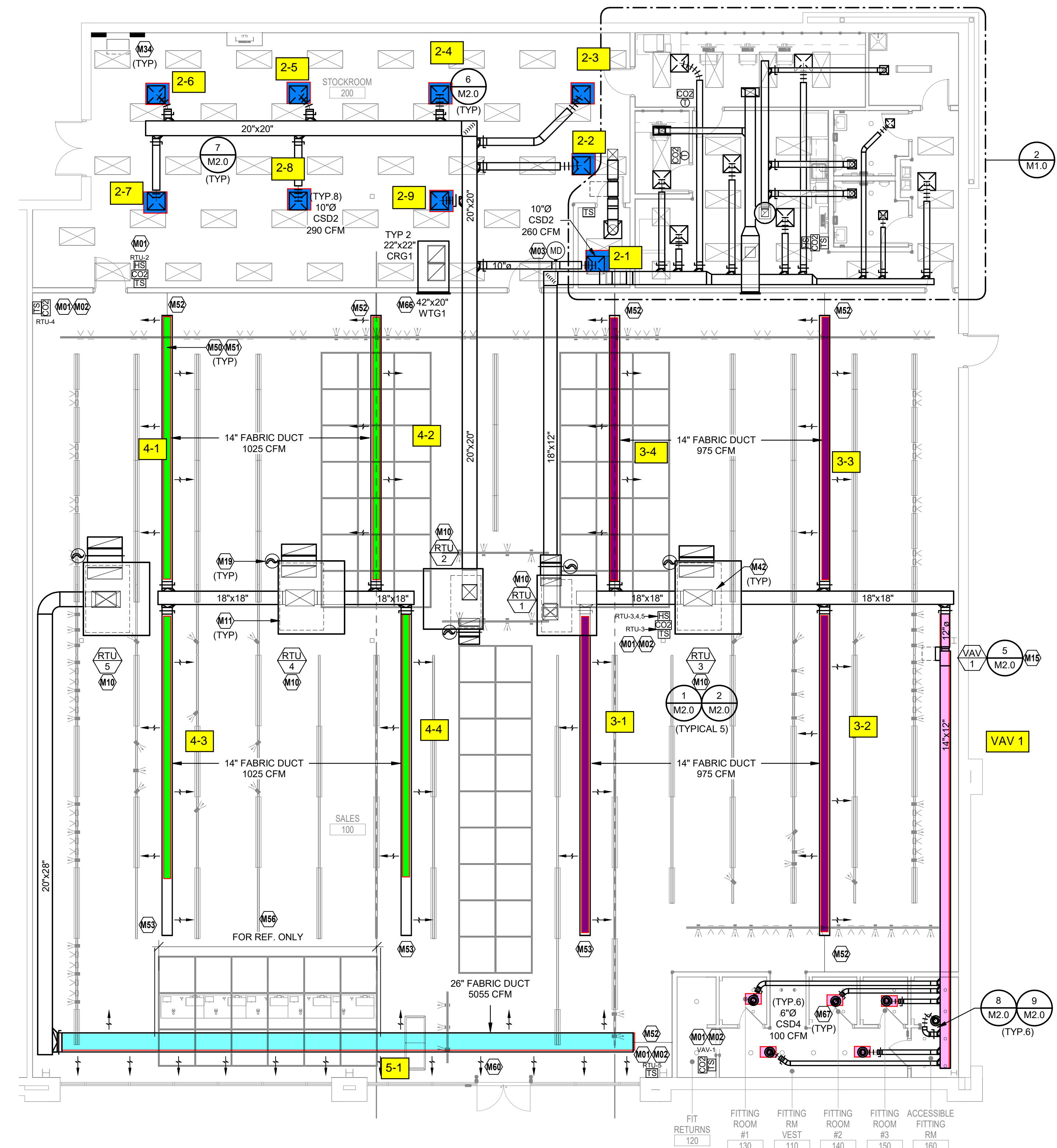


2 ENLARGED BACK OF HOUSE HVAC PLAN  
1/4" = 1'-0"



1 HVAC PLAN  
1/8" = 1'-0"

KEYNOTES ARE PROTOTYPICAL. MISSING KEYNOTE NUMBERS INDICATE A PROTOTYPICAL NOTE IS NOT USED OR REMOVED.

MECHANICAL PLAN NOTES

- M01 ALL THERMOSTATS AND SENSORS ARE FURNISHED BY EMS VENDOR AND INSTALLED BY DIVISION 26. UNLESS NOTED OTHERWISE, DIVISION 26 SHALL COORDINATE EXACT DEVICE QUANTITIES, LOCATIONS, AND POWER CONNECTIONS WITH REQUIREMENTS WITH EMS VENDOR PRIOR TO CONSTRUCTION.
- M02 DO NOT INSTALL SENSORS ON WALL GRAPHICS. CONFIRM LOCATIONS OF SENSORS WITH PM PRIOR TO INSTALLATION. DAMPER AND ACTUATOR IN LOCATION INDICATED. MANUFACTURER, CONTROLS RELAY FURNISHED BY EMS VENDOR.
- M03 INSTALL DAMPER AND ACTUATOR IN LOCATION INDICATED. DAMPER AND ACTUATOR FURNISHED BY FAN MANUFACTURER. CONTROLS RELAY FURNISHED BY EMS VENDOR.
- M04 MOTORIZED DAMPER SHALL BE ACCESSED THROUGH FAN ON ROOF AND IS SHOWN ON PLAN FOR REFERENCE ONLY. REFER TO MECHANICAL SCHEDULES FOR MORE INFORMATION.
- M10 PROVIDE NEW ROOFTOP UNIT WITH NEW ROOF CURB PROVIDE A NEW SET OF MERV 13 AIR FILTERS IN UNIT BEFORE TURNING SYSTEM OVER TO OWNER. COORDINATE CONDENSATE PIPING WITH DIVISION 22.
- M11 DASHED LINE REPRESENT THE ROOFTOP UNIT CURB.
- M15 PROVIDE NEW VAV BOX IN SUPPLY AIR DUCT SERVING FITTING ROOMS. INSTALL VAV BOX IN ACCESSIBLE LOCATION AND COORDINATE CONTROLS WITH EMS VENDOR PRIOR TO ORDERING.
- M17 COORDINATE FINAL INSTALLED LOCATION SUCH THAT THE HVAC EQUIPMENT REMAINS ACCESSIBLE. VERIFY NO OTHER PIPING, ELECTRICAL CONDUIT, STRUCTURE, AND/OR CEILING SUPPORTS IMPEDE ACCESS IN ANY WAY. INSTALL HVAC EQUIPMENT WITHIN 18'-0" ABOVE FINISHED FLOOR FOR SERVICEABILITY.
- M19 SMOKE DETECTORS AND WIRING IN RETURN AIR DUCTS SHALL BE PROVIDED BY DIVISION 28 CONTRACTOR. SMOKE DETECTORS SHALL SHUT-DOWN UNIT UPON ALARM.
- M22 PROVIDE NEW ROOF-MOUNTED EXHAUST FAN AS SCHEDULED FOR GENERAL RESTROOM EXHAUST.
- M23 EXHAUST FAN SERVES TO PROVIDE TRANSFER AIR ONLY AND SHALL DISCHARGE AIR INTO THE STOCKROOM.
- M25 INSTALL VAV POWER MODULE FOR CONTROL OF OFFICE VAV DIFFUSERS IN AN ACCESSIBLE LOCATION ABOVE THE CEILING. DIVISION 26 CONTRACTOR SHALL PROVIDE 120V POWER TO MODULE. REFER TO ELECTRICAL DRAWINGS FOR DETAILS.
- M34 DO NOT ROUTE DUCTWORK OVER ELECTRICAL EQUIPMENT. NOTIFY ENGINEER OF CONFLICTS IN FIELD.
- M42 ROUTE SUPPLY AND RETURN DUCTWORK TO ROOF CURB DUCT CONNECTIONS AND TRANSITION DUCTWORK IN RISER AS NECESSARY.
- M50 INSTALL FABRIC DUCT ABOVE ARCHITECTURAL LIGHTING GRID. REFER TO BOXED NOTES FOR ADDITIONAL INFORMATION.
- M51 ARROWS INDICATE DIRECTION AND DISPERSION OF AIRFLOW VOLUME. PROVIDE VENTS ON FABRIC DUCT TO DIRECT AIRFLOW AS SHOWN ON PLAN.
- M52 EXTEND AND TIGHTEN HANGING CABLE TO WALL. GENERAL CONTRACTOR TO PROVIDE 2X WOOD BACKING. COORDINATE REQUIREMENTS WITH FABRIC DUCT MANUFACTURER.
- M53 FIELD FABRICATE L BRACKET FOR SUPPORTING END OF FABRIC DUCT. COORDINATE REQUIREMENTS WITH FABRIC DUCT MANUFACTURER.
- M56 DO NOT INSTALL AIR VENTS ON FABRIC DUCT ADJACENT TO BACKWRAP WALL. DIMENSION SHOWN FOR REFERENCE ONLY.
- M60 SUPPORT FABRIC DUCTWORK WITH MANUFACTURER'S DOUBLE-CABLE CROSS BRACING SUPPORTS. COORDINATE REQUIREMENTS WITH FABRIC DUCT MANUFACTURER.
- M65 LOUVERED DOOR FOR MAKEUP AIR BY GENERAL CONTRACTOR. REFER TO ARCHITECTURAL DRAWINGS FOR MORE INFORMATION.
- M66 PROVIDE GRILLE ON WALL FOR TRANSFER AIR. MOUNT AS HIGH AS POSSIBLE WITHIN STRUCTURE AND INSTALL WITH BLADES ANGLED UP TOWARDS STRUCTURE FOR REDUCED VISIBILITY.
- M67 COORDINATE LOCATION OF FITTING ROOM DIFFUSERS WITH LIGHTS, SPRINKLERS, SPEAKERS, AND OTHER CEILING DEVICES FOR A NEAT AND ORDERLY INSTALLATION. INSTALL CELING DEVICES IN-LINE WITH EACH OTHER WHERE POSSIBLE.

INSTALL DUCTWORK AND PIPING AS TIGHT TO STRUCTURE AS POSSIBLE. COORDINATE WITH OTHER TRADES TO AVOID CONFLICTS. COORDINATE INSTALLATION OF DUCTWORK AND PIPING TO AVOID CONFLICTS WITH ELECTRICAL PANELS, LIGHTING FIXTURES, ETC. DO NOT INSTALL DUCTWORK BELOW THE BOTTOM OF THE LIGHT FIXTURES.

**FABRIC DUCT GENERAL NOTES:**  
 PROVIDE FABRIC DUCT THROUGHOUT THE SPACE AS SHOWN ON PLAN. FABRIC DUCT SHALL NOT REPLACE RECTANGULAR DUCT DROPS OR EXHAUST DUCTS. BASIS OF DESIGN SHALL BE "PRIHODA", "NMI" NONPOROUS FABRIC WITH "PERFORATIONS" (AIR OPENINGS) WITH ADJUSTABLE FLOW DEVICES (I.E. AFD'S) AT OPENINGS, AND ONE ROW, GALVANIZED CABLE. INTERNAL HOOP SUPPORT SYSTEM SHALL BE PROVIDED ON ALL FABRIC DUCT UNLESS NOTED OTHERWISE. INCLUDE ALL COMPONENTS AND ACCESSORIES REQUIRED TO MAKE A COMPLETE SYSTEM AS RECOMMENDED BY PRIHODA DURING BID PHASE, INCLUDING HANGING STRAPS AND CLIPS, END-CAPS, CONNECTIONS TO METAL DUCTS, ETC. PRIHODA FABRIC DUCT SHALL BE SIZED PER FACTORY RECOMMENDATIONS TO PROVIDE MINIMUM AIRFLOWS IN BRANCH DUCTS AS SHOWN. CONFIRM FABRIC DUCT COLOR WITH ARCHITECT PRIOR TO ORDERING. ALL FABRIC DUCT SHALL BE WHITE (BUT NOT WHITE IS BASIS OF DESIGN) FOR GLOBAL 3.0 FIXTURE PACKAGE, PANTONE 420 - LIGHT GREY IS BASIS OF DESIGN. CONTACT PRIHODA SALES DEPARTMENT (E-MAIL: SALES@PRIHODA-NA.COM, PHONE: 1-855-774-4632) FOR PRICING INFORMATION.

**FABRIC DUCT DESIGN GUIDELINE:**  
 DISTRIBUTE AIRFLOW EVENLY ALONG FABRIC DUCT IN THE DIRECTION OF FLOW ARROWS. ORIENT AND SIZE FABRIC DUCT DIFFUSER OPENINGS TO PROVIDE A 50 FPM THROW VELOCITY HALF WAY TO THE NEAREST ADJACENT FABRIC DUCT OR TO THE NEAREST PARTITION/DEMISING WALL AS APPLICABLE. VENTS ON FABRIC DUCT SHALL BE LOCATED AT 22.5 DEGREES BELOW HORIZONTAL UNLESS NOTED OTHERWISE.

**FABRIC DUCT COORDINATION NOTE:**  
 DURING THE FIRST WEEK OF THE PROJECT, THE GENERAL CONTRACTOR'S SUPERINTENDENT, MECHANICAL SUB-CONTRACTOR, AND A REPRESENTATIVE FROM "PRIHODA" SHALL MEET AT THE PROJECT SITE FOR CONFIRMATION OF ALL FIELD DIMENSIONS AND POTENTIAL INTERFERENCE. THIS EVENT MUST PRECEDE THE ORDERING OF ANY MATERIALS FROM "PRIHODA". CHANGE ORDERS AND EXPEDITING FEES WILL NOT BE APPROVED DUE TO LACK OF ON-SITE COLLABORATION AND/OR MEASUREMENT DURING SITE MEETING AT PROJECT COMMENCEMENT.

