

MECHANICAL LEGEND

ALL SYMBOLS INDICATED MAY NOT APPEAR ON THESE CONTRACT DRAWINGS

GENERAL

- EXISTING
- EXISTING TO BE REMOVED
- ITEM TO BE PROVIDED
- "DEMOLITION TO THIS POINT" SYMBOL
- "NEW CONSTRUCTION AT THIS POINT" SYMBOL

DUCTWORK AND ACCESSORIES

- REGISTER/GRILLE/DIFFUSER (MARK/CFM)
- EXISTING REGISTER/GRILLE/DIFFUSER (CFM AS SHOWN)
- EXISTING RELOCATED/REINSTALLED REGISTER/GRILLE/DIFFUSER (CFM AS SHOWN)
- SUPPLY DIFFUSER 4-WAY
- SUPPLY DIFFUSER 3-WAY
- SUPPLY DIFFUSER 2-WAY
- SUPPLY DIFFUSER 2-WAY CORNER
- SUPPLY DIFFUSER 1-WAY
- SUPPLY GRILLE OR REGISTER
- RETURN GRILLE
- EXHAUST GRILLE
- HORIZONTAL FIRE DAMPER
- VERTICAL FIRE DAMPER
- HORIZONTAL FIRE AND SMOKE DAMPER
- VERTICAL FIRE AND SMOKE DAMPER
- HORIZONTAL SMOKE DAMPER
- VERTICAL SMOKE DAMPER
- VOLUME DAMPER
- VOLUME DAMPER W/REMOTE DAMPER OPERATOR
- MOTOR OPERATED DAMPER
- OUTSIDE AIR DUCT (NEGATIVE PRESSURE)
- SUPPLY DUCT SECTION (POSITIVE PRESSURE)
- RETURN DUCT SECTION (NEGATIVE PRESSURE)
- EXHAUST DUCT SECTION (NEGATIVE PRESSURE)
- FLEXIBLE DUCT
- 22 x 14 DUCT SIZE (INCHES), FIRST FIGURE IS SIDE SHOWN
- 12" ROUND DUCT SIZE (INCHES)
- 24 x 12" OVAL DUCT SIZE (INCHES), FIRST FIGURE IS SIDE SHOWN
- CHANGE OF ELEVATION--RISE (UP)--DROP (DN)
- AIR FLOW STATION
- VAV BOX WITH HOT WATER COIL
- RADIANT CEILING PANEL
- ACCESS DOOR, VERTICAL OR HORIZONTAL
- 3/4" DOOR UNDERCUT
- DOOR GRILLE

CONTROLS

- ELECTRIC THERMOSTAT (MOUNT 48" AFF U.O.N)
- PNEUMATIC THERMOSTAT (MOUNT 48" AFF U.O.N)
- SMOKE DETECTOR
- PRESSURE SWITCH
- FLOW SWITCH

PIPING

- DOMESTIC COLD WATER
- A ----- COMPRESSED AIR
- BBD ----- BOILER BLOW DOWN
- CD ----- CONDENSATE DRAIN
- CR ----- CONDENSER WATER RETURN

PIPING (CONT.)

- CS ----- CONDENSER WATER SUPPLY
- CWR ----- CHILLED WATER RETURN
- CWS ----- CHILLED WATER SUPPLY
- FOR ----- FUEL OIL RETURN
- FOS ----- FUEL OIL SUCTION
- FOV ----- FUEL OIL TANK VENT
- G ----- NATURAL GAS
- HPC ----- HIGH PRESSURE CONDENSATE
- HPS ----- HIGH PRESSURE STEAM
- HWR ----- HEATING WATER RETURN
- HWS ----- HEATING WATER SUPPLY
- LPC ----- LOW PRESSURE CONDENSATE
- LPG ----- LIQUEFIED PETROLEUM GAS (PROPANE)
- LPS ----- LOW PRESSURE STEAM
- MPC ----- MEDIUM PRESSURE CONDENSATE
- MPS ----- MEDIUM PRESSURE STEAM
- PC ----- PUMPED CONDENSATE
- RL ----- REFRIGERANT LIQUID
- RS ----- REFRIGERANT SUCTION
- STM ----- STEAM
- SW ----- SOFT WATER

PIPE FITTINGS

- PIPE CAP
- PIPE TURNING UP
- PIPE TURNING DOWN
- TEE AND ELBOW UP
- TEE AND ELBOW DOWN
- TEE UP
- TEE DOWN
- UNION
- CONCENTRIC PIPE REDUCER/INCREASER
- ECCENTRIC PIPE REDUCER/INCREASER

VALVES AND PIPING SPECIALTIES

- ANGLE GATE VALVE
- ANGLE GLOBE VALVE
- PRESSURE RELIEF/SAFETY VALVE
- AUTOFLOW CONTROL VALVE
- CIRCUIT SETTER
- BALL VALVE
- BUTTERFLY VALVE
- GATE VALVE
- GLOBE VALVE
- NEEDLE VALVE
- PRESSURE REDUCING VALVE
- THREE WAY CONTROL VALVE
- THREE WAY VALVE
- TWO WAY CONTROL VALVE
- SOLENOID VALVE
- FLOW METER
- TRIPLE DUTY VALVE
- GAS COCK
- SWING GATE CHECK VALVE
- SPRING CHECK VALVE
- FLOW ORIFICE
- STRAINER
- STRAINER WITH BLOWDOWN
- PRESSURE GAUGE WITH GAUGE COCK
- THERMOMETER
- AUTOMATIC AIR VENT
- MANUAL AIR VENT

MECHANICAL ABBREVIATIONS

ALL ABBREVIATIONS INDICATED MAY NOT APPEAR ON THESE CONTRACT DRAWINGS

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| <ul style="list-style-type: none"> AMP AMPERE A/C AIR CONDITIONING ABV ABOVE AFV ABOVE FINISHED CEILING AFF ABOVE FINISHED FLOOR (18" UON) AFG ABOVE FINISHED GRADE (18" UON) AHU AIR HANDLING UNIT ALT ALTERNATE AMB AMBIENT ANSI AMERICAN NATIONAL STANDARDS INSTITUTE APPROX APPROXIMATE AVG AVERAGE BEL BELOW BHP BRAKE HORSEPOWER BLDG BUILDING BTUH BRITISH THERMAL UNIT PER HOUR CC COOLING COIL CLG CEILING dB DECIBELS Db DRY BULB TEMPERATURE DEMO DEMOLITION DIA DIAMETER DN DOWN DWG DRAWING DX DIRECT EXPANSION EA EXHAUST AIR EC ELECTRICAL CONTRACTOR EDH ELECTRIC DUCT HEATER EER ENERGY EFFICIENCY RATIO EF EXHAUST FAN EQUIP EQUIPMENT ER EXISTING RELOCATED ET EXPANSION TANK ETR EXISTING TO REMAIN EUH ELECTRIC UNIT HEATER EWL ELECTRIC WATER HEATER EWT ENTERING WATER TEMPERATURE EX EXISTING FBO FURNISHED BY OTHERS FCU FAN COIL UNIT FD FLOOR DRAIN FLEX FLEXIBLE FLR FLOOR FOB FLAT ON BOTTOM FOT FLAT ON TOP FTR FIN TUBE RADIATION GC GENERAL CONTRACTOR GPH GALLONS PER HOUR GPM GALLONS PER MINUTE HC HEATING COIL HORZ HORIZONTAL HP HORSEPOWER HPC HIGH PRESSURE STEAM CONDENSATE RETURN HPS HIGH PRESSURE STEAM HGT HEIGHT | <ul style="list-style-type: none"> HV HEATING AND VENTILATING UNIT HVAC HEATING, VENTILATING, AND AIR CONDITIONING I.E. INVERT ELEVATION I.V. INLET VANES KW KILOWATTS LBS POUNDS LBS/HR POUNDS PER HOUR LPC LOW PRESSURE STEAM CONDENSATE RETURN LPS LOW PRESSURE STEAM LWT LEAVING WATER TEMPERATURE MAX. MAXIMUM MBH 1,000 BTUH MC MECHANICAL CONTRACTOR MFR MANUFACTURER MIN. MINIMUM MOD MOTOR OPERATED DAMPER MPC MEDIUM PRESSURE STEAM CONDENSATE RETURN MPS MEDIUM PRESSURE STEAM NC NORMALLY CLOSED NIC NOT IN CONTRACT NO NORMALLY OPEN NOM. NOMINAL NTS NOT TO SCALE OA OUTSIDE AIR PC PUMPED CONDENSATE PD PRESSURE DROP PRV PRESSURE REDUCING VALVE PSI POUNDS PER SQUARE INCH P/T PRESSURE/TEMPERATURE TAP RA RETURN AIR RD ROOF DRAIN RF RETURN FAN RH RELATIVE HUMIDITY SA SUPPLY AIR S/S STAINLESS STEEL SF SQUARE FEET SP STATIC PRESSURE SPEC SPECIFICATION STD STANDARD SW SOFTENED WATER TEMP TEMPERATURE TOP TOP OF FOOTER TYP TYPICAL UC UNDERCOUNTER UH UNIT HEATER UL UNDERWRITERS LABORATORY U.O.N UNLESS OTHERWISE NOTED VD VOLUME DAMPER (MANUAL OPPOSED BLADE) VERT VERTICAL VFD VARIABLE FREQUENCY DRIVE W/ WITH W/O WITH OUT Wb WET BULB TEMPERATURE WTR WATER WWM WELDED WIRE MESH |
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MEP DESIGN SUMMARY

PROJECT INFORMATION

PROJECT NAME:	FARMERS MARKET RESTROOM RENOVATION
ADDRESS:	345 SOUTH MAIN STREET HARRISONBURG, VA. 22801
PROPOSED USE:	OFFICE AND PUBLIC RESTROOMS
OWNER:	CITY OF HARRISONBURG
OWNER CONTACT:	ADAM WRIGHT
PHONE:	540-560-9455
VE PROJ. NO.:	10895-3

APPLICABLE CODES

BUILDING CODE:	VIRGINIA REHABILITATION CODE: 2012
	WORK COMPLIANCE METHOD
MECHANICAL CODE:	VIRGINIA MECHANICAL CODE: 2012
PLUMBING CODE:	VIRGINIA PLUMBING CODE: 2012
ELECTRICAL CODE:	NFPA 70, 2011 NATIONAL ELECTRICAL CODE
ACCESSIBILITY CODE:	ICC/ANSI A117.1 2009 STANDARDS ON ACCESSIBLE AND USABLE BUILDING AND FACILITIES
GAS CODE:	VIRGINIA FUEL GAS CODE: 2012

PROJECT TEAM

PROJECT MANAGER:	PHIL GENTRY
PROJECT TEAM:	JOHN SOLDANO - HVAC ENGINEER MATT SHOCKEY - PLUMBING ENGINEER KEVIN KLINE - ELECTRICAL ENGINEER TED ENOSAKI - STRUCTURAL ENGINEER TIM HOUSDEN - ELECTRICAL DESIGNER

DRAWING LIST

- | | |
|-------|-------------------------------------------------|
| G1.01 | GENERAL CONSTRUCTION PLANS |
| G1.02 | DETAILS |
| G2.01 | GENERAL STRUCTURAL PLANS, SECTIONS, AND DETAILS |
| M0.01 | MECHANICAL LEGENDS, ABBREVIATIONS, AND NOTES |
| M0.02 | MECHANICAL SPECIFICATIONS |
| M0.03 | MECHANICAL SPECIFICATIONS |
| M0.04 | MECHANICAL SPECIFICATIONS |
| M0.05 | MECHANICAL SPECIFICATIONS |
| M0.06 | MECHANICAL SCHEDULES |
| M1.01 | MECHANICAL PLANS |
| M5.01 | MECHANICAL DETAILS |
| M6.01 | MECHANICAL CONTROL DIAGRAMS |

FARMERS MARKET RESTROOM RENOVATION

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CONSTRUCTION DOCUMENTS

REVISIONS:

DATE: 05-17-2016

PROJECT NO: 10895-3

EXP./CLIENT NO: N/A

SCALE: N/A

MECHANICAL LEGEND, ABBREVIATIONS, AND NOTES

SHEET NO.:

M0.01

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1: GENERAL

1.1 SUMMARY

A. CONTRACTOR SHALL BE RESPONSIBLE FOR A COMPLETE SYSTEM INCLUDING HVAC BALANCING, ALL EQUIPMENT AND RELATED ITEMS INDICATED ON CONTRACT DRAWINGS...

1.3 QUALITY ASSURANCE

A. STEEL SUPPORT WELDING: QUALITY PROCESSES AND OPERATORS ACCORDING TO AWS D1.1, "STRUCTURAL WELDING CODE--STEEL." B. STEEL PIPE WELDING: QUALITY PROCESSES AND OPERATORS ACCORDING TO ASME BOILER AND PRESSURE VESSEL CODE...

1.4 DELIVERY, STORAGE, AND HANDLING

A. DELIVER PIPES AND TUBES WITH FACTORY-APPLIED END CAPS. MAINTAIN END CAPS THROUGH SHIPPING, STORAGE, AND HANDLING TO PREVENT PIPE END DAMAGE AND TO PREVENT ENTRANCE OF DIRT, DEBRIS, AND MOISTURE.

1.5 COORDINATION

A. COORDINATE PIPE SPACES, CHASES, SLOTS, OPENINGS IN BUILDING STRUCTURE, INSTALLATION OF SUPPORTING DEVICES AND SLEEVES DURING PROGRESS OF CONSTRUCTION TO ALLOW FOR MECHANICAL INSTALLATIONS.

1.6 TEMPORARY HEATING, POWER, COMPRESSED AIR, AND WATER

A. WILL BE ARRANGED BY THE CONTRACTOR AT THE SITE.

1.7 ELECTRICAL WIRING

A. ELECTRICAL CONTRACTOR SHALL PROVIDE ALL POWER WIRING, INCLUDING CONDUIT, WIRE AND CONNECTIONS. ALL STARTERS, FUSES, AND DISCONNECTS BY ELECTRICAL CONTRACTOR EXCEPT WHERE SPECIFIED AS PART OF PACKAGED EQUIPMENT...

PART 2: PRODUCTS

2.1 MANUFACTURERS

A. IN OTHER PART 2 ARTICLES WHERE SUBPARAGRAPH TITLES BELOW INTRODUCE LISTS, THE FOLLOWING REQUIREMENTS APPLY FOR PRODUCT SELECTION: 1. MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE PRODUCTS BY THE MANUFACTURERS SPECIFIED.

2.2 JOINING MATERIALS

A. REFER TO INDIVIDUAL DIVISION 23 PIPING SECTIONS FOR SPECIAL JOINING MATERIALS NOT LISTED BELOW. B. PIPE-FLANGE GASKET MATERIALS: SUITABLE FOR CHEMICAL AND THERMAL CONDITIONS OF PIPING SYSTEM CONTENTS.

