DRAIN
DB	DRY BULB	PD	PRESSURE DROP
DIA	DIAMETER	P/V	POST INDICATOR VALVE
DN	DOWN	PLBG	PLUMBING
DW	DISTILLED WATER	PRESS	PRESSURE
EA	EACH	PRV	PRESSURE REDUCING VALVE
EAT	ENTERING AIR TEMPERATURE	PSI	POUNDS PER SQUARE INCH
ELEC	ELECTRICAL	PSIG	POUNDS PER SQUARE INCH GAUGE
EQUIP	EQUIPMENT	PWR	POWER
EW	ELECTRIC WATER COOLER	R	DUCT RISER
EWT	ENTERING WATER TEMPERATURE	R/A	RETURN AIR
E/A	EXHAUST AIR	RCP	RADIANT CEILING PANEL
EXIST	EXISTING	RD	ROOF DRAIN
F	DEGREES FAHRENHEIT	REC	RECESSED
FCO	FLOOR CLEAN OUT	RED	REDUCER
FD	FLOOR DRAIN	RH	RELATIVE HUMIDITY
FD	FIRE DAMPER	RLA	RELIEF AIR
FDV	FIRE DEPARTMENT VALVE	RM	ROOM
FL	FLOOR	RPM	REVOLUTIONS PER MINUTE
FO	FUEL OIL	RW	RAIN WATER
FOV	FUEL OIL VENT	SF	SQUARE FOOT
FOR	FUEL OIL RETURN	S/A	SUPPLY AIR
FOS	FUEL OIL SUPPLY	SAN	SANITARY
FS	FLOOR SINK	SAF	SQUARE FOOT
FT	FOOT/FEET	SD	SMOKE DAMPER
FTR	FIN TUBE RADIATION	SM	SURFACE MOUNT
GAL	GALLON	SP	STANDPIPE
GC	GENERAL CONTRACTOR	SP	STATIC PRESSURE
GPM	GALLONS PER MINUTE	STM	STEAM
GW	GREASE WASTE	T	THERMOSTAT
HB	HOSE BIB	TD	TEMPERATURE DROP
HP	HORSE POWER	TDR	TRENCH DRAIN
HTG	HEATING	TEMP	TEMPERATURE
HTR	HEATER	TYP	TYPICAL
HW	HOT WATER	UG	UNDERGROUND
HYD	HYDRANT	VAC	VACUUM
ID	INDIRECT	V	VENT
IN	INCH	VAV	VARIABLE AIR VOLUME
INV	INVERT	VENT	VENTILATION
LB	POUND	VTR	VENT THROUGH ROOF
LBHR	POUNDS PER HOUR	W	WASTE
LAT	LEAVING AIR TEMPERATURE	WB	WET BULB
LP	LOW PRESSURE	WCO	WALL CLEAN OUT
LPG	LIQUEFIED PETROLEUM GAS	WH	WALL HYDRANT

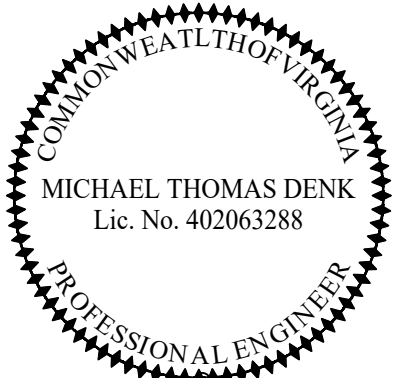
- HVAC GENERAL NOTES**
- GENERAL REQUIREMENTS**
- ALL HVAC EQUIPMENT, MATERIALS, AND INSTALLATIONS SHALL COMPLY WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL CODES, ORDINANCES, AND AUTHORITIES HAVING JURISDICTION, INCLUDING THE VIRGINIA CONSTRUCTION CODE, VIRGINIA MECHANICAL CODE, APPLICABLE ENERGY CODE, AND ALL OTHER APPLICABLE REQUIREMENTS.
 - INSTALL ALL HVAC EQUIPMENT, MATERIALS, AND APPURTENANCES IN ACCORDANCE WITH THE MANUFACTURER'S WRITTEN RECOMMENDATIONS AND INSTALLATION INSTRUCTIONS.
 - VERIFY EXISTING CONDITIONS AND DIMENSIONS IN THE FIELD PRIOR TO FABRICATION, ORDERING, OR INSTALLATION OF DUCTWORK, PIPING, EQUIPMENT, AND APPURTENANCES. REPORT DISCREPANCIES TO THE ENGINEER PRIOR TO PROCEEDING WITH THE WORK.
 - EXISTING CONDITIONS INDICATED ON THE DRAWINGS ARE BASED ON AVAILABLE INFORMATION AND MAY NOT REPRESENT ACTUAL FIELD CONDITIONS. VERIFY CONDITIONS PRIOR TO INSTALLATION.
 - COORDINATE ALL WORK WITH THE OWNER'S OPERATIONS AND CONSTRUCTION PHASING REQUIREMENTS. PERFORM WORK IN OCCUPIED OR OPERATIONAL AREAS ONLY AT TIMES APPROVED BY THE OWNER.
 - PROVIDE ALL HANGERS, SUPPORTS, OFFSETS, TRANSITIONS, FITTINGS, ACCESSORIES, VIBRATION ISOLATION, AND APPURTENANCES REQUIRED FOR A COMPLETE AND OPERABLE SYSTEM WHETHER OR NOT SPECIFICALLY INDICATED.
 - COORDINATE ELECTRICAL CHARACTERISTICS AND REQUIREMENTS OF ALL HVAC EQUIPMENT WITH THE ELECTRICAL DRAWINGS PRIOR TO ORDERING EQUIPMENT OR SUBMITTING SHOP DRAWINGS. FURNISH EQUIPMENT WIRED FOR THE VOLTAGES AND ELECTRICAL CHARACTERISTICS INDICATED.
- COORDINATION REQUIREMENTS**
- COORDINATE THE INSTALLATION OF ALL HVAC WORK WITH THE ARCHITECTURAL, STRUCTURAL, PLUMBING, ELECTRICAL, FIRE PROTECTION, AND OTHER TRADES. DUCTWORK, PIPING, AND EQUIPMENT LOCATIONS ARE DIAGRAMMATIC UNLESS DIMENSIONED. PROVIDE REQUIRED OFFSETS AND COORDINATION FOR A COMPLETE INSTALLATION.
 - DO NOT CUT, NOTCH, DRILL, OR OTHERWISE ALTER STRUCTURAL MEMBERS WITHOUT WRITTEN APPROVAL FROM THE ARCHITECT/ENGINEER.
 - LOCATIONS OF AIR DEVICES, THERMOSTATS, EQUIPMENT, DUCTWORK, PIPING, LOUVERS, AND OTHER HVAC COMPONENTS SHOWN ON THE DRAWINGS ARE APPROXIMATE UNLESS DIMENSIONED. COORDINATE EXACT LOCATIONS WITH ARCHITECTURAL FEATURES, LIGHTING, CEILING SYSTEMS, STRUCTURE, EQUIPMENT, AND OTHER WORK PRIOR TO INSTALLATION.
 - COORDINATE CEILING SPACE REQUIREMENTS AND ACCESS CLEARANCES FOR HVAC EQUIPMENT, VALVES, DAMPERS, FILTERS, CLEANOUTS, ACCESS DOORS, CONTROLS, AND OTHER COMPONENTS REQUIRING SERVICE OR MAINTENANCE.
 - COORDINATE ROOF MOUNTED EQUIPMENT, CURBS, DUCTWORK, PIPING, AND ROOF PENETRATIONS WITH STRUCTURAL, ARCHITECTURAL, AND ROOFING REQUIREMENTS PRIOR TO INSTALLATION.
- INSTALLATION REQUIREMENTS**
- SEAL ALL PENETRATIONS THROUGH WALLS, FLOORS, ROOFS, AND RATED ASSEMBLIES CAUSED BY HVAC WORK. PROVIDE FIRESTOPPING SYSTEMS AT RATED CONSTRUCTION IN ACCORDANCE WITH CODE AND LISTED ASSEMBLY REQUIREMENTS.
 - INSTALL DUCTWORK, REFRIGERANT PIPING, HYDRONIC PIPING, CONDENSATE DRAIN PIPING, AND OTHER HVAC SYSTEMS WITH ADEQUATE CLEARANCE FROM OTHER BUILDING SYSTEMS AND WITH PROPER ALLOWANCES FOR EXPANSION, CONTRACTION, SLOPE, SUPPORT, AND SERVICE ACCESS.
 - INSTALL DUCTWORK TRUE TO LINE AND GRADE WITH SMOOTH TRANSITIONS AND WITHOUT EXCESSIVE SAGGING, DEFLECTION, OR OFFSET.
 - SEAL ALL DUCTWORK JOINTS, SEAMS, AND CONNECTIONS IN ACCORDANCE WITH SMACNA STANDARDS AND APPLICABLE ENERGY CODE REQUIREMENTS.
 - PROVIDE BALANCING DAMPERS, VOLUME DAMPERS, TEST PORTS, ACCESS DOORS, AND OTHER ACCESSORIES REQUIRED FOR TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.
 - INSTALL CONDENSATE DRAIN PIPING WITH POSITIVE SLOPE TO DRAIN. PROVIDE TRAPS, CLEANOUTS, AUXILIARY DRAIN PANS, OVERFLOW PROTECTION, AND CONDENSATE PIPING ACCESSORIES AS REQUIRED BY CODE, THE DRAWINGS, AND MANUFACTURER REQUIREMENTS.
 - PROVIDE INSULATION WHERE REQUIRED BY ENERGY CODE, CONDENSATION CONTROL, FREEZE PROTECTION, ACOUSTICAL CONTROL, AND PROJECT SPECIFICATIONS.
 - PROTECT DUCTWORK, EQUIPMENT, FILTERS, AND HVAC COMPONENTS FROM DUST, MOISTURE, AND CONSTRUCTION DEBRIS DURING CONSTRUCTION. CAP OR COVER OPEN DUCTWORK DURING CONSTRUCTION.
 - INSTALL FIRE DAMPERS, SMOKE DAMPERS, COMBINATION FIRE/SMOKE DAMPERS, AND RELATED ACCESSORIES IN ACCORDANCE WITH CODE, LISTING REQUIREMENTS, AND MANUFACTURER INSTRUCTIONS.
- TESTING AND CLOSEOUT**
- TEST ALL HVAC SYSTEMS AS REQUIRED BY CODE AND SPECIFICATIONS. REPAIR LEAKS, DEFECTS, AND DEFICIENCIES AND RETEST UNTIL ACCEPTABLE RESULTS ARE OBTAINED.
 - PROVIDE TESTING, ADJUSTING, AND BALANCING (TAB) OF ALL HVAC SYSTEMS. SUBMIT FINAL TAB REPORTS AS SPECIFIED.
 - IDENTIFY HVAC SYSTEMS, DUCTWORK, PIPING, VALVES, CONTROLS, DAMPERS, AND EQUIPMENT WITH LABELS, MARKERS, AND FLOW DIRECTION ARROWS IN ACCORDANCE WITH CODE AND PROJECT SPECIFICATIONS.
 - CLEAN SYSTEMS AND PLACE EQUIPMENT IN OPERATION PRIOR TO SUBSTANTIAL COMPLETION. REPLACE TEMPORARY OR CONSTRUCTION FILTERS WITH NEW FILTERS PRIOR TO OCCUPANCY.
 - PROVIDE ALL REQUIRED STARTUP, COMMISSIONING SUPPORT, TESTING, CLOSEOUT, AND RECORD DOCUMENTATION AS SPECIFIED.



DSC
ARCHITECTS
401 FRONT STREET
BEREA, OHIO 44017
PHONE: 440.835.3957
mail@dscarchitects.com

DATE:
PERMIT SUBMISSION:
06.19.26

BENNETT'S CREEK
HEALTH & REHABILITATION CENTER
1931/1915 BRIDGE ROAD (HIGHWAY 17)
SUFFOLK, VIRGINIA



DRAWING NAME
MECHANICAL
SYMBOLS, NOTES &
ABBREVIATIONS

DAI PROJECT NO.
26032

M0.1

SECTION 23 0500 - COMMON WORK RESULTS FOR HVAC

1.01 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.

2. Dielectric fittings.

3. Mechanical sleeve seals.

4. Sleeves.

5. Escutcheons.

6. GROUT.

7. HVAC demolition.

8. Equipment installation requirements common to equipment sections.

9. Concrete bases.

10. Supports and anchorages.

1.02 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms; furnished spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

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

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.03 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code-Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately sized. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.01 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.02 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

C. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCUF Series or BAq1, unless otherwise indicated.

F. Welding Filler Metals: Comply with ASTM D10.12.

G. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.

2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.03 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

F. Dielectric Nipples: Electroplated steel pipe with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.04 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Stainless steel. Include two for each sealing element.

D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.05 SLEEVES

A. Galvanized-Steel Sheet: 0.0238-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

E. Underdeck Clamp: Clamping ring with set screws.

2.06 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

D. Finish: Polished chrome-plated.

E. Split-Casting, Cast-Brass Type: With concealed finish and set screw.

1. Finish: Polished chrome-plated.

2.07 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

2. Design Mix: 5000-psi, 28-day compressive strength.

3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping systems according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

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

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clearance between sleeve and pipe for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.

2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

P. Verify final equipment locations for roughing-in.

Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.03 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

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

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.

2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2872. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.

4. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.04 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

SECTION 23 0513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.02 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.

2. Torque, speed, and horsepower requirements of the load.

3. Ratings and characteristics of supply circuit and required control sequence.

4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

2.02 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.03 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Rotor: Random-wound, squirrel cage.

E. Bearings: Regreassable, shielded, antifriction ball bearings suitable for radial and thrust loading.

F. Temperature Rise: Class B.

G. Insulation: Class F.

H. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.

2. Motors Smaller than 15HP: Manufacturer's standard starting characteristic.

I. Enclosure Material: Cast iron for motor frame sizes 324Tand larger; rolled steel for motor frame sizes smaller than 324T.

2.04 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.

2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.

3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

2.05 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.

2. Split phase.

3. Capacitor start, inductor run.

4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (NOT APPLICABLE)

SECTION 23 0548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Isolation pads.

2. Isolation mounts.

3. Restrained elastomeric isolation mounts.

4. Restrained spring isolators.

5. Housed spring mounts.

6. Elastomeric hangers.

7. Spring hangers.

8. Spring hangers with vertical-limit stops.

9. Pipe riser resilient supports.

10. Resilient pipe guides.

11. Restraining braces and cables.

1.02 SUBMITTALS

A. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

B. Field quality-control test reports.

1.03 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic independent ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATORS

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

1. Kinetels Noise Control.

2. Mason Industries.

3. Vibration Eliminator Co., Inc.

B. Pads Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Restraint Material: Oil- and water-resistant rubber.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Restrained Mounts: All-directional mountings with seismic restraint.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

E. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch-thick, steel, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.

2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.

5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

F. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.

1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.

2. Base: Factory drilled for bolting to structure.

3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down before contacting a resilient collar.

G. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

H. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

I. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.

7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.

8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

J. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch-thick neoprene. Install steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psi and for equal resistance in all directions.

K. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch-thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

PART 3 - EXECUTION

3.01 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application.

B. Hanger Rod Spacers: Install hanger rod spacers where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.02 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

C. Piping Restraints:

1. Comply with requirements in MSS SP-127.

2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.

3. Brace a change of direction longer than 12 feet.

D. Install cables so they do not bend across edges of adjacent equipment or building structure.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting in concrete base.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

G. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Install wedge anchors before concrete anchorage device. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Set anchors to manufacturer's recommended torque, using a torque wrench.

5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.03 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.

2. Schedule independent Owner, third-party Architect, or other qualified structural engineer to retrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.

3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.

4. Test to 90 percent of rated proof load of device.

5. Measure isolator restraint clearance.

6. Measure isolator deflection.

7. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.04 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

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

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

SECTION 23 0553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Equipment labels.

2. Warning signs and labels.

3. Pipe labels.

4. Duct labels.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.

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

3. Minimum Label Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

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

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

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

2. Label Color: White.

3. Background Color: Black.

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

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

6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

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

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

C. Label Content: Include equipment's Drawing designation or unique equipment number, equipment type, general service type, and general service area.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Label Color: Black.

C. Background Color: Red.

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

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

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

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

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

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.

2. Lettering Size: At least 1-1/2 inches high.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Label Color: White.

C. Background Color: Black.

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

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

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

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

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

I. Label Content: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.

2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.

3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.

6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:

3.4 DUCT LABEL INSTALLATION

A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. White: General service.

2. Blue: Exhaust.

3. Red: Fire alarm.

4. Yellow: Gas.

5. Green: Refrigerant.

6. Purple: Sewer.

7. Orange: Steam.

8. Brown: Other.

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

END OF SECTION

SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
- Balancing Air Systems:
 - Constant-volume air systems.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.3 SUBMITTALS

- A. Certified TAB reports.