**FABRIC DUCT INSTALLATION NOTE:**  
 INSTALL FABRIC DUCT ABOVE ARCHITECTURAL LIGHTING SYSTEM. COORDINATE FABRIC DUCT INSTALLATION WITH GENERAL CONTRACTOR AND DIVISION 26. GENERAL CONTRACTOR SHALL VERIFY FABRIC DUCT IS INSTALLED SUCH THAT IT DOES NOT CLASH WITH ARCHITECTURAL LIGHTING SYSTEM, INCLUDING LIGHT FIXTURES, ARCHITECTURAL LIGHTING SYSTEM GRID AND SUSPENSION CABLES, OR ANY OTHER SUSPENDED FIXTURES WHEN DEFLATED.

THE DUCTWORK LAYOUT INDICATED ON THE DRAWINGS IS SCHEMATIC AND SHOWS DESIGNED INTENT ONLY. PRIOR TO FABRICATION AND INSTALLATION OF DUCTWORK, DIVISION 23 SHALL HAVE A QUALIFIED, EXPERIENCED SKETCHER PREPARE AND SUBMIT SHEET METAL SHOP DRAWINGS. SHOP DRAWINGS SHALL TAKE INTO ACCOUNT ALL EXISTING CONDITIONS, INCLUDING BUT NOT LIMITED TO, STRUCTURAL MEMBERS, CONDUITS AND PIPING TO REMAIN. SHOP DRAWINGS SHALL ALSO TAKE INTO ACCOUNT ALL NEW DESIGN CONDITIONS, INCLUDING BUT NOT LIMITED TO, STRUCTURAL MEMBERS, PIPING, CELLINGS, SOFFIT HEIGHTS, AND LIGHT FIXTURES.

SHOP DRAWINGS SHALL INDICATE ALL REVISIONS TO THE LAYOUT REQUIRED TO ACCOMMODATE THE EXISTING CONDITIONS AND/OR MAINTAIN THE CEILING HEIGHTS AND CLEARANCES REQUIRED. NOTIFY THE ARCHITECT AND ENGINEER OF ANY LOCATION WHERE THE DESIGN INTENT CANNOT BE MET PRIOR TO FABRICATION AND INSTALLATION OF DUCTWORK. REVISIONS TO DUCTWORK, EQUIPMENT, CONDUIT AND PIPING REQUIRED BY CONTRACTOR'S FAILURE TO SUBMIT PROPERLY PREPARED SHOP DRAWINGS SHALL BE THE RESPONSIBILITY OF DIVISION 23 AT NO ADDITIONAL COST TO THE CLIENT OR DELAY TO THE PROJECT SCHEDULE.

GENERAL CONTRACTOR IS RESPONSIBLE FOR PROVIDING TO ARCHITECT, ENGINEER, LANDLORD, AND BUILDING OFFICIAL/INSPECTOR A FINAL TEST AND BALANCE REPORT PER THE SPECIFICATIONS. PROVIDE TEST AND BALANCE REPORT TO ARCHITECT, ENGINEER, AND LANDLORD PRIOR TO THE FINAL BUILDING INSPECTION.

**LANDLORD REQUIREMENTS:**  
 LANDLORD APPROVED ROOFING CONTRACTOR SHALL BE RESPONSIBLE FOR MAKING ALL CUTS THROUGH THE EXISTING ROOF, MODIFYING EXISTING OPENINGS, AND/OR ALTERING CURB FLASHING AT GENERAL CONTRACTOR'S EXPENSE. COORDINATE WITH GENERAL CONTRACTOR.

**EMS CONTROLS:**  
 CONTRACTORS ARE RESPONSIBLE FOR COORDINATING ALL EQUIPMENT CONTROLS WITH EMS VENDOR PRIOR TO PURCHASE AND INSTALLATION. CONTRACTORS SHALL COORDINATE WITH EMS VENDOR TO PROVIDE ALL NECESSARY EQUIPMENT AND ACCESSORIES FOR A FULLY FUNCTIONING SYSTEM.

**TEMPERATURE CONTROLS:**  
 EMS VENDOR SHALL FURNISH SENSORS AND CONTROL COMPONENTS AS INDICATED ON PLANS AND AS NECESSARY TO ACCOMPLISH THE INTENT OF THE DRAWINGS. ALL CONTROLS SHALL BE TIED INTO THE EMS SYSTEM UNLESS NOTED OTHERWISE.

GENERAL CONTRACTOR SHALL INSTALL CARRIER FURNISHED TEMPORARY THERMOSTATS AND FEED THE WIRING DOWN INTO THE SPACE FOR START UP AND CONTROL OF RTU(S) UNTIL THE EMS SYSTEM IS OPERABLE. REFER TO M3.0 FOR CARRIER CONTACT INFORMATION.

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 04/06/2023

**Issued For:**  
**CONSTRUCTION**

**Issue Date:**  
 4/10/2023

NO.	REASON	DATE
1	BULLETIN #1	4/10/23

**PROJECT MANAGER:**  
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**CHECKED BY:**  
 Author  
**DRAWN BY:**  
 Author  
**Project Number:**  
 62301434  
**Sheet Title:**  
 MECHANICAL PLAN  
**Sheet Number:**  
 M1.0

CONTROL FEATURE	UNITS					POINT TYPE INTERFACE WITH DOC (READ/WRITE)	NOTES
	RTU-1 SETPOINT OR Y/N	RTU-2 SETPOINT OR Y/N	RTU-3 SETPOINT OR Y/N	RTU-4 SETPOINT OR Y/N	RTU-5 SETPOINT OR Y/N		
BUILDING AUTOMATION SYSTEM (BAS)							
ENERGY MANAGEMENT SYSTEM INTERFACE	Y	Y	Y	Y	Y	BACNET	A
COOLING - EFFECTIVE OCCUPIED COOLING SETPOINT	F	72	72	72	72	READWRITE	
COOLING - EFFECTIVE UNOCCUPIED COOLING SETPOINT	F	77	77	77	77	READWRITE	
COOLING - MINIMUM COOLING SUPPLY AIR TEMPERATURE (SAT) SETPOINT	F	50	50	50	50	READWRITE	
COOLING - LOCKOUT TEMPERATURE SETPOINT	F	55	55	55	55	READWRITE	
DEAD BAND - MINIMUM HEATING AND COOLING TEMPERATURE SETPOINT DIFFERENCE	F	4	4	4	4		
HEATING - EFFECTIVE OCCUPIED HEATING SETPOINT	F	70	70	70	70	READWRITE	
HEATING - EFFECTIVE UNOCCUPIED HEATING SETPOINT	F	60	60	60	60	READWRITE	
HEATING - MAXIMUM HEATING SUPPLY AIR TEMPERATURE (SAT) SETPOINT	F	120	120	120	120	READWRITE	
DEHUMIDIFICATION SETPOINT - HUMIDITY SENSOR FEEDBACK	% RH	55	55	55	55	READWRITE	
ECONOMIZER - HIGH OUTSIDE AIR TEMPERATURE (OAT) LOCKOUT SETPOINT	F	75	75	75	75	READWRITE	
PROGRAMMED CONTROL FEATURES							
HVAC SYSTEM OCCUPIED/UNOCCUPIED MODE - EMS INTERFACE	Y	Y	Y	Y	Y	READ	A
HVAC SYSTEM OCCUPIED/UNOCCUPIED MODE - PROGRAMMABLE THERMOSTAT (TEMPORARY)	Y	Y	Y	Y	Y	READ	DIV 23
REMOTE TEMPERATURE SENSOR	Y	Y	Y	Y	Y	READ	EMS
REMOTE HUMIDITY SENSOR	Y	Y	Y	Y	Y	READ	EMS
REMOTE CO2 SENSOR	Y	Y	Y	Y	N	READ	EMS
DEMAND CONTROL VENTILATION (DCV) HIGH ALARM SETPOINT - CO2 SENSOR FEEDBACK	PPM	750	750	750	N/A	READWRITE	M
EQUIPMENT ACCESSORIES AND CONTROL MODULES							
OUTSIDE AIR DAMPER - MOTOR OPERATED (MODULATING)	Y	Y	Y	Y	Y	READWRITE	M, N
INTEGRATED ECONOMIZER - DIFFERENTIAL ENTHALPY ENABLE (OA ENTHALPY * RA ENTHALPY)	BTULB	Y	Y	Y	Y	READWRITE	G, H
ECONOMIZER FAULT DETECTION AND DIAGNOSTICS (FDD) SYSTEM	Y	Y	Y	Y	Y	READ	P
RELIEF - BAROMETRIC DAMPER	Y	Y	Y	Y	Y	Y	Y
RELIEF - CONSTANT VOLUME POWVERED EXHAUST FAN	N	N	Y	Y	Y	READ STATUS	O, P
COOLING COIL (DX - STAGED)	Y	Y	Y	Y	Y	READ STATUS	E, F
DEHUMIDIFICATION - HOT GAS REHEAT	Y	Y	Y	Y	Y	READ STATUS	L
HEATING COIL (ELECTRIC)	Y	Y	Y	Y	Y	READ STATUS	J, K
SUPPLY FAN CONTROL METHOD							
ON DURING OCCUPIED HOURS	Y	Y	Y	Y	Y		B
UNIT START AND FAN OFF DELAY	Y	Y	Y	Y	Y		B
CONSTANT VOLUME FAN CONTROL	Y	Y	N	N	Y	READ STATUS	B
VARIABLE VOLUME - 2-SPEED FAN CONTROL	N	N	Y	Y	Y	READ STATUS	C
SAFETIES, INTERLOCKS, AND ALARMS							
SUPPLY AIR SMOKE DETECTOR - FIRE SAFETY SHUTDOWN	Y	Y	Y	Y	Y	READ	D
RETURN AIR SMOKE DETECTOR - FIRE SAFETY SHUTDOWN	Y	Y	Y	Y	Y	READ	D
LOW LIMIT FREEZE/STAT - FREEZE PROTECTION SAFETY SHUTDOWN	Y	N	N	N	N	READ	D, P
SAFETY CHAIN - SAFETY SHUTDOWN	Y	Y	Y	Y	Y	READ	D
SAT ALARM - SAFETY SHUTDOWN	Y	Y	Y	Y	Y	READ	D
SPT ALARM - SAFETY SHUTDOWN	Y	Y	Y	Y	Y	READ	D
FIRE ALARM CONTROL PANEL - FIRE SAFETY SHUTDOWN INTERLOCK	Y	Y	Y	Y	Y	READ	D, P

EMS VENDOR SHALL PROVIDE CONTROL PANEL, RELAYS, THERMOSTATS, TEMPERATURE SENSORS, HUMIDITY SENSORS, AND/OR CO2 SENSORS WHERE SHOWN ON THE DRAWINGS AND AS REQUIRED TO FACILITATE THE SCHEDULED SEQUENCE OF OPERATION. EACH UNIT SHALL CONTROL BASED ON ITS OWN INTERNAL SAFETIES, THE DELAYS, AND SEQUENCES UNLESS NOTED OTHERWISE. COORDINATE WITH OWNER FINAL BUILDING AND EQUIPMENT SCHEDULES DURING STARTUP. REFERENCE DIVISION SPECIFICATIONS FOR INDIVIDUAL DEVICE REQUIREMENTS.