2.3 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, DIELECTRIC UNIONS, FLANGES, FLANGE KITS, COUPLINGS, AND NIPPLES.

2.4 MECHANICAL SLEEVE SEALS

A. DESCRIPTION: MODULAR SEALING ELEMENT UNIT, DESIGNED FOR FIELD ASSEMBLY, TO FILL ANNUAL SPACE BETWEEN PIPE AND SLEEVE. SEALING ELEMENTS SHALL BE EPDM INTERLOCKING LINKS SHAPED TO FIT SURFACE OF PIPE AND OF TYPE AND NUMBER REQUIRED FOR PIPE MATERIAL AND SIZE OF PIPE...

2.5 SLEEVES

A. GALVANIZED-STEEL SHEET: 0.0239-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.

2.6 ESCUTCHEONS

A. DESCRIPTION: MANUFACTURED WALL AND CEILING ESCUTCHEONS AND FLOOR PLATES, WITH POLISHED CHROME-PLATED FINISH.

2.7 GROUT

A. DESCRIPTION: ASTM C 1107, GRADE B, NON-SHRINK AND NONMETALLIC, DRY HYDRAULIC-CEMENT GROUT. CHARACTERISTICS: POST-HARDENING, NON-CORROSIVE, NON-STAINING, STRONG, AND RECOMMENDED FOR INTERIOR AND EXTERIOR APPLICATIONS.

PART 3: EXECUTION

3.1 MECHANICAL DEMOLITION

A. DISCONNECT, DEMOLISH, AND REMOVE MECHANICAL SYSTEMS, EQUIPMENT, AND COMPONENTS INDICATED TO BE REMOVED. REMOVE PORTION OF PIPING OR DUCT INDICATED TO BE REMOVED AND OR PLUG REMAINING PIPING OR DUCT WITH SAME OR COMPATIBLE MATERIAL.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. INSTALL PIPING ACCORDING TO THE FOLLOWING REQUIREMENTS AND DIVISION 23 SECTIONS SPECIFYING PIPING SYSTEMS. SELECT SYSTEM COMPONENTS WITH PRESSURE RATING EQUAL TO OR GREATER THAN SYSTEM OPERATING PRESSURE. B. DRAWING PLANS, SCHEMATICS, AND DIAGRAMS INDICATE GENERAL LOCATION AND ARRANGEMENT OF PIPING SYSTEMS...

SIZE TO ALLOW FOR 1-INCH ANNUAL CLEAR SPACE BETWEEN PIPE AND SLEEVE FOR INSTALLING MECHANICAL SLEEVE SEALS. 1. INSTALL STEEL PIPE FOR SLEEVES SMALLER THAN 6 INCHES IN DIAMETER. 2. INSTALL CAST-IRON "WALL PIPES" FOR SLEEVES 6 INCHES AND LARGER IN DIAMETER.

3.3 PIPING JOINT CONSTRUCTION

A. JOIN PIPE AND FITTINGS ACCORDING TO THE FOLLOWING REQUIREMENTS AND DIVISION 23 SECTIONS SPECIFYING PIPING SYSTEMS. B. REAM ENDS OF PIPES AND TUBES AND REMOVE BURRS; BEVEL PLAIN ENDS OF STEEL PIPE. C. REMOVE SCALE, SLAG, DIRT, AND DEBRIS FROM INSIDE AND OUTSIDE OF PIPE AND FITTINGS BEFORE ASSEMBLY.

3.4 PIPING CONNECTIONS

A. MAKE CONNECTIONS ACCORDING TO THE FOLLOWING, UNLESS OTHERWISE INDICATED: 1. INSTALL UNIONS, IN PIPING NPS 2 AND SMALLER, ADJACENT TO EACH VALVE AND AT FINAL CONNECTION TO EACH PIECE OF EQUIPMENT.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. INSTALL UNIONS TO ALLOW MAXIMUM POSSIBLE HEADROOM UNLESS SPECIFIC MOUNTING HEIGHTS ARE INDICATED. INSTALL EQUIPMENT LEVEL AND PLUMB, PARALLEL AND PERPENDICULAR TO OTHER BUILDING SYSTEMS AND COMPONENTS IN EXPOSED INTERIOR SPACES.

3.6 EQUIPMENT START-UP

A. STARTUP: CONTRACTOR TO LUBRICATE BEARINGS AS REQUIRED. INSTALL BELTS AND CHECK FOR PROPER BELT TENSION AND MOTOR ROTATION. INSTALL ALL SAFETY DEVICES, AND FILTERS, AND CONNECT ALL DAMPER LINKAGES AND REMOVE ALL SHIPPING HOLD DOWN CLAMPS AND BLOCKING.

3.7 PAINTING

A. DAMAGE AND TOUCH-UP: REPAIR MARRED AND DAMAGED FACTORY-PAINTED FINISHES WITH MATERIALS AND PROCEDURES TO MATCH ORIGINAL FACTORY FINISH.

3.8 CONCRETE BASES

A. CONCRETE BASES: ANCHOR EQUIPMENT TO CONCRETE BASE ACCORDING TO EQUIPMENT MANUFACTURER'S WRITTEN INSTRUCTIONS AND ACCORDING TO SEISMIC CODES AT PROJECT. 1. CONSTRUCT CONCRETE BASES OF DIMENSIONS INDICATED, BUT NOT LESS THAN 4 INCHES LARGER IN BOTH DIRECTIONS THAN SUPPORTED UNIT.

3.9 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. STRUCTURAL STEEL SHALL COMPLY WITH THE FOLLOWING: 1. CHANNELS, ANGLES, PLATES AND BARS: ASTM A36. 2. W-SHAPES: ASTM A992 (GRADE 50).

3.10 GROUTING

A. MIX AND INSTALL GROUT FOR MECHANICAL EQUIPMENT BASE BEARING SURFACES, PUMP AND OTHER EQUIPMENT BASE PLATES, AND ANCHORS. CLEAN SURFACES AND PROVIDE FORMS AS REQUIRED FOR PLACEMENT OF GROUT.

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1: GENERAL

1.1 SUMMARY

A. ALL HVAC DEVICES AND EQUIPMENT SHALL BE SECURELY MOUNTED TO THE BUILDING STRUCTURE AND/OR EXTERIOR CONCRETE PAD (MIN. 4" DEPTH) AND SHALL NOT DEPEND UPON CEILING OR WALL SURFACES FOR THEIR SUPPORT.

SECTION 230533 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1: GENERAL

1.1 SUMMARY

A. THIS SECTION INCLUDES THE FOLLOWING MECHANICAL IDENTIFICATION MATERIALS AND THEIR INSTALLATION: 1. EQUIPMENT MARKERS. 2. ACCESS PANELS AND DOOR MARKERS.

1.2 SUBMITTALS

A. PRODUCT DATA: FOR EACH TYPE OF PRODUCT INDICATED. B. VALVE NUMBERING SCHEME. C. SCHEDULES: FOR EACH PIPING SYSTEM, FURNISH EXTRA COPIES (IN ADDITION TO MOUNTED COPIES) TO INCLUDE IN MAINTENANCE MANUALS.

1.3 QUALITY ASSURANCE

A. ASME REQUIREMENT: COMPLY WITH ASME A13.1, "SCHEME FOR THE IDENTIFICATION OF PIPING SYSTEMS," FOR LETTER SIZE, LENGTH OF COLOR FIELD, COLORS, AND VIEWING ANGLES OF IDENTIFICATION DEVICES FOR PIPING.

1.4 COORDINATION

A. COORDINATE INSTALLATION OF IDENTIFYING DEVICES WITH COMPLETION OF COVERING AND PAINTING OF SURFACES WHERE DEVICES ARE TO BE APPLIED. B. COORDINATE INSTALLATION OF IDENTIFYING DEVICES WITH LOCATION OF ACCESS PANELS AND DOORS.

PART 2: PRODUCTS

2.1 MANUFACTURERS

A. MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE PRODUCTS BY THE MANUFACTURERS SPECIFIED. 1. BRADY CORP. 2. SETON. 3. WESTLINE.

2.2 EQUIPMENT IDENTIFICATION DEVICES

A. EQUIPMENT MARKERS: ENGRAVED, LAMINATED PLASTIC WITH BLACK SURFACE AND WHITE CORE. WHEN USED EXPOSED IN FINISHED ROOMS, PROVIDE WHITE SURFACE AND BLACK CORE. 1. TERMINOLOGY: MATCH SCHEDULES AS CLOSELY AS POSSIBLE. 2. DATA: a. UNIT MARK/DESIGNATION. b. EQUIPMENT SERVICE/AREA SERVED. 3. SIZE: 2-1/2 BY 4 INCHES FOR CONTROL DEVICES, DAMPERS, AND VALVES; 4-1/2 BY 6 INCHES FOR EQUIPMENT.

B. ACCESS PANEL AND DOOR MARKERS: 1/16-INCH THICK, ENGRAVED LAMINATED PLASTIC, WHITE SURFACE AND BLACK CORE, WITH ABBREVIATED TERMS AND NUMBERS CORRESPONDING TO IDENTIFICATION. PROVIDE 1/8-INCH CENTER HOLE FOR ATTACHMENT. 1. FASTENERS: SELF-TAPPING, STAINLESS-STEEL SCREWS.

2.3 PIPING IDENTIFICATION DEVICES

A. MANUFACTURED PIPE MARKERS, GENERAL: PREPRINTED, COLOR-CODED, WITH LETTERING INDICATING SERVICE, AND SHOWING DIRECTION OF FLOW. 1. COLORS: COMPLY WITH ASME A13.1, UNLESS OTHERWISE INDICATED. 2. LETTERING: a. CHILLED WATER SUPPLY/CHILLED WATER RETURN. b. HEATING HOT WATER SUPPLY/HEATING HOT WATER RETURN. c. HIGH PRESSURE STEAM. d. HIGH PRESSURE CONDENSATE. e. MEDIUM PRESSURE STEAM. f. MEDIUM PRESSURE CONDENSATE. g. LOW PRESSURE STEAM. h. LOW PRESSURE CONDENSATE. i. PUMPED CONDENSATE. j. REFRIGERANT LIQUID. k. REFRIGERANT SUCTION. l. PUMPS WITH OD, INCLUDING INSULATION, LESS THAN 6 INCHES: FULL-BAND PIPE MARKERS EXTENDING 360 DEGREES AROUND PIPE AT EACH LOCATION.

2.4 VALVE TAGS

A. VALVE TAGS: STAMPED OR ENGRAVED WITH 1/4-INCH LETTERS FOR PIPING SYSTEM ABBREVIATION AND 1/2-INCH NUMBERS, WITH NUMBERING SCHEME. PROVIDE 5/32-INCH HOLE FOR FASTENER. 1. MATERIAL: 0.032-INCH THICK BRASS. 2. VALVE-TAG FASTENERS: BRASS WIRE-LINK OR BEADED CHAIN; OR S-HOOK.

2.5 VALVE SCHEDULES

A. VALVE SCHEDULES: FOR EACH PIPING SYSTEM, ON STANDARD-SIZE BOND PAPER, TABULATE VALVE NUMBER, PIPING SYSTEM, SYSTEM ABBREVIATION (AS SHOWN ON VALVE TAG), LOCATION OF VALVE (ROOM OR SPACE), NORMAL-OPERATING POSITION (OPEN, CLOSED, OR MODULATING) AND MOUNTING POSITION FOR IDENTIFICATION. MARK VALVES FOR EMERGENCY SHUTOFF AND SHUTTER SPECIAL USES. 1. VALVE-SCHEDULE FORMS: GLAZED DISPLAY FRAME FOR REMOVABLE MOUNTING ON MASONRY WALLS FOR EACH PAGE OF VALVE SCHEDULE. INCLUDE MOUNTING SCREWS. 2. FRAME: EXTRUDED ALUMINUM. 3. GLAZING: ASTM C 1036, TYPE I, CLASS 1, GLAZING QUALITY B, 2.5-MM, SINGLE-THICKNESS GLASS.

PART 3: EXECUTION

3.1 EQUIPMENT IDENTIFICATION

A. INSTALL EQUIPMENT MARKERS WITH PERMANENT ATTACHMENT ON OR NEAR EACH MAJOR ITEM OF MECHANICAL EQUIPMENT. 1. LETTER SIZE: MINIMUM 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 WITH FASTENERS. 2. DATA: IDENTIFY UNITS, DISTINGUISHING AMONG MULTIPLE UNITS. 3. LOCATE MARKERS WHERE ACCESSIBLE AND VISIBLE. INCLUDE MARKERS FOR THE FOLLOWING GENERAL CATEGORIES OF EQUIPMENT: a. PACKAGED ROOFTOP UNITS. b. DYNAMIC AIR CLEANERS. c. VAV BOXES. d. EXHAUST FANS.

3.2 PIPING IDENTIFICATION

A. INSTALL MANUFACTURED PIPE MARKERS INDICATING SERVICE ON EACH PIPING SYSTEM. INSTALL WITH FLOW INDICATION ARROWS SHOWING DIRECTION OF FLOW. 1. PIPES WITH OD, INCLUDING INSULATION, LESS THAN 6 INCHES: PRETENSIONED PIPE MARKERS. USE SIZE TO ENSURE A TIGHT FIT. 2. PIPES WITH OD, INCLUDING INSULATION, 6 INCHES AND LARGER: SHAPED PIPE MARKERS. USE SIZE TO MATCH PIPE AND SECURE WITH FASTENERS. B. LOCATE PIPE MARKERS WHERE PIPING IS EXPOSED IN FINISHED SPACES; MACHINE ROOMS; ACCESSIBLE MAINTENANCE SPACES SUCH AS SHAFTS, TUNNELS, AND PLENUMS; CEILING SPACES AND UNDER FLOOR AREAS; AND EXTERIOR NON-CONCEALED 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 NON-ACCESSIBLE ENCLOSURES. 4. AT ACCESS DOORS, MANHOLES, AND SIMILAR ACCESS POINTS THAT PERMIT VIEW OF CONCEALED PIPING. 5. NEAR MAJOR EQUIPMENT UNITS. 6. SPACED AT MAXIMUM INTERVALS OF 50 FEET ALONG EACH RUN. REDUCE INTERVALS TO 25 FEET IN AREAS OF CONGESTED PIPING AND EQUIPMENT.