1.4 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC NEBB or TABB.
- B. Certify TAB field data reports and perform the following:
- Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by Construction Manager.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

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 the approved submittals for HVAC systems and equipment.
- C. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- D. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- E. Examine equipment performance data including fan and pump curves.
- Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - Calculate system-effect factors to reduce performance failures of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine operating safety interlocks and controls on HVAC equipment.
- J. 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 strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
- Permanent electrical-power wiring is complete.
 - Temperature-control systems are operational.
 - Equipment and duct access doors are securely closed.
 - Balance, smoke, and fire dampers are open.
 - Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
- After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with point or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures.
- B. Crosscheck the summation of required outlet volumes with required fan volumes.
- C. Prepare schematic diagrams of systems' "as-built" duct layouts.
- D. For variable-air-volume systems, develop a plan to simulate diversity.
- E. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- F. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing ducts.
- G. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- H. Verify that motor starters are equipped with properly sized thermal protection.
- I. Check dampers for proper position to achieve desired airflow path.
- J. Check for airflow blockages.
- K. Check condensate drains for proper connections and functioning.
- L. Check for proper sealing of air-handling-unit components.
- M. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total airflow within the maximum allowable fan speed listed by fan manufacturer.
- Measure total airflow.
 - Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 - Measure fan static pressures as follows to determine actual fan pressure:
 - Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - Measure static pressure directly at the fan outlet or through the flexible connection.
 - Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan. - Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - Report the cleanliness status of filters and the time static pressures are measured.
4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
- Measure airflow of submain and branch ducts.
 - Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 - Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 - Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
- Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
 - Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
 - Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 - Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved total flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
- Open all manual valves for maximum flow.
 - Check liquid level in expansion tank.
 - Check makeup water-station pressure gauge for adequate pressure for highest vent.
 - Check flow-control valves for specified sequence of operation, and set at indicated flow.
 - Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 - Set system controls so automatic valves are wide open to heat exchangers.
 - Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 - Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.7 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
- Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for friction loss in pipe heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - If impeller sizes must be adjusted to achieve pump performance, obtain approval from Architect and comply with requirements in Division 23 Section "Hydronic Systems."
 - Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - Monitor motor performance during procedures and do not operate motors in overload conditions.
 - Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 - Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated presettings.

- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
- System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
- Determine the balancing station with the highest percentage over indicated flow.
 - Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 - Motor horsepower and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

3.8 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
- Manufacturer's name, model number, and serial number.
 - Motor horsepower rating.
 - Motor rpm.
 - Efficiency rating.
 - Nameplate and measured voltage, each phase.
 - Nameplate and measured amperage, each phase.
 - Air Outlets and Inlets: Plus or minus 10 percent
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.
- Measure flow through bypass.

3.9 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
- Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent >
 - Air Outlets and Inlets: Plus or minus 10 percent

3.10 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.11 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
- Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
- Fan curves.
 - Manufacturers' test data.
 - Field test reports prepared by system and equipment installers.
 - 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:
- Title page.
 - Name and address of the TAB contractor.
 - Project name.
 - Project location.
 - Architect's name and address.
 - Engineer's name and address.
 - Contractor's name and address.
 - Report date.
 - Signature of TAB supervisor who certifies the report.
 - Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - Summary of contents including the following:
 - Indicated versus final performance.
 - Notable characteristics of systems.
 - Nomenclature sheets for each item of equipment.
 - Data for terminal units, including manufacturer's name, type, size, and fittings.
 - Notes to explain why certain final data in the body of the reports vary from indicated values.
 - Test conditions for fans and pump performance forms including the following:
 - Settings for outdoor-, return-, and exhaust-air dampers.
 - Conditions of filters.
 - Cooling coil, wet- and dry-bulb conditions.
 - Face and bypass damper settings at coils.
 - Fan drive settings including settings and percentage of maximum pitch diameter.
 - Inlet vane settings for variable-air-volume systems.
 - Settings for supply-air, static-pressure controller.
 - Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
- Quantities of outdoor, supply, return, and exhaust airflows.
 - Water and steam flow rates.
 - Duct, outlet, and inlet sizes.
 - Pipe and valve sizes and locations.
 - Terminal units.
 - Balancing stations.
 - Position of balancing devices.

3.12 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 0700 - HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

- Insulation Materials:
 - Cellular glass.
 - Flexible elastomeric.
 - Mineral fiber.
 - Adhesives.
 - Mastics.
 - Sealants.
 - Factory-applied jackets.
 - Field-applied fabric-reinforcing mesh.
 - Field-applied jackets.
 - Tapes.
 - Securements.
 - Corner angles.
- B. Related Sections:
- Division 22 Section "Plumbing Insulation."
 - Division 23 Section "Metal Ducts" for duct liners.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
- Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - Detail attachment and covering of heat tracing inside insulation.
 - Detail insulation application at pipe expansion joints for each type of insulation.
 - Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - Detail removable insulation at piping specialties, equipment connections, and access panels.
 - Detail application of field-applied jackets.
 - Detail application of field-applied jackets of control devices.
 - Detail field application for each equipment type.
- C. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Fire-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
- Insulation Installation: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1230, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- I. Mineral-Fiber, Preformed Pipe Insulation:
- Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
 - CertainTeed Corp.: Commercial Board.
 - Fibrex Insulations Inc.: FBX.
 - Knaf Insulation; Insulation Board.
 - Owens Corning; Alu-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, including the following:
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- Products: Subject to compliance with requirements, provide one of the following:
 - Aeroflex USA Inc.: Aeroseal.
 - Armaceil LLC; 520 Adhesive.
 - Foster Products Corporation; H. B. Fuller Company; 85-75.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- Products: Subject to compliance with requirements, provide the following:
 - Foster Products Corporation; H. B. Fuller Company; 85-20.
- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- Products: Subject to compliance with requirements, provide the following:
 - Foster Products Corporation; H. B. Fuller Company; 85-20.

2.3 SEALANTS

- A. Joint Sealants:
- Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - Childers Products, Division of ITW: CP-76.
 - Foster Products Corporation; H. B. Fuller Company; 30-45.
 - Marathon Industries, Inc.; 405.
 - Materials shall be compatible with insulation materials, jackets, and substrates.
 - Permanently flexible, elastomeric sealant.
 - Service Temperature Range: Minus 100 to plus 300 deg F
 - Color: White or gray.
- B. FSK and Metal Jacket Flashing Sealants:
- Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - Foster Products Corporation; H. B. Fuller Company; 95-44.
 - Materials shall be compatible with insulation materials, jackets, and substrates.
 - Fire- and water-resistant, flexible, elastomeric sealant.
 - Service Temperature Range: Minus 40 to plus 250 deg F.
 - Color: Aluminum.

2.4 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
- ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covering by a removable protective strip; complying with ASTM C 1136, Type I.
 - FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 - PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 - Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.5 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for field or shop cold cutting and forming. Thickness is indicated in field-applied jacket schedules.
- Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - Johns Manville; Zeston.
 - P.I.C. Plastics, Inc.; FG Series.
 - Proto PVC Corporation; LoSmoke.
 - Speedline Corporation; SmokeSafe.
 - Adhesive: As recommended by jacket material manufacturer.
 - Color: White.
 - Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
 - Factory-fabricated tank heads and tank side panels.
- A. available.

2.6 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
- Products: Subject to compliance with requirements, provide one of the following:
 - Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - Compac Corp.; 104 and 105.
 - Ideal Tape Co., Inc., an American Blitrite Company; 428 AWF ASJ.
 - Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - Width: 3 inches.
 - Thickness: 11.5 mils.
 - Adhesion: 90 ounces force/inch in width.
 - Elongation: 2 percent.
 - Tensile Strength: 40 lb/inch in width.
- ASJ Tape Disk and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: FSK Tape Disk and Squares: Precut disks or squares of ASJ tape.
- Products: Subject to compliance with requirements, provide one of the following:
 - Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - Compac Corp.; 110 and 111.
 - Ideal Tape Co., Inc., an American Blitrite Company; 491 AWF FSK.

- Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
- Width: 3 inches.
- Thickness: 6.5 mils.
- Adhesion: 90 ounces force/inch in width.
- Elongation: 2 percent.
- Tensile Strength: 40 lb/inch in width.
- FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.7 SECUREMENTS

- A. Insulation Pins and Hangers:
- Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 - Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - Adhesive-backed base with a peel-off protective cover.
 - Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, [galvanized-steel [aluminum] [stainless-steel] sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

2.8 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Field Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.
- D. Insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.
- E. Insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.
- 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.
- J. Install insulation continuously through hangers and around anchor attachments.
- K. 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.
- L. Install insulation materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- M. Cover inserts with jacket material matching jacket material. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- N. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- O. Install insulation with factory-applied jackets as follows:

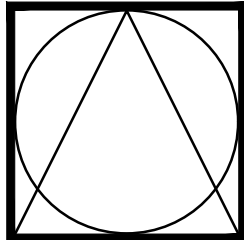
- Draw jacket tight and smooth around object to be insulated.
- Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
- Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [2 inches] [4 inches] o.c.
 - For below ambient services, apply vapor-barrier mastic over staples.
- Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
- Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- 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 adjacent to butt joints.
- For above ambient services, do not install insulation to the following:
 - Vibration-control devices.
 - Testing agency labels and stamps.
 - Nameplates and data plates.
 - Menholes.
 - Handholes.
 - Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
- Seal penetrations with flashing sealant.
 - 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.
 - Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
- Seal penetrations with flashing sealant.
 - For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
- Comply with requirements in Division 07 Section "Penetration Firestopping"testopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
- Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - Pipe: Install insulation continuously through floor penetrations.
 - Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
- Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - Insulate tee fittings with same preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers a strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 - Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 - Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforced mesh. Trowel the mastic to a smooth and well-shaped contour.
 - For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 - Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gauges, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
- Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulator jacket as adjoining pipe insulation.
 - When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 - Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.

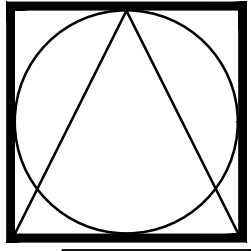


DSC
ARCHITECTS
401 FRONT STREET
BEREA, OHIO 44017
PHONE: 440.835.3957
mail@dscarchitects.com

DATE:
PERMIT SUBMISSION:
06.19.26

BENNETT'S CREEK
HEALTH & REHABILITATION CENTER
1931/1915 BRIDGE ROAD (HIGHWAY 17)
SUFFOLK, VIRGINIA



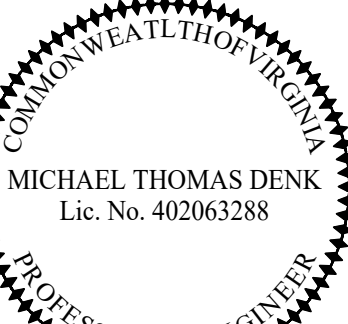


DSC
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401 FRONT STREET
BEREA, OHIO 44017
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DRAWING NAME
MECHANICAL
SPECIFICATIONS

DAI PROJECT NO.
26032

M0.4

SECTION 23 2300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes refrigerant piping used for air-conditioning applications.

1.02 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-454B:

1. Suction Lines for Air-Conditioning Applications: 400 psig.
2. Suction Lines for Heat-Pump Applications: 400 psig.
3. Hot-Gas and Liquid Lines: 400 psig.

1.03 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe penetrations, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

C. Field quality-control test reports.

D. Operation and maintenance data.

1.04 QUALITY ASSURANCE

A. Comply with latest published edition of ASHRAE 15, "Safety Code for Refrigeration Systems."

B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.05 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.01 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Brazing Filler Metals: AWS A5.8.

F. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
4. End Connections: Socket, union, threaded, or flanged.
5. Maximum Operating Temperature: 250 deg F.

2.02 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

B. Packed-Angle Valves:

1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

C. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast stainless steel with stainless-steel spring.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Operating Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

D. Service Valves:

1. Body: Forged brass with brass cap featuring key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

E. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color-coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS

A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

B. Suction Lines NPS 1-1/2 and Smaller for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

C. Safety-Relief-Valve Discharge Piping: Copper, Type ACR drawn-temper tubing and wrought-copper fittings with soldered joints.

3.02 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless valves in suction and discharge lines of compressor.

B. Install service valves for gas taps at strainers if they are not an integral part of strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.

E. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outdoors.

F. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

G. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Compressor.

H. Install filter dryers in liquid line between compressor and thermostatic expansion valve.

3.03 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Piping located in concealed locations where tubing is installed in studs, joists, rafters or similar member spaces, and located less than 1 1/2 inches from the nearest edge of the member, shall be continuously protected by shield plates.

1. Where shield plates are required, the minimum thickness of 0.0675 inch (No. 16 gage) shall cover the area of the tube plus the area extending not less than 2 inches beyond both sides of the tube.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Install piping adjacent to machines to allow service and maintenance.

H. Install piping free of sags and bends.

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

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

M. Install refrigerant piping in protective conduit where indicated belowground.

N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

O. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
4. Liquid lines may be installed level.

P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

Q. Install pipe sleeves at penetrations in exterior walls and floor assemblies.

R. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."

S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

T. Use postwall sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

U. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.

V. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

PIPE JOINT CONSTRUCTION

A. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BCuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
2. Use Type BAq, cadmium-free silver alloy for joining copper with bronze or steel.

3.05 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
3. Pipe Roller, MSS SP 58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
2. NPS 3/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.

3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.

4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.

5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.

6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.

7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.

8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.

3.06 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.

a. Fill system with nitrogen to the required test pressure.

b. System shall maintain test pressure at the manifold gage throughout duration of test.

c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.

d. Replace leaking joints using new materials, and retest until satisfactory results are achieved.

3.07 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 microns.
3. Break vacuum with dry nitrogen.
4. Dump nitrogen and evacuate again down to 500 microns or less.
5. Repeat process with nitrogen again evacuating down to 500 microns or less. If vacuum holds for 12 hours, system is ready for charging.
6. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
7. Charge system with a new filter-dryer core in charging line.

3.08 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 23 3113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.
6. Seismic-restraint devices.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
3. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
4. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.3 SUBMITTALS

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

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory and shop drawings, including details, and parallel and perpendicular building lines.
3. Duct layout indicating sizes, configuration, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

- a. Lighting fixtures.
- b. Air outlets and inlets.
- c. Speakers.
- d. Sprinklers.
- e. Access panels.
- f. Perimeter moldings.

D. Welding certificates.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1/MD9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

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

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) 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 according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 ROUND DUCTS AND FITTINGS

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

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

- a. Lindab Inc.
- b. McGill AirFlow LLC.
- c. SEMCO Incorporated.
- d. Spiral Metal Connectors, Inc.
- e. Spiral Manufacturing Co., Inc.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," 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."

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

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "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."

2.3 SHEET METAL MATERIALS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon Steel Sheet: Comply with ASTM A 1008/A 1008M, with oil, matte finish for exposed ducts.

D. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper, with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Substrate: Compatible with galvanized sheet metal (both PVC coated and bare), stainless steel, or aluminum.

For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS

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

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet metal (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, 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 C 920.

General: Single-component, acid-curing, silicone, elastomeric.

1. Type: S.
2. Grade: NS.
3. Class: 25.
4. Use: O.
5. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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

- B. Supply Ducts:
1. Ducts Connected to Fan Coil Units, and Terminal Units:
- a. Pressure Class: Positive 1-inch wg.
- b. Minimum SMACNA Seal Class: B.
- c. SMACNA Leakage Class for Rectangular: 12.
- d. SMACNA Leakage Class for Round and Flat Oval: 6.
2. Ducts Connected to Equipment Not Listed Above:
- a. Pressure Class: Positive 2-inch wg.
- b. Minimum SMACNA Seal Class: A.
- c. SMACNA Leakage Class for Rectangular: 6.
- d. SMACNA Leakage Class for Round and Flat Oval: 3.
- C. Return Ducts:
1. Ducts Connected to Fan Coil Units and Terminal Units Insert equipment:
- a. Pressure Class: Positive or negative 1-inch wg.
- b. Minimum SMACNA Seal Class: C.
- c. SMACNA Leakage Class for Rectangular: 24.
- d. SMACNA Leakage Class for Round and Flat Oval: 12.
2. Ducts Connected to Equipment Not Listed Above:
- a. Pressure Class: Negative 3-inch wg.
- b. Minimum SMACNA Seal Class: A.
- c. SMACNA Leakage Class for Rectangular: 6.
- d. SMACNA Leakage Class for Round and Flat Oval: 3.
- D. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
- a. Pressure Class: Negative 4-inch wg.
- b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
- c. SMACNA Leakage Class for Rectangular: 12.
- d. SMACNA Leakage Class for Round and Flat Oval: 6.
- E. Intermediate Reinforcement:
1. Galvanized Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
- F. Elbow Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
- a. Velocity 1000 fpm or Lower:
- 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
- 2) Mitered Type RE 4 without vanes.
- b. Velocity 1000 to 1500 fpm:
- 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
- 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
- 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
- c. Velocity 1500 fpm or Higher:
- 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
- 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
- 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "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 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
- a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
- 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
- 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
- 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
- 4) Radius-to-Diameter Ratio: 1.5.
- b. Round Elbows, 12 inches and Smaller in Diameter: Stamped or pleated.
- c. Round Elbows, 14 inches and Larger in Diameter: Standing seam.
- G. Branch Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
- a. Rectangular Main to Rectangular Branch: 45-degree entry.
- b. Rectangular Main to Round Branch: 30° in.
2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "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

SECTION 23 3300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
- Manual volume dampers.
 - Control dampers.
 - Fire dampers.
 - Smoke dampers.
 - Flange connectors.
 - Turning vanes.
 - Duct-mounted access doors.
 - Flexible connectors.
 - Flexible ducts.
 - Duct accessory hardware.
- 1.2 SUBMITTALS
- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For duct accessories, include plans, elevations, sections, details and attachments to other work.
1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, load, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
- Special fittings.
 - Manual volume damper installations.
 - Control damper installations.
 - Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
 - Wiring Diagrams: For power, signal, and control wiring.
- C. Operation and maintenance data.
- 1.3 QUALITY ASSURANCE
- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
- Galvanized Coating Designation: G60.
 - Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts.
- D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14, with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
- 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:
 - Greenheck.
 - Nalor Industries Inc.
 - Pottorff.
 - Ruskin.
 - Vent Products Company, Inc.
2. Standard leakage rating.
3. Suitable for horizontal or vertical applications.
4. Frames:
- Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
 - Mitered and welded corners.
 - Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
- Multiple or single blade.
 - Parallel- or opposed-blade design.
 - Stiffen damper blades for stability.
 - Galvanized-steel, 0.064 inch thick.
6. Blade Axes: Galvanized steel.
7. Bearings:
- Molded synthetic.
 - Dampers in ducts with pressure classes of 3-inch wg or less shall have axes full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Galvanized steel.
- B. Standard, Aluminum, Manual Volume Dampers:
- 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:
 - Greenheck.
 - Nalor Industries Inc.
 - Pottorff.
 - Ruskin.