**NOTES:**

- A. EMS SHALL PROVIDE REMOTE SETPOINT ADJUSTMENT, SCHEDULING, AND MONITORING OF THE POINTS LISTED IN THE SCHEDULE FOR EACH UNIT. THE RTU SHALL BE SCHEDULED WITH A MINIMUM OF AN OCCUPIED AND UNOCCUPIED SCHEDULE. ADDITIONAL UNIT SCHEDULES SHALL BE AVAILABLE FOR REMOTE IMPLEMENTATION IF REQUIRED.
- B. THE SUPPLY FAN SHALL RUN CONTINUOUSLY IN OCCUPIED MODE AND SHALL CYCLE ON AND OFF IN UNOCCUPIED MODE. A UNIT START DELAY IS USED WHEN TRANSITIONING FROM UNOCCUPIED TO OCCUPIED. FAN OFF DELAY ALLOWS THE SUPPLY FAN TO CONTINUE TO OPERATE AFTER HEATING AND COOLING STOPS.
- C. VIA FACTORY VFD, THE RTU OPEN BOARD SHALL DETERMINE FAN SPEED REQUIRED FOR HEATING AND COOLING. FACTORY VFD SHALL CONTROL TO 2 FAN SPEEDS. LOW SPEED SHALL NOT EXCEED 60% OF FULL SPEED AND SHALL DRAW NO MORE THAN 40% OF FAN POWER AT FULL SPEED. DURING FAN ONLY OR SINGLE STAGE COOLING, SUPPLY FAN SHALL OPERATE AT LOW SPEED. DURING HEATING, SECOND STAGE COOLING, DEHUMIDIFICATION OR FULL ECONOMIZER OPERATION, FAN SHALL OPERATE AT HIGH SPEED.
- D. IF A LOCAL UNIT CONTROL ALARM IS ACTIVE, THE SUPPLY FAN TURNS OFF IMMEDIATELY REGARDLESS OF OCCUPANCY STATE OR DEMAND.
- E. COOLING STAGES ARE CONTROLLED BY THE RTU OPEN COOLING CONTROL PID LOOP AND COOLING STAGES CAPACITY ALGORITHM. THEY CALCULATE THE REQUIRED NUMBER OF STAGES NEEDED TO SATISFY THE SPACE BY COMPARING THE SPACE TEMPERATURE TO THE EFFECTIVE OCCUPIED COOLING SETPOINT IN OCCUPIED MODE AND THE EFFECTIVE UNOCCUPIED COOLING SETPOINT IN UNOCCUPIED MODE. THE FOLLOWING CONDITIONS MUST BE TRUE FOR THE COOLING ALGORITHM TO OPERATE:
  - THE OUTDOOR AIR TEMPERATURE IS GREATER THAN THE COOLING LOCKOUT TEMPERATURE SETPOINT.
  - THE SUPPLY FAN HAS BEEN ON FOR AT LEAST 30 SECONDS.
  - THE UNIT HAS A VALID SUPPLY AIR TEMPERATURE INPUT.
  - THE UNIT HAS A VALID SPACE TEMPERATURE INPUT.
  - HEATING MODE IS NOT ACTIVE AND THE TIME GUARD BETWEEN MODES HAS EXPIRED.
  - ECONOMIZER IS UNAVAILABLE OR ECONOMIZER IS ACTIVE AND THE FOLLOWING ARE TRUE: (1) ECONOMIZER IS GREATER THAN 85% OPEN, (2) SUPPLY AIR TEMPERATURE IS GREATER THAN 3 DEGREES ABOVE THE MINIMUM COOLING SAT SETPOINT, AND (3) SPACE TEMPERATURE IS GREATER THAN 0.5 DEGREES ABOVE THE EFFECTIVE OCCUPIED TEMPERATURE SETPOINT.
- F. WHEN THE COOLING ALGORITHM PRECONDITIONS ARE MET, THE COMPRESSORS ARE ENERGIZED IN STAGES, AS APPLICABLE. ANTI-RECYCLE TIMERS ARE EMPLOYED TO PROTECT THE EQUIPMENT FROM SHORT-CYCLING. THERE ARE FIXED THREE-MINUTE MINIMUM ON-TIMES AND FIVE-MINUTE OFF-TIMES FOR EACH COMPRESSOR OUTPUT.
- G. DURING COMPRESSOR OPERATION, THE RTU OPEN CONTROL LOGIC MAY REDUCE THE NUMBER OF ACTIVE STAGES IF THE SUPPLY AIR TEMPERATURE FALLS BELOW THE MINIMUM COOLING SAT SETPOINT. A CYCLING STAGED OFF IN THIS FASHION MAY BE STARTED AGAIN AFTER THE NORMAL TIME-GUARD PERIOD HAS EXPIRED IF THE SUPPLY AIR TEMPERATURE HAS INCREASED ABOVE THE MINIMUM COOLING SAT SETPOINT.
- H. THE SYSTEM SHALL UTILIZE THE FACTORY MODULATING ECONOMIZER FOR FREE COOLING WHEN OUTDOOR AIR CONDITIONS ARE SUITABLE. FOR THE ECONOMIZER TO OPERATE DURING OCCUPIED HOURS, THE FOLLOWING CONDITIONS MUST BE TRUE:
  - OUTDOOR AIR TEMPERATURE IS LESS THAN THE SPACE TEMPERATURE AND LESS THAN THE ECONOMIZER HIGH OAT LOCKOUT SETPOINT.
  - THE INDOOR FAN HAS BEEN ON FOR AT LEAST 30 SECONDS.
  - THE UNIT HAS A VALID SUPPLY AIR TEMPERATURE INPUT.
  - THE UNIT HAS A VALID SPACE TEMPERATURE INPUT.
  - OUTDOOR AIR ENTHALPY IS LESS THAN THE SPACE ENTHALPY. (ENTHALPY STATUS SHALL READ "LOW").
  - IF ANY OF THE PRECEDING CONDITIONS ARE NOT TRUE AND THE SUPPLY FAN IS ON HIGH SPEED, THE ECONOMIZER SHALL BE SET TO THE DCV MINIMUM OUTDOOR AIR DAMPER POSITION (TBD BY TAB CONTRACTOR), IF ANY OF THE PRECEDING CONDITIONS ARE NOT TRUE AND THE SUPPLY FAN IS ON LOW SPEED, THE ECONOMIZER SHALL BE SET TO THE LOW FAN ECONOMIZER MINIMUM DAMPER POSITION (TBD BY TAB CONTRACTOR). IF ALL OF THE PRECEDING CONDITIONS ARE TRUE, THE ECONOMIZER PID LOOP SHALL MODULATE THE DAMPER. THE ECONOMIZER POSITION SHALL BE REDUCED AS THE SUPPLY AIR TEMPERATURE FALLS TO WITHIN 5 DEGREES OF THE MINIMUM COOLING SAT SETPOINT, BUT SHALL NEVER GOSE BELOW THE DCV MINIMUM OUTDOOR AIR DAMPER POSITION.
- I. DURING UNOCCUPIED HOURS, UNOCCUPIED FREE COOLING SHALL BE ENABLED. THE ECONOMIZER SHALL REMAIN CLOSED UNLESS THE FOLLOWING CONDITIONS ARE TRUE:
  - OUTDOOR AIR TEMPERATURE IS BELOW THE ECONOMIZER HIGH OAT LOCKOUT SETPOINT.
  - OUTDOOR AIR TEMPERATURE IS LESS THAN THE SPACE TEMPERATURE.
  - OUTDOOR AIR ENTHALPY IS LESS THAN THE SPACE ENTHALPY. (ENTHALPY STATUS SHALL READ "LOW").
  - IF ALL OF THE PRECEDING CONDITIONS ARE TRUE AND THE SPACE TEMPERATURE RISES 1 DEGREE ABOVE THE EFFECTIVE UNOCCUPIED COOLING SETPOINT, THE SUPPLY FAN SHALL START AND THE ECONOMIZER DAMPER SHALL OPEN AS NECESSARY TO COOL THE SPACE. THE DAMPER SHALL REMAIN OPEN UNTIL THE SPACE IS SATISFIED OR THE PRECEDING CONDITIONS ARE NO LONGER TRUE. IF ANY OF THE PRECEDING CONDITIONS ARE NOT TRUE, THE ECONOMIZER SHALL CLOSE COMPLETELY.
- J. HEATING STAGES ARE CONTROLLED BY THE RTU OPEN HEATING CONTROL PID LOOP AND HEATING STAGES CAPACITY ALGORITHM. THEY CALCULATE THE REQUIRED NUMBER OF STAGES NEEDED TO SATISFY THE SPACE BY COMPARING THE SPACE TEMPERATURE TO THE EFFECTIVE OCCUPIED HEATING SETPOINT IN OCCUPIED MODE AND THE EFFECTIVE UNOCCUPIED HEATING SETPOINT IN UNOCCUPIED MODE. THE FOLLOWING CONDITIONS MUST BE TRUE FOR THE HEATING ALGORITHM TO OPERATE:
  - OUTDOOR AIR TEMPERATURE IS LESS THAN THE HEATING LOCKOUT TEMPERATURE SETPOINT.
  - THE SUPPLY FAN HAS BEEN ON FOR AT LEAST 30 SECONDS.
  - THE UNIT HAS A VALID SUPPLY AIR TEMPERATURE INPUT.
  - THE UNIT HAS A VALID SPACE TEMPERATURE INPUT.
  - HEATING MODE IS NOT ACTIVE AND THE TIME GUARD BETWEEN MODES HAS EXPIRED.
- K. WHEN THE HEATING ALGORITHM PRECONDITIONS ARE MET, THE HEAT IS ENERGIZED IN STAGES, AS APPLICABLE. ANTI-RECYCLE TIMERS ARE EMPLOYED TO PROTECT THE EQUIPMENT FROM SHORT-CYCLING. THERE ARE FIXED ONE-MINUTE MINIMUM ON AND OFF TIMES FOR EACH HEATING OUTPUT.
- L. DURING HEATING OPERATION, THE RTU OPEN CONTROL LOGIC MAY REDUCE THE NUMBER OF ACTIVE STAGES IF THE SUPPLY AIR TEMPERATURE EXCEEDS THE MAXIMUM HEATING SAT SETPOINT. A HEAT STAGE TURNED OFF IN THIS FASHION MAY BE STARTED AGAIN AFTER THE NORMAL TIME-GUARD PERIOD HAS EXPIRED IF THE SUPPLY AIR TEMPERATURE HAS DECREASED BELOW THE MAXIMUM HEATING SAT SETPOINT.
- M. THE SYSTEM SHALL UTILIZE HUMIDITY SENSORS IN THE SALES AREA, STOCKROOM, AND EMPLOYEE LOUNGE. DEHUMIDIFICATION IS CONTROLLED BY THE RTU OPEN CONTROL. DEHUMIDIFICATION SYSTEM DURING OCCUPIED AND UNOCCUPIED MODE. THE FOLLOWING CONDITIONS MUST BE TRUE FOR THE DEHUMIDIFICATION SYSTEM TO OPERATE:
  - OUTDOOR AIR TEMPERATURE IS LESS THAN THE SPACE TEMPERATURE.
  - THE INDOOR FAN HAS BEEN ON FOR AT LEAST 30 SECONDS.
  - THE UNIT HAS A VALID SUPPLY AIR TEMPERATURE INPUT.
  - THE UNIT HAS A VALID SPACE RELATIVE HUMIDITY SENSOR INPUT.
  - HEAT MODE IS NOT ACTIVE AND THE TIME GUARD BETWEEN MODES HAS EXPIRED.
- N. IF ALL OF THE PRECEDING CONDITIONS ARE TRUE AND ANY ZONE RISES ABOVE THE DEHUMIDIFICATION SETPOINT, THE RTU OPEN SHALL ENABLE DEHUMIDIFICATION MODE AND ENERGIZE THE HUMIDIMIZER OUTPUT FOR ALL UNITS SERVING THAT ZONE. DEHUMIDIFICATION MODE SHALL CONTINUE UNTIL THE SPACE RELATIVE HUMIDITY DROPS BELOW THE DEHUMIDIFICATION SETPOINT BY A 5% FIXED HYSTERESIS.
- O. THE SYSTEM SHALL UTILIZE A CO2 SENSOR FOR THE SALES AREA, FITTING ROOM, STOCKROOM AND EACH OFFICE (HIGHEST READING WILL BE TAKEN FOR OFFICE DCV CONTROL). DCV IS CONTROLLED BY THE INDOOR AIR CO2 ALGORITHM. THE ALGORITHM CALCULATES THE CO2 MINIMUM DAMPER POSITION USING A PID LOOP. THE CALCULATED CO2 MINIMUM DAMPER POSITION IS THEN COMPARED AGAINST THE DCV MINIMUM POSITION SETPOINT AND THE GREATEST VALUE BECOMES THE FINAL MINIMUM DAMPER POSITION. DURING OCCUPIED HOURS, THE INDOOR AIR CO2 SEQUENCE SHALL BE ENABLED. THE FOLLOWING CONDITIONS MUST BE TRUE FOR THE INDOOR AIR CO2 ALGORITHM TO OPERATE:
  - THE SUPPLY FAN HAS BEEN ON FOR AT LEAST 30 SECONDS.
  - THE UNIT HAS A VALID CO2 SENSOR READING.
- P. IF ALL OF THE PRECEDING CONDITIONS ARE TRUE, THE FACTORY OUTDOOR AIR DAMPER SHALL MODULATE BETWEEN ITS MINIMUM (ABS. MIN. OIA) AND MAXIMUM (MIN. OIA CFM) POSITION (TBD BY TAB CONTRACTOR). THE SYSTEM SHALL START TO MODULATE THE DAMPER OPEN WHEN CO2 LEVEL RISES TO 10 PPM (ADJUSTABLE) ABOVE AMBIENT CO2 LEVEL (400 PPM) AND SHALL CONTINUE TO OPEN TO ITS MAXIMUM POSITION AS CO2 LEVEL RISES TO AND ABOVE THE DCV HIGH ALARM SETPOINT. AS THE CO2 LEVEL DROPS, THE DAMPER SHALL START TO MODULATE TO ITS MINIMUM POSITION. DURING UNOCCUPIED HOURS, THE INDOOR AIR CO2 SEQUENCE SHALL BE DISABLED.
- Q. EQUIPMENT MANUFACTURER SHALL PROVIDE MODULATING DAMPER AND CONTROLS CAPABLE OF ADJUSTING THE DAMPER POSITION BASED ON DEMAND CONTROL VENTILATION TO MAINTAIN THE SCHEDULED OUTSIDE AIR AS SHOWN ON THE DRAWINGS. TAB CONTRACTOR SHALL COORDINATE DAMPER POSITION SETPOINTS IN FIELD DURING TESTING AND BALANCING TO MAINTAIN MINIMUM VENTILATION WHEN NOT IN ECONOMIZER. DAMPER SHALL BE CLOSED DURING UNOCCUPIED HOURS.
- R. POWERED EXHAUST FAN SHALL STAGE ON AND OFF ACCORDING TO DAMPER POSITION.
- S. DEVICE SHALL BE FACTORY MOUNTED AND PREWIRED FOR OPERATION SUBJECT TO THE RTU OPEN CONTROLLER.

**SEQUENCE OF OPERATION**

**A. ROOFTOP UNIT CONTROL (RTU-1,2,3,4,5)**

Refer to Rooftop Unit Control Matrix for sequence of operations.

**B. VAV DIFFUSER CONTROL (CSD1)**

In occupied mode, the VAV diffuser shall modulate airflow to maintain the room temperature setpoint (adjustable). Set VAV diffuser minimum position to maintain 30% of the maximum airflow.