3.3 VALVE-TAG INSTALLATION

A. INSTALL TAGS ON MAIN AND BRANCH SHUT-OFF VALVES AND CONTROL DEVICES IN PIPING SYSTEMS, EXCEPT THE FOLLOWING: CHECK VALVES; TAGS WITHIN FACTORY-FABRICATED EQUIPMENT UNITS; PLUMBING FIXTURE SUPPLY STOPS; SHUTOFF VALVES; FAUCETS; CONVENIENCE AND LAWN-WATERING HOSE CONNECTIONS; AND HVAC TERMINAL DEVICES AND SIMILAR ROUGHING-IN CONNECTIONS OF END-USE FIXTURES AND UNITS. INSTALL VALVE TAGS FOR OTHER VALVES INCLUDING THE FOLLOWING: MAIN SYSTEM SHUTOFF VALVES, VALVES ON PIPING LEAVING CHASES, BRANCH OR RISER SHUTOFF VALVES. LIST TAGGED VALVES IN A VALVE SCHEDULE. B. VALVE-TAG APPLICATION SCHEDULE: TAG VALVES ACCORDING TO SIZE, SHAPE, AND COLOR SCHEME AND WITH CAPTIONS SIMILAR TO THOSE INDICATED IN THE FOLLOWING: 1. VALVE-TAG SIZE AND SHAPE: a. STEAM: 1-1/2 INCHES, ROUND. b. CONDENSATE: 1-1/2 INCHES, ROUND. c. CHILLED WATER: 1-1/2 INCHES, ROUND. d. HEATING HOT WATER: 1-1/2 INCHES, ROUND. 2. VALVE-TAG COLOR: a. STEAM: NATURAL. b. CONDENSATE: NATURAL. c. CHILLED WATER: NATURAL. d. HEATING HOT WATER: NATURAL. 3. LETTER COLOR: a. STEAM: BLACK. b. CONDENSATE: BLACK. c. CHILLED WATER: BLACK. d. HEATING HOT WATER: BLACK.

3.4 VALVE-SCHEDULE INSTALLATION

A. MOUNT VALVE SCHEDULE ON WALL IN ACCESSIBLE LOCATION IN EACH MAJOR EQUIPMENT ROOM.

3.5 WARNING-TAG INSTALLATION

A. WRITE REQUIRED MESSAGE ON, AND ATTACH WARNING TAGS TO, EQUIPMENT AND OTHER ITEMS WHERE REQUIRED.

3.6 ADJUSTING

A. RELOCATE MECHANICAL IDENTIFICATION MATERIALS AND DEVICES THAT HAVE BECOME VISUALLY BLOCKED BY OTHER WORK.

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1: GENERAL

1.1 SUMMARY

A. TAB CONTRACTOR RESPONSIBILITIES 1. THE MECHANICAL CONTRACTOR IS RESPONSIBLE FOR START UP AND OPERATION OF SYSTEMS DURING SYSTEM BALANCE. START UP SHALL INCLUDE: ALL EQUIPMENT OPERABLE IN SAFE AND NORMAL CONDITION. TEMPERATURE/HUMIDITY CONTROL SYSTEMS INSTALLED COMPLETE AND OPERABLE. 2. CONTRACTOR SHALL ASSIST TAB CONTRACTOR WITH MECHANICAL SYSTEMS AS REQUIRED TO COMPLETE BALANCE WORK. 3. HVAC CONTROLS CONTRACTOR SHALL ASSIST TAB CONTRACTOR WITH CONTROLS AS REQUIRED TO COMPLETE BALANCE WORK.

SECTION 230700 - HVAC INSULATION

PART 1: GENERAL

1.1 SUMMARY

A. THIS SECTION INCLUDES MECHANICAL INSULATION FOR DUCT AND PIPE INCLUDING THE FOLLOWING: INSULATION MATERIALS, INSULATING CEMENTS, ADHESIVES, MASTICS, SEALANTS, FACTORY-APPLIED JACKETS, FIELD-APPLIED FABRIC-REINFORCING MESH, FIELD-APPLIED JACKETS, TAPES, SECUREMENTS, CORNER ANGLES.

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1.2 QUALITY ASSURANCE

A. FIRE-TEST-RESPONSE CHARACTERISTICS: INSULATION AND RELATED MATERIALS SHALL HAVE FIRE-TEST-RESPONSE CHARACTERISTICS INDICATED, AS DETERMINED BY TESTING IDENTICAL PRODUCTS PER ASTM E 84, BY A TESTING AND INSPECTING AGENCY ACCEPTABLE TO AUTHORITIES HAVING JURISDICTION; FACTORY LABEL INSULATION AND JACKET MATERIALS AND ADHESIVE, MASTIC, AND CEMENT MATERIAL CONTAINERS, WITH APPROPRIATE MARKINGS OF APPLICABLE TESTING AND INSPECTING AGENCY.

PART 2: PRODUCTS

2.1 MANUFACTURERS

- A. MANUFACTURERS - INSULATION MATERIALS:
1. CERTAIN TEED CORP.
2. JOHNS MANVILLE.
3. KNAUF INSULATION.
4. OWENS CORNING.
B. MANUFACTURERS - INSULATING CEMENTS:
1. INSULCO, DIVISION OF MFS, INC.
2. P. K. INSULATION MFG. CO., INC.
3. ROCK WOOL MANUFACTURING COMPANY.
C. MANUFACTURERS - ADHESIVES, MASTICS, SEALANTS.
1. CHILDERS PRODUCTS, DIVISION OF ITW.
2. FOSTER PRODUCTS CORPORATION, H. B. FULLER COMPANY.
3. ITW TACO, DIVISION OF ILLINOIS TOOL WORKS.
4. MON-ECO INDUSTRIES.
5. VIMASCO CORPORATION.
D. MANUFACTURERS - FIELD-APPLIED CLOTHES.
1. ALPHA ASSOCIATES, INC. OR APPROVED EQUAL.
E. MANUFACTURERS - FIELD APPLIED JACKETS.
1. CHILDERS PRODUCTS, DIVISION OF ITW; METAL JACKETING SYSTEMS.
2. PABCO METALS CORPORATION; SUREFIT.
3. RPR PRODUCTS, INC.; INSUL-MATE.

2.2 INSULATION MATERIALS

- A. MINERAL-FIBER BLANKET INSULATION: MINERAL OR GLASS FIBERS BONDED WITH A THERMOSETTING RESIN. COMPLY WITH ASTM C 553, TYPE II AND ASTM C 1290, TYPE I WITH FACTORY-APPLIED FSK JACKET.
B. 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.
C. MINERAL-FIBER, REFORMED PIPE INSULATION: TYPE I, 850 DEG F MATERIALS: MINERAL OR GLASS FIBERS BONDED WITH A THERMOSETTING RESIN, COMPLY WITH ASTM C 547, TYPE I, GRADE A, WITH FACTORY-APPLIED ASJ OR WITH FACTORY-APPLIED ASJ-SSL.
D. MINERAL-FIBER, PIPE AND TANK INSULATION: MINERAL OR GLASS FIBERS BONDED WITH A THERMOSETTING RESIN. SEMIRIGID BOARD MATERIAL WITH FACTORY-APPLIED ASJ COMPLYING WITH ASTM C 1393, TYPE II OR TYPE IIIA CATEGORY 2, OR WITH PROPERTIES SIMILAR TO ASTM C 612, TYPE IB, NOMINAL DENSITY IS 2.5 LB/CU. FT. OR MORE. THERMAL CONDUCTIVITY (K-VALUE) AT 100 DEG F IS 0.29 BTU-IN./H-SQ. FT.-FT) OR LESS.

2.3 INSULATION CEMENTS

A. MINERAL-FIBER, HYDRAULIC-SETTING INSULATING AND FINISHING CEMENT: COMPLY WITH ASTM C 449/C 449M.

2.4 ADHESIVES

- A. MATERIALS SHALL BE COMPATIBLE WITH INSULATION MATERIALS, JACKETS, AND SUBSTRATES AND FOR BONDING INSULATION TO ITSELF AND TO SURFACES TO BE INSULATED, UNLESS OTHERWISE INDICATED.
B. ASJ ADHESIVE, AND FSK JACKET ADHESIVE: COMPLY WITH MIL-A--3316C, CLASS 2, GRADE A FOR BONDING INSULATION JACKET LAP SEAMS AND JOINTS.
C. MINERAL-FIBER ADHESIVE: COMPLY WITH MIL-A--3316C, CLASS 2, GRADE A.

2.5 MASTICS

- A. MATERIALS SHALL BE COMPATIBLE WITH INSULATION MATERIALS, JACKETS, AND SUBSTRATES: COMPLY WITH MIL-C--1956SC, TYPE II.
B. VAPOR-BARRIER MASTIC: WATER BASED; SUITABLE FOR INDOOR AND OUTDOOR USE ON BELOW AMBIENT SERVICES. WATER-VAPOR PERMEANCE SHALL BE ASTM E 96, PROCEDURE B, 0.013 PERM AT 45-MIL DRY FILM THICKNESS. SERVICE TEMPERATURE RANGE SHALL BE MINUS 20 TO PLUS 180 DEG F. SOLIDS CONTENT SHALL BE ASTM D 1644, 59 PERCENT BY VOLUME AND 71 PERCENT BY WEIGHT. COLOR SHALL BE WHITE.
C. BREATHER MASTIC: WATER BASED; SUITABLE FOR INDOOR AND OUTDOOR USE ON ABOVE AMBIENT SERVICES. WATER-VAPOR PERMEANCE SHALL BE ASTM F 1249, 3 PERMS AT 0.025-INCH DRY FILM THICKNESS. SERVICE TEMPERATURE RANGE SHALL BE MINUS 20 TO PLUS 200 DEG F. SOLIDS CONTENT SHALL BE 63 PERCENT BY VOLUME AND 73 PERCENT BY WEIGHT. COLOR SHALL BE WHITE.

2.6 SEALANTS

- A. JOINT SEALANTS: MATERIALS SHALL BE COMPATIBLE WITH INSULATION MATERIALS, JACKETS, AND SUBSTRATES. PERMANENTLY FLEXIBLE, ELASTOMERIC SEALANT SERVICE TEMPERATURE RANGE SHALL BE MINUS 100 TO PLUS 300 DEG F. COLOR SHALL BE WHITE OR GRAY.
B. FSK AND METAL JACKET FLASHING SEALANTS: MATERIALS SHALL BE COMPATIBLE WITH INSULATION MATERIALS, JACKETS, AND SUBSTRATES. FIRE-AND WATER-RESISTANT, FLEXIBLE, ELASTOMERIC SEALANT. SERVICE TEMPERATURE RANGE SHALL BE MINUS 40 TO PLUS 250 DEG F. COLOR SHALL BE ALUMINUM.
C. ASJ FLASHING SEALANTS, AND VINYL, PVC, AND PVC JACKET FLASHING SEALANTS: MATERIALS SHALL BE COMPATIBLE WITH INSULATION MATERIALS, JACKETS, AND SUBSTRATES. FIRE- AND WATER-RESISTANT, FLEXIBLE, ELASTOMERIC SEALANT. SERVICE TEMPERATURE RANGE SHALL BE MINUS 40 TO PLUS 250 DEG F. COLOR SHALL BE WHITE.

2.7 FACTORY-APPLIED JACKETS

- A. INSULATION SYSTEM SCHEDULES INDICATE FACTORY-APPLIED JACKETS ON VARIOUS APPLICATIONS. WHEN FACTORY-APPLIED JACKETS ARE INDICATED, COMPLY WITH THE FOLLOWING:
1. FSK JACKET: ALUMINUM-FOIL, FIBERGLASS-REINFORCED SCRIM WITH KRAFT-PAPER BACKING; COMPLYING WITH ASTM C 1136, TYPE II.
2. ASJ: WHITE, KRAFT-PAPER, FIBERGLASS-REINFORCED SCRIM WITH ALUMINUM-FOIL BACKING; COMPLYING WITH ASTM C 1136, TYPE I.
3. ASJ-SSL: ASJ WITH SELF-SEALING, PRESSURE-SENSITIVE, ACRYLIC-BASED ADHESIVE COVERED BY A REMOVABLE PROTECTIVE STRIP; COMPLYING WITH ASTM C 1136, TYPE I.

2.8 FIELD-APPLIED CLOTHES

A. WOVEN GLASS-FIBER FABRIC: COMPLY WITH MIL-C--20079H, TYPE I, PLAIN WEAVE, AND PRESIZED A MINIMUM OF 8 OZ./SQ. YD.

2.9 FIELD-APPLIED JACKETS

- A. FIELD-APPLIED JACKETS SHALL COMPLY WITH ASTM C 921, TYPE I, UNLESS OTHERWISE INDICATED.
B. ALUMINUM JACKET: COMPLY WITH ASTM B 209, ALLOY 3003, 3005, 3105 OR 5005, TEMPER H-14. SHEET AND ROLL STOCK SHALL BE READY FOR SHOP OR FIELD SIZING, FINISH AND THICKNESS AS INDICATED IN FIELD-APPLIED JACKET SCHEDULES. MOISTURE BARRIER FOR INDOOR APPLICATIONS SHALL BE 1-MIL- THICK, HEAT-BONDED POLYETHYLENE AND KRAFT PAPER. MOISTURE BARRIER FOR OUTDOOR APPLICATIONS SHALL BE 3-MIL- THICK, HEAT-BONDED POLYETHYLENE AND KRAFT PAPER. FACTORY-FABRICATED FITTING COVERS SHALL BE:
1. SAME MATERIAL, FINISH, AND THICKNESS AS JACKET.
2. FIELD FABRICATED FITTING COVERS ONLY IF FACTORY-FABRICATED FITTING COVERS ARE NOT AVAILABLE.
3. PREFORMED 2-PIECE OR GORE, 45 AND 90 DEGREE, SHORT AND LONG RADIUS ELBOWS.
4. TEE COVERS.
5. FLANGE AND UNION COVERS.
6. END CAPS.
7. BEVELED COLLARS.
8. VALVE COVERS.
C. FSK JACKET: ALUMINUM-FOIL-FACE, FIBERGLASS-REINFORCED SCRIM WITH KRAFT-PAPER BACKING.
D. PVC JACKET: HIGH IMPACT RESISTANT, UV RESISTANT PVC COMPLYING WITH ASTM D 1784, CLASS 16354-C. ADHESIVE AS RECOMMENDED BY JACKET MATERIAL MANUFACTURER. WHITE IN COLOR.
1. FACTORY FABRICATED FITTING COVERS: PREFORMED SHAPES FOR ELBOWS, TEES, VALVES, FLANGES, UNIONS, REDUCERS, AND STRAINERS.

2.10 TAPES

- A. FSK TAPE: FOIL-FACE, VAPOR-RETARDER TAPE MATCHING FACTORY-APPLIED JACKET WITH ACRYLIC ADHESIVE; COMPLYING WITH ASTM C 1136 AND UL LISTED. TAPE SHALL HAVE CHARACTERISTICS AS FOLLOWS: 3 INCH WIDTH, 6.5 MIL THICKNESS, 90 OUNCES FORCE/INCH IN WIDTH ADHESION, 2 PERCENT ELONGATION, AND 40 LBF/INCH IN WIDTH TENSILE STRENGTH.
B. ASJ TAPE: WHITE VAPOR-RETARDER TAPE MATCHING FACTORY-APPLIED JACKET WITH ACRYLIC ADHESIVE, COMPLYING WITH ASTM C 1136 AND UL LISTED. TAPE SHALL HAVE CHARACTERISTICS AS FOLLOWS: 3 INCH WIDTH, 11.5 MILS THICKNESS, 90 OUNCES FORCE/INCH IN WIDTH ADHESION, 2 PERCENT ELONGATION, AND 40 LBF/INCH IN WIDTH TENSILE STRENGTH.
C. ALUMINUM-FOIL TAPE: VAPOR-RETARDER TAPE WITH ACRYLIC ADHESIVE AND UL LISTED. TAPE SHALL HAVE CHARACTERISTICS AS FOLLOWS: 2 INCH WIDTH, 3.7 MILS THICKNESS, 100 OUNCES FORCE/INCH IN WIDTH ADHESION, 5 PERCENT ELONGATION, AND 34 LBF/INCH IN WIDTH TENSILE STRENGTH.