- e. Vent Products Company, Inc.
2. Standard leakage rating.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
- Multiple or single blade.
 - Parallel- or opposed-blade design.
 - Stiffen damper blades for stability.
 - Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
 - Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.
6. Blade Axes: Galvanized steel.
7. Bearings:
- Molded synthetic.
 - Dampers in ducts with pressure classes of 3-inch wg or less shall have axes full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Aluminum.
- C. Jackshaft:
- Size: 1-inch diameter.
 - Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- D. Damper Hardware:
- Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
 - Include center hole to suit damper operating-rod size.
 - Include elevated platform for insulated duct mounting.

2.3 CONTROL DAMPERS

- 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:
- Greenheck.
 - Nalor Industries Inc.
 - Pottorff.
 - Ruskin.
 - Vent Products Company, Inc.
- B. Frames:
- Hat shaped.
 - Galvanized-steel channels, 0.064 inch thick.
 - Mitered and welded corners.
- C. Blades:
- Multiple blade with maximum blade width of 8 inches.
 - Opposed-blade design.
 - Galvanized steel.
 - 0.064 inch thick.
 - Blade Edging: Closed-cell neoprene edging.
- D. Blade Axes: 1/2-inch-diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
- Operating Temperature Range: From minus 40 to plus 200 deg F.
- E. Bearings:
- Molded synthetic.
 - Dampers in ducts with pressure classes of 3-inch wg or less shall have axes full length of damper blades and bearings at both ends of operating shaft.
 - Thrust bearings at each end of every blade.

2.4 FIRE DAMPERS

- 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:
- Air Balance Inc.
 - Greenheck.
 - Nalor Industries Inc.
 - Pottorff.
 - Ruskin.
- B. Type: Static; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 1-1/2 and 3 hours.
- E. Frame: Curtain type with blades inside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
- Minimum Thickness: 0.02 or 0.138 inch thick, as indicated, and of length to suit application.
 - Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.5 SMOKE DAMPERS

- 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:
- Air Balance Inc.
 - Greenheck.
 - Nalor Industries Inc.
 - Pottorff.
 - Ruskin.
- B. General Requirements: Label according to UL 555S by an NRTL.
- C. Smoke Detector: Integral, factory wired for single-point connection.
- D. Frame: Curtain type with blades inside airstream fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- E. Blades: Roll-formed, horizontal, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- F. Leakage: Class II.
- G. Rated pressure and velocity to exceed design airflow conditions.
- H. Mounting Sleeve: Factory-installed, 0.052-inch-thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone caulking.
- I. Damper Motors: Two-position action.
- J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
- 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.
 - Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section "Instrumentation and Control for HVAC."
 - Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 - Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 - Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 - Electrical Connection: 115 V, single phase, 60 Hz.

2.6 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:
- Ductmate Industries, Inc.
 - Nexus PGO.
 - C.L. Ward & Family Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.7 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:
- Ductmate Industries, Inc.
 - Duro Dyne Inc.
 - METALAIRE, Inc.
 - SEMCO Incorporated.
 - C.L. Ward & Family Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- 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," Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- E. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.8 DUCT-MOUNTED ACCESS DOORS

- 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:
- Ductmate Industries, Inc.
 - Greenheck.
 - McGill AirFlow LLC.
 - Nalor Industries Inc.
 - Pottorff.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
- Door:
 - Double wall, rectangular.
 - Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - Vision panel.
 - Hinges and Latches: 1-by-1-inch hinge and cam latches.
 - Fabricate doors airtight and suitable for duct pressure class. - Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - Number of Hinges and Locks:
 - Access Doors Less Than 12 Inches Square: No hinges and two sash locks.

- b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
- c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
- d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.9 DUCT ACCESS PANEL ASSEMBLIES

- 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:
- Ductmate Industries, Inc.
 - Flame Gard, Inc.
 - 3M.
- B. Labeled according to UL 97B by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.
- D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.10 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:
- Ductmate Industries, Inc.
 - Duro Dyne.
 - Ventfabrics, Inc.
 - C.L. Ward & Family Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 incheswide attached to 2 strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
- Minimum Weight: 26 oz./sq. yd..
 - Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - Service Temperature: Minus 40 to plus 200 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
- Minimum Weight: 24 oz./sq. yd..
 - Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - Service Temperature: Minus 50 to plus 250 deg F.
- G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
- Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 - Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.11 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
- Install steel volume dampers in steel ducts.
 - Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
- On both sides of duct coils.
 - Upstream from duct filters.
 - At outdoor-air intakes and mixed-air plenums.
 - At drain pans and seals.
 - Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - At each change in direction and at maximum 50-foot spacing.
 - Upstream from turning vanes.
 - Control devices requiring inspection.
 - Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
- One-Hand or Inspection Access: 8 by 5 inches.
 - Two-Hand Access: 12 by 6 inches.
 - Head and Hand Access: 18 by 10 inches.
 - Head and Shoulders Access: 21 by 14 inches.
 - Body Access: 25 by 14 inches.
 - Body plus Ladder Access: 25 by 17 inches.
- K. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. For fan developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- N. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- O. Connect diffusers or light troffer boots to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- P. Connect flexible ducts to metal ducts with draw bands.
- Q. Install duct test holes where required for testing and balancing purposes.
- R. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
- Operate dampers to verify full range of movement.
 - Inspect locations of access doors and verify that purpose of access door can be performed.
 - Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 - Inspect turning vanes for proper and secure installation.

END OF SECTION

SECTION 23 3713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
- Rectangular and square ceiling diffusers.
 - Linear slot diffusers.
 - Adjustable bar registers and grilles.
 - Fixed face registers and grilles.
- 1.2 SUBMITTALS
- A. Product Data: For each type of product indicated, include the following:
- Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 TYPES AND DESIGNATIONS

2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.
- B. Do not use air pattern controllers for air balancing.

END OF SECTION

SECTION 23 4100 - PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes factory-fabricated air-filter devices and media used to remove particulate matter from air for HVAC applications.
- 1.02 SUBMITTALS
- A. Product Data: Include dimensions; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each unit indicated.
- B. Shop Drawings: Include plans, elevations, sections, and details to illustrate component assemblies and attachments.
- Show filter rack assembly, dimensions, materials, and methods of assembly of components.
 - Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.
 - Include wiring diagrams.
- C. Operation and maintenance data.
- 1.03 QUALITY ASSURANCE
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with ARI 850.
- C. Comply with ASHRAE 52.1andASHRAE 52.2 for method of testing and rating air-filter units.
- D. Comply with NFPA 90A and NFPA 90B.

1.04 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- Provide one complete set of filters for each filter bank. If system includes prefilters, provide only prefilters.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

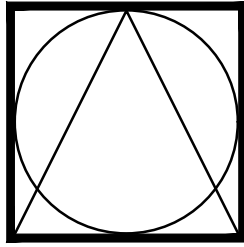
- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 3M Filtrete Commercial
 - AAF International.
 - Cenfil.
 - Koch Filter.
- B. Extended-Surface, Disposable Panel Filters: Factory-fabricated, dry, extended-surface filters with holding frames.
- Media: Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid.
 - Media and Media-Grid Frame: Nonflammable cardboard.
 - Duct-Mounting Frames: Welded, galvanized steel with gaskets and fasteners, and suitable for bolting together into built-up filter banks.
- C. High Efficiency Particulate Filters: Factory-fabricated, dry, extended-surface filters with holding frames.
- Media: Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid.
 - Media and Media-Grid Frame: Nonflammable cardboard.
 - Diffuser-Mounting Frames: Welded, galvanized steel with gel seal gaskets.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.
- B. Install filters in position to prevent passage of unfiltered air.
- C. Coordinate filter installations with duct and air-handling unit installations.
- D. Electrical wiring and connections are specified in Division 26 Sections.
- E. Provide (2) spare sets of all filters including but not limited to filters used for the following:
- Split Furnaces and AC units (MERV 8).
 - Split Air Source Heat Pumps (MERV 8).

END OF SECTION



DSC
ARCHITECTS
401 FRONT STREET
BEREA, OHIO 44017
PHONE: 440.835.3957
mail@dscarchitects.com

DATE:
PERMIT SUBMISSION:
06.19.26

BENNETT'S CREEK
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1931/1915 BRIDGE ROAD (HIGHWAY 17)
SUFFOLK, VIRGINIA

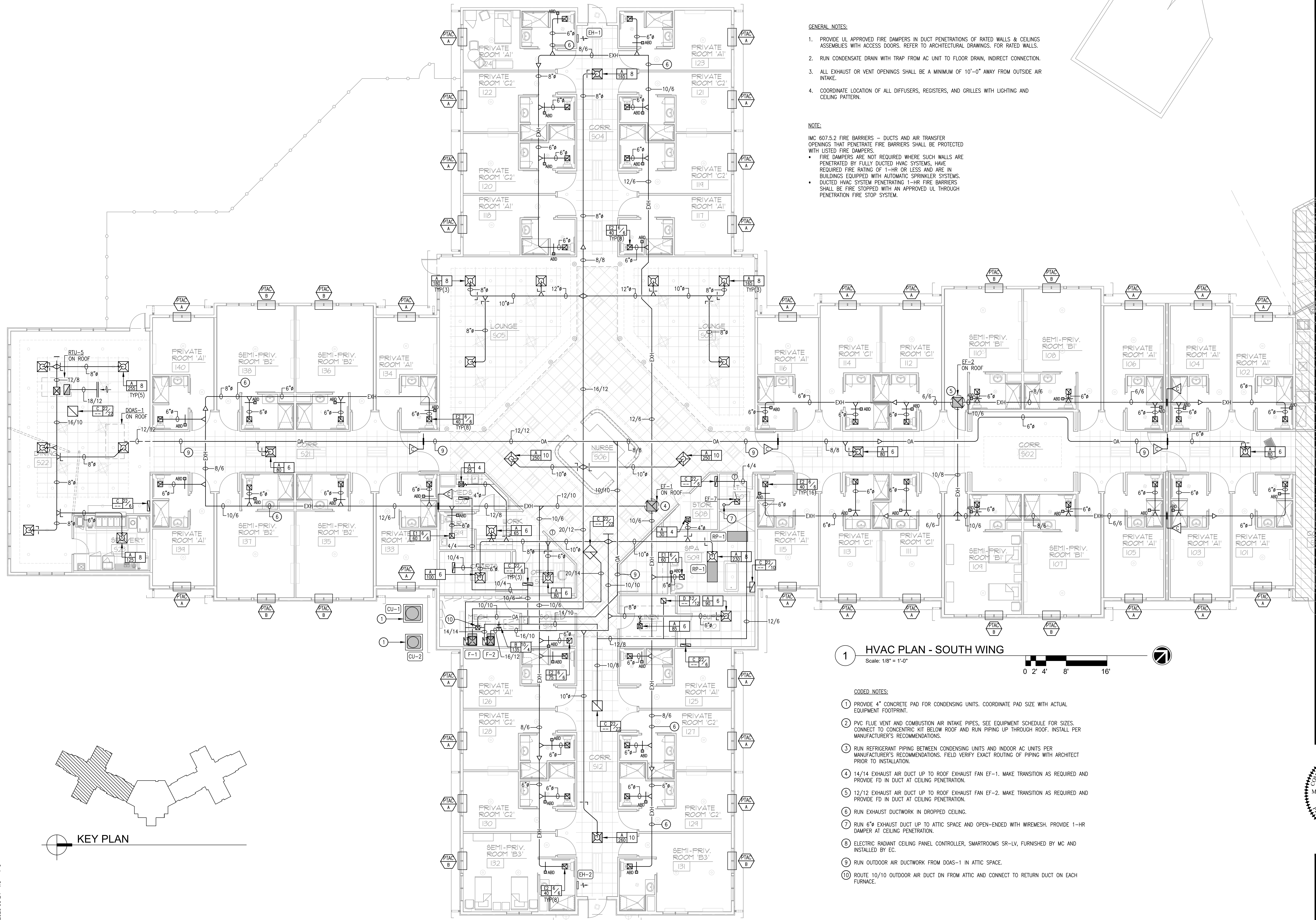
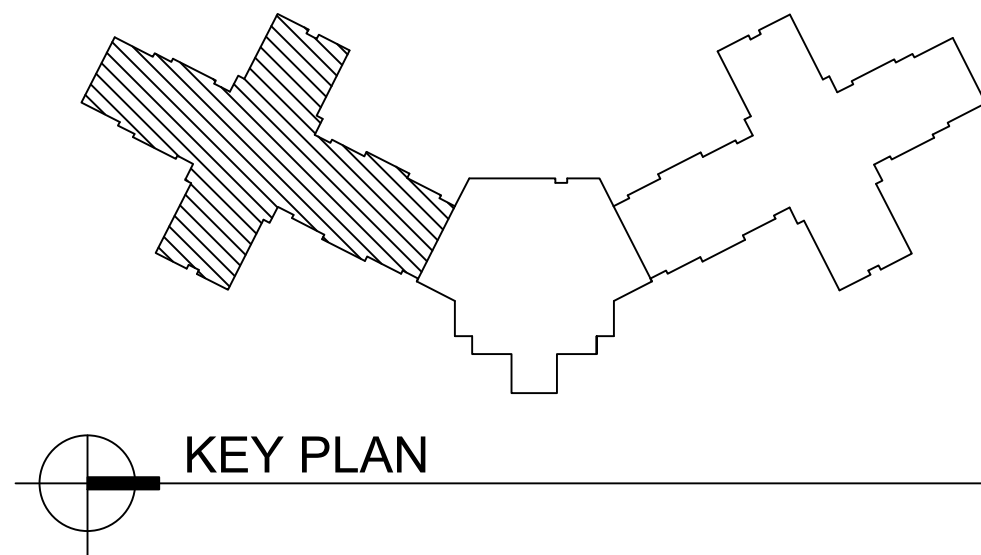


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MECHANICAL
SPECIFICATIONS

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2026-06-24 - 1/8" = 1'-0"



GENERAL NOTES:

1. PROVIDE UL APPROVED FIRE DAMPERS IN DUCT PENETRATIONS OF RATED WALLS & CEILINGS ASSEMBLIES WITH ACCESS DOORS. REFER TO ARCHITECTURAL DRAWINGS. FOR RATED WALLS.
2. RUN CONDENSATE DRAIN WITH TRAP FROM AC UNIT TO FLOOR DRAIN, INDIRECT CONNECTION.
3. ALL EXHAUST OR VENT OPENINGS SHALL BE A MINIMUM OF 10'-0" AWAY FROM OUTSIDE AIR INTAKE.
4. COORDINATE LOCATION OF ALL DIFFUSERS, REGISTERS, AND GRILLES WITH LIGHTING AND CEILING PATTERN.

NOTE:

- IMC 607.5.2 FIRE BARRIERS - DUCTS AND AIR TRANSFER OPENINGS THAT PENETRATE FIRE BARRIERS SHALL BE PROTECTED WITH LISTED FIRE DAMPERS.
- FIRE DAMPERS ARE NOT REQUIRED WHERE SUCH WALLS ARE PENETRATED BY FULLY DUCTED HVAC SYSTEMS, HAVE REQUIRED FIRE RATING OF 1-HR OR LESS AND ARE IN BUILDINGS EQUIPPED WITH AUTOMATIC SPRINKLER SYSTEMS.
 - DUCTED HVAC SYSTEM PENETRATING 1-HR FIRE BARRIERS SHALL BE FIRE STOPPED WITH AN APPROVED UL THROUGH PENETRATION FIRE STOP SYSTEM.

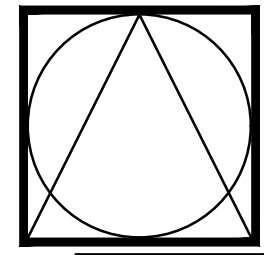
1 HVAC PLAN - SOUTH WING

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

0 2' 4' 8' 16'

CODED NOTES:

- 1 PROVIDE 4" CONCRETE PAD FOR CONDENSING UNITS. COORDINATE PAD SIZE WITH ACTUAL EQUIPMENT FOOTPRINT.
- 2 PVC FLUE VENT AND COMBUSTION AIR INTAKE PIPES, SEE EQUIPMENT SCHEDULE FOR SIZES. CONNECT TO CONCENTRIC KIT BELOW ROOF AND RUN PIPING UP THROUGH ROOF. INSTALL PER MANUFACTURER'S RECOMMENDATIONS.
- 3 RUN REFRIGERANT PIPING BETWEEN CONDENSING UNITS AND INDOOR AC UNITS PER MANUFACTURER'S RECOMMENDATIONS. FIELD VERIFY EXACT ROUTING OF PIPING WITH ARCHITECT PRIOR TO INSTALLATION.
- 4 14/14 EXHAUST AIR DUCT UP TO ROOF EXHAUST FAN EF-1. MAKE TRANSITION AS REQUIRED AND PROVIDE FD IN DUCT AT CEILING PENETRATION.
- 5 12/12 EXHAUST AIR DUCT UP TO ROOF EXHAUST FAN EF-2. MAKE TRANSITION AS REQUIRED AND PROVIDE FD IN DUCT AT CEILING PENETRATION.
- 6 RUN EXHAUST DUCTWORK IN DROPPED CEILING.
- 7 RUN 6" Ø EXHAUST DUCT UP TO ATTIC SPACE AND OPEN-ENDED WITH WIREMESH. PROVIDE 1-HR DAMPER AT CEILING PENETRATION.
- 8 ELECTRIC RADIANT CEILING PANEL CONTROLLER, SMARTROOMS SR-LV, FURNISHED BY MC AND INSTALLED BY EC.
- 9 RUN OUTDOOR AIR DUCTWORK FROM DOAS-1 IN ATTIC SPACE.
- 10 ROUTE 10/10 OUTDOOR AIR DUCT DN FROM ATTIC AND CONNECT TO RETURN DUCT ON EACH FURNACE.