The room occupancy sensor, upon sensing the space to be vacant for 15 minutes (adjustable), shall signal the diffuser through the EMS to maintain an unoccupied temperature setpoint (adjustable). When occupancy is detected, the EMS shall direct the diffuser to control to the room temperature setpoint.

The room CO2 sensor, upon reading a CO2 level above 100 PPM (adjustable) above ambient CO2 level (400 PPM), shall signal the diffuser through the EMS to modulate the zone damper between its minimum and maximum position. The system shall start to modulate the damper open when CO2 level rises 100 PPM above ambient CO2 level and continue to open to its maximum position as CO2 level rises to and above 700 PPM (adjustable) above ambient CO2 levels. As the CO2 level drops, the system shall start to modulate the damper to the minimum position.

In unoccupied mode, VAV diffuser control shall be disabled unless occupancy is detected. When occupancy is detected, the EMS shall direct the diffuser to control to the room temperature setpoint.

**C. MOTORIZED DAMPER CONTROL SERVING IT ROOM (MD)**

When RTU-2 is in heating mode, the motorized damper shall be closed.

When RTU-2 is in cooling mode and the supply air temperature drops below 65 degrees Fahrenheit (adjustable), the motorized damper shall open.

A damper and switch shall prove if the motorized damper is open when called. If failure to open occurs, an alarm shall be generated to the EMS.

**D. REPTOOR EXHAUST FAN CONTROL (EF-1)**

In occupied mode, the exhaust fan shall be enabled and the motorized damper shall open.

In unoccupied hours, the exhaust fan shall be disabled and the motorized damper shall be closed.

**E. IT ROOM EXHAUST FAN CONTROL (EF-2)**

A damper and switch shall prove if the motorized damper is open when called. If failure to open occurs, the fan shall not be enabled and an alarm shall be generated to the EMS.

**H. FITTING ROOM VAV BOX CONTROL (VAV-1)**

For single duct terminal units, upon a rise in space temperature above cooling setpoint (72 degrees Fahrenheit, adjustable), the terminal unit primary damper shall modulate towards its maximum cooling CFM. A damper and switch shall prove if the damper is open when called. If failure to open occurs, the fan shall not be enabled and an alarm shall be generated to the EMS.

During unoccupied hours, the unit shall sequence the same as the occupied cycle to maintain a reduced setback space temperature (78 degrees Fahrenheit, adjustable).

Heating/cooling auto-changover shall sequence terminal unit when associated RTU-3 is in heating mode as follows: when supply temperature is below 70 degrees Fahrenheit, the unit shall operate in the cooling mode, as described above. Upon a rise in supply temperature above 75 degrees Fahrenheit, the unit shall changover to the heating mode and modulate primary damper to modulate towards its maximum heating CFM. An increase in room temperature above heating setpoint shall cause primary damper to modulate towards its minimum heating CFM. If supply temperature decreases below 70 degrees Fahrenheit, the unit shall changover back to the cooling mode.

**CARRIER UNIT STARTUP REQUIREMENTS**

INSTALLING CONTRACTOR SHALL COMPLETE THE PRE-START CHECKLIST AND EMAIL JENIFER.TYE@COMFORTSYSTEMSUSA.COM TWO WEEKS PRIOR TO SCHEDULING EQUIPMENT STARTUP.

COORDINATE EQUIPMENT STARTUP WORK WITH COMFORT SYSTEMS USA EMAIL: JENIFER.TYE@COMFORTSYSTEMSUSA.COM, OFFICE: 317-246-5176

DEPARTMENT MANAGER EMAIL: KLORIKARAMDAD@COMFORTSYSTEMSUSA.COM, OFFICE: 317-246-4656

TECHNICAL SUPPORT EMAIL: RICK.FARRIS@COMFORTSYSTEMSUSA.COM, MOBILE: 317-638-5363 X444

**PRE-START CHECKLIST (VERIFY FOR ALL UNITS)**

- VERIFY ALL ITEMS ON THE EQUIPMENT ORDER RECEIVED.
- VERIFY ALL PACKAGING MATERIAL REMOVED FROM THE UNIT.
- VERIFY CURB GASKETS PROPERLY INSTALLED.
- VERIFY ROOFTOP UNIT INSTALLED LEVEL AND PROPERLY ALIGNED WITH CURB.
- VERIFY DUCTWORK/FABRIC DUCT COMPLETELY INSTALLED PER MECHANICAL PLANS.
- VERIFY OAT HOOD INSTALLED, AIR INLET SCREEN INSTALLED.
- VERIFY POWER EXHAUST ACCESSORY INSTALLED, (IF APPLICABLE).
- VERIFY CLEAN PLEATED FILTERS INSTALLED, MINIMUM MERV 8 RATING.
- VERIFY CONDENSATE DRAIN LINE INSTALLED, MINIMUM 2" DEEP TRAP, DRAIN PAN CHECKLEVEL.
- VERIFY SUPPLY FAN ROTATES FREELY IN THE HOUSING.
- VERIFY PULLEYS ALIGNED AND BELT TENSION CORRECT.
- VERIFY SMOKE DETECTORS INSTALLED IN DUCTWORK, CLEANED AND TESTED.
- VERIFY GAS METER INSTALLED AND GAS AVAILABLE FROM THE UTILITY, GAS PIPING COMPLETED, CHECKED FOR LEAKS AND PURGED (IF APPLICABLE).
- VERIFY GAS PIPING DRIP LEG INSTALLED PROPERLY, (DOWNSTREAM OF SHUTOFF VALVE AND NO INTERFERENCE WITH ACCESS DOOR).
- VERIFY FLUE HOOD INSTALLED.
- VERIFY JOBSITE POWER SUPPLY MATCHES THE VOLTAGE ON THE UNIT DATA PLATE.
- VERIFY ELECTRIC POWER CONNECTED TO UNIT VIA THE ACCESS PROVIDED, IF NOT, DATE POWER WILL BE AVAILABLE.
- VERIFY NO WIRES TOUCHING REFRIGERANT LINES OR SHARP EDGES.
- VERIFY ELECTRIC CONNECTORS AND TERMINALS TIGHT.
- VERIFY THRU-THE-CURB UTILITY CONNECTIONS COMPLETE.
- VERIFY UNIT TRANSFORMER PRIMARY TAPPED FOR JOBSITE VOLTAGE.
- VERIFY VENSTAR THERMOSTAT INSTALLED IN THE RETURN AIR DUCT DROP AND WIRED FOR TEMPORARY UNIT OPERATION.

**EMS INSTALLATION CHECKLIST**

ITEMS ON EMS CHECK-OFF LIST MUST BE COMPLETED PRIOR TO EMS AND GBS COMMISSIONING AT THE END OF THE JOB. SOME ITEMS LISTED BELOW MAY NOT BE APPLICABLE.

COORDINATE EQUIPMENT STARTUP WORK WITH COMFORT SYSTEMS USA. EMAIL: PAUL.SAWYER@COMFORTSYSTEMSUSA.COM OFFICE: 317-246-5170

**EMS CHECKLIST**

- REVIEW EMS PRINT SET AND INSTALL EMS OPUS PANE AND LCP AS DESCRIBED IN THE EMS PRINT SET.
- REVIEW EMS PRINT SET AND PULL ALL WIRE AND TERMINATE ON DEVICES AS DESCRIBED IN THE EMS PRINT SET.
- REVIEW EMS PRINT SET AND INSTALL ALL EMS HVAC CONTROLS AS DESCRIBED IN THE EMS PRINT SET.
- REVIEW EMS PRINT SET AND INSTALL ALL EMS LIGHTING CONTROLS AS DESCRIBED IN THE EMS PRINT SET.
- REVIEW EMS PRINT SET AND WATTSTOPPER SUBMITTAL AND INSTALL THE WATTSTOPPER LIGHTING SYSTEM AND PULL ALL WIRE AS DESCRIBED IN THE EMS PRINT SET AND WATTSTOPPER SUBMITTAL.

**ROOFTOP UNIT SCHEDULE (DX COOLING, ELECTRIC HEATING)**

MARK	MANUFACTURER	MODEL	NOMINAL TONS	SUPPLY FAN										COOLING COIL										HEATING COIL										MIN OIA	ABS MIN	ELECTRICAL V/PH	MCA	MOCP	WEIGHT (LBS)	NOTES
				CFM	ESP (IN)	NOM HP	TH (MBH)	SH (MBH)	EAT (°F DB)	(°F WB)	(°F DB)	(°F WB)	REFR TYPE	MIN EFF (EER)	(IEER)	MIN NO STAGES	MIN OUT (MBH)	NOM (KW)	EAT (°F DB)	(°F WB)	MIN NO STAGES	MIN OUT (MBH)	NOM (KW)	EAT (°F DB)	(°F WB)															
				MIN	MAX	(IN)																																		
RTU-1	CAPITVEAIRE	CASRTU-1-E-154-15	5	1,320	0.8	1.35	43	34	76.5	63.1	53.0	51.8	R-410A	13	16.5	2	36	12	62.7	85	2	175	75	4803	21.5	25	1280	A-W												
RTU-2	CAPITVEAIRE	CASRTU-1-E-304-18	7.5	2,580	0.8	5.0	73	57	74.2	62.6	54.0	52.9	R-410A	11	14.8	2	82	27	61.7	90	2	325	275	4803	43.8	45	1401	A-W												
RTU-3	CAPITVEAIRE	CASRTU-1-E-604-20	15	4,500	1.2	5.0	175	110	75.8	66.2	53.7	53.4	R-410A	11	14.2	2	180	54	53.7	90	2	1200	625	4803	85.1	90	2570	A-W												
RTU-4	CAPITVEAIRE	CASRTU-1-E-604-18	15	4,300	1.2	5.0	179	112	77.0	66.7	53.3	53.1	R-410A	11	14.2	2	175	54	53.0	90	2	1200	625	4803	81.6	90	2542	A-W												
RTU-5	CAPITVEAIRE	CASRTU-1-E-604-24	15	5,055	1.2	5.0	106	100	72.0	60.0	54.0	52.6	R-410A	11	14.2	2	150	54	68.0	90	2	0	0	4803	85.1	90	2583	A-S,W												

MODEL NUMBERS AND NOMINAL TONS LISTED SHALL NOT BE CONSIDERED COMPLETE AND MATERIAL SHALL NOT BE ORDERED BY MANUFACTURER, MODEL NUMBERS, OR NOMINAL TONS ONLY. REVIEW THE COMPLETE DESCRIPTION, NOTES AND SPECIFICATIONS TO DETERMINE THE EXACT MATERIAL AND ACCESSORIES TO BE ORDERED. THE MANUFACTURERS LISTED ARE THE BASIS FOR THE DESIGN.

**NOTES:**

- A. REFER TO ROOFTOP UNIT CONTROL MATRIX FOR CONTROL FEATURES, MODULES, AND ACCESSORIES THAT SHALL BE PROVIDED WITH THE EQUIPMENT.
- B. EQUIPMENT SIZED FOR 100°F AMBIENT TEMPERATURE.
- C. PROVIDE 2 INCH MERV 13, EFFICIENT PLEATED THROWAWAY AIR FILTERS.
- D. PROVIDE FACTORY MOUNTED DISCONNECT INSTALLED ON SERVICE SIDE OF UNIT.
- E. STARTERS FOR ALL MOTORS SHALL BE FURNISHED INTEGRAL WITH MOTOR.
- F. PROVIDE FACTORY MOUNTED VARIABLE FREQUENCY DRIVE OR 3-SPEED MOTOR TO FACILITATE STAGED FAN SPEED CONTROL.
- G. COORDINATE SIZE OF CONDUCTOR TERMINATION LUGS WITH CONDUCTOR SIZES SHOWN ON ELECTRICAL DRAWINGS.
- H. PROVIDE 125 VAC, 20 AMP DUPLEX CONVENIENCE RECEPTACLE MOUNTED TO UNIT READY FOR FIELD WIRING WITH A COVER UL LISTED FOR WET AND DAMPER LOCATIONS WHEN IN USE.
- K. SPECIFIED FAN ESP ACCOUNTS FOR DUCT LOSSES EXTERNAL TO UNIT.
- L. PROVIDE MOTOR HORSEPOWER TO OVERCOME INTERNAL UNIT STATIC PRESSURE DROP PLUS SPECIFIED EXTERNAL STATIC PRESSURE DROP. NOMINAL MOTOR HP SHALL BE NO LARGER THAN THE FIRST AVAILABLE NOMINAL MOTOR SIZE GREATER THAN THE REQUIRED BHP.
- M. PROVIDE INSULATED CURB CURB WITH MINIMUM HEIGHT REQUIRED TO MAINTAIN BOTTOM OF EQUIPMENT A MINIMUM OF 8 INCHES ABOVE FINISHED ROOF SURFACE. PROVIDE SLOPED CURB IF NEEDED TO MATCH ROOF SLOPE. COORDINATE WITH ROOF INSULATION THICKNESS AND ROOF TAPER AT INSTALLED LOCATION. COORDINATE CURB TYPE WITH DRAWINGS.
- P. SCHEDULED WEIGHT IS THE MAXIMUM ALLOWABLE OPERATING WEIGHT OF THE EQUIPMENT AND CURB.
- Q. COOLING COIL LAT IS LEAVING AIR TEMPERATURE OF COOLING COIL.
- R. PROVIDE GUARDS TO PROTECT CONDENSER COIL FROM HAIL OR OTHER DAMAGE.
- S. PROVIDE HEATER TO MEET OR EXCEED SCHEDULED MINIMUM MBH OUTPUT. NOMINAL KW IS BASED ON LISTED MANUFACTURER'S STANDARD PRODUCT. COORDINATE EQUIPMENT POWER SUPPLY WITH ELECTRICAL CONTRACTOR IF DIFFERENT FROM THAT SCHEDULED.
- U. ABS. MIN. OIA IS THE ABSOLUTE MINIMUM OUTSIDE AIR CFM USING VENTILATION RESET OR DEMAND CONTROL VENTILATION.
- W. PROVIDE UNIT WITH FACTORY INSTALLED BACNET OPEN BOARD CONTROLLER WITH SUPPLY AND OUTSIDE AIR TEMPERATURE SENSORS. COORDINATE ALL CONTROLS WITH EMS VENDOR PRIOR TO PURCHASE.