2.11 SECUREMENTS

- A. ALUMINUM BANDS: ASTM B 209, ALLOY 3003, 3005, 3105, OR 5005; TEMPER H-14, 0.020 INCH THICK, 3/4 INCH WIDE WITH WING SEAL.
B. 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:
1. BASEPLATE: PERFORATED, GALVANIZED CARBON-STEEL SHEET, 0.030 INCH THICK BY 2 INCHES SQUARE.
2. SPINDLE: COPPER- OR ZINC-COATED, LOW CARBON STEEL, FULLY ANNEALED, 0.106-INCH- DIAMETER SHANK, LENGTH TO SUIT DEPTH OF INSULATION INDICATED.
3. ADHESIVE: RECOMMENDED BY HANGER MANUFACTURER. PRODUCT WITH DEMONSTRATED CAPABILITY TO BOND INSULATION HANGER SECURELY TO SUBSTRATES INDICATED WITHOUT DAMAGING INSULATION, HANGERS, AND SUBSTRATES.
C. INSULATION-RETAINING WASHERS: SELF-LOCKING WASHERS FORMED FROM 0.016-INCH- THICK, GALVANIZED-STEEL SHEET, WITH BEVELED EDGE SIZED AS REQUIRED TO HOLD INSULATION SECURELY IN PLACE BUT NOT LESS THAN 1-1/2 INCHES IN DIAMETER.
1. PROTECT ENDS WITH CAPED SELF-LOCKING WASHERS INCORPORATING A SPRING STEEL INSERT TO ENSURE PERMANENT RETENTION OF CAP IN EXPOSED LOCATIONS.
D. STAPLES: OUTWARD-CLINCHING INSULATION STAPLES, NOMINAL 3/4-INCH- WIDE, STAINLESS STEEL OR MONEL.
E. WIRE: 0.062-INCH SOFT-ANNEALED, STAINLESS STEEL.

2.12 CORNER ANGLES

A. 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 DUCT AND PLENUM INSULATION INSTALLATION

- A. BLANKET INSULATION INSTALLATION ON DUCTS AND PLENUMS: SECURE WITH INSULATION PINS.
1. INSTALL EITHER CAPACITOR-DISCHARGE-WELD PINS AND SPEED WASHERS OR CUPPED-HEAD, CAPACITOR-DISCHARGE-WELD PINS ON SIDES AND BOTTOM OF HORIZONTAL DUCTS AND SIDES OF VERTICAL DUCTS AS FOLLOWS:
a. ON DUCT SIDES WITH DIMENSIONS 18 INCHES AND SMALLER, PLACE PINS ALONG LONGITUDINAL CENTERLINE OF DUCT. SPACE 3 INCHES MAXIMUM FROM INSULATION JOINTS. INSTALL ADDITIONAL PINS TO HOLD INSULATION TIGHTLY AGAINST SURFACE AT CROSS BRACING.
b. ON DUCT SIDES WITH DIMENSIONS LARGER THAN 18 INCHES, SPACE PINS 12 INCHES O.C. EACH WAY, AND 3 INCHES MAXIMUM FROM INSULATION JOINTS. INSTALL ADDITIONAL PINS TO HOLD INSULATION TIGHTLY AGAINST SURFACE AT CROSS BRACING.
c. PINS MAY BE OMITTED FROM TOP SURFACE OF HORIZONTAL, RECTANGULAR DUCTS AND PLENUMS.
d. DO NOT OVERCOMPRESS INSULATION DURING INSTALLATION.
e. CUT EXCESS PORTION OF PINS EXTENDING BEYOND SPEED WASHERS OR BEND PARALLEL WITH INSULATION SURFACE. COVER EXPOSED PINS AND WASHERS WITH TAPE MATCHING INSULATION FACING.
2. INSTALL INSULATION ON RECTANGULAR DUCT ELBOWS AND TRANSITIONS WITH A FULL INSULATION SECTION FOR EACH SURFACE. GROOVE AND SCORE INSULATION TO FIT AS CLOSELY AS POSSIBLE TO OUTSIDE AND INSIDE RADIUS OF ELBOWS.
3. INSULATE DUCT STIFFENERS, HANGERS, AND FLANGES THAT PROTRUDE BEYOND INSULATION SURFACE WITH 6-INCH-WIDE STRIPS OF SAME MATERIAL USED TO INSULATE DUCT. SECURE ON ALTERNATING SIDES OF STIFFENER, HANGER, AND FLANGE WITH PINS SPACED 6 INCHES O.C.
B. VAPOR BARRIER FOR DUCTS AND PLENUM INSULATION
1. FOR DUCTS AND PLENUMS WITH SURFACE TEMPERATURES BELOW AMBIENT, INSTALL A CONTINUOUS UNBROKEN VAPOR BARRIER. CREATE A FACING LAP FOR LONGITUDINAL SEAMS AND END JOINTS WITH INSULATION BY REMOVING 3 INCHES FROM 1 EDGE AND 1 END OF INSULATION SEGMENT. SECURE LAPS TO ADJACENT INSULATION SECTION WITH 1/2-INCH OUTWARD-CLINCHING STAPLES, 1 INCH O.C. INSTALL VAPOR BARRIER CONSISTING OF FACTORY- OR FIELD-APPLIED JACKET, ADHESIVE, VAPOR-BARRIER MASTIC, AND SEALANT AT JOINTS, SEAMS, AND PROTRUSIONS.
a. REPAIR PUNCTURES, TEARS, AND PENETRATIONS WITH TAPE OR MASTIC TO MAINTAIN VAPOR-BARRIER SEAL.
b. INSTALL VAPOR STOPS FOR DUCTWORK AND PLENUMS OPERATING BELOW 50 DEG F AT 18-FOOT INTERVALS. VAPOR STOPS SHALL CONSIST OF VAPOR-BARRIER MASTIC APPLIED IN A Z-SHAPED PATTERN OVER INSULATION FACE, ALONG BUTT END OF INSULATION, AND OVER THE SURFACE. COVER INSULATION FACE AND SURFACE TO BE INSULATED A WIDTH EQUAL TO 2 TIMES THE INSULATION THICKNESS BUT NOT LESS THAN 3 INCHES.

3.2 PIPE INSULATION

- A. SHALL BE APPLIED IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS, INCLUDING COVERAGE RATES, MASTICS, ADHESIVES AND COATINGS TO BE USED. INSULATION SHALL BE APPLIED TO PROVIDE FULL INSULATION THICKNESS ON ALL SURFACES, INCLUDING CORNERS AND BENDS.
B. INSULATION SHALL BE APPLIED TO CLEAN, DRY SURFACES. REMOVE ALL MILL SCALE, GREASE OR DIRT. INSULATION SHALL NOT BE APPLIED TO PIPING AND EQUIPMENT UNTIL ALL REQUIRED TESTING HAS BEEN COMPLETED AND ALL NECESSARY REPAIRS HAVE BEEN MADE.
C. INSTALL PIPING INSULATION MATERIALS AFTER PIPING HAS BEEN TESTED AND APPROVED. CONTINUE INSULATION WITH VAPOR BARRIER THROUGH PENETRATIONS. IN EXPOSED PIPING, LOCATE INSULATION AND COVER SEAMS IN LEAST VISIBLE LOCATIONS. NEATLY FINISH INSULATION AT SUPPORTS, PROTRUSIONS AND INTERRUPTIONS. PIPE INSULATION SHALL BE INSTALLED WITH JOINTS BUTTED FIRMLY TOGETHER. NO EXCEPTIONS.
D. MATERIALS SHALL BE APPLIED BY A QUALIFIED INSULATION APPLICATOR / WORKMAN SKILLED IN THIS TRADE. INSULATION SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S WRITTEN INSTRUCTIONS AND IN ACCORDANCE WITH RECOGNIZED INDUSTRY STANDARDS. MECHANICAL FASTENERS SHALL BE USED WHENEVER POSSIBLE TO ASSURE PERMANENT CONSTRUCTION. UNSIGHTLY WORK SHALL BE A CAUSE FOR REJECTION.
E. NON-COMPRESSIBLE INSULATION MATERIAL SHALL BE INSTALLED AT HANGER SUPPORTS TO PREVENT DAMAGE TO INSULATION AND VAPOR BARRIER.
F. MINIMUM THICKNESS OF INSULATION SHALL BE AS SCHEDULED; HOWEVER, SUFFICIENT INSULATION SHALL BE PROVIDED TO ELIMINATE CONDENSATION ON COLD SURFACES, AND TO MAINTAIN A MAXIMUM EXTERIOR INSULATION SURFACE TEMPERATURE OF 125 DEG. FOR HOT PIPING.
G. COVER ALL VALVES, STRAINERS, UNIONS, FLANGES AND FITTINGS WITH PVC FITTING COVERS.
H. INSTALL PROTECTIVE METAL SHIELDS WHERE PIPE HANGERS BEAR ON THE OUTSIDE OF INSULATION. PROVIDE WOOD BLOCKING FROM THE SHIELD THROUGH THE INSULATION OR O.C. KAYLO (MINIMUM 24" LONG) TO PREVENT CRUSHING OF THE INSULATION.

3.3 FIELD-APPLIED CLOTHES

A. WHERE WOVEN GLASS-FIBER FABRIC IS INDICATED, INSTALL AS FOLLOWS: BRUSH ON INSULATING CEMENT OVER ENTIRE SURFACE AND COVER WITH WOVEN GLASS-FIBER FABRIC. FABRIC SHALL BE DRAWN TIGHT SO SURFACE IS SMOOTH AND WITHOUT WRINKLES. BRUSH ON A TOP LAYER OF INSULATING CEMENT OVER THE ENTIRE AREA.

3.4 FIELD-APPLIED JACKET INSTALLATION

A. WHERE METAL JACKETS ARE INDICATED, INSTALL WITH 2-INCH OVERLAP AT LONGITUDINAL SEAMS AND END JOINTS. OVERLAP LONGITUDINAL SEAMS ARRANGED TO SHED WATER. SEAL END JOINTS WITH WEATHERPROOF SEALANT RECOMMENDED BY INSULATION MANUFACTURER. SECURE JACKET WITH STAINLESS-STEEL BANDS 12 INCHES O.C. AND AT END JOINTS.

3.5 FIELD QUALITY CONTROL

- A. PERFORM THE FOLLOWING FIELD TESTS AND INSPECTIONS:
3. INSPECT DUCTWORK, RANDOMLY SELECTED BY ENGINEER, BY REMOVING FIELD-APPLIED JACKET AND INSULATION IN LAYERS IN REVERSE ORDER OF THEIR INSTALLATION. EXTENT OF INSPECTION SHALL BE LIMITED TO TWO LOCATIONS FOR EACH DUCT SYSTEM DEFINED IN THE "DUCT INSULATION SCHEDULE, GENERAL" ARTICLE.
B. ALL INSULATION APPLICATIONS WILL BE CONSIDERED DEFECTIVE WORK IF SAMPLE INSPECTION REVEALS NONCOMPLIANCE WITH REQUIREMENTS. REMOVE DEFECTIVE WORK.
C. INSTALL NEW INSULATION AND JACKETS TO REPLACE INSULATION AND JACKETS REMOVED FOR INSPECTION. REPEAT INSPECTION PROCEDURES AFTER NEW MATERIALS ARE INSTALLED.

3.6 DUCT AND PLENUM INSULATION SCHEDULE

- A. PLENUMS AND DUCTS REQUIRING INSULATION: SEE DUCT INSULATION SCHEDULE.
B. ITEMS NOT INSULATED:
1. FACTORY-INSULATED FLEXIBLE DUCTS.
2. FACTORY-INSULATED PLENUMS AND CASINGS.
3. FLEXIBLE CONNECTORS.
4. VIBRATION-CONTROL DEVICES.
5. FACTORY-INSULATED ACCESS PANELS AND DOORS.

3.7 FIELD-APPLIED JACKET SCHEDULE

- A. INSTALL JACKET OVER INSULATION MATERIAL. FOR INSULATION WITH FACTORY-APPLIED JACKET, INSTALL THE FIELD-APPLIED JACKET OVER THE FACTORY-APPLIED JACKET.
B. DUCTS AND PLENUMS, EXPOSED IN MECHANICAL EQUIPMENT ROOMS AND OTHER NON-COITIONED AREAS:
1. WOVEN GLASS-FIBER FABRIC WITH INSULATING CEMENT.
C. DUCTS AND PLENUMS, EXPOSED IN AIR-CONDITIONED AREAS:
1. WOVEN GLASS-FIBER FABRIC WITH INSULATING CEMENT.
D. DUCTS AND PLENUMS, EXPOSED OUTDOORS:
1. WOVEN GLASS-FIBER FABRIC WITH INSULATING CEMENT.
2. ALUMINUM, SMOOTH, 0.016 INCH THICK.

SECTION 233113 - METAL DUCTS

PART 1: GENERAL

1.1 SUMMARY

- B. THIS SECTION INCLUDES METAL DUCTS FOR SUPPLY, RETURN, OUTSIDE, AND EXHAUST AIR-DISTRIBUTION SYSTEMS IN PRESSURE CLASSES FROM MINUS 2- TO PLUS 10-INCH WG. METAL DUCTS INCLUDE THE FOLLOWING:
1. RECTANGULAR DUCTS AND FITTINGS.
2. SINGLE-WALL, ROUND, AND FLAT-OVAL SPIRAL-SEAM DUCTS AND FORMED FITTINGS.

1.2 SYSTEM DESCRIPTION

A. DUCT SYSTEM DESIGN, AS INDICATED, HAS BEEN USED TO SELECT SIZE AND TYPE OF AIR-MOVING AND AIR-DISTRIBUTION EQUIPMENT AND OTHER AIR SYSTEM COMPONENTS. CHANGES TO LAYOUT OR CONFIGURATION OF DUCT SYSTEM MUST BE SPECIFICALLY APPROVED IN WRITING BY ENGINEER. ACCOMPANY REQUESTS FOR LAYOUT MODIFICATIONS WITH CALCULATIONS SHOWING THAT PROPOSED LAYOUT WILL PROVIDE ORIGINAL DESIGN RESULTS WITHOUT INCREASING SYSTEM TOTAL PRESSURE.