DSC
ARCHITECTS
401 FRONT STREET
BEREA, OHIO 44017
PHONE: 440.835.3957
mail@dscarchitects.com

DATE:
PERMIT SUBMISSION: 06.19.26

BENNETT'S CREEK
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1931/1915 BRIDGE ROAD (HIGHWAY 17)
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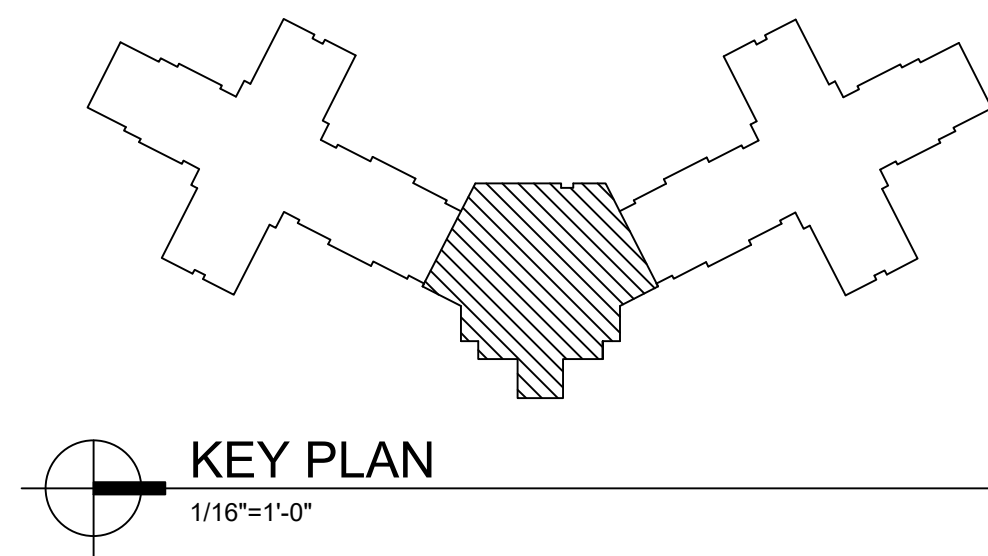


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HVAC PLAN -
SOUTH WING

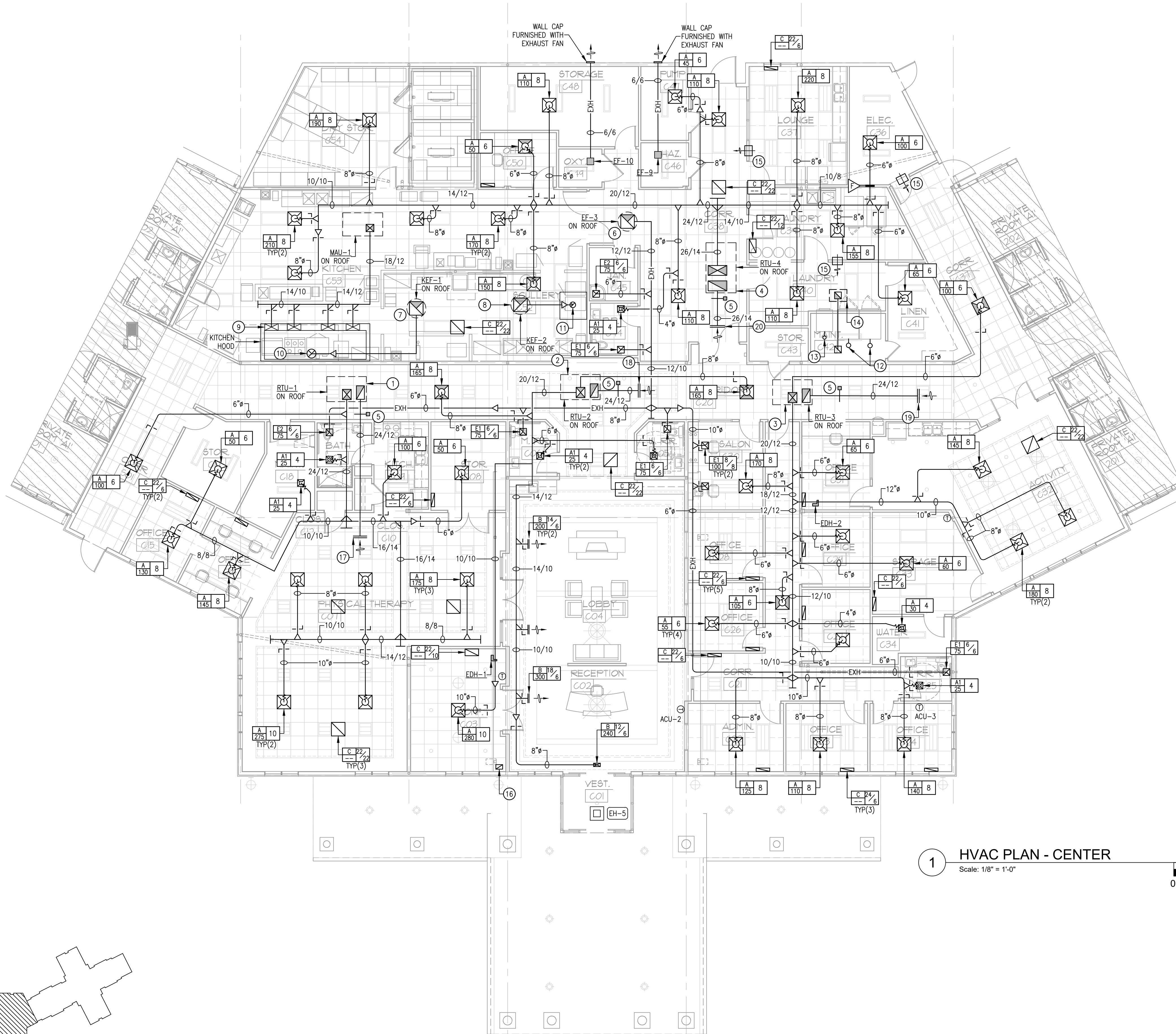
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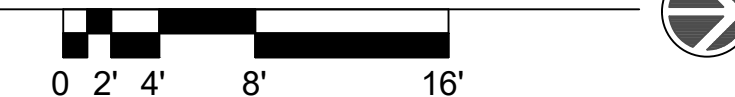
2026-06-24 - 1/8" = 1'-0"



KEY PLAN
1/16" = 1'-0"



1 HVAC PLAN - CENTER
Scale: 1/8" = 1'-0"



GENERAL NOTES:

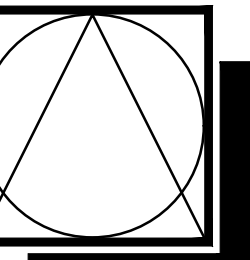
1. PROVIDE UL APPROVED FIRE DAMPERS IN DUCT PENETRATIONS OF RATED WALLS & CEILINGS ASSEMBLIES WITH ACCESS DOORS. REFER TO ARCHITECTURAL DWGS. FOR RATED WALLS.
2. RUN CONDENSATE DRAIN WITH TRAP FROM AC UNIT TO FLOOR DRAIN, INDIRECT CONNECTION.
3. ALL EXHAUST OR VENT OPENINGS SHALL BE A MINIMUM OF 10'-0" AWAY FROM OUTSIDE AIR INTAKE.
4. COORDINATE LOCATION OF ALL DIFFUSERS, REGISTERS, AND GRILLES WITH LIGHTING AND CEILING PATTERN.
5. KITCHEN EXHAUST CONTRACTOR (KEC) SHALL FURNISH AND INSTALL EXHAUST HOODS. HVAC/MECHANICAL CONTRACTOR SHALL INSTALL KEC FURNISHED EXHAUST/MAKE-UP AIR FAN(S) AND CURBS. REFER KEC DWGS. FOR FURTHER KITCHEN EQUIPMENT DETAILS.
6. HVAC CONTRACTOR SHALL FURNISH AND INSTALL DUCTWORK BETWEEN EXHAUST HOOD COLLARS AND FAN(S). FINAL CONNECTION BY HVAC/MECHANICAL CONTRACTOR.

CODED NOTES:

- 1 24/12 SA AND RA DUCTS UP TO RTU-1 ON ROOF. MAKE TRANSITION AS REQUIRED AND PROVIDE FLEXIBLE CONNECTION AT UNIT INLET.
- 2 24/12 SA AND RA DUCTS UP TO RTU-2 ON ROOF. MAKE TRANSITION AS REQUIRED AND PROVIDE FLEXIBLE CONNECTION AT UNIT INLET.
- 3 24/12 SA AND RA DUCTS UP TO RTU-3 ON ROOF. MAKE TRANSITION AS REQUIRED AND PROVIDE FLEXIBLE CONNECTION AT UNIT INLET.
- 4 26/14 SA AND RA DUCTS UP TO RTU-4 ON ROOF. MAKE TRANSITION AS REQUIRED AND PROVIDE FLEXIBLE CONNECTION AT UNIT INLET.
- 5 SMOKE DETECTOR IN RA DUCT FURNISHED AND INSTALLED BY ELECTRICAL CONTRACTOR.
- 6 12/12 EXHAUST AIR DUCT UP TO ROOF EXHAUST FAN EF-3. MAKE TRANSITION AS REQUIRED AND PROVIDE FD IN DUCT AT CEILING PENETRATION.
- 7 20/18 EXHAUST AIR DUCT UP TO ROOF EXHAUST FAN KEF-1. MAKE TRANSITION AS REQUIRED.
- 8 12/10 EXHAUST AIR DUCT UP TO ROOF EXHAUST FAN KEF-2. MAKE TRANSITION AS REQUIRED.
- 9 24/10 SA DUCT DOWN, 513 CFM EA. (TYP. OF 4). CONNECT TO KITCHEN HOOD INLET.
- 10 16" EXHAUST DUCT DOWN, 2625 CFM, CONNECT TO KITCHEN HOOD OUTLET.
- 11 10" EXHAUST DUCT DOWN, 600 CFM, CONNECT TO DISHWASHER HOOD OUTLET.
- 12 8" DRYER EXHAUST UP THRU ROOF. INSTALL IN-LINE DUCT MOUNTED LINT STOPPER ENERGENICS GRIP MODEL AF-1-5 (SELF-CLEANING), 8" INLET AND 10" OUTLET AND RUN 10" EXHAUST DUCT UP THRU ROOF AND TERMINATE WITH GOOSENECK ABOVE ROOF.
- 13 4" DRYER EXHAUST THRU ROOF AND TERMINATE ABOVE ROOF WITH VENT CAP.
- 14 OUTSIDE AIR INTAKE LOREN COOK MODEL GI THROAT AREA 16/18 (2 SQ. FT.) 29/36 HOOD WITH BIRDSCREEN. COMPLETE WITH ROOF CURB, BIRDSCREEN AND MOTORIZED DAMPERS. RUN 18/16 SUPPLY AIR DUCT, OPEN ENDED WITH BIRD SCREEN. INTERLOCK DRYERS WITH MOTORIZED DAMPER. DAMPER SHALL OPEN WHENEVER ONE DRYER IS OPERATING.
- 15 18/10 TRANSFER AIR OPENING WITH FD ABOVE CEILING.
- 16 12/8 RAG IN WALL ABOVE CEILING. PROVIDE ONE ON EACH SIDE OF WALL.
- 17 24/12 RA INLET INTAKE W/WIRE MESH SCREEN.
- 18 24/12 RA INLET INTAKE W/WIRE MESH SCREEN.
- 19 24/12 RA INLET INTAKE W/WIRE MESH SCREEN.
- 20 26/14 RA INLET INTAKE W/WIRE MESH SCREEN.

NOTE:

- IMC 607.5.2 FIRE BARRIERS - DUCTS AND AIR TRANSFER OPENINGS THAT PENETRATE FIRE BARRIERS SHALL BE PROTECTED WITH LISTED FIRE DAMPERS.
- FIRE DAMPERS ARE NOT REQUIRED WHERE SUCH WALLS ARE PENETRATED BY FULLY DUCTED HVAC SYSTEMS, HAVE REQUIRED FIRE RATING OF 1-HR OR LESS AND ARE IN BUILDINGS EQUIPPED WITH AUTOMATIC SPRINKLER SYSTEMS.
 - DUCTED HVAC SYSTEM PENETRATING 1-HR FIRE BARRIERS SHALL BE FIRE STOPPED WITH AN APPROVED UL THROUGH PENETRATION FIRE STOP SYSTEM.



DSC
ARCHITECTS
401 FRONT STREET
BEREA, OHIO 44017
PHONE: 440.835.3957
mail@dscarchitects.com

DATE:
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DRAWING NAME
HVAC PLAN -
CENTER

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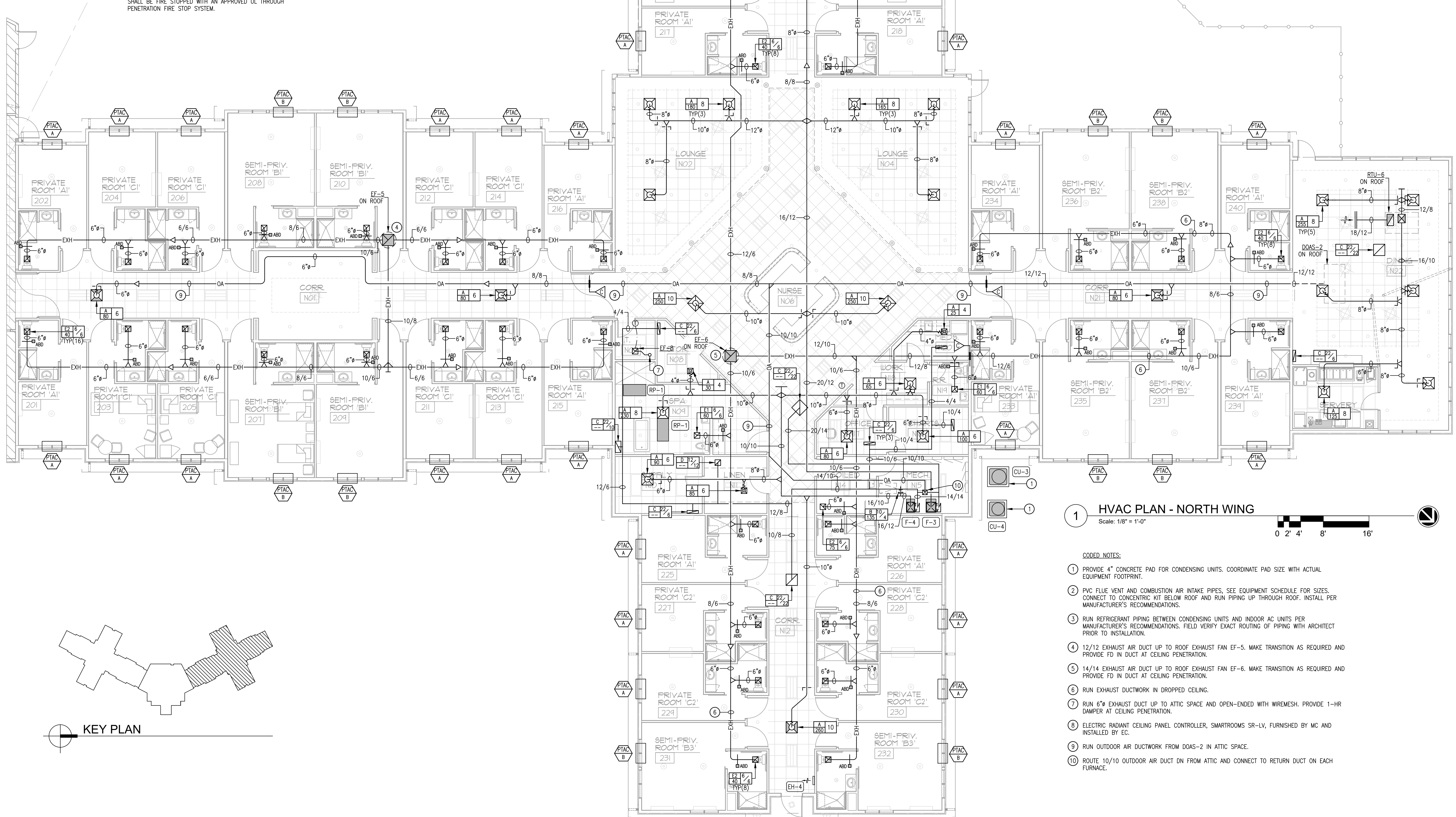
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GENERAL NOTES:

1. PROVIDE UL APPROVED FIRE DAMPERS IN DUCT PENETRATIONS OF RATED WALLS & CEILINGS ASSEMBLIES WITH ACCESS DOORS. REFER TO ARCHITECTURAL DRAWINGS. FOR RATED WALLS.
2. RUN CONDENSATE DRAIN WITH TRAP FROM AC UNIT TO FLOOR DRAIN, INDIRECT CONNECTION.
3. ALL EXHAUST OR VENT OPENINGS SHALL BE A MINIMUM OF 10'-0" AWAY FROM OUTSIDE AIR INTAKE.
4. COORDINATE LOCATION OF ALL DIFFUSERS, REGISTERS, AND GRILLES WITH LIGHTING AND CEILING PATTERN.