**OUTSIDE AIR REQUIREMENTS, IMC-2018 (IP)**

SYSTEM DESIGNATION	SYSTEM TYPE	VENTILATION ZONE ASSOCIATED WITH SYSTEM	WORST CASE ZONE AIR DISTRIBUTION EFFECTIVENESS [Ez]	MULTI-ZONE SYSTEMS SYSTEM VENTILATION EFFICIENCY [Ev]	FLOOR AREA SERVED BY SYSTEM [Aa] (SF)	SYSTEM AVERAGED AREA-BASED OUTDOOR AIR RATE (CFM/SF)	SYSTEM POPULATION [Pa] (PEOPLE)	SYSTEM AVERAGED PEOPLE-BASED OUTDOOR AIR RATE (CFM/PP)	DESIGN VALUES				NOTES





# MECHANICAL SYMBOLS

THIS IS A MASTER LEGEND AND NOT ALL SYMBOLS OR ABBREVIATIONS ARE USED.

V2.01

STANDARD MOUNTING HEIGHT	
THERMOSTATS (USER ADJUSTABLE) (TOP OF DEVICE) CONTROLS (TOP OF DEVICE)	48" 48"

USE THE DEFAULT MOUNTING HEIGHTS SHOWN ABOVE UNLESS NOTED OTHERWISE IN THE SPECIFICATIONS OR ELSEWHERE. MOUNTING HEIGHTS LISTED ARE ABOVE FINISHED FLOOR (AFF) OR ABOVE FINISHED GRADE (AFG) TO TOP OF DEVICE. ALL DEVICES SHALL BE INSTALLED IN COMPLIANCE WITH CURRENT ADA AND LOCAL REQUIREMENTS.

ANNOTATION	
	MECHANICAL PLAN NOTE CALLOUT
	MECHANICAL EQUIPMENT DESIGNATION (CONTRACTOR FURNISHED AND INSTALLED UNLESS NOTED OTHERWISE)
	CONNECTION POINT OF NEW WORK TO EXISTING
	DETAIL REFERENCE. UPPER NUMBER INDICATES DETAIL NUMBER LOWER NUMBER INDICATES SHEET NUMBER
	SECTION CUT DESIGNATION

ABBREVIATIONS			
AC	AIR CONDITIONING	HWP	HEATING WATER PUMP
ACCU	AIR COOLED CONDENSING UNIT	IN WC	INCHES OF WATER COLUMN
AFC	ABOVE FINISHED CEILING	L	LOUVER
AFB	ABOVE FINISHED FLOOR	LAT	LEAVING AIR
AFG	ABOVE FINISHED GRADE	LP	LEAVING WET BULB
AHJ	AUTHORITY HAVING JURISDICTION	LWB	LEAVING WATER BULB
AHU	AIR HANDLING UNIT	LWT	LEAVING WATER TEMPERATURE
AI	AIR INPUT	MAX	MAXIMUM
AO	ANALOG OUTPUT	MBH	1000 BTU PER HOUR
AP	ACCESS PANEL	MD	MOTORIZED DAMPER
APD	AIR PRESSURE DROP	MFR	MANUFACTURER
AWG	AMERICAN WIRE GAUGE	MIN	MINIMUM
BAS	BUILDING AUTOMATION SYSTEM	N/A	NOT APPLICABLE
BB	BACKBONE	N/C	NORMALLY CLOSED
BD	BACKDRAFT DAMPER	N/O	NORMALLY OPEN
BDN	BELOW FINISHED CEILING	NOM	NOMINAL
BFC	BELOW FINISHED CEILING	NC	NOISE CRITERIA
BFF	BELOW FINISHED FLOOR	ND	NOT IN CONTRACT
BSP	BELT HORSEPOWER	OA	OUTSIDE AIR
BI	BINARY INPUT	PCV	PRESSURE INDEP. CONTROL VALVE
BO	BINARY OUTPUT	QTY	QUANTITY
BOD	BOTTOM OF DUCT	RA	RETURN AIR
BOS	BOTTOM OF STRUCTURE	RC	ROOM CRITERIA
BTU	BRITISH THERMAL UNIT	RD	RETURN DUCT
CFM	CUBIC FEET PER MINUTE	REA	RELIEF AIR
CLG	COOLING	RF	RETURN FAN
CP	CONDENSATE PUMP	RFR	REFRIGERANT
CPT	CONTROL POWER TRANSFORMER	RH	RELATIVE HUMIDITY
CV	CONTROL VALVE	RH	ROOF HOOD
CWP	CONDENSER WATER PUMP	RPM	REVOLUTIONS PER MINUTE
CU	CONDENSING UNIT	RTU	ROOFTOP UNIT
CHWP	CHILLED WATER PUMP	SA	SUPPLY AIR
DB	DECIBELS	SD	SMOKE DUCT DETECTOR
DBA	DECIBEL AVERAGE	SD	SUPPLY DUCT
DDC	DIRECT DIGITAL CONTROL	SF	SUPPLY FAN
DI	DIGITAL INPUT	SH	SENSIBLE HEAT CAPACITY
DISC	DISCONNECT	SOW	SCOPE OF WORK
DN	DOWN	SP	STATIC PRESSURE
DX	DIRECT EXPANSION	ST	STEAM TRAP
(E)	EXISTING	STM	STEAM
EA	EXHAUST AIR	TBD	TO BE DETERMINED
EAT	ENTERING AIR TEMPERATURE	TCIC	TEMPERATURE CONTROLS CONTRACTOR
ED	ENTERING DRY BULB	TCF	TEMPERATURE CONTROL PANEL
EDB	ENTERING DRY BULB	TF	TRANSFER FAN
EF	EXHAUST FAN	TH	TOTAL HEAT CAPACITY
EFF	EFFICIENCY	TSP	TOTAL STATIC PRESSURE
EMS	ENERGY MANAGEMENT SYSTEM	TYP	TYPICAL
ESP	EXTERNAL STATIC PRESSURE	UH	UNIT HEATER
ETR	EXISTING TO REMAIN	UNO	UNLESS NOTED OTHERWISE
EWB	ENTERING WET BULB	VAV	VARIABLE AIR VOLUME
EWT	ENTERING WATER TEMPERATURE	VEL	VELOCITY
FCU	FAN COIL UNIT	VFD	VARIABLE FREQUENCY DRIVE
FF	FINISHED FLOOR	VRF	VARIABLE REFRIGERANT FLOW
FPI	FEET PER INCH	W/	WITH
FPM	FEET PER MINUTE	W/O	WITHOUT
GC	GENERAL CONTRACTOR	WB	WET BULB
GPM	GALLONS PER MINUTE	WC	WATER COLUMN
HP	HORSEPOWER	WPD	WATER PRESSURE DROP
HTG	HEATING		

HVAC DUCTWORK AND ACCESSORIES	
	LINEAR SLOT DIFFUSER
	INSULATED FLEXIBLE DUCT (MAX. 5'-0" LONG)
	BRANCH DUCT WITH 45° RECTANGLE-ROUND BRANCH FITTING AND MANUAL VOLUME DAMPER
	ELBOW WITH TURNING VANES
	BRANCH DUCT WITH BELL-MOUTH FITTING & MANUAL VOLUME CONTROL DAMPER
	RETURN, EXHAUST, OR OUTSIDE AIR DUCT UP
	RETURN, EXHAUST, OR OUTSIDE AIR DUCT DOWN
	SUPPLY AIR DUCT UP
	SUPPLY AIR DUCT DOWN
	EQUIPMENT WITH FLEXIBLE DUCT CONNECTION
	10" (NECK SIZE) CSD-1 (TYPE) 300 CFM (CFM OF SUPPLY DIFFUSER)
	24x24 (NECK SIZE) CEG-1 (TYPE) 800 CFM (CFM OF EXHAUST GRILLE)
	MANUAL VOLUME DAMPER
	SQUARE TO ROUND TRANSITION
	DUCT MOUNTED SMOKE DETECTOR (SD=SUPPLY/RD=RETURN)
	RISER DESIGNATION
	FIRE DAMPER
	FIRE SMOKE DAMPER
	SMOKE DAMPER
	VOLUME DAMPER
	MOTORIZED DAMPER
	BACKDRAFT DAMPER

ALL DUCT DIMENSIONS SHOWN ON DRAWINGS ARE INSIDE DIMENSIONS. REFER TO DUCTWORK SPECIFICATIONS FOR DUCTWORK INSULATION AND LINER INFORMATION.

HVAC CONTROL DEVICES	
	HUMIDISTAT
	THERMOSTAT
	STATIC PRESSURE SENSOR
	TEMPERATURE SENSOR
	CARBON MONOXIDE SENSOR
	CARBON DIOXIDE SENSOR
	DIFFERENTIAL PRESSURE SENSOR
	FLOW SWITCH
	HUMIDITY SENSOR
	PULL STATION

PIPING SYMBOLS	
	DIRECTION OF FLOW
	CONTROL VALVE
	THREE-WAY CONTROL VALVE
	SHUTOFF VALVE
	CHECK VALVE
	BALANCING VALVE WITH PRESSURE PORTS
	TRIPLE DUTY VALVE WITH PRESSURE PORTS
	STRAINER
	STRAINER WITH BLOWDOWN VALVE
	RELIEF / SAFETY VALVE
	SOLENOID VALVE
	PRESSURE REDUCING VALVE
	GAS PRESSURE REGULATOR
	THERMOSTATIC MIXING VALVE
	PIPE ANCHOR
	EXPANSION JOINT
	PIPE GUIDE
	PIPING SUPPORT
	F & T TRAP
	BUCKET TRAP
	THERMOSTATIC TRAP
	BACKFLOW PREVENTER
	PRESSURE GAUGE
	THERMOMETER
	PRESSURE AND TEMPERATURE TEST PLUG
	UNION
	FLANGE CONNECTION
	VACUUM RELIEF VALVE
	AUTOMATIC AIR VENT
	MANUAL AIR VENT
	PRESSURE / VACUUM SWITCH
	CLEANOUT
	CAP
	ELBOW UP
	ELBOW DOWN
	TEE UP
	TEE DOWN
	ELBOW UP WITH SHUT-OFF VALVE (SOV)
	ELBOW DOWN WITH SHUT-OFF VALVE (SOV)
	TEE UP WITH SHUT-OFF VALVE (SOV)
	TEE DOWN WITH SHUT-OFF VALVE (SOV)
	REDUCER
	RECIRCULATION PUMP
	P-TRAP
	GAS COCK
	TOP BEAM CLAMP
	TRAPEZE HANGER

PIPING LINETYPES	
	CONDENSATE DRAIN (CD)
	AUXILIARY CONDENSATE DRAIN (ACD)
	NON-POTABLE WATER (NFW)
	NATURAL GAS (G)
	NATURAL GAS ON ROOF (G)
	MEDIUM PRESSURE NATURAL GAS (MPG)
	MED. PRESSURE NAT. GAS ON ROOF (MGP)
	FUEL OIL SUPPLY (FOS)
	FUEL OIL RETURN (FOR)
	FUEL OIL VENT (FOV)
	LIQUEFIED PETROLEUM GAS (LPG)
	BOILER FEED WATER (BFW)
	HIGH PRESSURE STEAM SUPPLY (HPS)
	HIGH PRESSURE STEAM CONDENSATE (HPC)
	MEDIUM PRESSURE STEAM SUPPLY (MPS)
	MED. PRESSURE STEAM CONDENSATE (MPC)
	LOW PRESSURE STEAM SUPPLY (LPS)
	LOW PRESSURE STEAM CONDENSATE (LPC)
	CONDENSATE PUMP DISCHARGE (PD)
	HEATING HOT WATER SUPPLY (HWS)
	HEATING HOT WATER RETURN (HWR)
	CHILLED WATER SUPPLY (CHWS)
	CHILLED WATER RETURN (CHWR)
	HOT / CHILLED WATER SUPPLY (HCS)
	HOT / CHILLED WATER SUPPLY (HCR)
	CONDENSER WATER SUPPLY (CWS)
	CONDENSER WATER RETURN (CWR)
	HEAT PUMP WATER SUPPLY (HPWS)
	HEAT PUMP WATER RETURN (HPWR)
	REFRIGERANT LIQUID (RL)
	REFRIGERANT DISCHARGE (HOT GAS) (RD)
	REFRIGERANT SUCTION (RS)
	REFRIGERANT DISCHARGE BYPASS (RDB)
	REFRIGERANT VENT (RV)