1.3 SUBMITTALS

A. PRODUCT DATA: SUBMIT PRODUCT DATA ON MANUFACTURED DUCTS AND FITTINGS.

1.4 QUALITY ASSURANCE

- A. WELDING: QUALIFY PROCEDURES AND PERSONNEL ACCORDING TO AWS D1.1, "STRUCTURAL WELDING CODE--STEEL," FOR HANGERS AND SUPPORTS; AWS D1.2, "STRUCTURAL WELDING CODE--ALUMINUM," FOR ALUMINUM SUPPORTING MEMBERS; AND AWS D9.1, "SHEET METAL WELDING CODE," FOR DUCT JOINT AND SEAM WELDING.
B. NFPA COMPLIANCE:
1. NFPA 90A, "INSTALLATION OF AIR CONDITIONING AND VENTILATING SYSTEMS."
2. NFPA 90B, "INSTALLATION OF WARM AIR HEATING AND AIR CONDITIONING SYSTEMS."

PART 2: PRODUCTS

2.1 MANUFACTURERS

- A. TRANSVERSE JOINTS:
1. DUCTIMATE INDUSTRIES, INC.
2. NEXUS INC.
3. WARD INDUSTRIES, INC.
B. FORMED-ON FLANGES:
1. DUCTIMATE INDUSTRIES, INC.
2. LOCKFORM.
C. ROUND AND FLAT OVAL DUCT AND FITTINGS:
1. MCGILL AIRFLOW CORPORATION.
2. SEMCO INCORPORATED.
2.2 SHEET METAL 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: ASTM A 653/A 653M, LOCK-FORMING QUALITY, G60 COATING DESIGNATION; MILL-PHOSPHATIZED FINISH FOR SURFACES EXPOSED TO VIEW.
C. CARBON-STEEL SHEETS: ASTM A 366/A 366M, COLD-ROLLED SHEETS; COMMERCIAL QUALITY; WITH OILED, MATTE FINISH FOR EXPOSED DUCTS.
D. STAINLESS STEEL: ASTM A 480/A 480M, TYPE 316 OR 304 AS INDICATED, AND HAVING A NO. 2D FINISH FOR CONCEALED DUCTS AND A NO. 2B FINISH FOR EXPOSED DUCTS.
E. ALUMINUM SHEETS: ASTM B 209, ALLOY 3003, TEMPER H14; WITH AMILL FINISH FOR CEONCEALED DUCTS AND EXPOSED DUCTS.

2.3 SEALANT MATERIALS

- A. JOINT AND SEAM SEALANTS, GENERAL: THE TERM "SEALANT" IS NOT LIMITED TO MATERIALS OF ADHESIVE OR MASTIC NATURE BUT INCLUDES TAPES AND COMBINATIONS OF OPEN-WEAVE FABRIC STRIPS AND MASTICS.
B. TAPE SEALING SYSTEM: WOVEN-FIBER TAPE IMPREGNATED WITH GYPSUM MINERAL COMPOUND AND MODIFIED ACRYLIC/SILOXANE ACTIVATOR TO REACT EXOTHERMICALLY WITH TAPE TO FORM HARD, DURABLE, AIRTIGHT SEAL.
C. WATER-BASED JOINT AND SEAM SEALANT: FLEXIBLE, ADHESIVE SEALANT, RESISTANT TO UV LIGHT WHEN CURED, UL 723 LISTED, AND COMPLYING WITH NFPA REQUIREMENTS FOR CLASS 1 DUCTS.
D. SOLVENT-BASED JOINT AND SEAM SEALANT: ONE-PART, NON-SAG, SOLVENT-RELEASE-CURING, POLYMERIZED BUTYL SEALANT FORMULATED WITH A MINIMUM OF 75 PERCENT SOLIDS.
E. FLANGED JOINT MASTIC: ONE-PART, SOLVENT-BASED JOINT AND SEAM SEALANT: ONE-PART, NON-SAG, SOLVENT-RELEASE-CURING, POLYMERIZED BUTYL SEALANT FORMULATED WITH A MINIMUM OF 75 PERCENT SOLIDS.
F. FLANGE GASKETS: BUTYL RUBBER OR EPDM POLYMER WITH POLYISOBUTYLENE PLASTICIZER.

2.4 HANGERS AND SUPPORTS

- A. BUILDING ATTACHMENTS: CONCRETE INSERTS OR STRUCTURAL-STEEL FASTENERS APPROPRIATE FOR CONSTRUCTION MATERIALS TO WHICH HANGERS ARE BEING ATTACHED.
B. HANGER MATERIALS: MATERIALS SHALL BE COMPATIBLE WITH DUCT MATERIALS. GALVANIZED SHEET STEEL OR THREADED STEEL ROD FOR GALVANIZED-STEEL DUCTS.
1. HANGERS/SUPPORTS INSTALLED OUTDOORS: ELECTRO-GALVANIZED, ALL-THREAD RODS OR GALVANIZED RODS WITH THREADS PAINTED WITH ZINC-CHROMATE PRIMER AFTER INSTALLATION.
2. STRAP AND ROD SIZES: COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS--METAL AND FLEXIBLE" FOR STEEL SHEET WIDTH AND THICKNESS AND FOR STEEL ROD DIAMETERS.
C. DUCT ATTACHMENTS: SHEET METAL SCREWS OR SELF-TAPPING METAL SCREWS; COMPATIBLE WITH DUCT MATERIALS.
D. TRAPEZE AND RISER SUPPORTS: STEEL SHAPES COMPLYING WITH ASTM A 36/A 36M.
1. SUPPORTS FOR GALVANIZED-STEEL DUCTS: GALVANIZED-STEEL SHAPES AND PLATES.
2. SUPPORTS FOR STAINLESS-STEEL DUCTS: STAINLESS-STEEL SUPPORT MATERIALS.
3. SUPPORTS FOR ALUMINUM DUCTS: ALUMINUM SUPPORT MATERIALS.

2.5 RECTANGULAR DUCT FABRICATION

- A. FABRICATE DUCTS, ELBOWS, TRANSITIONS, OFFSETS, BRANCH CONNECTIONS, AND OTHER CONSTRUCTION ACCORDING TO SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS--METAL AND FLEXIBLE" AND COMPLYING WITH REQUIREMENTS FOR METAL THICKNESS, REINFORCING TYPES AND INTERVALS, TEE-RD APPLICATIONS, AND JOINT TYPES AND INTERVALS.
1. LENGTHS: FABRICATE RECTANGULAR DUCTS IN LENGTHS APPROPRIATE TO REINFORCEMENT AND RIGIDITY CLASS REQUIRED FOR "PRESSURE CLASS."
2. DEFLECTION: DUCT SYSTEMS SHALL NOT EXCEED DEFLECTION LIMITS ACCORDING TO SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS--METAL AND FLEXIBLE."
B. TRANSVERSE JOINTS: PREFABRICATED SLIDE-ON JOINTS AND COMPONENTS CONSTRUCTED USING MANUFACTURER'S GUIDELINES FOR MATERIAL THICKNESS, REINFORCEMENT SIZE AND SPACING, AND JOINT REINFORCEMENT.
C. FORMED-ON FLANGES: CONSTRUCT ACCORDING TO SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS--METAL AND FLEXIBLE," FIGURE 1-4, USING CORNER, BOLT, CLEAT, AND GASKET DETAILS.
1. DUCT SIZE: MAXIMUM 30 INCHES WIDE AND UP TO 2-INCH WG PRESSURE CLASS.
2. LONGITUDINAL SEAMS: PITTSBURGH LOCK SEAL WITH CON-CURING POLYMER SEALANT.
D. CROSS BREAKING OR CROSS BRACING: CROSS BRACE DUCT SIDES 19 INCHES AND LARGER AND 0.0359 INCH THICK OR LESS, WITH MORE THAN 10 SQ. FT. OF NON-BRACED PANEL AREA UNLESS DUCTS ARE LINED.

2.6 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

- A. DIAMETER AS APPLIED TO FLAT-OVAL DUCTS IN THIS ARTICLE IS THE DIAMETER OF A ROUND DUCT WITH A CIRCUMFERENCE EQUAL TO THE PERIMETER OF A GIVEN SIZE OF FLAT-OVAL DUCT.
B. ROUND, SPIRAL LOCK-SEAM DUCTS AND FITTINGS: FABRICATE DUCTS AND FITTINGS OF INDICATED MATERIAL ACCORDING TO SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS--METAL AND FLEXIBLE." USE OF ADDITIONAL RIBS OR CORRUGATIONS TO ALLOW USAGE OF A LIGHTER GAUGE SHALL NOT BE ACCEPTABLE.
C. FLAT-OVAL, SPIRAL LOCK-SEAM DUCTS AND FITTINGS: FABRICATE DUCTS AND FITTINGS OF INDICATED MATERIAL ACCORDING TO SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS--METAL AND FLEXIBLE." FABRICATE DUCTS LARGER THAN 72 INCHES IN DIAMETER WITH BUTT-WELDED LONGITUDINAL SEAMS. USE OF ADDITIONAL RIBS OR CORRUGATIONS TO ALLOW USAGE OF A LIGHTER GAUGE SHALL NOT BE ACCEPTABLE.
D. DUCT JOINTS:
1. DUCTS UP TO 20 INCHES IN DIAMETER: INTERIOR, CENTER-BEADED SLIP COUPLING, SEALED BEFORE AND AFTER FASTENING, ATTACHED WITH SHEET METAL SCREWS.
2. DUCTS LARGER THAN 20 INCHES IN DIAMETER: THREE-PIECE, GASKETED, FLANGED JOINT CONSISTING OF TWO INTERNAL FLANGES WITH SEALANT AND ONE EXTERNAL CLOSURE BAND WITH GASKET.
3. DUCTS LARGER THAN 72 INCHES IN DIAMETER: COMPANION ANGLE FLANGED JOINTS PER SMACNA "HVAC DUCT CONSTRUCTION STANDARDS--METAL AND FLEXIBLE," FIGURE 3-2.
4. ROUND DUCTS: PREFABRICATED CONNECTION SYSTEM CONSISTING OF DOUBLE-LIPPED, EPDM RUBBER GASKET. MANUFACTURE DUCTS ACCORDING TO CONNECTION SYSTEM MANUFACTURER'S TOLERANCES.
5. FLAT-OVAL DUCTS: PREFABRICATED CONNECTION SYSTEM CONSISTING OF TWO FLANGES AND ONE SYNTHETIC RUBBER GASKET.
E. FABRICATE ELBOWS USING DIE-FORMED, GORED, PLEATED, OR MITERED CONSTRUCTION. END RADIUS OF DIE-FORMED, GORED, AND PLEATED ELBOWS SHALL BE 1-1/2 TIMES DUCT DIAMETER. UNLESS ELBOW CONSTRUCTION TYPE IS INDICATED, FABRICATE ELBOWS AS FOLLOWS:
1. MITERED-ELBOW CONSTRUCTION: MITERED CONSTRUCTION COMPLYING WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS--METAL AND FLEXIBLE," UNLESS OTHERWISE INDICATED.
F. LOW PRESSURE ROUND DUCTS SHALL BE FACTORY FABRICATED SPIRAL DUCTS AND FITTINGS OR GROOVED LONGITUDINAL SEAM DUCTS. GROOVED LONGITUDINAL SEAM DUCTS SHALL HAVE SEAMS SEALED WITH MASTIC WHEN FABRICATED AND SECTIONS JOINED WITH BELL AND SPOUT FITTINGS OR COUPLINGS. FITTINGS AND COUPLINGS SHALL BE SEALED WITH MASTIC TO MAKE AN AIR TIGHT JOINT. FITTINGS FOR SHOP FABRICATED DUCTS MAY BE FORMED OR MITERED CONSTRUCTION WITH NOT LESS THAN 3-PIECE 45 DEGREE ELBOWS AND 5-PIECE 90 DEGREE ELBOWS.

PART 3: EXECUTION

3.1 DUCT APPLICATIONS

- A. STATIC-PRESSURE CLASSES: UNLESS OTHERWISE INDICATED, SELECT DUCT TYPE, JOINT CONNECTIONS, MATERIALS, AND STATIC-PRESSURE CLASSES ACCORDING TO THE DUCT CONSTRUCTION SCHEDULE ON THE DRAWINGS.
B. ALL DUCTS SHALL BE GALVANIZED STEEL UNLESS OTHERWISE NOTED.

3.2 DUCT INSTALLATION

- A. CONSTRUCT AND INSTALL DUCTS ACCORDING TO SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS--METAL AND FLEXIBLE," UNLESS OTHERWISE INDICATED. INSTALL DUCTS WITH FEWEST POSSIBLE JOINTS. INSTALL FABRICATED FITTINGS FOR CHANGES IN DIRECTIONS, SIZE, AND SHAPE AND FOR CONNECTIONS.
B. INSTALL DUCTS, UNLESS OTHERWISE INDICATED, VERTICALLY AND HORIZONTALLY AND PARALLEL AND PERPENDICULAR TO BUILDING LINES; AVOID DIAGONAL RUNS.
C. INSTALL DUCTS CLOSE TO WALLS, OVERHEAD CONSTRUCTION, COLUMNS, AND OTHER STRUCTURAL AND PERMANENT ENCLOSURE ELEMENTS OF BUILDING.
D. INSTALL DUCTS WITH A CLEARANCE OF 1 INCH, PLUS ALLOWANCE FOR INSULATION THICKNESS.
E. CONCEAL DUCTS FROM VIEW IN FINISHED SPACES. DO NOT ENCASE HORIZONTAL RUNS IN SOLID PARTITIONS UNLESS SPECIFICALLY INDICATED.
F. COORDINATE LAYOUT WITH SUSPENDED CEILING, FIRE-AND SMOKE-CONTROL DAMPERS, LIGHTING LAYOUTS, AND SIMILAR FINISHED WORK. ROUTE DUCTWORK AT UNDERSIDE OF STRUCTURAL STEEL BEAMS OR BETWEEN STRUCTURAL STEEL BEAMS UNLESS OTHERWISE INDICATED.
G. SEAL ALL JOINTS AND SEAMS. APPLY SEALANT TO MALE END CONNECTORS BEFORE INSERTION, AND AFTERWARD TO COVER ENTIRE JOINT AND SHEET METAL SCREWS.
H. ELECTRICAL EQUIPMENT SPACES: ROUTE DUCTS TO AVOID PASSING THROUGH ELECTRICAL EQUIPMENT SPACES AND ENCLOSURES.
I. NON-FIRE-RATED PARTITIONS: WHERE DUCTS PASS THROUGH INTERIOR PARTITIONS, EXTERIOR WALLS AND ARE EXPOSED TO VIEW OR CONCEALED, CONCEAL SPACES BETWEEN CONSTRUCTION OPENINGS AND DUCTS OR DUCT INSULATION WITH SHEET METAL FLANGES OF SAME METAL THICKNESS AS DUCTS. OVERLAP OPENINGS ON 4 SIDES BY AT LEAST 1-1/2 INCHES.
J. FIRE-RATED PENETRATIONS: WHERE DUCTS PASS THROUGH RATED WALLS, PARTITIONS, FLOORS OR ROOFS, INSTALL APPROPRIATELY RATED FIRE DAMPERS, SLEEVES, AND FIRESTOPPING SEALANT. FIRE AND SMOKE DAMPERS ARE SPECIFIED IN DIVISION 23 SECTION "DUCT ACCESSORIES."
K. INSTALL DUCTS WITH HANGERS AND BRACES DESIGNED TO WITHSTAND, WITHOUT DAMAGE TO EQUIPMENT, SEISMIC FORCE REQUIRED BY APPLICABLE BUILDING CODES. REFER TO SMACNA'S "SEISMIC RESTRAINT MANUAL: GUIDELINES FOR MECHANICAL SYSTEMS."