NOTE:

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- FIRE DAMPERS ARE NOT REQUIRED WHERE SUCH WALLS ARE PENETRATED BY FULLY DUCTED HVAC SYSTEMS, HAVE REQUIRED FIRE RATING OF 1-HR OR LESS AND ARE IN BUILDINGS EQUIPPED WITH AUTOMATIC SPRINKLER SYSTEMS.
 - DUCTED HVAC SYSTEM PENETRATING 1-HR FIRE BARRIERS SHALL BE FIRE STOPPED WITH AN APPROVED UL THROUGH PENETRATION FIRE STOP SYSTEM.

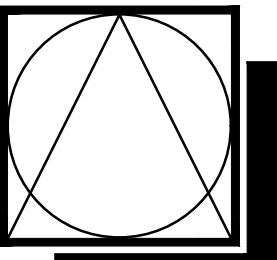


1 HVAC PLAN - NORTH WING

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

CODED NOTES:

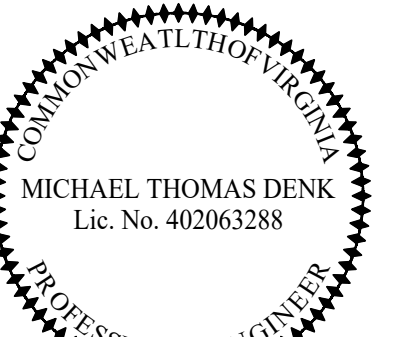
1. PROVIDE 4" CONCRETE PAD FOR CONDENSING UNITS. COORDINATE PAD SIZE WITH ACTUAL EQUIPMENT FOOTPRINT.
2. PVC FLUE VENT AND COMBUSTION AIR INTAKE PIPES, SEE EQUIPMENT SCHEDULE FOR SIZES. CONNECT TO CONCENTRIC KIT BELOW ROOF AND RUN PIPING UP THROUGH ROOF. INSTALL PER MANUFACTURER'S RECOMMENDATIONS.
3. RUN REFRIGERANT PIPING BETWEEN CONDENSING UNITS AND INDOOR AC UNITS PER MANUFACTURER'S RECOMMENDATIONS. FIELD VERIFY EXACT ROUTING OF PIPING WITH ARCHITECT PRIOR TO INSTALLATION.
4. 12/12 EXHAUST AIR DUCT UP TO ROOF EXHAUST FAN EF-5. MAKE TRANSITION AS REQUIRED AND PROVIDE FD IN DUCT AT CEILING PENETRATION.
5. 14/14 EXHAUST AIR DUCT UP TO ROOF EXHAUST FAN EF-6. MAKE TRANSITION AS REQUIRED AND PROVIDE FD IN DUCT AT CEILING PENETRATION.
6. RUN EXHAUST DUCTWORK IN DROPPED CEILING.
7. RUN 6" EXHAUST DUCT UP TO ATTIC SPACE AND OPEN-ENDED WITH WIREMESH. PROVIDE 1-HR DAMPER AT CEILING PENETRATION.
8. ELECTRIC RADIANT CEILING PANEL CONTROLLER, SMARTROOMS SR-LV, FURNISHED BY MC AND INSTALLED BY EC.
9. RUN OUTDOOR AIR DUCTWORK FROM DOAS-2 IN ATTIC SPACE.
10. ROUTE 10/10 OUTDOOR AIR DUCT DN FROM ATTIC AND CONNECT TO RETURN DUCT ON EACH FURNACE.



DSC
ARCHITECTS
401 FRONT STREET
BEREA, OHIO 44017
PHONE: 440.835.3957
mail@dscarchitects.com

DATE:
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06.19.26

BENNETT'S CREEK
HEALTH & REHABILITATION CENTER
1931/1915 BRIDGE ROAD (HIGHWAY 17)
SUFFOLK, VIRGINIA

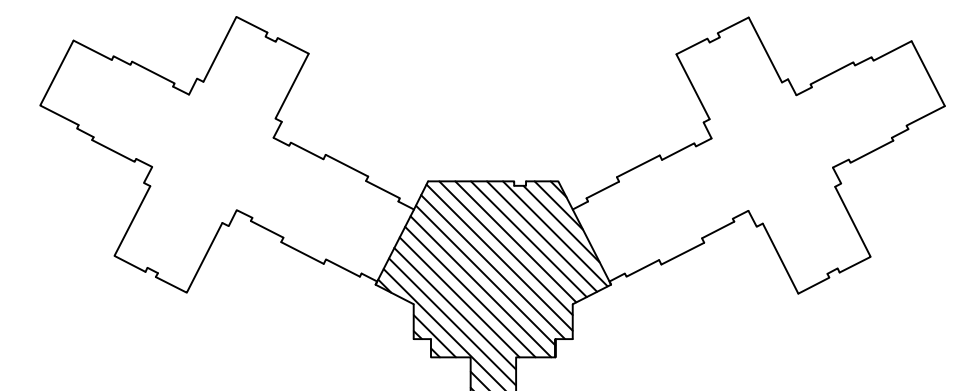
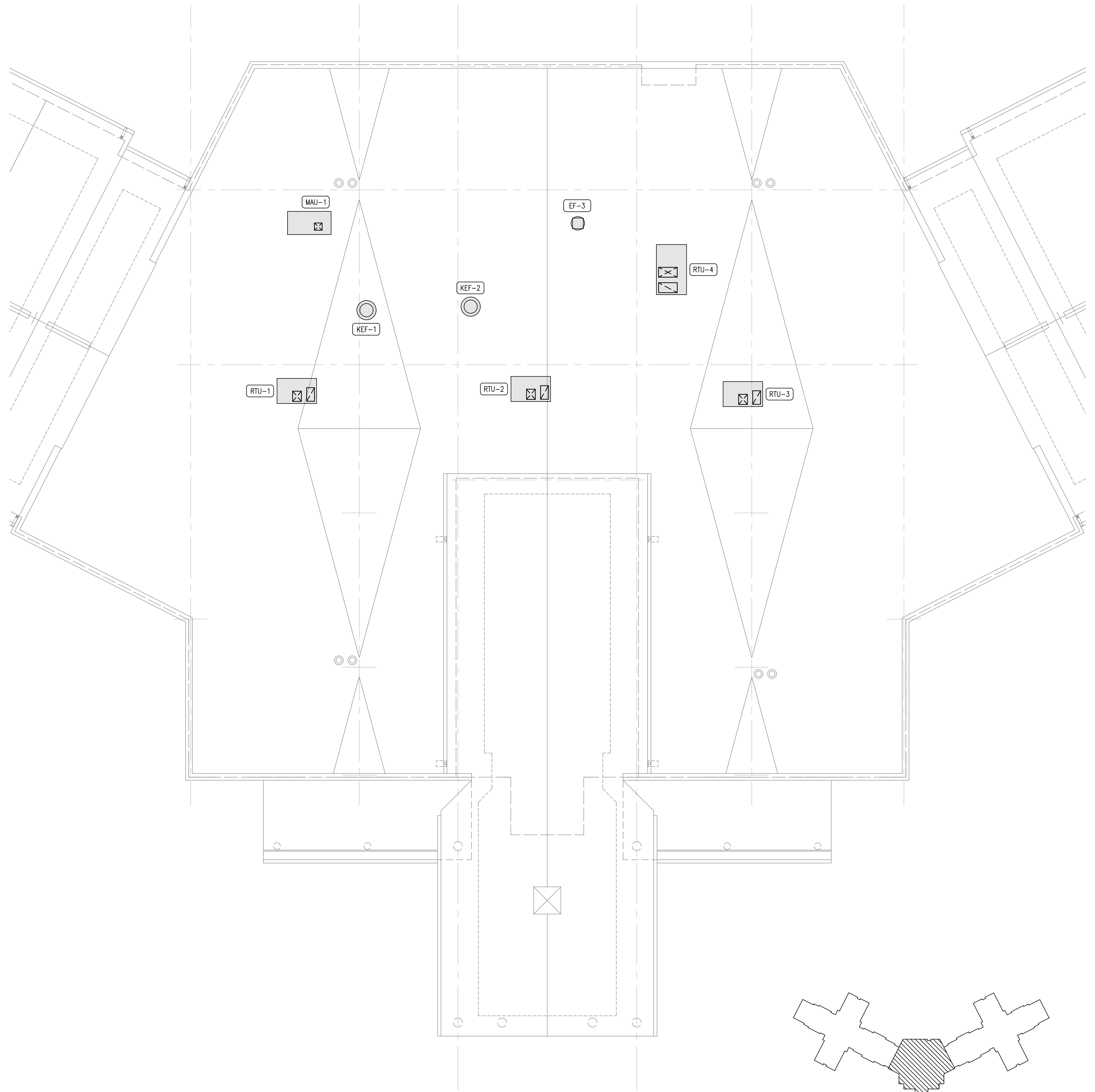


DRAWING NAME
HVAC PLAN -
NORTH WING

DAI PROJECT NO.
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M1.3

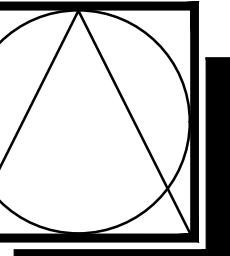
2026-06-24 - 1/8" = 1'-0"



1 HVAC ROOF PLAN - CENTER
Scale: 1/8" = 1'-0"



KEY PLAN



DSC
ARCHITECTS
401 FRONT STREET
BEREA, OHIO 44017
PHONE: 440.835.3957
mail@dscarchitects.com

DATE:
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HEALTH & REHABILITATION CENTER
1931/1915 BRIDGE ROAD (HIGHWAY 17)
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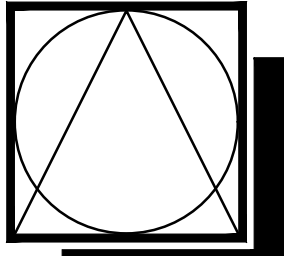


Michael Thomas Denk

DRAWING NAME
HVAC ROOF PLAN
- CENTER

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M1.4



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ARCHITECTS
401 FRONT STREET
BEREA, OHIO 44017
PHONE: 440.835.3957
mail@dscarchitects.com

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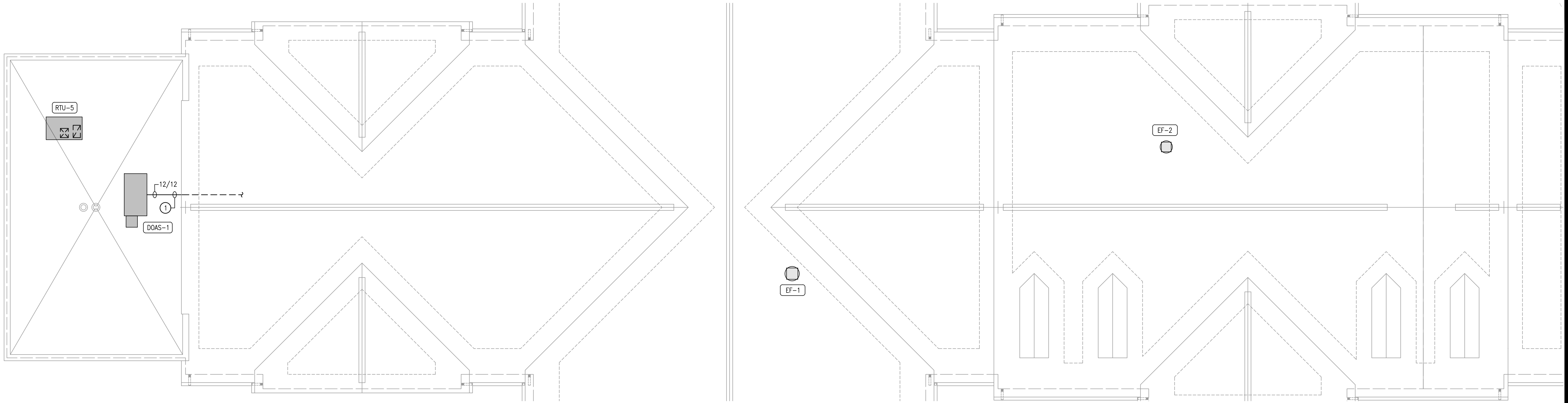
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HEALTH & REHABILITATION CENTER
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SUFFOLK, VIRGINIA



DRAWING NAME
HVAC ROOF PLAN - SOUTH WING & NORTH WING

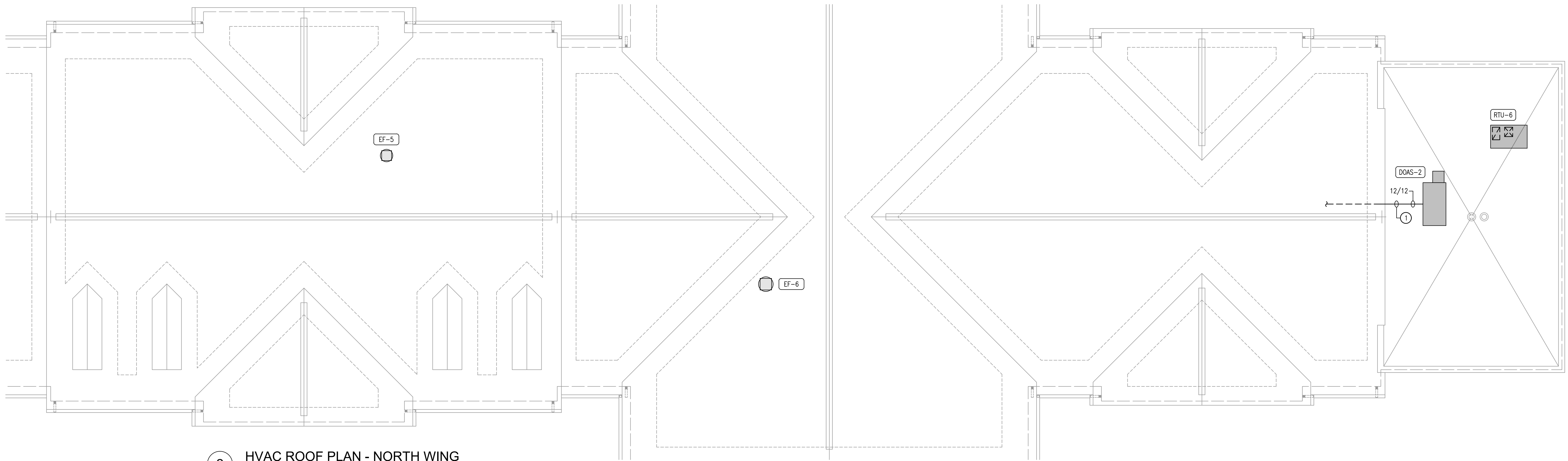
DAI PROJECT NO.
26032

M1.5



1 HVAC ROOF PLAN - SOUTH WING
Scale: 1/8" = 1'-0"

0 2' 4' 8' 16'

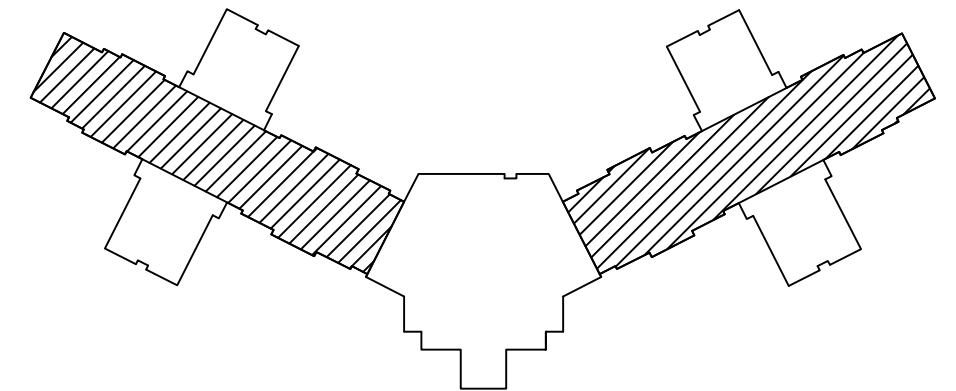


2 HVAC ROOF PLAN - NORTH WING
Scale: 1/8" = 1'-0"

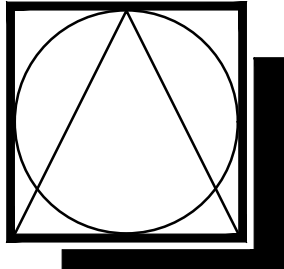
0 2' 4' 8' 16'

CODED NOTES:

- ① OUTDOOR AIR DUCT FROM DOAS UNIT ALONG ROOFTOP AND THROUGH SIDEWALL INTO ATTIC SPACE.