LINETYPE LEGEND	
	EXISTING
	DEMOLISH
	NEW
	FUTURE

## MECHANICAL GENERAL NOTES:

- PRIOR TO SUBMITTING BID, VISIT THE JOB SITE AND BECOME FULLY ACQUAINTED WITH THE EXISTING CONDITIONS OF THE PROJECT. REVIEW THE GENERAL NOTES, SPECIFICATIONS AND OTHER DRAWINGS FOR ADDITIONAL REQUIREMENTS WHICH MAY NOT BE SPECIFICALLY CALLED OUT IN THIS PORTION OF THE CONSTRUCTION DOCUMENTS. NOTIFY ARCHITECT, ENGINEER AND/OR OWNER OF CONFLICTS OR DISCREPANCIES PRIOR TO SUBMISSION OF BID.
- PROVIDE SEISMIC RESTRAINTS AS NEEDED FOR THE MECHANICAL SYSTEMS IN THE PROJECT BASED ON THE SEISMIC ANALYSIS REQUIRED BY THE SPECIFICATIONS.
- EXISTING CONDITIONS WERE TAKEN FROM ORIGINAL DRAWINGS AND SITE VISITS AND MAY NOT REFLECT EXACT "AS-BUILT" CONDITIONS. FIELD VERIFY EXISTING CONDITIONS PRIOR TO SUBMITTING FINAL BIDS. COORDINATE NEW WORK AND DEMOLITION WITH OTHER DISCIPLINES AND EXISTING CONDITIONS PRIOR TO CONSTRUCTION. COORDINATE THE INSTALLATION OF THE MECHANICAL SYSTEMS WITH OTHER TRADES TO ENSURE A NEAT AND ORDERLY INSTALLATION. INSTALL DUCTWORK AND PIPING AS TIGHT TO STRUCTURE AS POSSIBLE. COORDINATE WITH OTHER TRADES TO AVOID CONFLICTS. COORDINATE INSTALLATION OF DUCTWORK AND PIPING TO AVOID CONFLICTS WITH ELECTRICAL PANELS, LIGHTING FIXTURES, ETC. ANY MODIFICATIONS REQUIRED DUE TO LACK OF COORDINATION WILL BE THE RESPONSIBILITY OF THE CONTRACTOR AT NO EXTRA COST TO THE OWNER.
- WHERE SHUTDOWN OF EXISTING SYSTEMS IS REQUIRED DURING NEW WORK, COORDINATE SHUTDOWN TIME AND DURATION WITH THE OWNER TO MINIMIZE DOWNTIME. NOTIFY OWNER SEVEN (7) DAYS PRIOR TO INTERFERENCE.
- DURING INSTALLATION OF NEW WORK, AVOID DAMAGING EXISTING SURFACES AND EQUIPMENT TO REMAIN. REPAIR DAMAGE CAUSED DURING CONSTRUCTION AT NO EXTRA COST TO THE OWNER.
- PROVIDE TEMPORARY BARRIERS TO CONTAIN DUST AND DEBRIS RESULTING FROM THE PERFORMANCE OF THE WORK TO THE AREA WHERE WORK IS BEING PERFORMED.
- ALL MECHANICAL EQUIPMENT SHOWN ON THE MECHANICAL PLANS SHALL BE PROVIDED BY DIVISION 23 UNLESS OTHERWISE NOTED.
- NEW MECHANICAL EQUIPMENT SHALL BE PROVIDED BY DIVISION 23 AT APPROXIMATE LOCATIONS. FIELD MEASURE FINAL DUCTWORK AND PIPING LOCATIONS PRIOR TO FABRICATION AND MAKE ADJUSTMENTS AS NECESSARY TO ACCOMMODATE PIPING WITHIN THE AVAILABLE SPACE. VERIFY THAT FINAL EQUIPMENT LOCATIONS MEET MANUFACTURER'S RECOMMENDATIONS REGARDING SERVICE CLEARANCES AND PROPER AIRFLOW CLEARANCE AROUND EQUIPMENT.
- REFER TO ARCHITECTURAL DRAWINGS FOR RELATED CONSTRUCTION DETAILS APPLICABLE TO THE HVAC SYSTEM. VERIFY CHASES AND PENETRATIONS SHOWN ON ARCHITECTURAL DRAWINGS THAT ARE INTENDED FOR DUCTWORK AND PIPING MEET REQUIREMENTS.
- COORDINATE LOCATION OF ROOF MOUNTED HVAC EQUIPMENT AND ROOF PENETRATIONS WITH THE ARCHITECTURAL AND STRUCTURAL DRAWINGS.
- INDOOR AIR QUALITY MEASURES: PROTECT INSIDE OF (INSTALLED AND DELIVERED) DUCTWORK AND HVAC UNITS FROM EXPOSURE TO DUST, DIRT, PAINT AND MOISTURE. REPLACE INSULATION THAT HAS BECOME WET AT ANY TIME DURING CONSTRUCTION. DRYING THE INSULATION IS NOT ACCEPTABLE. SEAL ANY TEARS OR JOINTS OF INTERNAL FIBERGLASS INSULATION. REMOVE DEBRIS FROM CEILING/RETURN AIR PLENUM INCLUDING DUST. AN INDEPENDENT PROFESSIONAL ENGINEER SHALL VACUUM CLEAN ALL INTERNAL SURFACES OF ANY DUCTWORK CONNECTED TO HVAC UNITS THAT WERE OPERATED DURING THE CONSTRUCTION PERIOD AFTER NEW FILTERS ARE INSTALLED AND PRIOR TO TURNING SYSTEM OVER TO THE OWNER. THE INTERNAL SURFACES AND ASSOCIATED COILS OF ANY HVAC UNITS THAT WERE OPERATED SHALL ALSO BE CLEANED.
- INSTALL DUCTWORK PARALLEL TO BUILDING COLUMN LINES UNLESS OTHERWISE SHOWN OR NOTED.
- OVERHEAD HANGERS AND SUPPORTS FOR EQUIPMENT, DUCTWORK AND PIPING SHALL BE INSTALLED TO BUILDING JOISTS OR BEAMS. DO NOT ATTACH HANGERS AND SUPPORTS TO THE ABOVE FLOOR SLAB OR ROOF EXCEPT WHERE CONCRETE INSERTS IN CONCRETE SLABS ARE ALLOWED BY THE SPECIFICATIONS.
- COORDINATE LOCATION OF EQUIPMENT SUPPORTS WITH LOCATION OF EQUIPMENT ACCESS PANELS/DOORS TO ENABLE SERVICE OF EQUIPMENT AND/OR FILTER REPLACEMENT.
- COORDINATE THE EXACT MOUNTING SIZE AND FRAME TYPE OF DIFFUSERS, REGISTERS AND GRILLES WITH THE SUPPLIER TO MEET THE CEILING, WALL AND DUCT INSTALLATION REQUIREMENTS.
- ADJUST LOCATION OF CEILING DIFFUSERS, REGISTERS AND GRILLES AS REQUIRED TO ACCOMMODATE FINAL CEILING GRID AND LIGHTING LOCATIONS.
- LOCATE AND SET THERMOSTATS AND SENSORS AT LOCATIONS SHOWN ON PLANS. VERIFY EXACT LOCATIONS WITH ARCHITECT PRIOR TO INSTALLATION. INSTALL DEVICES WITH TOP OF DEVICE AT MAXIMUM 48" AFF TO MEET ADA REQUIREMENTS UNLESS NOTED OTHERWISE ON PLANS. PROVIDE INSULATED BACKING FOR THERMOSTATS MOUNTED ON EXTERIOR BUILDING WALLS. INSTALL WIRING IN CONDUIT PROVIDED BY DIVISION 26. AT A MINIMUM, PROVIDE CONDUIT IN THE WALL FROM THE JUNCTION BOX TO 6" ABOVE THE CEILING.
- COORDINATE THE LOCATION AND ELEVATION OF WALL-MOUNTED DEVICES WITH PRESENTATION BOARDS, DISPLAY CABINETS, SHELVES OR OTHER COMPONENTS SHOWN ON THE ARCHITECTURAL DRAWINGS THAT ARE TO BE INSTALLED UNDER OTHER DIVISIONS. CONTRACTOR WILL NOT BE REIMBURSED FOR RELOCATION OF WALL-MOUNTED DEVICES CAUSED BY A LACK OF COORDINATION.
- PROVIDE A MANUAL BALANCING DAMPER IN EACH DUCT TAKEOFF FROM SUPPLY, RETURN, OUTDOOR AND EXHAUST AIR DUCTS.
- PROVIDE A PREFABRICATED 45 DEGREE, HIGH EFFICIENCY, RECTANGULAR/ROUND BRANCH DUCT TAKEOFF FITTING FOR BRANCH DUCT CONNECTIONS AND TAKE-OFFS TO INDIVIDUAL DIFFUSERS, REGISTERS AND GRILLES. PROVIDE WITH INTEGRAL MANUAL BALANCING DAMPER AND LOCKING QUADRANT WHERE INDICATED ON PLANS.
- BRANCH DUCTWORK TO AIR OUTLETS SHALL BE SAME SIZE AS OUTLET NECK SIZE UNLESS OTHERWISE NOTED.
- REFER TO SPECIFICATIONS FOR DUCTWORK AND PIPING INSULATION REQUIREMENTS. DIMENSIONS ON MECHANICAL PLANS INDICATE CLEAR INSIDE AIRFLOW DIMENSIONS. INCREASE SHEET METAL SIZES ACCORDINGLY TO ACCOUNT FOR THICKNESS OF DUCT LINER.
- FLEXIBLE DUCTWORK SHALL NOT EXCEED 9'-0" IN LENGTH AND SHALL BE INSTALLED AND SUPPORTED TO AVOID SHARP BENDS AND SAGGING. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.
- PROVIDE A NEW SET OF AIR FILTERS IN UNITS PRIOR TO TESTING, ADJUSTING AND BALANCING AND BEFORE TURNING SYSTEM(S) OVER TO OWNER.

## LANDLORD MECHANICAL NOTES:

- ALL MODIFICATIONS AND WORK TO BUILDING STRUCTURE AND/OR ROOF SHALL BE DONE BY LANDLORD'S APPROVED CONTRACTORS. COORDINATE SCOPE OF WORK WITH LANDLORD PRIOR TO CONSTRUCTION.

GENERAL NOTES SHOWN HERE SHALL GOVERN FOR ALL MECHANICAL SHEETS.

## APPLICABLE MECHANICAL CODES:

PROJECT IS DESIGNED IN COMPLIANCE WITH THE FOLLOWING CODES. THIS IS NOT AN EXHAUSTIVE LIST. PROJECT SHALL COMPLY WITH ALL APPLICABLE CODES, STANDARDS, AND LOCAL REQUIREMENTS. REFER TO THE SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

MECHANICAL CODE: 2018 INTERNATIONAL MECHANICAL CODE  
BUILDING CODE: 2018 INTERNATIONAL BUILDING CODE  
ENERGY CODE: 2018 INTERNATIONAL ENERGY CONSERVATION CODE

## COMMISSIONING / FUNCTIONAL TESTING:

CONTRACTOR'S BID SHALL INCLUDE PROVISIONS TO PROVIDE ALL SERVICES RELATED TO THE CODE REQUIRED BUILDING SYSTEMS COMMISSIONING INCLUDING A COMMISSIONING PLAN, FUNCTIONAL TESTING, AND RELATED DOCUMENTATION, REPORTS, AND OWNER TRAINING. THIS INCLUDES RETAINING THE SERVICES OF A 3RD PARTY REGISTERED DESIGN PROFESSIONAL OR APPROVED AGENCY. REFER TO THE LATEST ADOPTED EDITION OF THE APPLICABLE ENERGY CODE FOR MORE INFORMATION. CONTRACTOR SHALL COMPLETE ALL RELATED COMMISSIONING REQUIREMENTS PRIOR TO FINAL INSPECTIONS IN ACCORDANCE WITH THE CONSTRUCTION DOCUMENTS, CODE, AND MANUFACTURER'S INSTRUCTIONS.