3.3 SEAM AND JOINT SEALING

- A. SEAL DUCT SEAMS AND JOINTS ACCORDING TO SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS--METAL AND FLEXIBLE" FOR DUCT PRESSURE CLASS INDICATED.
1. MEDIUM PRESSURE DUCTWORK ABOVE 2" PRESSURE CLASS: SEAL TO CLASS "A" STANDARDS AS OUTLINED IN SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS--METAL AND FLEXIBLE."
a. RECTANGULAR DUCTWORK: SEAL ALL JOINTS AND CONNECTIONS WITH HARD CAST II.
b. ROUND AND FLAT OVAL DUCTWORK: SEAL JOINTS, SEAMS AND CONNECTIONS WITH NON-MIGRATING MASTIC OR LIQUID ELASTIC SEALANT AS RECOMMENDED BY THE MANUFACTURER.
2. LOW PRESSURE DUCTWORK 2-INCH AND LOWER PRESSURE CLASS: SEAL TO CLASS "B" STANDARDS AS OUTLINED IN SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS--METAL AND FLEXIBLE."
B. SEAL JOINTS, SEAMS AND CONNECTIONS WITH LIQUID ELASTIC SEALANT AS RECOMMENDED BY THE MANUFACTURER.
C. SEAL DUCTS BEFORE EXTERNAL INSULATION IS APPLIED.

3.4 HANGING AND SUPPORTING

- A. DUCTWORK SHALL BE SUPPORTED FROM BUILDING STRUCTURAL STEEL, SUPPLEMENTARY STEEL ANGELES/SUPPORTS, OR CONCRETE FLOOR/ROOF SLABS. DUCTWORK HANGERS/SUPPORTS SHALL NOT BE ATTACHED SOLELY TO METAL DECKING. PROVIDE SUPPLEMENTARY ANGLES/SUPPORTS AS REQUIRED AND PRIOR TO STRUCTURAL STEEL FIREPROOFING.
B. SUPPORT HORIZONTAL DUCTS WITHIN 24 INCHES OF EACH ELBOW AND WITHIN 48 INCHES OF EACH BRANCH INTERSECTION.
C. SUPPORT VERTICAL DUCTS AT MAXIMUM INTERVALS OF 16 FEET AND AT EACH FLOOR.
D. INSTALL UPPER ATTACHMENTS TO STRUCTURES WITH AN ALLOWABLE LOAD NOT EXCEEDING ONE-FOURTH OF FAILURE (PROOF-TEST) LOAD.
E. INSTALL CONCRETE INSERTS BEFORE PLACING CONCRETE.

3.5 CONNECTIONS

- A. MAKE CONNECTIONS TO EQUIPMENT WITH FLEXIBLE CONNECTORS ACCORDING TO DIVISION 23 SECTION "DUCT ACCESSORIES."
B. COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS--METAL AND FLEXIBLE" FOR BRANCH, OUTLET AND INLET, AND TERMINAL UNIT CONNECTIONS.

3.6 DUCT SYSTEM PROTECTION

- A. PROTECT DUCT INTERIORS FROM THE ELEMENTS UNTIL BUILDING IS ENCLOSED AND FOREIGN MATERIALS THROUGHOUT THE PROJECT DURATION. FOLLOW SMACNA'S "DUCT CLEANLINESS FOR NEW CONSTRUCTION."
B. PROVIDE FILTERS IN HVAC SYSTEMS AND AT DUCT ENDS TO PROTECT DUCT SYSTEMS FROM DUST IF UNITS ARE PLACED IN OPERATION WHILE CONSTRUCTION IS STILL IN PROGRESS. FILTERS SHALL BE CHANGED REGULARLY TO PREVENT DUST ENTRY INTO DUCTWORK, BUT NO LESS THAN EVERY WEEK.
C. DUCT SYSTEMS THAT HAVE NOT BEEN PROPERLY PROTECTED, AS DETERMINED BY THE ENGINEER, SHALL BE REQUIRED TO BE MECHANICALLY CLEANED USING MECHANICAL AGITATION AND VACUUM-COLLECTION DEVICES.

SECTION 233300 – AIR DUCT ACCESSORIES

PART 1: GENERAL

- 1.1 **SUMMARY**
 - A. THIS SECTION INCLUDES THE FOLLOWING: VOLUME DAMPERS, MOTORIZED CONTROL DAMPERS, FIRE DAMPERS, TURNING VANES, DUCT-MOUNTING ACCESS DOORS, FLEXIBLE CONNECTORS, FLEXIBLE DUCTS, AND DUCT ACCESSORY HARDWARE.
- 1.2 **QUALITY ASSURANCE**
 - A. COMPLY WITH NFPA 90A, "INSTALLATION OF AIR CONDITIONING AND VENTILATING SYSTEMS," AND NFPA 90B, "INSTALLATION OF WARM AIR HEATING AND AIR CONDITIONING SYSTEMS."

PART 2: PRODUCTS

- 2.1 **MANUFACTURERS**
 - A. MANUFACTURERS – VOLUME DAMPERS, MOTORIZED CONTROL DAMPERS, FIRE DAMPERS, SMOKE DAMPERS:
 1. CESCO PRODUCTS.
 2. GREENHECK.
 3. NAILOR INDUSTRIES.
 4. NATIONAL CONTROLLED AIR.
 5. POTTORFF.
 6. PREFCO PRODUCTS, INC.
 7. RUSKIN COMPANY.
 - B. MANUFACTURERS – TURNING VANES:
 1. DUCTMATE INDUSTRIES, INC.
 2. DURO DYNE CORP.
 3. METALAIR, INC.
 4. WARD INDUSTRIES, INC.
 - C. MANUFACTURERS – DUCT MOUNTED ACCESS DOORS
 1. AIR BALANCE (FSA 100 BASIS OF DESIGN).
 2. CESCO PRODUCTS.
 3. FLEXMASTER U.S.A., INC.
 4. GREENHECK.
 5. NAILOR INDUSTRIES INC.
 6. POTTORFF.
 7. VENTFABRICS, INC.
 - D. MANUFACTURERS – FLEXIBLE CONNECTORS
 1. DUCTMATE INDUSTRIES, INC.
 2. DURO DYNE CORP.
 3. VENTFABRICS, INC.
 4. WARD INDUSTRIES, INC.
 - E. MANUFACTURERS – FLEXIBLE DUCTS
 1. FLEXMASTER U.S.A., INC.
 2. HART & COOLEY, INC.
 3. THERMAFLEX.
 4. WIREMOLD.
- 2.2 **SHEET METAL 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.
 - B. GALVANIZED SHEET STEEL: LOCK-FORMING QUALITY; COMPLYING WITH ASTM A 653/A 653M AND HAVING G60 COATING DESIGNATION; DUCTS SHALL HAVE MILL-PHOSPHATIZED FINISH FOR SURFACES EXPOSED TO VIEW.
 - C. STAINLESS STEEL: ASTM A 480/A 480M.
 - D. ALUMINUM SHEETS: 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: 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.
- 2.3 **VOLUME DAMPERS**
 - A. GENERAL DESCRIPTION: FACTORY FABRICATED, WITH REQUIRED HARDWARE AND ACCESSORIES. STIFFEN DAMPER BLADES FOR STABILITY. INCLUDE LOCKING DEVICE TO HOLD SINGLE-BLADE DAMPERS IN A FIXED POSITION WITHOUT VIBRATION. CLOSE DUCT PENETRATIONS FOR DAMPER COMPONENTS TO SEAL DUCT CONSISTENT WITH PRESSURE CLASS.
 1. PRESSURE CLASSES OF 3-INCH WG OR HIGHER: END BEARINGS OR OTHER SEALS FOR DUCTS WITH AXLES FULL LENGTH OF DAMPER BLADES AND BEARINGS AT BOTH ENDS OF OPERATING SHAFT.
 - B. STANDARD VOLUME DAMPERS: MULTIPLE-OR SINGLE-BLADE, OPPOSED-BLADE DESIGN, STANDARD LEAKAGE RATING, WITH LINKAGE OUTSIDE AIRSTREAM, AND SUITABLE FOR HORIZONTAL OR VERTICAL APPLICATIONS.
 1. STEEL FRAMES: HAT-SHAPED, GALVANIZED SHEET STEEL CHANNELS, MINIMUM OF 0.064 INCH THICK, WITH MITERED AND WELDED CORNERS; FRAMES WITH FLANGES WHERE INDICATED FOR ATTACHING TO WALLS AND FLANGELESS FRAMES WHERE INDICATED FOR INSTALLING IN DUCTS.
 2. ROLL-FORMED STEEL BLADES: 0.064-INCH-THICK, GALVANIZED SHEET STEEL, MAXIMUM 10 INCHES WIDE.
 3. ALUMINUM FRAMES: HAT-SHAPED, 0.10-INCH- THICK, ALUMINUM SHEET CHANNELS; FRAMES WITH FLANGES WHERE INDICATED FOR ATTACHING TO WALLS; AND FLANGELESS FRAMES WHERE INDICATED FOR INSTALLING IN DUCTS.
 4. ROLL-FORMED ALUMINUM BLADES: 0.10-INCH- THICK ALUMINUM SHEET.
 5. EXTRUDED-ALUMINUM BLADES: 0.050-INCH- THICK EXTRUDED ALUMINUM.
 6. BLADE AXLES: GALVANIZED STEEL.
 7. BEARINGS: OIL-IMPREGNATED BRONZE OR MOLDED SYNTHETIC.
 8. TIE BARS AND BRACKETS: ALUMINUM.
 9. TIE BARS AND BRACKETS: GALVANIZED STEEL.
 - C. JACKSHAFT: 1-INCH- DIAMETER, GALVANIZED-STEEL PIPE ROTATING WITHIN PIPE-BEARING ASSEMBLY MOUNTED ON SUPPORTS AT EACH MULLION AND AT EACH END OF MULTIPLE-DAMPER ASSEMBLIES.
 1. LENGTH AND NUMBER OF MOUNTINGS: APPROPRIATE 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.
- 2.4 **FIRE DAMPERS**
 - A. FIRE DAMPERS SHALL BE DYNAMIC TYPE UNLESS OTHERWISE INDICATED AND SHALL BE LABELED ACCORDING TO UL 555. FIRE RATING SHALL BE 1-1/2 HOUR FOR FIRE RESISTIVE RATINGS OF 2 HOURS OR LESS; 3 HOURS FOR FIRE RESISTIVE RATINGS OF 3 HOURS OR MORE.
 - B. FRAME: CURTAIN TYPE WITH BLADES OUTSIDE AIRSTREAM (TYPE B) AND MULTIPLE-BLADE TYPE; FABRICATED WITH ROLL-FORMED, 0.034-INCH - THICK GALVANIZED STEEL; WITH MITERED AND INTERLOCKING CORNERS.
 - C. MOUNTING SLEEVE: FACTORY- OR FIELD-INSTALLED, GALVANIZED SHEET STEEL.
 1. MINIMUM THICKNESS: 0.052 OR 0.138 INCH THICK AS INDICATED AND OF LENGTH TO SUIT APPLICATION.
 2. EXCEPTIONS: OMIT SLEEVE WHERE DAMPER FRAME WIDTH PERMITS DIRECT ATTACHMENT OF PERIMETER MOUNTING ANGLES ON EACH SIDE OF WALL OR FLOOR, AND THICKNESS OF DAMPER FRAME COMPLIES WITH SLEEVE REQUIREMENTS.
 - D. MOUNTING ORIENTATION: VERTICAL OR HORIZONTAL AS INDICATED.
 - E. 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.
 - F. HORIZONTAL DAMPERS: INCLUDE BLADE LOCK AND STAINLESS-STEEL CLOSURE SPRING.
 - G. FUSIBLE LINKS: REPLACEABLE, 165 DEG F RATED.
- 2.5 **TURNING VANES**
 - A. FABRICATE TO COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS--METAL AND FLEXIBLE" FOR VANES AND VANE RUNNERS. VANE RUNNERS SHALL AUTOMATICALLY ALIGN VANES.
 - B. MANUFACTURED TURNING VANES: FABRICATE 1-1/2-INCH- WIDE, AIRFOIL-VANE, CURVED BLADES OF GALVANIZED SHEET STEEL SET 3/4 INCH O.C.; SUPPORT WITH BARS PERPENDICULAR TO BLADES SET 2 INCHES O.C.; AND SET INTO VANE RUNNERS SUITABLE FOR DUCT MOUNTING.
- 2.6 **DUCT-MOUNTING ACCESS DOOR**
 - A. GENERAL DESCRIPTION: FABRICATE DOORS AIRTIGHT AND SUITABLE FOR DUCT PRESSURE CLASS.
 - B. DOOR: DOUBLE WALL, DUCT MOUNTING, AND RECTANGULAR; FABRICATED OF GALVANIZED SHEET METAL WITH INSULATION FILL AND THICKNESS AS INDICATED FOR DUCT PRESSURE CLASS (MINIMUM 1-INCH). INCLUDE VISION PANEL WHERE INDICATED. INCLUDE 1-BY-1-INCH BUTT OR PIANO HINGE AND CAM LATCHES.
 1. FRAME: GALVANIZED SHEET STEEL, WITH BEND-OVER TABS AND FOAM GASKETS.
 2. PROVIDE NUMBER OF HINGES AND LOCKS AS FOLLOWS:
 - a. LESS THAN 12 INCHES SQUARE: SECURE WITH TWO SASH LOCKS.
 - b. UP TO 18 INCHES SQUARE: TWO HINGES AND TWO SASH LOCKS.
 - c. UP TO 24 BY 48 INCHES: THREE HINGES AND TWO COMPRESSION LATCHES WITH OUTSIDE AND INSIDE HANDLES.
 - d. SIZES 24 BY 48 INCHES AND LARGER: ONE ADDITIONAL HINGE.
 - C. DOOR: DOUBLE WALL, DUCT MOUNTING, AND ROUND; FABRICATED OF GALVANIZED SHEET METAL WITH INSULATION FILL AND 1-INCH THICKNESS. INCLUDE CAM LATCHES.
 1. FRAME: GALVANIZED SHEET STEEL, WITH SPIN-IN NOTCHED FRAME.
 - D. SEAL AROUND FRAME ATTACHMENT TO DUCT AND DOOR TO FRAME WITH NEOPRENE OR FOAM RUBBER.
 - E. INSULATION: 1-INCH- THICK, FIBROUS-GLASS OR POLYSTYRENE-FOAM BOARD.
- 2.7 **FLEXIBLE CONNECTORS**
 - A. GENERAL DESCRIPTION: FLAME-RETARDANT OR NONCOMBUSTIBLE FABRICS, COATINGS, AND ADHESIVES COMPLYING WITH UL 181, CLASS 1. METAL-EDGED CONNECTORS: FACTORY FABRICATED WITH A FABRIC STRIP ALUMINUM SHEETS. SELECT METAL COMPATIBLE WITH DUCTS. CONNECTOR FABRIC IN PARAGRAPH BELOW IS NOT SUITABLE FOR EXPOSURE TO SUN, WEATHER, OR CORROSIVE ENVIRONMENTS. IT IS SUITABLE FOR SYSTEM TEMPERATURES FROM MINUS 10 TO PLUS 200 DEG F (MINUS 23 TO PLUS 93 DEG C).
 - C. INDOOR SYSTEM, FLEXIBLE CONNECTOR FABRIC: GLASS FABRIC DOUBLE COATED WITH NEOPRENE.
 1. MINIMUM WEIGHT: 29 OZ./SQ. YD.
 2. SERVICE TEMPERATURE: MINUS 20 TO PLUS 200 DEG F.
 - D. OUTDOOR SYSTEM, FLEXIBLE CONNECTOR FABRIC: GLASS FABRIC DOUBLE COATED WITH WEATHERPROOF, SYNTHETIC RUBBER RESISTANT TO UV RAYS AND OZONE.
 1. MINIMUM WEIGHT: 24 OZ./SQ. YD.
 2. TENSILE STRENGTH: 530 LBF/INCH IN THE WARP AND 440 LBF/INCH IN THE FILLING.
 3. SERVICE TEMPERATURE: MINUS 10 TO PLUS 250 DEG F.
- 2.8 **FLEXIBLE DUCTS**
 - A. INSULATED-DUCT CONNECTORS: UL 181, CLASS 1, VINYL IMPREGNATED AND COATED FIBER GLASS MESH INNER SLEEVE SUPPORTED BY HELICALLY WOUND, VINYL COATED SPRING-STEEL WIRE; 1-INCH THICK FIBROUS-GLASS INSULATION; OUTER FOIL BAKED KRAFT PAPER VAPOR BARRIER.
 1. PRESSURE RATING: 6-INCH WG POSITIVE AND 1.0-INCH WG NEGATIVE.
 2. MAXIMUM AIR VELOCITY: 4000 FPM.
 3. TEMPERATURE RANGE: MINUS 20 TO PLUS 250 DEG F.
 - B. FLEXIBLE DUCT CLAMPS: STAINLESS-STEEL BAND WITH CADMIUM-PLATED HEX SCREW TO TIGHTEN BAND WITH A WORM-GEAR ACTION, IN SIZES 3 THROUGH 18 INCHES TO SUIT DUCT SIZE.
- 2.9 **DUCT ACCESSORY HARDWARE**
 - A. INSTRUMENT TEST HOLES: CAST IRON OR CAST ALUMINUM TO SUIT DUCT MATERIAL, INCLUDING SCREW CAP AND GASKET. SIZE TO ALLOW