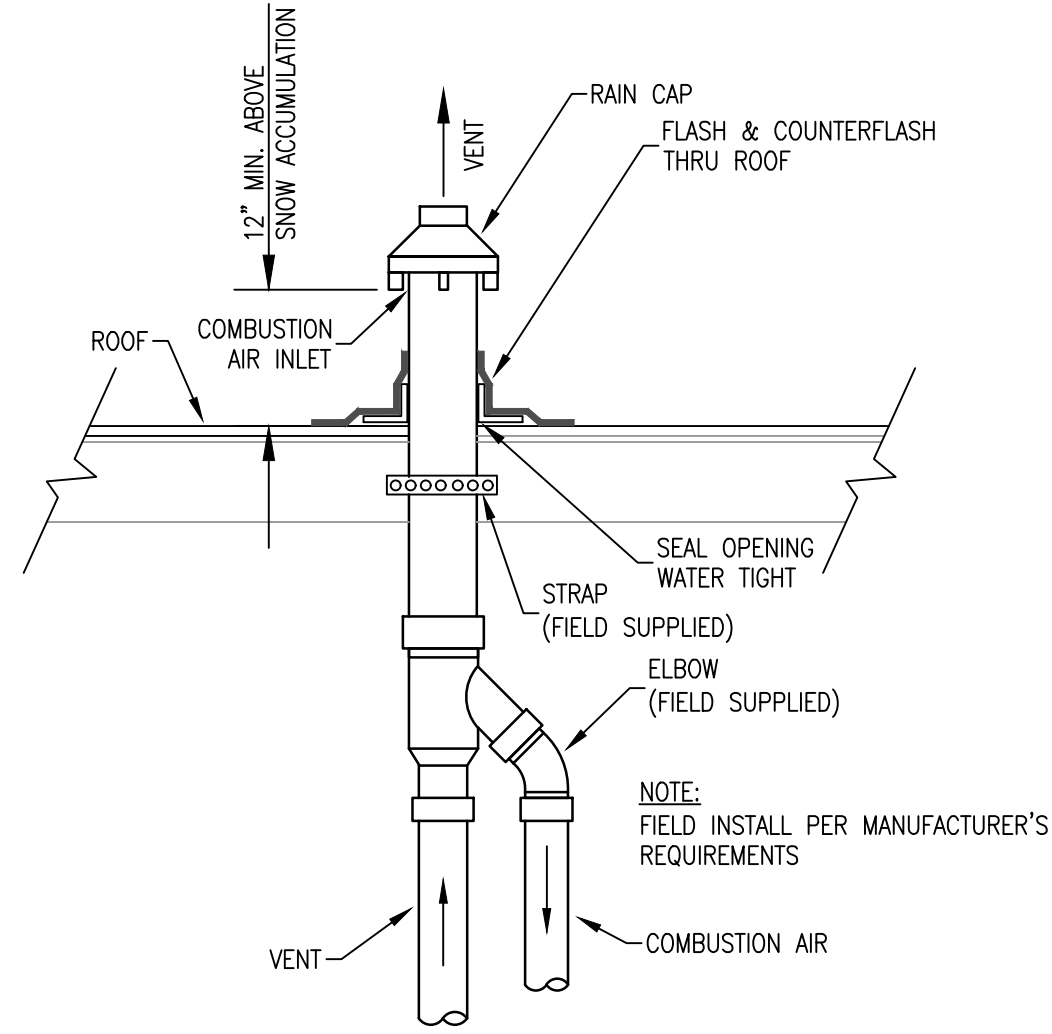


KEY PLAN

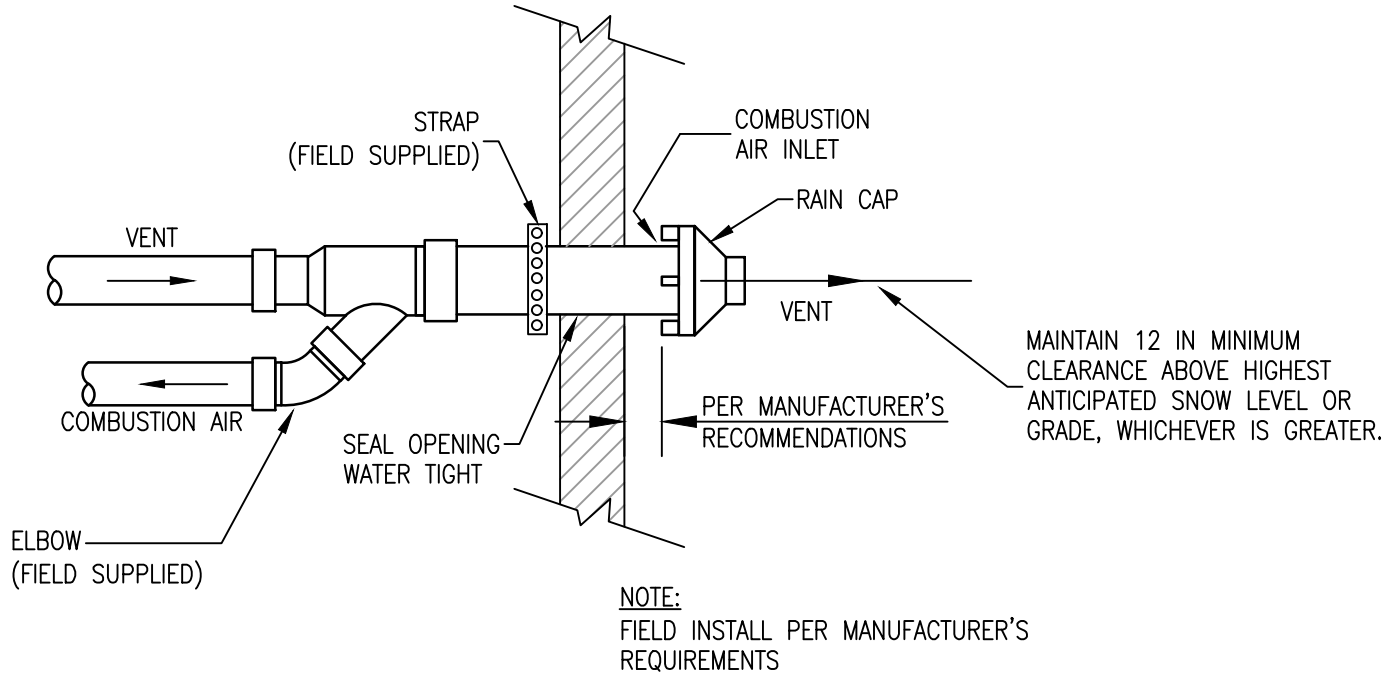


DSC
ARCHITECTS
401 FRONT STREET
BEREA, OHIO 44017
PHONE: 440.835.3957
mail@dscarchitects.com

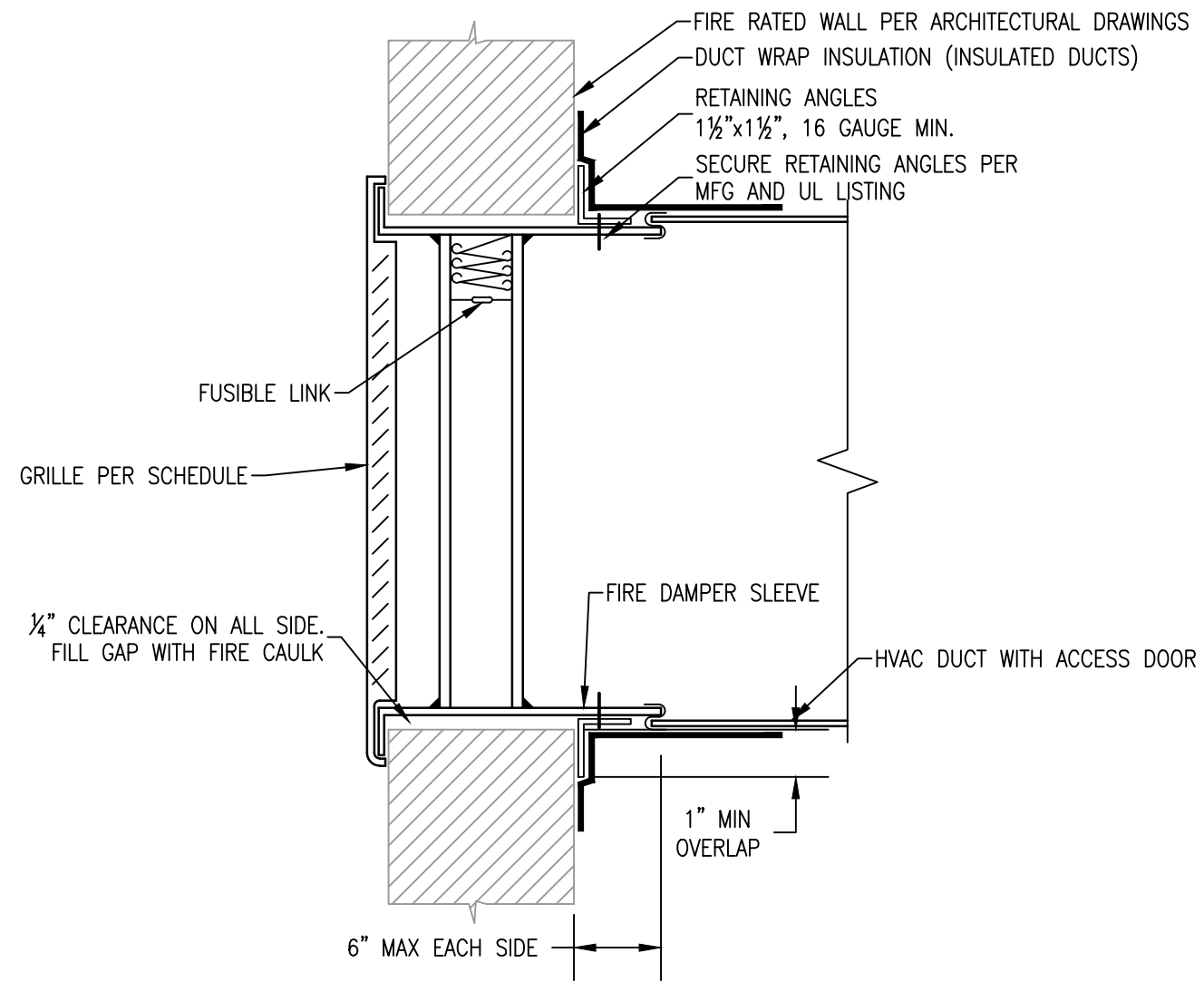
DATE:
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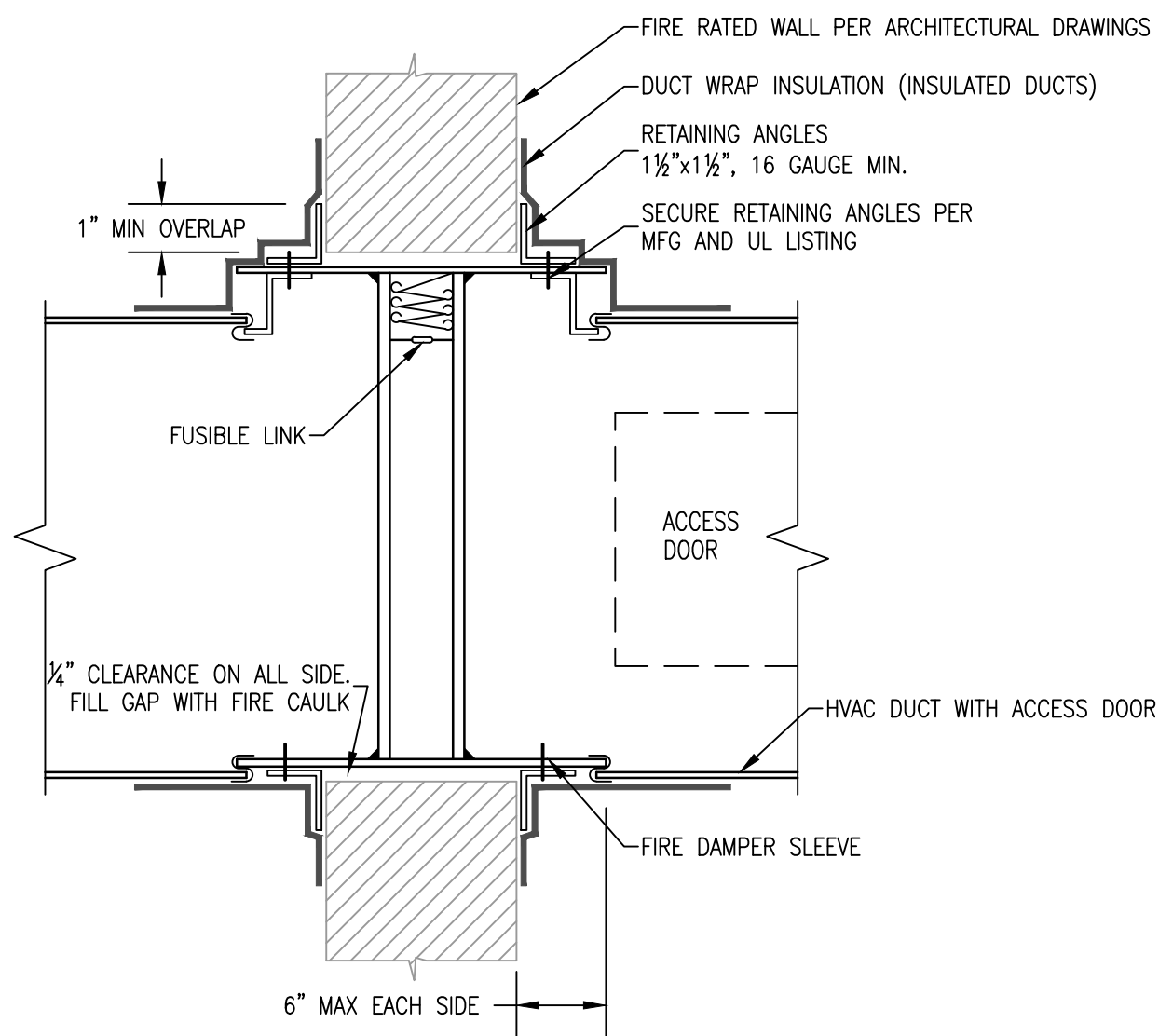
1 CONCENTRIC VENTING THROUGH ROOF - DETAIL
Scale: NTS



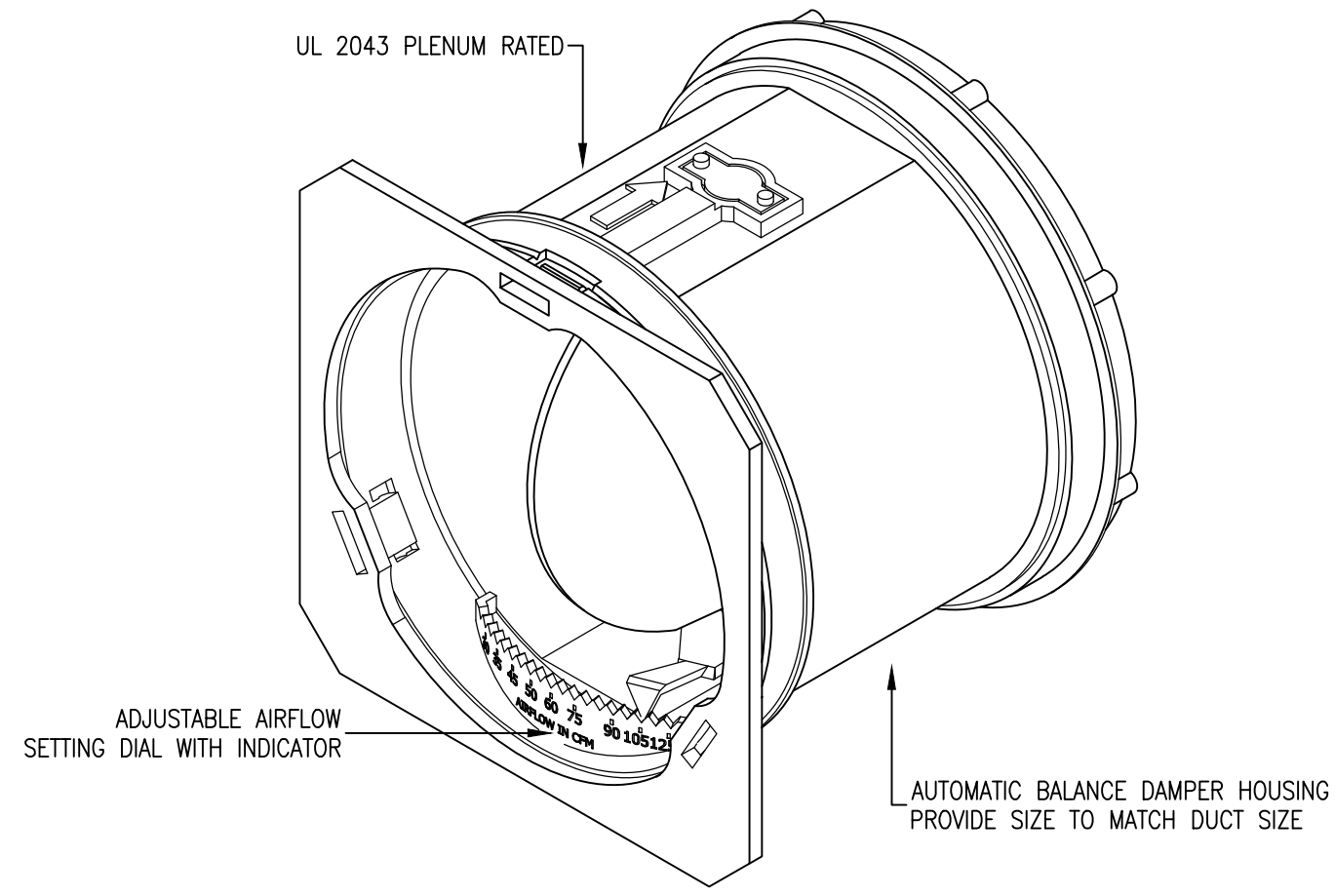
2 CONCENTRIC VENTING THROUGH WALL - DETAIL
Scale: NTS