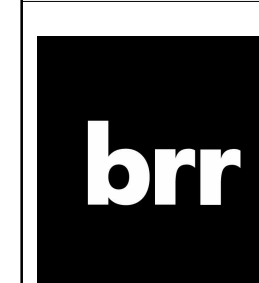
## MECHANICAL DEMOLITION GENERAL NOTES:

- COORDINATE ALL DEMOLITION WITH WHAT IS SHOWN ON ARCHITECTURAL PLANS. NOTIFY ARCHITECT OF ANY DISCREPANCIES.
- PRIOR TO SUBMITTING BID, VISIT THE JOB SITE AND BECOME FULLY ACQUAINTED WITH THE EXISTING CONDITIONS OF THE PROJECT. REVIEW GENERAL NOTES, SPECIFICATIONS AND OTHER DRAWINGS FOR ADDITIONAL REQUIREMENTS THAT MAY NOT BE SPECIFICALLY CALLED OUT IN THIS PORTION OF THE CONSTRUCTION DOCUMENTS. NOTIFY ARCHITECT, ENGINEER OR OWNER, AS DEFINED IN BID DOCUMENTS, OF CONFLICTS OR DISCREPANCIES PRIOR TO SUBMISSION OF BID.
- OWNER RETAINS RIGHTS OF SALVAGE FOR EQUIPMENT AND FIXTURES TO BE REMOVED. COORDINATE WITH OWNER THE EQUIPMENT AND FIXTURES TO BE SALVAGED AND THE LOCATION FOR STORAGE. AVOID DAMAGE TO SALVAGED EQUIPMENT, FIXTURES AND DEVICES DURING DEMOLITION WORK AND DURING TRANSPORT TO OWNER'S DESIGNATED STORAGE LOCATION.
- REMOVE ITEMS SHOWN HEAVY-LINED DASHED, AND/OR NOTED TO BE REMOVED.
- AVOID DAMAGING EXISTING SURFACES AND EQUIPMENT TO REMAIN FOR NEW INSTALLATION. REPAIR DAMAGE CAUSED DURING WORK AT NO EXTRA COST TO THE OWNER.
- SEAL PENETRATIONS THROUGH FLOORS, WALLS, CEILINGS AND ROOFS WHERE MECHANICAL COMPONENTS ARE REMOVED AND WHERE THE EXISTING PENETRATION IS NOT USED FOR THE NEW INSTALLATION. REPAIR DAMAGED SURFACES TO MATCH ADJACENT AREAS OR AS INDICATED ON THE ARCHITECTURAL DRAWINGS.
- REMOVE HANGERS AND SUPPORTS WHERE DUCTWORK, PIPING AND/OR EQUIPMENT ARE REMOVED AND THE EXISTING HANGERS AND SUPPORTS ARE NOT USED FOR THE NEW INSTALLATION.
- INSTALL PERMANENT CAPS WHERE DUCTWORK AND PIPING IS REMOVED AND THE EXISTING TAPS ARE NOT USED FOR THE NEW INSTALLATION. WHERE DUCTWORK AND PIPING ARE REMOVED AND THE EXISTING TAPS WILL BE USED FOR THE NEW INSTALLATION, INSTALL TEMPORARY CAPS TO PROTECT THE INTERIOR SURFACES UNTIL NEW DUCTWORK AND PIPING ARE INSTALLED.
- INSPECT EXISTING EQUIPMENT TO REMAIN TO VERIFY THAT EQUIPMENT IS OPERATING PROPERLY. NOTIFY OWNER OF DAMAGED AND/OR MALFUNCTIONING COMPONENTS.
- WHERE SHUTDOWN OF EXISTING SYSTEMS IS REQUIRED DURING DEMOLITION, COORDINATE SHUTDOWN TIME AND DURATION WITH OWNER TO MINIMIZE DOWNTIME. NOTIFY OWNER SEVEN (7) DAYS PRIOR TO INTERRUPTION OF SERVICE.
- CEASE WORK AND IMMEDIATELY NOTIFY THE OWNER SHOULD ANY HAZARDOUS MATERIALS BE ENCOUNTERED DURING THE PERFORMANCE OF THE WORK.
- REMOVAL, RECOVERY, RECYCLING, AND DISPOSAL OF REFRIGERANT, CONTAINED IN ANY EQUIPMENT TO BE REMOVED, SHALL BE PERFORMED IN STRICT ACCORDANCE WITH CURRENT EPA GUIDELINES.

## MECHANICAL EMS NOTES:

- COORDINATE ALL CONTROLS, EQUIPMENT ACCESSORIES, AND ASSOCIATED WORK WITH EMS VENDOR PRIOR TO ALL EQUIPMENT PURCHASES AND INSTALLATION.
- GENERAL CONTRACTOR IS RESPONSIBLE FOR COORDINATING WITH EMS VENDOR TO PROVIDE A FULLY FUNCTIONAL SYSTEM AT START-UP. FAILURE TO COORDINATE CONTROLS AND REQUIRED EQUIPMENT ACCESSORIES RESULTING IN MODIFICATIONS SHALL BE RESPONSIBILITY OF THE CONTRACTOR AT NO EXTRA COST TO THE OWNER.
- PROVIDE CARRIER ROOFTOP UNITS, AS APPLICABLE, WITH FACTORY INSTALLED BACNET OPEN BOARD CONTROLLER WITH SUPPLY AND OUTSIDE AIR TEMPERATURE SENSORS.
- THERMOSTATS AND SENSORS SHALL BE FURNISHED BY EMS VENDOR AND INSTALLED BY DIVISION 26 CONTRACTOR UNLESS NOTED OTHERWISE.
- PROVIDE ALL MOTORIZED DAMPERS ON PLAN, AS APPLICABLE, TO BE ABLE TO CONNECT TO ACTUATOR PROVIDED BY EMS VENDOR. MOTORIZED DAMPERS SHALL BE ACCESSIBLE FROM WITHIN SPACE VIA DUCT ACCESS PANELS. REFER TO SPECIFICATIONS FOR MORE INFORMATION.
- OUTDOOR SENSOR ASSEMBLY FOR ECONOMIZER CONTROL IS PROVIDED BY EMS VENDOR, WHERE REQUIRED. PROVIDE CHASE LARGE ENOUGH FOR 1/4" POLY TUBE AND (2) WIRE PULLS FOR EMS CONTROLS.

## Architect:



ARCHITECT OF RECORD:  
8131 METCALF AVE  
SUITE 300  
OVERLAND PARK, KS 66204  
www.brrarch.com  
TEL: 913-262-9095  
FAX: 913-262-9094

## COPYRIGHT NOTICE

This drawing was prepared for use on a specific site contemporaneously with the issue date and it is not suitable for use on a different project or for any other use. Use of this drawing for reference or example on another project without the written consent of the architect and engineer is prohibited. Reproduction of this drawing for use on another project is not authorized and may be cause for legal action.

## Engineer:

**HENDERSON ENGINEERS**  
8545 LENEXA DRIVE, SUITE 300  
LENEXA, KS 66245  
(503) 671-6453  
WWW.HENDERSONENGINEERS.COM  
22500137  
TN. CORPORATE NO. 3847

## Project Owner:

**NIKE, Inc.**  
One Bowerman Drive  
Beaverton, OR 97005  
(503) 671-6453  
www.nike.com

## Project Address:

4000 CANE RIDGE PARKWAY  
SUITE 301  
ANTIOCH, TN 37013  
UNITE  
TEMPLATE ISSUE DATE: 11/28/2018

## Fixture Package:

UNITE

## Stamp:



04/06/2023



## Division 23: HEATING, VENTILATING, AND AIR CONDITIONING

### 1. GENERAL INSTRUCTIONS

#### A. GENERAL REQUIREMENTS

All requirements under Division 01 of the general and supplementary conditions of these specifications apply to this section and division. Where the requirements of this section and division exceed those of Division 01, this section and division take precedence. Become thoroughly familiar with all contents as they apply to this division, section, and division. Work required under this division includes all materials, equipment, appliances, transportation, services, and labor required to complete the entire system as required by the drawings and specifications, or reasonably inferred to be necessary to facilitate the function of each system as implied by the design and the equipment specified.

The specifications and drawings for the project are complementary, and any portion of work described in one shall be provided as if described in both. In the event of discrepancies, notify the Engineer and request clarification prior to proceeding with the work involved.

Drawings are graphic representations of the work upon which the contract is based. They show the materials and their relationship to one another, including sizes, shapes, locations, and connections. They convey the scope of work, indicating the intended general arrangement of the materials and the exact details as to locations, offsets, control lines, and other installation requirements. Use the drawings as a guide when laying out the work to verify that materials and equipment will fit into the designated spaces, and when installed per manufacturer's requirements, will ensure a complete, coordinated, satisfactory, and properly operating system.

#### B. DEFINITIONS

Division: Sections contained in this specification follow the numbering system defined in the Construction Specifications Institute (CSI) MasterFormat 2004 Edition. Specifications for sections in this project are identified by the Division and Section. The corresponding division references between the 2004 Edition and 1995 Edition are as follows:

2004 Edition	1995 Edition
Division 21 - Fire Suppression	Division 15
Division 22 - Plumbing	Division 24
Division 23 - HVAC	Division 26
Division 28 - Electrical	Division 16
Division 27 - Communications	Division 16
Division 29 - Electronic Safety and Security	Division 16

Furnish: "to supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations."

Install: "to perform all operations at the project site including, but not limited to, the actual unloading, unpacking, assembling, erecting, placing, anchoring, applying, working to installation, finishing, curing, protecting, cleaning, adjusting, commissioning, starting up and similar operations, and to be ready to receive the work of other trades."

Provide: "to furnish and install."

Furnished by Owner (Or Owner-Furnished) or Furnished by Others: "an item furnished by the Owner or under other divisions or contracts, and installed under the requirements of this division, complete and ready for intended use, including all items and services incidental to the work necessary for proper installation and operation. Include the installation under the warranty required by this division."

Engineer: Where referenced in this division, "Engineer" is the Engineer of Record and the Design Professional for the work under this division, and is a consultant to, and an authorized representative of, the Owner. The Engineer is not responsible for the design of the work. When used in this division, "Engineer" means increased involvement by and obligations to the Engineer, in addition to involvement by and obligations to the Architect.

AHJ: The local code officer and inspection agency (Authority Having Jurisdiction over the work).

NRTL: Nationally recognized testing laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, and acceptable to the AHJ over this project. Nationally recognized testing laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other NRTLs that are acceptable to the AHJ and standards that are acceptable to the AHJ.

Substitution: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and approved by the Contractor. Substitutions include Value Engineering proposals.

Approved by Contractor: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.

Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantages to Contractor or Owner.

The terms "approved equal," "equivalent," or "equal" are used synonymously and shall mean "accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified." The term "approved" shall include, but not be limited to, both, by an NRTL, and acceptable to the AHJ over this project.

#### C. PREBID SITE VISIT

Prior to submitting bid, visit the site of the proposed work and become fully informed as to the conditions under which the work is to be done. Failure to comply with this requirement shall not be considered sufficient justification to request or obtain extra compensation over and above the contract price.

#### D. MATERIAL AND WORKMANSHIP

Provide new material, equipment, and apparatus under this contract unless otherwise stated herein; be of best quality normally used for the purpose in good commercial practice, and free from defects. Install material and equipment in accordance with the manufacturer's installation instructions. Model numbers listed in the specifications or shown on the drawings are not necessarily intended to designate the required item, unless otherwise stated in the item's government model number.

Pipe, pipe fittings, pipe specialties and valves shall be manufactured in plants located in the United States or certified to meet the specified ASTM and ANSI standards.

Work performed under this contract shall provide a neat and "workmanlike" appearance when completed, to the satisfaction of the Architect and Engineer. Workmanship shall be the finest possible by experienced mechanics. Installations shall comply with applicable codes and laws.

The complete installation shall conform as designed and intended with respect to efficiency, capacity, noise level, etc. Abnormal noise caused by rattling equipment, piping, ducts, air devices, and squeaks in relating components shall not be acceptable. Materials and equipment shall be of best commercial quality. Light duty and residential grade equipment shall not be accepted unless otherwise indicated.

Remove from the premises waste material present as a result of work, including carts, cans, paper, stickers, and/or excavation material not used in backfilling, etc. Clean equipment installed under this contract to present a neat and clean condition at the termination of the work.

Repair or replace public and private property damaged as a result of work performed under this contract to the satisfaction of authorities and regulatory having jurisdiction. Provide all safety lights, guards, and warning signs required for the performance of the work and for the safety of the public.

#### E. MANUFACTURERS

In other articles where lists of manufacturers are introduced, subject to compliance with requirements, provide products by one of the manufacturers specified.

Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference.

Where manufacturers are not listed, provide products subject to compliance with requirements from manufacturers that have been actively involved in manufacturing the specified product for no less than 5 years.

#### F. COORDINATION

Coordinate work with that of other trades so that the various components of the systems are installed at the proper time, will fit the available space, and will allow proper service access to the various requiring maintenance. Components which are installed without regard to the above shall be relocated at an additional cost to the Owner.

Unless otherwise indicated, the General Contractor shall provide chases and openings in building construction required for installation of the systems specified herein. Contractor shall furnish the General Contractor with information where chases and openings are required. Contractor shall keep informed as to the work of other trades engaged in the construction of the project and shall execute work in a manner as to not interfere with or delay the work of other trades.

Figured dimensions shall be taken in preference to scale dimensions. Contractor shall take his own measurements at the buildings, as variations may occur. Contractor shall be held responsible for errors that could have been avoided by proper checking and inspection.

Provide materials with trim that will properly fit the types of casing, wall, or floor finishes actually installed. Model numbers listed in the specifications or shown on the drawings are not intended to designate the required item.

#### G. ORDINANCES AND CODES

Work performed under this contract shall, at a minimum, be in conformance with applicable national, state and local codes having jurisdiction. Equipment furnished and associated installation work performed under this contract shall be in strict compliance with current applicable codes adopted by the local AHJ, including any amendments and standards as set forth by the following:

- National Fire Protection Association (NFPA)
- Underwriters Laboratories (UL)
- Occupational Safety and Health Administration (OSHA)
- American Society of Mechanical Engineers (ASME)
- American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)
- American National Standards Institute (ANSI)
- American Society of Testing and Materials (ASTM)

Other national standards and codes where applicable.

Where the contract documents exceed the requirements of the referenced codes, standards, etc., the contract documents shall take precedence. Where conflicts between various codes, ordinances, rules, and regulations exist, comply with the most restrictive.

promptly bring all conflicts observed between codes, ordinances, rules, regulations, referenced standards, and these documents to the attention of the Architect and Engineer for final resolution. Contractor will be held responsible for any violation of the law.

Procure and pay for permits and licenses required for the accomplishment of the work herein described. Where required, obtain pay, and furnish certificates of inspection to Owner.

#### H. PROTECTION OF EQUIPMENT AND MATERIALS

Store and protect from damage equipment and materials stored to job site. For materials and equipment susceptible to changing weather conditions, dampness, or temperature variations, store inside in conditioned spaces. For materials and equipment not susceptible to these conditions, cover with waterproof, tear-resistant, heavy tarp or polyethylene plastic as required to protect from rain, sleet, dirt, and/or physical damage. Replace insulation that has become wet at any time during construction. Drying the insulation is not acceptable. Seal any tears or joints of internal flexible joints. Equipment and material damaged by construction activities shall be rejected and Contractor shall furnish new equipment and material at his own expense.