- B. ADHESIVES: HIGH STRENGTH, QUICK SETTING, NEOPRENE BASED, WATERPROOF, AND RESISTANT TO GASOLINE AND GREASE.

PART 3: EXECUTION

- 3.1 **APPLICATION AND INSTALLATION**
 - A. INSTALL DUCT ACCESSORIES ACCORDING TO APPLICABLE DETAILS IN SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS--METAL AND FLEXIBLE" FOR METAL DUCTS.
 - B. PROVIDE DUCT ACCESSORIES OF MATERIALS SUITED TO DUCT MATERIALS; USE GALVANIZED-STEEL ACCESSORIES IN GALVANIZED-STEEL DUCTS, STAINLESS-STEEL ACCESSORIES IN STAINLESS-STEEL DUCTS, AND ALUMINUM ACCESSORIES IN ALUMINUM DUCTS.
 - C. PROVIDE BALANCING DAMPERS AT POINTS ON SUPPLY, RETURN, AND EXHAUST SYSTEMS WHERE BRANCHES LEAD FROM LARGER DUCTS AS REQUIRED FOR AIR BALANCING. INSTALL AT A MINIMUM OF TWO DUCT WIDTHS FROM BRANCH TAKEOFF.
 - D. PROVIDE TEST HOLES AT FAN INLETS AND OUTLETS AND ELSEWHERE AS INDICATED.
 - E. INSTALL FIRE AND SMOKE DAMPERS, WITH FUSIBLE LINKS, ACCORDING TO MANUFACTURER'S UL-APPROVED WRITTEN INSTRUCTIONS. PROVIDE FIRE DAMPERS AS FOLLOWS:
 1. FLOOR AND ROOF PENETRATIONS: MULTIPLE BLADE TYPE.
 2. WALL PENETRATIONS: CURTAIN TYPE OR MULTIPLE BLADE TYPE.
 - F. INSTALL DUCT ACCESS DOORS TO ALLOW FOR INSPECTING, ADJUSTING, AND MAINTAINING ACCESSORIES AND TERMINAL UNITS AS FOLLOWS:
 1. ON BOTH SIDES OF DUCT COILS.
 2. DOWNSTREAM FROM EQUIPMENT.
 3. ADJACENT TO FIRE AND SMOKE DAMPERS, PROVIDING ACCESS TO RESET OR REINSTALL FUSIBLE LINKS.
 4. ON SIDES OF DUCTS WHERE ADEQUATE CLEARANCE IS AVAILABLE.
 - G. INSTALL THE FOLLOWING SIZES FOR DUCT-MOUNTING, RECTANGULAR ACCESS DOORS:
 1. ONE-HAND OR INSPECTION ACCESS: 8 BY 5 INCHES.
 2. TWO-HAND ACCESS: 12 BY 6 INCHES.
 3. HEAD AND HAND ACCESS: 18 BY 10 INCHES.
 4. HEAD AND SHOULDERS ACCESS: 21 BY 14 INCHES.
 5. BODY ACCESS: 25 BY 14 INCHES.
 6. BODY PLUS LADDER ACCESS: 25 BY 17 INCHES.
 - H. INSTALL THE FOLLOWING SIZES FOR DUCT-MOUNTING, ROUND ACCESS DOORS:
 1. ONE-HAND OR INSPECTION ACCESS: 8 INCHES IN DIAMETER.
 2. TWO-HAND ACCESS: 10 INCHES IN DIAMETER.
 3. HEAD AND HAND ACCESS: 12 INCHES IN DIAMETER.
 4. HEAD AND SHOULDERS ACCESS: 18 INCHES IN DIAMETER.
 5. BODY ACCESS: 24 INCHES IN DIAMETER.
 - I. LABEL ACCESS DOORS ACCORDING TO DIVISION 23 SECTION "MECHANICAL IDENTIFICATION."
 - J. INSTALL FLEXIBLE CONNECTORS IMMEDIATELY ADJACENT TO EQUIPMENT IN DUCTS ASSOCIATED WITH FANS AND MOTORIZED EQUIPMENT SUPPORTED BY VIBRATION ISOLATORS. FOR FANS DEVELOPING STATIC PRESSURES OF 5-INCH WG AND HIGHER, COVER FLEXIBLE CONNECTORS WITH LOADED VINYL SHEET HELD IN PLACE WITH METAL STRAPS.
 - K. CONNECT TERMINAL UNITS TO SUPPLY DUCTS DIRECTLY.
 - L. CONNECT DIFFUSERS OR GRILLES TO LOW PRESSURE DUCTS DIRECTLY. MAXIMUM 60-INCH LENGTHS OF STRAIGHT FLEXIBLE DUCT CAN BE USED FOR STRAIGHT RUNS. DO NOT USE FLEXIBLE DUCTS TO CHANGE DIRECTIONS. CONNECT FLEXIBLE DUCTS TO METAL DUCTS WITH DRAW BANDS. PROVIDE HARD ELBOW AT DIFFUSERS.
- 3.2 **ADJUSTING**
 - A. ADJUST DUCT ACCESSORIES FOR PROPER SETTINGS.
 - B. ADJUST FIRE AND SMOKE DAMPERS FOR PROPER ACTION.
 - C. FINAL POSITIONING OF MANUAL-VOLUME DAMPERS IS SPECIFIED IN DIVISION 23 SECTION "TESTING, ADJUSTING, AND BALANCING."

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CONSTRUCTION DOCUMENTS

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MECHANICAL SPECIFICATIONS

SHEET NO.: **M0.04**

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DUCT CONSTRUCTION SCHEDULE

SERVICE	LOCATION	DUCT TYPE/ MATERIAL	SINGLE WALL/ DOUBLE WALL	PRESSURE CLASSIFICATION	SMACNA SEAL CLASS.	SMACNA LEAKAGE CLASS.		APPLICABLE CODE/STANDARD
						RECTANGULAR	ROUND	
SUPPLY / OUTSIDE AIR	CONCEALED ABOVE CEILINGS OR IN CHASES, OR LOCATED IN MECHANICAL ROOMS	GALVANIZED STEEL, RECTANGULAR W/ FLANGED OR SLIP & DRIVE JOINTS, SPIRAL, OR GROOVED LONG SEAM	SINGLE	2"	B	12	6	NOTES 1, 2, 3, 4
EXHAUST	CONCEALED ABOVE CEILINGS OR IN CHASES, OR LOCATED IN MECHANICAL ROOMS	GALV. STEEL, RECTANGULAR W/ FLANGED OR SLIP & DRIVE JOINTS, SPIRAL, OR GROOVED LONG SEAM	SINGLE	2"	B	12	6	NOTES 1, 2, 3, 4

- NOTES:**
- SMACNA HVAC DUCT CONSTRUCTION STANDARDS – METAL AND FLEXIBLE.
 - NFPA 90A, INSTALLATION OF AIR CONDITIONING AND VENTILATION SYSTEMS.
 - INTERNATIONAL MECHANICAL CODE.
 - LISTED CODES AND STANDARDS SHALL BE CURRENT ADOPTED EDITION.
 - NFPA 96, VENTILATION CONTROL AND FIRE PROTECTION OF COMMERCIAL COOKING OPERATIONS.
 - PROVIDE GIRTH RINGS ON 5 FOOT CENTERS.

DUCT INSULATION SCHEDULE

SERVICE	INSULATION TYPE	FINISH/JACKET	INSULATION THICKNESS (IN.)	INSUL. DENSITY (LB./CF)
EXHAUST, SUPPLY AND OUTSIDE AIR	FIBERGLASS BLANKET	FSK	2.2	0.75

- NOTES:**
- PROVIDE CONTINUOUS VAPOR BARRIER ON ALL DUCTWORK.
 - FIBERGLASS DUCT LINER SHALL CONTAIN AN ANTI-MICROBIAL AGENT TO RESIST BACTERIAL AND FUNGAL GROWTH.
 - FINISH/JACKET LEGEND: FOIL/SCRIM/KRAFT JACKET (FSK), CANVAS JACKET (CJ), INSULATION CEMENT (IC), ALUMINUM JACKET (AJ), ALUMINUM JACKET, STUCCO EMBOSSED (AJ-SE), WATERPROOF MASTIC (WM).

RADIANT CEILING PANEL SCHEDULE

MARK	WATT RATING	VOLT/PH/HZ	PANEL SIZE (IN.)	MODEL NO.	NOTES
RCP-1	750	120/1/60	24 x 48	CP127	1, 2, 3, 4, 5

- NOTES:**
- ACCEPTABLE MANUFACTURERS ARE Q-MARK. MODEL NUMBERS BASED ON Q-MARK.
 - PROVIDE WITH BACNET CAPABLE THERMOSTAT AND METAL LOCKABLE COVER.
 - LINE VOLTAGE THERMOSTAT WIRING BY ELECTRICAL CONTRACTOR.
 - DISCONNECT SWITCHES FOR RADIANT HEATERS BY ELECTRICAL CONTRACTOR.
 - CONTROLS, LOW VOLTAGE WIRING, AND COMMUNICATION WITH HVAC CONTROL SYSTEM BY CONTROLS CONTRACTOR.

HVAC EQUIPMENT

MARK	DESCRIPTION	SUPPLY (CFM)	RETURN (CFM)	OUTSIDE AIR (CFM)	TOTAL CLG (MBH)	SENS CLG (MBH)	COND. AMB AIR (*F DB)	COOLING INPUT (W)	HEATING OUTPUT (MBH)	POWER SUPPLY	FAN HP	MINIMUM CIRCUIT AMP	MODEL
DSS-1	EVAPORATOR	300	-	-	9	-	-	890	-	208V/1Ø/60	-	3.15 A	TRANE 4MXW6509A10NOBA
DSS-0	HEAT PUMP	-	-	-	-	-	95	-	9	208V/1Ø/60	-	10 MCA, 15 MOP	TRANE 4TXK6509A10NOBA

- SPLIT SYSTEMS NOTES:**
- PROVIDE OUTDOOR UNITS WITH ANTI-SHORT-CYCLE TIMERS.
 - UNITS SHALL BE MATCHED SPLIT SYSTEM HEAT PUMPS.
 - PROVIDE THERMAL EXPANSION VALVE WITH INDOOR UNITS. PROVIDE FILTER DRYER WITH OUTDOOR UNITS.
 - SPLIT SYSTEMS SHALL HAVE 7 DAY PROGRAMMABLE HEATING/COOLING THERMOSTATS. THERMOSTATS SHALL BE MINIMUM 2 STAGE HEATING/1 STAGE COOLING THERMOSTATS.
 - DRAIN EVAPORATOR OUT TO GRADE WITH SPLASH BLOCK.
- DUCTLESS SPLIT SYSTEMS NOTES:**
- ACCEPTABLE MANUFACTURERS ARE TRANE, MITSUBISHI AND SANYO. SELECTIONS BASED ON TRANE.