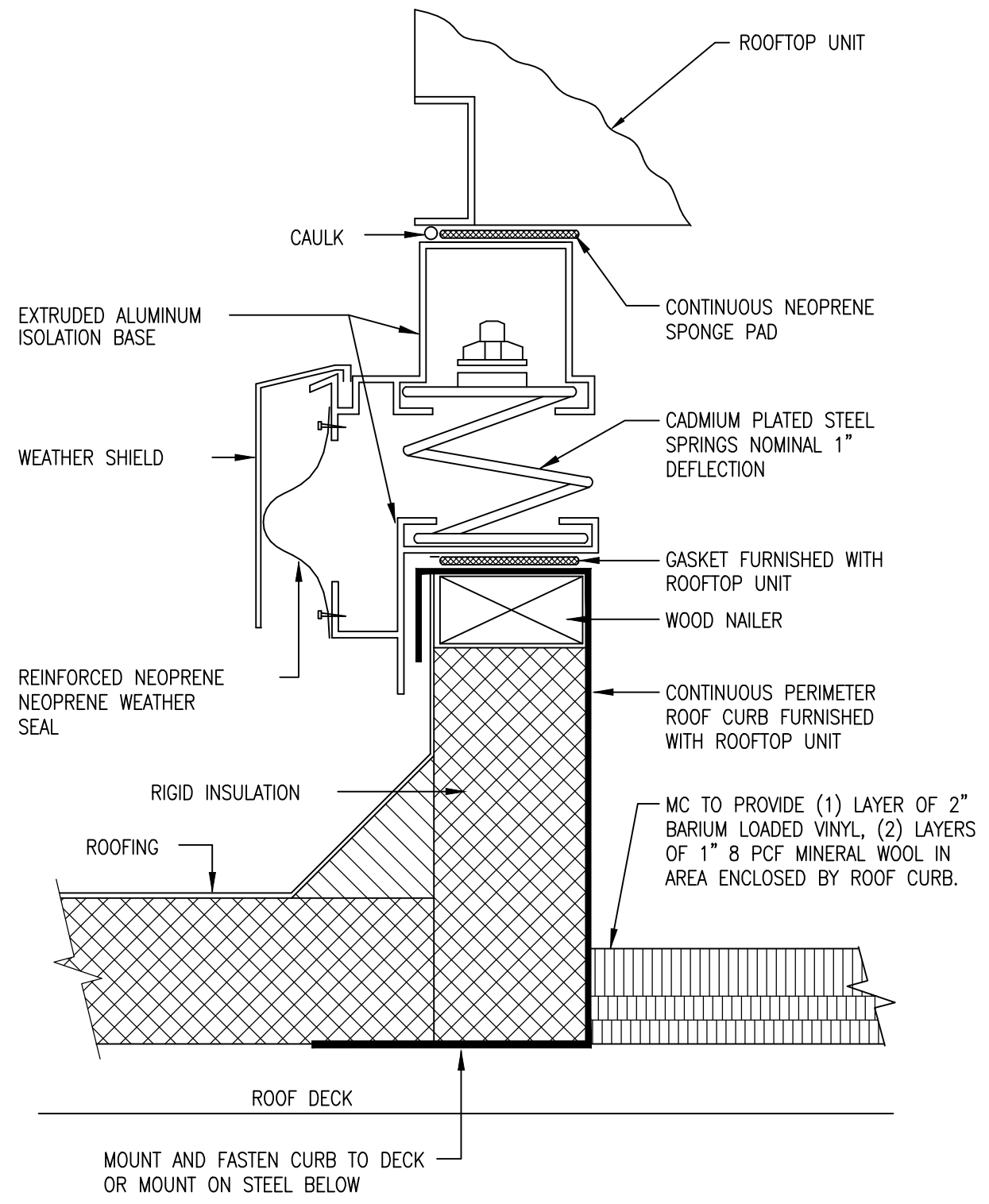
3 FIRE DAMPER WITH GRILLE (VERTICAL MOUNTING)
Scale: NTS



4 FIRE DAMPER VERTICAL MOUNTING
Scale: NTS

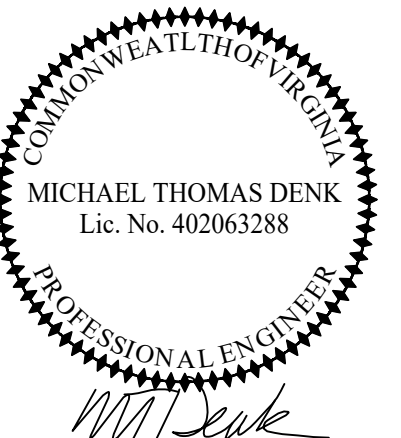


5 AUTOMATIC BALANCE DAMPER DETAIL
Scale: NTS



6 ROOFTOP AIR CONDITIONING UNIT MOUNTING DETAIL
Scale: None

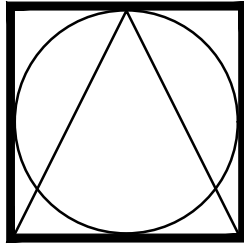
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SUFFOLK, VIRGINIA



DRAWING NAME
MECHANICAL
DETAILS

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M5.1



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ARCHITECTS
401 FRONT STREET
BEREA, OHIO 44017
PHONE: 440.835.3957
mail@dscarchitects.com

DATE:
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ROOFTOP UNIT SCHEDULE

		UNIT					SUPPLY FAN					COOLING					HEATING					ELECTRICAL			MANUFACTURER MODEL	WEIGHT (LBS)	REMARKS				
		NOMINAL TONS	EFFICIENCY (SEER2)	ECONO- MIZER	HOT GAS REHEAT	CONFIGURATION	OUTSIDE AIR	AIR FLOW (CFM)	ESP (IN WC)	TSP (IN WC)	MOTOR (HP)	EAT DB (°F)	EAT WB (°F)	LAT DB (°F)	LAT WB (°F)	TOTAL (MBH)	SENSIBLE (MBH)	HEAT EXCHANGER	CONTROL TYPE	STAGES	MAX INPUT (MBH)	MAX OUTPUT (MBH)	MIN OUTPUT (MBH)	EAT DB (°F)				LAT DB (°F)	VOLTAGE	MCA	MOCp
RTU-1	PHYSICAL THERAPY	5	13.40	REFERENCE ENTHALPY	YES	DOWN DISCHARGE	320	1,600	0.75	1.13	1	78.63	66.67	56.44	54.93	60.24	41.43	STD INDIRECT	STAGED	2	80	64.8	--	57.1	94.23	208V/3Ø	33	45	TRANE YSK060A3	849	1-6
RTU-2	LOBBY	5	13.40	REFERENCE ENTHALPY	YES	DOWN DISCHARGE	270	1,600	0.75	1.13	1	77.81	66.19	55.79	54.31	60.35	41.17	STD INDIRECT	STAGED	2	80	64.8	--	60.5	97.58	208V/3Ø	33	45	TRANE YSK060A3	849	1-6
RTU-3	OFFICES/ ACTIVITY	5	13.40	REFERENCE ENTHALPY	YES	DOWN DISCHARGE	310	1,600	0.75	1.13	1	78.52	66.58	56.34	54.83	60.16	41.41	STD INDIRECT	STAGED	2	80	64.8	--	59.7	96.83	208V/3Ø	33	45	TRANE YSK060A3	849	1-6
RTU-4	KITCHEN, LAUNDRY	6	14.60 (IEER)	REFERENCE ENTHALPY	YES	DOWN DISCHARGE	520	2,200	0.75	0.95	3	79.17	67.17	56.34	55.29	83.24	57.64	STD INDIRECT	STAGED	2	80	64.8	--	57.1	83.99	208V/3Ø	38	50	TRANE YSK072A3	1,202	1-6
RTU-5	SOUTH DINING	4	13.40	REFERENCE ENTHALPY	YES	DOWN DISCHARGE	328	1,400	0.75	1.05	1	81	68.15	59.56	57.38	49.92	34.77	STD INDIRECT	STAGED	2	80	64.8	--	55	97.68	208V/3Ø	31	45	TRANE YSK048A3	821	1-6
RTU-6	NORTH DINING	4	13.40	REFERENCE ENTHALPY	YES	DOWN DISCHARGE	361	1,400	0.75	1.05	1	80.9	68.05	59.47	57.28	49.82	34.77	STD INDIRECT	STAGED	2	80	64.8	--	55	97.67	208V/3Ø	31	45	TRANE YSK048A3	821	1-6

- REMARKS:
- MULTI-SPEED, DIRECT DRIVE FAN.
 - RETURN AIR SMOKE DETECTOR.
 - FACTORY INSTALLED NON-FUSED DISCONNECT SWITCH.
 - POWERED 15A CONVENIENCE OUTLET.
 - SEACOAST CONDENSER COIL PROTECTION.
 - 14" HIGH INSULATED CURB.

NOTE: TRANE MAKE & MODEL NUMBER NOTED IN SCHEDULE.
AAON, CARRIER, JOHNSON CONTROLS, MCQUAY OR AS
APPROVED.

DEDICATED OUTSIDE AIR SYSTEM SCHEDULE

MARK	LOCATION	SERVICE	CFM	MIN OA	ESP	SUPPLY FAN			HEAT EXCHANGER				DIRECT EXPANSION COIL								MANUFACTURER MODEL	WEIGHT (LBS)	REMARKS	
									AIR TEMP. DRY BULB (°F)		CAPACITY		RATED	EAT (°F)		LAT (°F)		CAPACITY		REHEAT				
						HP	MCA / MOC/P	VOLTI/PH	ENTERING	LEAVING	INPUT	OUTPUT	TURNDOWN	DRY BULB	WET BULB	DRY BULB	WET BULB	TOTAL	SENSIBLE	LAT DB (°F)				CAPACITY
DOAS-1	SOUTH WING ROOF	OUTSIDE AIR	800	800	0.75	3/4	28.7 / 45	208V/3Ø	19.7	89.9	75 MBH	60.8 MBH	12.1	88.9	79.1	54.1	53.7	69.4 MBH	28.7 MBH	94.2	33.7 MBH	GREENHECK RV-20-5-1	1,157	1-3
DOAS-2	NORTH WING ROOF	OUTSIDE AIR	800	800	0.75	3/4	28.7 / 45	208V/3Ø	19.7	89.9	75 MBH	60.8 MBH	12.1	88.9	79.1	54.1	53.7	69.4 MBH	28.7 MBH	94.2	33.7 MBH	GREENHECK RV-20-5-1	1,157	1-3

- REMARKS:
- MERV 8 SUPPLY AIR FILTERS.
 - END INTAKE, SIDE DISCHARGE.
 - OUTDOOR AIR DAMPER.

FURNACE AND CONDENSING UNIT SCHEDULE

MARK	SERVICE	INDOOR													OUTDOOR						REMARKS
		FAN				COOLING			HEATING		ELECTRICAL			MANUFACTURER	ELECTRICAL				MANUFACTURER		
		CFM	OA	ESP	HP	TOTAL	SENSIBLE	SEER2	INPUT	OUTPUT	EFFICIENCY	VOLTAGE	MCA	MOCOP	MODEL	MARK	VOLTAGE	MCA	MOCOP	MODEL	
F-1	SOUTH WING NURSE/LOUNGE	1,700	381	0.75	1	52,497 BTUH	39,077 BTUH	13.40	80,000 BTUH	50,440 BTUH 77,600 BTUH	95%	120V/1Ø	14A	15A	TRANE S9X2C080U5PSB + STXCC007AS3	CU-1	208V/1Ø	30A	50A	TRANE 5TTR3060A1	1-3
F-2	SOUTH WING OFFICE/SPA/STOR.	1,100	177	0.75	1/2	32,181 BTUH	23,912 BTUH	14.30	40,000 BTUH	25,220 BTUH 38,000 BTUH	95%	120V/1Ø	9A	15A	TRANE S9X2B040U3PSB + STXCB004AS3	CU-2	208V/1Ø	18A	30A	TRANE 5TTR4036A1	1-3
F-3	NORTH WING NURSE/LOUNGE	1,700	381	0.75	1	52,497 BTUH	39,077 BTUH	13.40	80,000 BTUH	50,440 BTUH 77,600 BTUH	95%	120V/1Ø	14A	15A	TRANE S9X2C080U5PSB + STXCC007AS3	CU-3	208V/1Ø	30A	50A	TRANE 5TTR3060A1	1-3
F-4	NORTH WING OFFICE/SPA/STOR.	1,100	177	0.75	1/2	32,181 BTUH	23,912 BTUH	14.30	40,000 BTUH	25,220 BTUH 38,000 BTUH	95%	120V/1Ø	9A	15A	TRANE S9X2B040U3PSB + STXCB004AS3	CU-4	208V/1Ø	18A	30A	TRANE 5TTR4036A1	1-3

- REMARKS:
- CONCENTRIC VENT TERMINATION KIT.
 - 2 STAGE HEATING.
 - PROVIDE 1" FILTER RACK WITH MERV 8 FILTER.

NOTE: EQUIVALENT UNITS BY APPROVED
MANUFACTURERS.

EXHAUST FAN SCHEDULE - GENERAL

MARK	SERVICE	FAN					ELECTRICAL					MANUFACTURER MODEL	REMARKS
		AIRFLOW CFM	ESP IN WC	RPM	SIZE HP	TYPE	FEI	VOLTAGE PHASE	FLA A	MCA A	MOCAP A		
EF-1	PRIVATE ROOM, UTIL, LAV, SPA (SOUTH WING)	1,155	0.57	1,013	1/2	DD EC	--	120V/ 1Ø	6.6	8.2	15	GREENHECK G-140-VG	1, 3, 4, 7
EF-2	PRIVATE, SEMI-PRIVATE ROOMS (SOUTH WING)	640	0.62	1,291	1/4	DD EC	--	120V/ 1Ø	3.8	4.8	15	GREENHECK G-100-VG	1, 3, 4, 7
EF-3	MENS, WOMENS, LAV, BATH, JAN (CENTRAL WING)	650	0.62	1,299	1/4	DD EC	--	120V/ 1Ø	3.8	4.8	15	GREENHECK G-100-VG	2, 4, 7
EF-4	RESERVED	--	--	--	--	--	--	--	--	--	--	--	--
EF-5	PRIVATE, SEMI-PRIVATE ROOMS (NORTH WING)	640	0.62	1,291	1/4	DD EC	--	120V/ 1Ø	3.8	4.8	15	GREENHECK G-100-VG	1, 3, 4, 7
EF-6	PRIVATE ROOM, UTIL, LAV, SPA (NORTH WING)	1,100	0.57	998	1/2	DD EC	--	120V/ 1Ø	6.6	8.2	15	GREENHECK G-140-VG	1, 3, 4, 7
EF-7	IT CLOSET (SOUTH WING)	150	0.25	916	FRAC	DD EC	--	120V/ 1Ø	1.5	1.9	15	GREENHECK SP-A390-VG	4, 5, 8, 9
EF-8	IT CLOSET (NORTH WING)	150	0.25	916	FRAC	DD EC	--	120V/ 1Ø	1.5	1.9	15	GREENHECK SP-A390-VG	4, 5, 8, 9
EF-9	C46 HAZ (CENTRAL WING)	75	0.29	950	FRAC	DD EC	--	120V/ 1Ø	0.19	0.2	15	GREENHECK SP-A110	4, 5, 9-10
EF-10	C49 OXYGEN (CENTRAL WING)	75	0.29	950	FRAC	DD EC	--	120V/ 1Ø	0.19	0.2	15	GREENHECK SP-A110	4, 5, 9-10

- REMARKS:
- PREFAB. ROOF CURB FOR PITCHED ROOF.
 - PREFAB. ROOF CURB FOR FLAT ROOF.
 - GRAVITY DAMPER.
 - DISCONNECT SWITCH.
 - SPRING LOADED BACKDRAFT DAMPER
 - LIGHT SWITCH CONTROL.
 - PROGRAMMABLE TIME CLOCK OPERATION.
 - OPERATE FROM WALL THERMOSTAT.
 - CEILING GRILLE.
 - CONTINUOUS OPERATION.

GRILLE, REGISTER AND DIFFUSER SCHEDULE

MARK	MANUFACTURER MODEL	DESCRIPTION	DAMPER NUMBER	FRAME/ BORDER	MODULE SIZE	PATTERN	FINISH	REMARKS
A	PRICE SPD	SQUARE FLAT PLAQUE DIFFUSER	VCR7 OBD	LAY-IN	24 X 24	4 - WAY	WHITE	1
B	PRICE 520	LOUVERED SUPPLY GRILLE	VCS3 OBD	GYP BRD	AS NOTED	DOUBLE DEFLECTION	WHITE	--
C	PRICE 530	FIXED, LOUVERED RETURN GRILLE	VCS3 OBD	LAY-IN	AS NOTED	SINGLE DEFLECTION	WHITE	2
E1	PRICE 530	FIXED, LOUVERED EXHAUST GRILLE	VCS3 OBD	LAY-IN	AS NOTED	3/4", FIXED 45 DEFLECTION	WHITE	3-4
E2	PRICE 530	FIXED, LOUVERED EXHAUST GRILLE	VCS3 OBD	GYP BRD	AS NOTED	3/4", FIXED 45 DEFLECTION	WHITE	3-4

- SAMPLE REMARKS:
- MODEL SPF, STEEL PLASTER FRAME, WHITE FINISH, IF LOCATED IN GYPSUM BOARD.
 - MODEL LS, LIGHT SHIELD, BLACK FINISH AT RETURN AIR PLENUMS.
 - MODEL SR, SQUARE TO ROUND ADAPTER, BLACK INTERIOR.
 - PROVIDE GREENHECK ABD, SET TO SCHEDULED CFM. SEE DETAIL.

ELECTRIC DUCT HEATER SCHEDULE

MARK	AREA SERVED	CFM	DUCT SIZE	KW	VOLTAGE	MANUFACTURER MODEL	REMARKS
EDH-1	CONFERENCE & LOBBY (CENTRAL WING)	400	10/10	2	208 1Ø	INDEECO QUA	1-6
EDH-2	ACTIVITY & OFFICES (CENTRAL WING)	780	10/10	3.5	208 1Ø	INDEECO QUA	1-6

- REMARKS:
- OPEN COIL, SLIP-IN.
 - THERMAL CUT-OUTS.
 - AIRFLOW SWITCH.
 - CONTACTORS, FUSES, CONTROL
CIRCUIT, TRANSFORMER.
 - BUILT IN SNAP ACTING DOOR.
 - INTERLOCKED DISCONNECT SWITCH
& CONTROL PANEL.
- NOTE: EQUIVALENT BY BRASCH,
CHROMOLOX, OR AS APPROVED.