FAN SCHEDULE

MARK	DESCRIPTION	TYPE	HP	POWER SUPPLY	ESP (IN. WC)	CFM	MAX FAN RPM	MAX SONES	MIN FAN DIA. (IN.)	DRIVE ARRANGEMENT	ACCESSORIES								MODEL	NOTES	CONTROL	
											A	B	C	D	E	F	G	H				
EF-1	BATHROOM	CEILING EXHAUST FAN	-	115V/1Ø/60	.25	200	900	2	-	BELT DRIVE			X	X	X					SP-A200	1, 2	OCCUPANCY
SF-1	BATHROOM	INLINE CABINET FAN	-	115V/1Ø/60	.25	200	900	2	-	BELT DRIVE			X	X	X					CSP-A200	1, 3	OCCUPANCY

- NOTES:**
- ACCEPTABLE MANUFACTURERS ARE ACME, GREENHECK, AND LOREN COOK. SELECTIONS BASED ON ACME.
 - SURFACE MOUNT.
 - MOUNT ABOVE HARD CEILING IN BETWEEN JOISTS.
- ACCESSORIES:**
- 120V MOTOR OPERATED DAMPER
 - ROOF CURB, 18-INCH HIGH U.O.N.
 - SPEED CONTROLLER
 - DISCONNECT SWITCH
 - MOTOR OVERLOADS FOR 115V/1Ø FAN MOTORS
 - CURB ADAPTER
 - MOTOR RATED FOR VARIABLE FREQUENCY DRIVE SERVICE
 - WALL CAP

REGISTER, GRILLE, AND DIFFUSER SCHEDULE

MARK	CFM	P.D. (IN. W.G.)	RUNOUT SIZE (DIA. INCHES)	NECK SIZE (INCHES)	AIR PATTERN	PANEL SIZE (INCHES)	TYPE	MATERIAL	FINISH	ACCESSORIES								MODEL		NOTES
										A	B	C	D	E	F	G	H	T&B	PRICE	
A	180-280	0.06	AS INDICATED	12 x 12	SEE PLANS	-	SURFACE MT. SUPPLY	ALUMINUM	WHITE									AM	AMD	1, 2

- GENERAL NOTES:**
- SELECTIONS BASED ON PRICE AND TUTTLE & BAILEY.
 - MAXIMUM 30 NC RATING.
- ACCESSORIES:**
- OPPOSED BLADE DAMPERS (SQUARE/RECT NECK)
 - RADIAL DAMPER (ROUND NECK)
 - SQUARE TO ROUND ADAPTERS (AS REQUIRED)
 - DOUBLE DEFLECTION WITH ADJUSTABLE VANES.
 - ADJUSTABLE AIR PATTERN VANES.
 - PLASTER FRAME.
 - PROVIDE DIFFUSER WITH MULTI-ORIFICED JET INDUCTION AND AIR MIXING DIFFUSING VANES.

PIPING APPLICATION CHART

LINE	SYSTEM	PIPE SIZE	PRESSURE RANGE	PIPING APPLICATION						FITTING APPLICATION		
				MATERIAL	ASTM STANDARD	MFG. PROCESS	WEIGHT	JOINT	PRESSURE RATING (PSIG)	MATERIAL	CLASS	JOINT
1	REFRIGERANT LIQUID & SUCTION PIPING	NPS 2" AND SMALLER	-	WROUGHT COPPER	B 280	DRAWN	ACR	BRAZED	350	WROUGHT COPPER	-	BRAZED
2	COOLING COIL CONDENSATE DRAIN PIPING	NPS 2" AND SMALLER	-	COPPER	B 88	DRAWN	TYPE L	95-5 LEAD FREE SOLDER	350	WROUGHT COPPER	-	95-5 LEAD FREE SOLDER

NOTES:

LOUVER SCHEDULE

MARK	LOCATION	SIZE (IN.) (W X H)	MIN FREE AREA (SF)	CFM	MODEL NUMBER	MANUFACTURER	NOTES
L-1	SEE PLANS	45 x 61	10.2	-	ESJ-401	GREENHECK	1,2,3

- NOTES:**
- ACCEPTABLE MANUFACTURERS ARE GREENHECK, CESCO, AND RUSKIN. SELECTIONS BASED ON GREENHECK.
 - LOUVER COLOR AND FINISH SELECTION BY OWNER.
 - VERIFY SIZE WITH CURRENT OPENINGS.

PIPE INSULATION SCHEDULE

SERVICE	INSULATION TYPE	FINISH / JACKET		PIPE SIZE		
		INDOOR	OUTDOOR	3/4" & 1" TO LESS	1" TO 1-1/4"	1-1/2"
REFRIGERANT SUCTION PIPING AND CONDENSATE DRAIN PIPING	FLEXIBLE ELASTOMERIC	-	UPC	1/2"	1/2"	1"

- NOTES:**
- ALL PIPING SYSTEMS 2 1/2" AND ABOVE SHALL HAVE CALCIUM SILICATE INSERTS AT HANGERS.
 - PROTECT INDIRECT HUNG PIPING WITH GALVANIZED INSULATION PROTECTION SHIELDS FOR TEMPERATURES 180°F AND BELOW.
 - ALL PIPING SHALL HAVE INSULATION CONTINUOUS THROUGH HANGERS.
 - TIGHTEN ALL HANGER NUTS AFTER INSTALLATION OF INSULATION THROUGH HANGERS.
 - FINISH / JACKET LEGEND: ALL SERVICE JACKET WITH SELF-SEALING LAB (ASJ-SSL), ALUMINUM JACKET-STUCCO EMBOSSED (AJ-SE), ULTRAVIOLET PROTECTIVE COATING (UPC).

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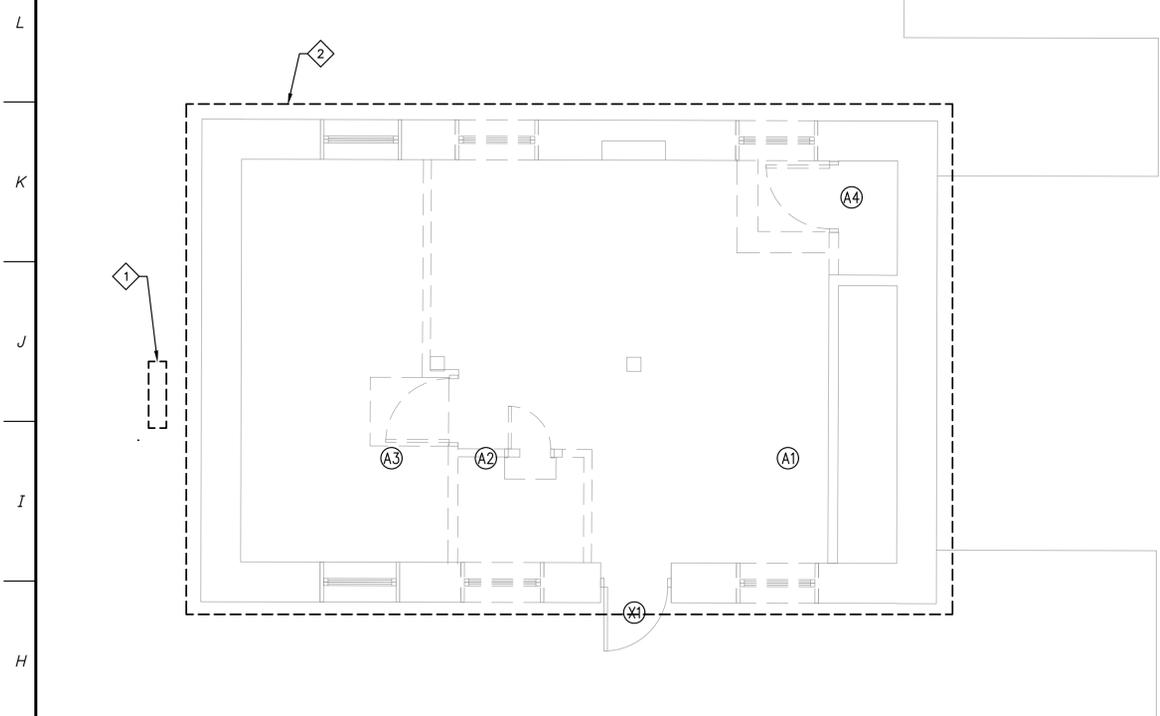
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SCALE: N/A

MECHANICAL SCHEDULES

SHEET NO.:

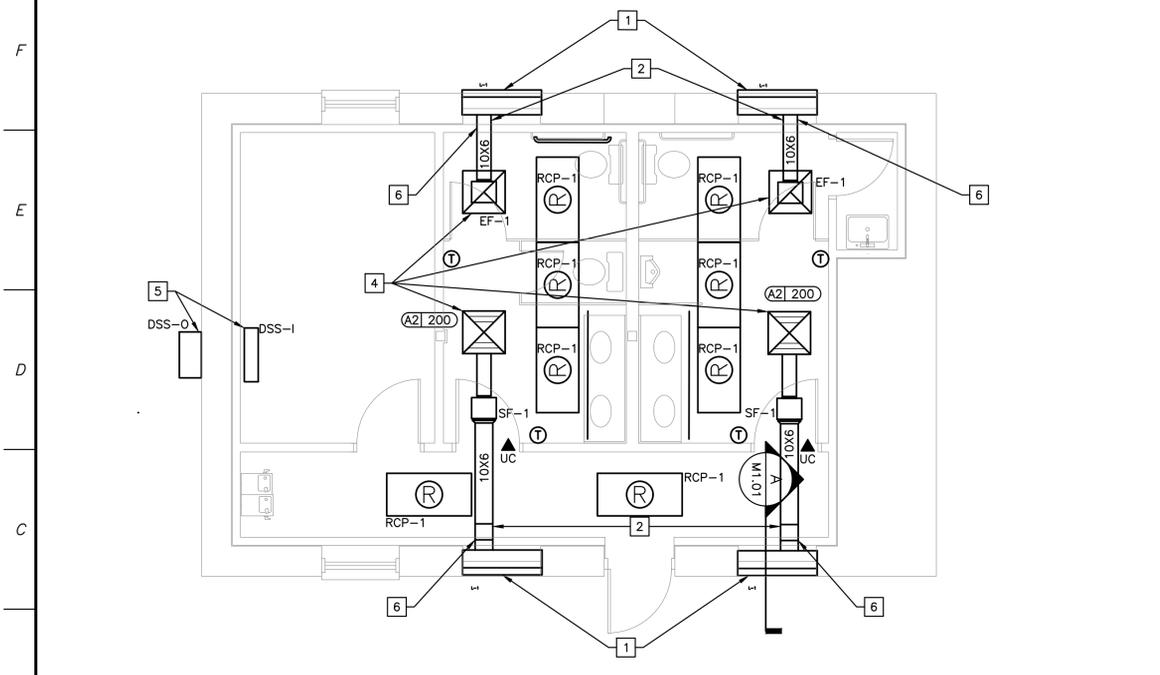
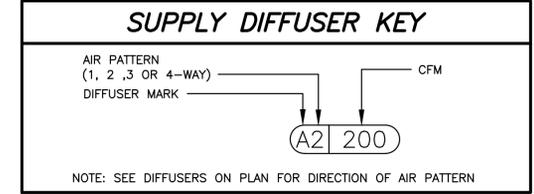
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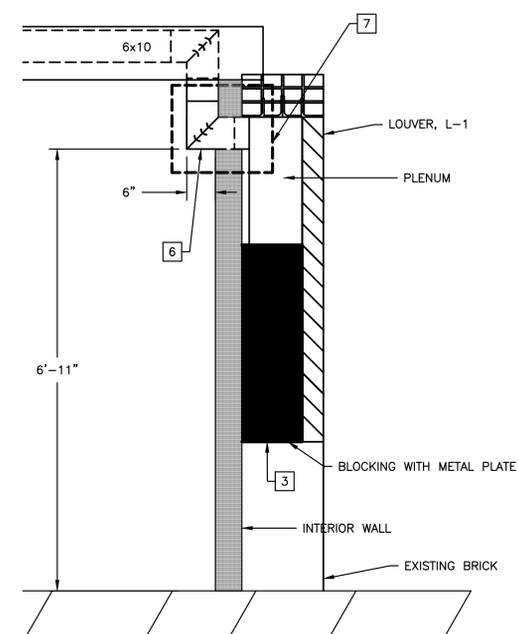
MECHANICAL DEMOLITION PLAN
SCALE: 1/4" = 1'-0"

- DEMOLITION NOTES**
- REMOVE EXISTING DUCTLESS SPLIT SYSTEM AND ALL ASSOCIATED EQUIPMENT, HARDWARE, PIPING, WIRING ETC.
 - DEMOLISH ALL MECHANICAL EQUIPMENT AND PIPING WITHIN AND ABOVE PROJECT BOUNDARY.
- CONSTRUCTION NOTES**
- WEATHER SEAL WITH EXTERIOR GRADE CAULKING ASSEMBLY OF LOUVER, PLENUM AND BLOCKING. CAULKING COLOR BY OWNER.
 - LOCATE JOISTS AND POSITION DUCT CENTERED IN BETWEEN JOISTS IN ORDER TO ALLOW STRAIGHT RUN AND ENSURE FAN WILL FIT WITHIN JOIST SPACE.
 - BLOCKING BEHIND LOUVER AND UNDERNEATH PLENUM SHALL ENCOMPASS ENTIRE REMAINING WIDTH OF MASONRY WALL. THE BLOCKING SHALL BE CONSTRUCTED METAL PLATE LINER, WOOD FRAMING, R-13 INSULATION, AND DRY WALL.
 - GRILLS AND DIFFUSERS ARE TO BE SURFACE MOUNTED ON HARD CEILING AND WILL BE AT PROPER CEILING HEIGHT. THEY SHALL HAVE FLEX CONNECTIONS.
 - MINI DUCTLESS SPLIT SYSTEM INSTALLED PER MANUFACTURERS MANUAL. OUTDOOR UNIT PLACED ON EXTERIOR WALL AND INDOOR UNIT HUNG ON INTERIOR WALL.
 - REDUCE DUCT PROTRUSION AS MUCH AS POSSIBLE AND PROTECT ACCORDINGLY.
 - WELDED SEAM DUCT CONNECTION TO PLENUM IS NEEDED. SEE DETAIL VIEW ON THIS SHEET.

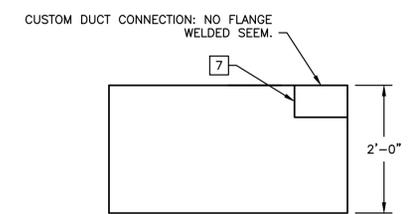
- GENERAL NOTES**
- DEMOLITION INCLUDES REMOVAL OF ALL PIPING SERVING FLOORS ABOVE. CAP ALL REMAINING PIPING IN FLOOR ABOVE.
 - FIELD VERIFY BRICK WINDOW OPENING DIMENSIONS POST DEMOLITION. COORDINATE WITH MASONRY TO CREATE A SQUARED OPENING OF TYPICAL DIMENSION. CONTRACTOR SHALL THEN SIZE CUSTOM LOUVER AND PLENUM PER DIMENSION.



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



SECTION VIEW A (TYP 4)
SCALE: 3/4" = 1'-0"



DETAIL VIEW
SCALE: 3/4" = 1'-0"

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

MECHANICAL PLAN

SHEET NO.: **M1.01**