ELECTRIC HEATER SCHEDULE

MARK	AREA SERVED	TYPE	KW	VOLTAGE PHASE	MANUFACTURER MODEL	REMARKS
EH-1	CORRIDOR S04 (SOUTH WING)	WALL (FAN FORCED)	3	208V 1Ø	MARKEL 3326	1-3
EH-2	CORRIDOR S12 (SOUTH WING)	WALL (FAN FORCED)	3	208V 1Ø	MARKEL 3326	1-3
EH-3	CORRIDOR N03 (NORTH WING)	WALL (FAN FORCED)	3	208V 1Ø	MARKEL 3326	1-3
EH-4	CORRIDOR N12 (NORTH WING)	WALL (FAN FORCED)	3	208V 1Ø	MARKEL 3326	1-3
EH-5	VEST, C01 (CENTRAL WING)	CEILING	4	208V 3Ø	MARKEL 3470 SERIES MODEL J3474	1-2, 4
RP-1	SPA CEILING	RADIANT CEILING	0.675	208V 1Ø	INDEECO AS2448-675-208	5-7

- REMARKS:
- FURNISH WITH BUILT-IN THERMOSTAT.
 - DISCONNECT SWITCH.
 - FAN-FORCED WALL HEATER, RECESSED.
 - SURFACE MOUNTED
 - SR-LV SMARTROOMS COMFORT CONTROLLER LOW VOLTAGE COMPLETE WITH SENSORS.
 - LAY-IN CEILING FRAME.
 - 2", 4LB DENSITY HIGH TEMPERATURE MINERAL WOOL INSULATION.
- NOTE: EQUIVALENT BY QMARK, BERKO,
OR AS APPROVED.

PACKAGED TERMINAL AIR CONDITIONING UNIT SCHEDULE

MARK	SERVICE	FAN				COOLING			HEATING			ELECTRICAL			MANUFACTURER MODEL	WEIGHT	REMARKS
		CFM	O A CFM	ESP	HP	TOTAL COOLING	SENSIBLE COOLING	EER (MIN)	STANDARD HEATING	COP HEATING	ELECTRIC HEATING	VOLTAGE	MCA	MOCp			
PTAC-A	PRIVATE ROOM	360/212	45	--	--	9,600	--	12.4	7,900	3.8	6,600 BTUH 1.96 KW	208/1Ø	15	15	GE AZHS09DCXXA	100	1-7
PTAC-B	SEMI-PRIVATE ROOM	370/284	45	--	--	11,900	--	11.6	10,600	3.7	9,400 BTUH 2.78 KW	208/1Ø	20	20	GE AZHS12DCXXA	100	1-7

- REMARKS:
- INCLUDE CORROSION RESISTANT WALL SLEEVE & ARCHITECTURAL GRILLE
KIT. COLOR TO MATCH BRICK & TO BE APPROVED BY THE ARCHITECT.
 - REMODE WALL MOUNTED SENSOR.
 - CONDENSATE DRAIN KIT.
 - 5-YEAR SEALED COMPRESSOR WARRANTY.
 - FUSE HOLDER KIT. POWER CORD CONNECTION KIT. NEMA 6-20R
 - REFRIGERANT R-410A HEAT PUMP, 28.0/30.5 OZ.
 - RAKVENT 1 KIT, VENTILATION DAMPER.

NOTE: GE MAKE & MODEL NUMBER IN SCHEDULE.
EQUIVALENT BY AMANA, FRIEDRICH, OR AS APPROVED.

KITCHEN EXHAUST FAN SCHEDULE

FAN NO.	LOCATION	SERVICE	CFM	E.S.P.	HP	VOLTAGE	FLA	RPM	OUTLET VELOCITY OR TIP SPEED	SONES	TYPE	MANUFACTURER & MODEL NO.	WEIGHT (LBS)	REMARKS
KEF-1 #1 #2	ROOFTOP	KITCHEN HOOD	2625	1.850	2.000	208/3	7.2	1,360	606 FPM	19.7	UTILITY SET SINGLE WIDTH	ECON-AIR EADU180H	215	1-3
KEF-2 #1 #2	ROOFTOP	DISHWASHER HOOD	600	0.500	0.333	120/1	5.6	1,255	297 FPM	10.9	UTILITY SET SINGLE WIDTH	ECON-AIR EADU33H	76	1-4

- REMARKS:
- PREFAB ROOF CURB FOR FLAT ROOF.
 - GRAVITY DAMPER.
 - DISCONNECT SWITCH.
 - MANUAL OPERATION.

*1 FURNISHED BY KITCHEN HOOD SUPPLIER & INSTALLED BY MECHANICAL CONTRACTOR.
*2 ELECTRICAL REQUIREMENTS & FAN PERFORMANCE TO BE VERIFIED WITH ACTUAL
EXHAUST FAN FURNISHED BY KITCHEN EQUIPMENT SUPPLIER.

OUTDOOR MAKE-UP AIR UNIT SCHEDULE

MARK	LOCATION	SERVICE	FAN				HEATING			UNIT	ELECTRICAL			MANUFACTURER MODEL	REMARKS
			CFM	MINIMUM OA CFM	ESP	HP	INPUT MBH	OUTPUT MBH	STAGES	WEIGHT LBS	VOLTAGE	MCA	MOC		
MAU-1 #1 #2	ROOFTOP	KITCHEN HOOD HOOD #1	2050	2050	0.5"	2	163.7	132.6	--	1,223	208/3Ø	28.4	30A	ECON-AIR EARTU14200-15-ST-MPU	1-6

- REMARKS:
- ROOF CURB.
 - SINGLE ZONE UNIT.
 - FILTERS SHALL BE MINIMUM 25% ASHRAE DUSTSTOP EFFICIENCY
IN ACCORDANCE WITH ASHRAE TEST STANDARD 52.1 & 52.2.
 - DISCONNECT SWITCH.
 - DOWNFLOW ARRANGEMENT.
 - MODULATION CONTROL FURNISHED BY KITCHEN HOOD SUPPLIER.
 - LP CONVERSION KIT.

*1 FURNISHED BY KITCHEN HOOD SUPPLIER & INSTALLED BY MECHANICAL CONTRACTOR.
*2 ELECTRICAL REQUIREMENTS & FAN PERFORMANCE TO BE VERIFIED WITH ACTUAL
EXHAUST FAN FURNISHED BY KITCHEN EQUIPMENT SUPPLIER.

MAINTENANCE INFORMATION AND SYSTEM COMMISSIONING

GENERAL
THIS SECTION COVERS THE PROVISION OF MAINTENANCE INFORMATION AND THE COMMISSIONING OF, AND THE FUNCTIONAL TESTING REQUIREMENTS FOR, BUILDING SYSTEMS. MECHANICAL CONTRACTOR SHALL PROVIDE COMMISSIONING SERVICES IN ACCORDANCE WITH IECC SECTION C408.

BUILDING OPERATIONS AND MAINTENANCE INFORMATION
THE BUILDING OPERATIONS AND MAINTENANCE DOCUMENTS SHALL BE PROVIDED TO THE OWNER AND SHALL CONSIST OF MANUFACTURERS' INFORMATION, SPECIFICATIONS AND RECOMMENDATIONS, PROGRAMMING PROCEDURES AND DATA POINTS, NARRATIVES, AND OTHER MEANS OF ILLUSTRATING TO THE OWNER HOW THE BUILDING, EQUIPMENT AND SYSTEMS ARE INTENDED TO BE INSTALLED, MAINTAINED AND OPERATED. REQUIRED REGULAR MAINTENANCE ACTIONS FOR EQUIPMENT AND SYSTEMS SHALL BE CLEARLY STATED ON A READILY VISIBLE LABEL. THE LABEL SHALL INCLUDE THE TITLE OR PUBLICATION NUMBER FOR THE OPERATION AND MAINTENANCE MANUAL FOR THAT PARTICULAR MODEL AND TYPE OF PRODUCT.

Mechanical systems and service water-heating systems commissioning and completion requirements
Prior to the final mechanical and plumbing inspections, the approved agency shall provide evidence of mechanical systems commissioning and completion in accordance with the provisions of this section. Copies of all documentation shall be given to the owner or owner's authorized agent and made available to the code official upon request.
Exceptions: The following systems are exempt:
1. Systems that serve individual dwelling units and sleeping units.

Commissioning plan
A commissioning plan shall be developed by the approved agency and shall include the following items:
1. A narrative description of the activities that will be accomplished during each phase of commissioning, including the personnel intended to accomplish each of the activities.
2. A listing of the specific equipment, appliances or systems to be tested and a description of the tests to be performed.
3. Functions to be tested including, but not limited to, calibrations and economizer controls.
4. Conditions under which the test will be performed. Testing shall affirm winter and summer design conditions and full outside air conditions.
5. Measurable criteria for performance.

Systems adjusting and balancing
HVAC systems shall be balanced in accordance with generally accepted engineering standards. Air and water flow rates shall be measured and adjusted to deliver final flow rates within the tolerances provided in the product specifications. Test and balance activities shall include air system and hydronic system balancing.

Air systems balancing
Each supply air outlet and zone terminal device shall be equipped with means for air balancing in accordance with the requirements of Chapter 6 of the International Mechanical Code. Discharge dampers used for air-system balancing are prohibited on constant-volume fans and variable volume fans with motors 10 hp and larger. Air systems shall be balanced in a manner to first minimize throttling losses then, for fans with system power of greater than 1 hp, fan speed shall be adjusted to meet design flow conditions.
Exception: Fans with fan motors of 1 hp or less are not required to be provided with a means for air balancing.

Hydronic systems balancing
Individual hydronic heating and cooling coils shall be equipped with means for balancing and measuring flow. Hydronic systems shall be proportionately balanced in a manner to first minimize throttling losses, then the pump impeller shall be trimmed, or pump speed shall be adjusted to meet design flow conditions. Each hydronic system shall have either the capability to measure pressure across the pump, or test ports at each side of each pump.
Exception: The following equipment is not required to be equipped with a means for balancing or measuring flow:
1. Pumps with pump motors of 5 hp (3.7 kW) or less.

2. Where throttling results in not greater than 5 percent of the nameplate horsepower draw above that required if the impeller were trimmed.

Functional performance testing
Functional performance testing shall be provided as indicated below.

Equipment
Equipment functional performance testing shall demonstrate the installation and operation of components, systems and system-to-system interfacing relationships in accordance with approved plans and specifications such that operation, function and maintenance serviceability for each of the commissioned systems are confirmed. Testing shall include all modes and sequence of operation, including under full-load, part-load and the following emergency conditions:
1. All modes as described in the sequence of operation.
2. Redundant or automatic back-up mode.
3. Performance of alarms.
4. Mode of operation upon a loss of power and restoration of power.
5. Exception: Unitary or packaged HVAC equipment that does not require supply air economizers.

Controls
HVAC and service water-heating control systems shall be tested to document that control devices, components, equipment and systems are calibrated and adjusted and operate in accordance with approved plans and specifications. Sequences of operation shall be functionally tested to document they operate in accordance with approved plans and specifications.

Economizers
Air economizers shall undergo a functional test to determine that they operate in accordance with the manufacturer's specifications.

Preliminary commissioning report
A preliminary report of commissioning test procedures and results shall be completed and certified by the approved agency and provided to the building owner or owner's authorized agent. The report shall be organized with mechanical and service hot water findings in separate sections to allow independent review. The report shall be identified as "Preliminary Commissioning Report," shall include the completed Commissioning Compliance Checklist, and shall identify:
1. Itemization of deficiencies found during testing required by this section that have not been corrected at the time of report preparation.
2. Deferred tests that cannot be performed at the time of report preparation because of climatic conditions.
3. Climatic conditions required for performance of the deferred tests.
4. Results of functional performance tests.
5. Functional performance test procedures used during the commissioning process, including measurable criteria for test acceptance.

Acceptance of report
Buildings, or portions thereof, shall not be considered as acceptable for a final inspection pursuant to IECC Section C105.2.6 until the code official has received the Preliminary Commissioning Report from the building owner or owner's authorized agent.

Copy of report
The code official shall be permitted to require that a copy of the Preliminary Commissioning Report be made available for review by the code official.

COMMISSIONING COMPLIANCE CHECKLIST
PROJECT INFORMATION: _____ PROJECT NAME: _____
PROJECT ADDRESS: _____
COMMISSIONING AUTHORITY: _____
COMMISSIONING PLAN (SECTION C408.2.1)

Commissioning plan was used during construction and includes all items required by Section C408.2.1

Systems Adjusting and Balancing has been completed.

HVAC Equipment Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on: _____

Economizer Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on: _____

Lighting Controls Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on: _____

Service Water Heating Systems Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on: _____

Manual, record documents and training have been completed or scheduled.

Preliminary Commissioning Report submitted to owner and includes all items required by Section C408.2.4

I hereby certify that the commissioning provider has provided me with evidence of mechanical, service water heating and lighting systems commissioning in accordance with the 2021 IECC.

Documentation requirements
The documents described in this section be provided to the building owner or owner's authorized agent within 90 days of the date of receipt of the certificate of occupancy.

System balancing report
A written report describing the activities and measurements completed in accordance with system adjusting and balancing noted above.

Final commissioning report
A report of test procedures and results identified as "Final Commissioning Report" shall be delivered to the building owner or owner's authorized agent. The report shall be organized with mechanical system and service hot water system findings in separate sections to allow independent review. The report shall include the following:
1. Results of functional performance tests.
2. Disposition of deficiencies found during testing, including details of corrective measures used or proposed.
3. Functional performance test procedures used during the commissioning process, including measurable criteria for test acceptance, provided herein for repeatability.
Exception: Deferred tests that cannot be performed at the time of report preparation due to climatic conditions.

Functional testing of lighting controls
Automatic lighting controls required by this code shall comply with this section.

Functional testing
Prior to passing final inspection, the approved agency shall provide evidence that the lighting control systems have been tested to ensure that control hardware and software are calibrated, adjusted, programmed and in proper working condition in accordance with the construction documents and manufacturer's instructions. Functional testing shall be in accordance with the applicable control type.

Occupant sensor controls
Where occupant sensor controls are provided, the following procedures shall be performed:
1. Certify that the occupant sensor has been located and aimed in accordance with manufacturer recommendations.
2. For projects with seven or fewer occupant sensors, each sensor shall be tested.
3. For projects with more than seven occupant sensors, testing shall be done for each unique combination of sensor type and space geometry. Where multiples of each unique combination of sensor type and space geometry are provided, not less than 10 percent and in no case fewer than one of each combination shall be tested unless the code official or design professional requires a higher percentage to be tested. Where 30 percent or more of the tested controls fail, all remaining combinations shall be tested. For occupant sensor controls to be tested, verify the following:
a. Where occupant sensor controls include status indicators, verify correct operation.
b. The controlled lights turn off or down to the permitted level within the required time.
c. For auto-on occupant sensor controls, the lights turn on to the permitted level when an occupant enters the space.
d. For manual-on occupant sensor controls, the lights turn on only when manually activated.
e. The lights are not incorrectly turned on by movement in adjacent areas or by HVAC operation.

Time-switch controls
Where time-switch controls are provided, the following procedures shall be performed:
1. Confirm that the time-switch control is programmed with accurate weekday, weekend and holiday schedules.
2. Provide documentation to the owner of time-switch controls programming including weekday, weekend, holiday schedules, and set-up and preference program settings.
3. Verify the correct time and date in the time switch.
4. Verify that any battery back-up is installed and energized.
5. Verify that the override time limit is set to not more than 2 hours.
6. Simulate occupied condition. Verify and document the following:
a. All lights can be turned on and off by their respective area control switch.
b. The switch only operates lighting in the enclosed space in which the switch is located.
7. Simulate unoccupied condition. Verify and document the following:
a. Nonexempt lighting turns off.
b. Manual override switch allows only the lights in the enclosed space where the override switch is located to turn on or remain on until the next scheduled shutoff occurs.
8. Additional testing as specified by the registered design professional.

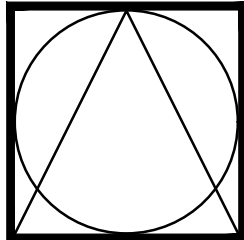
Daylight responsive controls
Where daylight responsive controls are provided, the following shall be verified:
1. Control devices have been properly located, field calibrated and set for accurate setpoints and threshold light levels.
2. Daylight controlled lighting loads adjust to light level setpoints in response to available daylight.
3. The calibration adjustment equipment is located for ready access only by authorized personnel.

Documentation requirements
The documents described in this section be provided to the building owner or owner's authorized agent within 90 days of the date of receipt of the certificate of occupancy.

Drawings
Construction documents shall include the location and catalogue number of each piece of equipment.

Manuals
An operating and maintenance manual shall be provided and include the following:
1. Name and address of not less than one service agency for installed equipment.
2. A narrative of how each system is intended to operate, including recommended setpoints.
3. Submittal data indicating all selected options for each piece of lighting equipment and lighting controls.
4. Operation and maintenance manuals for each piece of lighting equipment. Required routine maintenance actions, cleaning and recommended relamping shall be clearly identified.
5. A schedule for inspecting and recalibrating all lighting controls.

Report
A report of test results shall be provided and include the following:
1. Results of functional performance tests.
2. Disposition of deficiencies found during testing, including details of corrective measures used or proposed.



DSC
ARCHITECTS
401 FRONT STREET
BEREA, OHIO 44017
PHONE: 440.835.3957
mail@dscarchitects.com

DATE:
PERMIT SUBMISSION:
06.19.26

BENNETT'S CREEK
HEALTH & REHABILITATION CENTER
1931/1915 BRIDGE ROAD (HIGHWAY 17)
SUFFOLK, VIRGINIA



MT Denke

DRAWING NAME
MAINTENANCE
INFORMATION &
CHECKLIST

DAI PROJECT NO.
26032

M7.1