Keep premises clean at all times. Remove material created during work performed under this contract. Piping, equipment, etc. shall have a neat and clean appearance throughout the termination of the work. Remove debris from collection area, including dust.

Plug, seal, or cap open ends of ductwork and piping systems while stored and installed during construction when not in use to prevent the entrance of debris into the systems. Remove temporary provision prior to starting equipment and turning the system over to the Owner.

#### I. SUBSTITUTIONS

Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications. To request a substitution, request the Substitution Request Form from the Architect or Engineer. Complete and send the Substitution Request Form for each material, product, equipment, or system that is proposed to be substituted. The burden of proof of the merit of the proposed substitution is upon the proposer.

Unless otherwise directed in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner the following: 1. Proposed substitution has been fully investigated and determined to meet or exceed the intent of the Work as it respects issues stated otherwise in the substitution request.

2. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional characteristics, maintenance service, and sourcing of replacement parts.

3. Proposed substitution has received necessary approvals of authorities having jurisdiction.

4. Same warranty will be furnished for proposed substitution as for specified Work.

5. If accepted substitution falls in preference as required, Contractor shall replace substitute material or system with that originally specified and/or otherwise reducing any damage resulting therefrom.

6. Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.

No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation. No substitution will be considered prior to receipt of bids unless written verification for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of bids.

If the proposed substitution is approved prior to receipt of bids, no approval will be stated in an addendum. Bidders shall not rely upon approvals made in any other way. Verbal approval will not be given. No substitutions will be considered after the contract is awarded unless specifically provided in the contract documents.

#### J. SUBMITTALS

Assemble and submit for review shop drawings, material lists, manufacturer product literature for equipment to be furnished, and items requiring coordination between contractors under the contract. Provide submittals in sufficient detail so as to demonstrate compliance with these contract documents and the design concept. Prior to transmitting submittals, verify that the equipment submitted is mutually compatible and suitable for the intended use, will fit the available space, and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location or configuration, submit a shop drawing showing the proposed layout.

Transient submittals as may be required to support the project schedule. Allow for two weeks Engineer review time, plus 10 days for making time via the Architect, plus a duplicate of the time for resubmission, if required. Only request those sections requested for resubmission.

Contractor shall be responsible for correct rough-in dimensions and shall verify them with Architect and equipment supplier prior to service installations.

#### K. SYSTEM TESTING, ADJUSTING, AND BALANCING

Upon completion of each phase of the installation, test each system in conformance with local code requirements and as noted below. Furnish labor and equipment required to test each system under this contract. Assume all costs involved in making the tests and repairing and/or replacing any damaged resulting therefrom.

Final system testing, balancing and adjustments (TAB) shall be performed by a Contractor certified by the National Environmental Balancing Bureau (NEBB), Associated Air Balance Council (AABC), or Testing, Adjusting and Balancing Bureau (TABJ), TAB shall be performed in accordance with the most current edition of the certified agencies' procedural standard for testing, adjusting and balancing and shall comply with the strictest interpretation of that standard for execution and reporting of all TAB work.

Test, adjust, and balance equipment and systems included in the scope of work. Prepare testing and balancing report log using specified equipment and the standard forms available from the TAB certification standard being followed. Adjust equipment to deliver uniform flow throughout the system under design conditions, entering and leaving dampers to be some lesser than design. Provide close attention to the distance from the damper to the remote operator location. Install piping in branch duct. Do not install in diffuse air. Install remote operator on the back of the offshore frame or side of a flat offshore frame. Support cable assembly to avoid bends and stress in cable at manufacturer's recommended limits. Where approved by architect, a sealing cap with cover plate may be used for access to diffuser control. Provide round access to the diffuser control. The use of square throat, radius head elbows is prohibited. Remove and replace all installed elbows of this type with an approved oval at an additional cost to the owner.

Connect ducts to vibrating equipment and when transitioning between two different metal duct materials (e.g., aluminum to galvanized steel) by means of flexible connectors. Flexible connectors shall be neoprene coated glass cloth convuls connectors, Duo-Dyne, Egan, Ventabloc or equal. Flexible connectors shall have a smooth spread of 25 or less and smoke developed rating not higher than 8A. Make tight joints and install with minimum 1-1/2 inches slack.

Providing balancing dampers, manufactured by Cesco, Greenheck, Louvers & Dampers, Nakor Industries, Poturff, Buskin, Tomco, or approved equal, where shown on drawings, shall be installed in accordance with the manufacturer's instructions. Each damper shall be equipped with quadrants; provide Young Regulator or Ventlok end bearings for the damper rod. Rectangular volume dampers shall be opposed blade interlocking type. Round volume dampers shall be single-blade type consisting of circular blade mounted to a shaft. Provide Flamerator model RT-0 or equal 45 degree rectangular opposed blade type with mode (EQ) damper with locking quadrants and insulation built out to round ductwork branch latches to individual air devices. Provide damper at takeoff fitting where damper is located downstream of takeoff.

Where access to dampers through a hard ceiling is required, provide a concealed, remote cable-actuated, butterfly-type volume damper upstream of fans to meet SMACNA standards relative to gauge, bearing, joints, etc. Provide a minimum of 24 inches clearance around the damper. Seal rest on top of the roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with embedded support fasteners necessary to support the damper. Provide rigid pedestal type supports with minimum 18x18 inch framing or rubber bands of 1/2 inch wide closed cell polyethylene foam with length to meet SMACNA minimum 8 inches clearance around duct to finished roof surface.

Balance air volume to within plus or minus 10 percent for terminal devices and branch lines and plus or minus 5 percent for main ducts and air handling equipment of the amount of air shown on the drawings. TAB Contractor shall record space measurements and make adjustments in accordance with the design intent and to provide complete control of air flow. Splitter dampers shall be controlled by locking quadrants. Balance hydronic systems to provide flow rates within plus or minus 5 percent of design flow. Include fan and test readings, motor voltage and amp draws, etc., and submit six copies of the final completion data of this to the Architect for evaluation and approval before final inspection of the project.

Balance air volume to within plus or minus 10 percent for terminal devices and branch lines and plus or minus 5 percent for main ducts and air handling equipment of the amount of air shown on the drawings. TAB Contractor shall record space measurements and make adjustments in accordance with the design intent and to provide complete control of air flow. Splitter dampers shall be controlled by locking quadrants. Balance hydronic systems to provide flow rates within plus or minus 5 percent of design flow. Include fan and test readings, motor voltage and amp draws, etc., and submit six copies of the final completion data of this to the Architect for evaluation and approval before final inspection of the project.

TAB Contractor shall be responsible to calibrate, seal, and adjust automatic temperature control sensors, actuators and control devices. Check proper sequencing of interlock systems, and operation of safety controls, adjust thermostats, and control sensors, limits and time based

adjustment to operate in accordance with the performance requirements of the Construction Documents. Adjust pumps, fans, etc. for proper and efficient operation. Carry to Architect that adjustments have been made and that a system is operating satisfactorily. Calibrate, seal, and adjust automatic temperature control sensors. Check proper sequencing of interlock systems, and operation of safety controls.

Division 23 contractor shall apply bearings and replace bearings that have dirt or foreign material in them with new bearings without additional cost to the Owner.

#### K. VIBRATION ISOLATION

Provide vibration isolation equipment and materials by a single manufacturer. If type and deflection for specific equipment is not specified within the contract documents, reference ASHRAE Handbook "HVAC Applications" or provide and manufacturer's recommendations. Approved under Division 01 are: Kinetics Noise Control, Mason Industries, Inc., Vibra-Tek Mounting and Controls, or Vibro-Acoustics. Select their systems are in compliance with the specified design and performance deflection.

General Requirements: Provide vibration isolators by the weight distribution to produce uniform deflection. Vibration isolators shall have either known un-deflected height or calibration marks so that, after adjustment, the static deflection can be verified, thus determining that the load capacity is sufficient to protect the system from dirt, dirt, and moisture. Replace and maintain filters when needed, but not less than every month. Have 10 percent excess capacity without becoming soft bound. Coat vibration isolators with factory-applied paint. Coat vibration isolators with a clear protective finish to protect the isolator elements with factory-applied corrosion resistance protection. Install and adjust vibration isolators in accordance with manufacturer's written instructions.

Pipe connections: Provide flexible connectors for piping system connections on equipment side of shutoff valves for all pumps, mechanical equipment supported or suspended by spring isolators, and when indicated on drawings. Fabricate flexible piping connectors from stainless steel or materials as suitable for application. Flexible piping connections shall be in accordance with the manufacturer's written instructions.

#### L. RECORD DRAWINGS (AS-BUILT DRAWINGS)

During preparation of shop drawings or record drawings, Contractor may, at his option, obtain electronic drawing files in AutoCAD or DXF format on a CD-ROM disk, DVD disk, flash drive or direct download, as desired, from the Engineer for a shipping and handling fee of \$200 for a drawing set up to 12 sheets and \$15 per sheet for each additional sheet. Contact the Architect for writing authorization and Engineer for the necessary design agreement for electronic drawing method and drawing format. In addition to providing the written authorization from the Architect and design agreement form (AS-BUILT) must be received before electronic drawing files will be sent.

#### M. ELECTRONIC DRAWING FILES

In preparation of shop drawings or record drawings, Contractor may, at his option, obtain electronic drawing files in AutoCAD or DXF format on a CD-ROM disk, DVD disk, flash drive or direct download, as desired, from the Engineer for a shipping and handling fee of \$200 for a drawing set up to 12 sheets and \$15 per sheet for each additional sheet. Contact the Architect for writing authorization and Engineer for the necessary design agreement for electronic drawing method and drawing format. In addition to providing the written authorization from the Architect and design agreement form (AS-BUILT) must be received before electronic drawing files will be sent.

#### N. SEISMIC CONTROLS FOR MEPP SYSTEMS

Seismic Protection Criteria: L or III  
Seismic Design Category: D  
Seismic Risk Category: I  
Seismic Importance Factor: Determined from ASCE 7, most recent version.

The Contractor shall be responsible for determining the requirements for seismic bracing of mechanical, electrical, and plumbing systems. Seismic protection criteria used to determine seismic bracing requirements of all mechanical, electrical, and plumbing systems shall be operational and maintenance instructions, manufacturer's catalog sheets, wiring diagrams, parts lists, approved submittals and shop drawings, warranties, and descriptive literature as furnished by the equipment manufacturer. Include an inside cover sheet that lists the project name, date, Owner, Architect, Engineer, General Contractor, Sub-Contractor, and an index of contents.

Submit three copies of literature bound in approved binders with index and label separating equipment types to the Architect, for Engineer's review, at the termination of the project. Local materials maximum 10 feet along each duct side and within 5 feet of each control and balancing dampers. Final approval of systems installed under this contract shall be withheld until this equipment brochure is received and deemed complete by the Architect and Engineer. Install workmen to save required literature shipped with the equipment itself for inclusion in the brochure.

Include Record Drawings as described above.

Refer to Division 01 for acceptance of electronic manuals for the project. For electronic manuals, refer to paragraph "Submittals" for requirements.

#### N. SPARE PARTS

Furnish to Owner, with receipt, the following spare parts for the equipment furnished for the project:

- One set of spare filters of each type required for each unit. In addition to the spare set of filters, install new filters prior to testing, adjusting, and balancing work and before turning system over to Owner.
- Shop drawings showing bracing type and location.
- Installation details of all equipment.
- Calculations showing that the seismic restraints meet the seismic requirements.

Shop drawings and calculations shall be prepared by a registered professional engineer, licensed in the state of the project and employed by the manufacturer of the seismic bracing products. Calculations shall include dead loads, static seismic loads, and capacity of materials utilized for connections.

Seismic bracing, restraints, isolators, and isolation materials shall be of the same manufacturer and shall be certified by the manufacturer. Approved manufacturers are: Ambrico/Booth Company, Inc., Bulmar/Esco, BAT, Kinetics Noise Control, Inc., Loos & Company, Inc., Mason Industries, Inc., Uni-Stat, or Vibro-Acoustics. Each device shall have a pre-approved number from California OSHDP or other recognized government agency showing minimum restraint ratings.

At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel on the operation and maintenance of the equipment provided for this facility.

Provide training to include, but not be limited to, an overview of the system and/or equipment as it relates to the facility as a whole; operation and maintenance procedures and schedules related to starting and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operation, and review of data related to the operation and maintenance.

Submit a certification letter to the Architect stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The Contractor and the Owner's representative shall sign the certification letter indicating agreement that the training has been provided.

Schedule training with Owner well at least 7 days advance notice.

#### O. WARRANTIES

Warrant each system and each element thereof against all defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in the construction documents or manufacturer's standard warranty exceeds 12 months. Renewal all defects, occurring within the warranty periods, as stated in the General Conditions and Division 01.

Warranties shall include labor and material. Where an equipment manufacturer warrants material only, the mechanical contractor shall warrant labor for a period of 12 months from date of substantial completion and make repairs or replacements without any additional costs to the Owner.

Perform the remedial work promptly, upon written notice from the Engineer or Owner.

At the time of Substantial Completion, deliver to the Owner all warranties, in writing and properly executed, including form warranties for maintenance and repair, at the time when the building is ready for occupancy or in order to maintain warranty status. Each warranty shall be addressed to the Owner and state the commencement date and term.

## 2. GENERAL MATERIALS AND INSTALLATION

### A. BUILDING OPERATION

Comply with the schedule of operations as outlined in the architectural portions of this specification. Accomplish work requiring interruption of building operation at a time when the building is not in operation. Coordinate work with other trades engaged in the construction of the project and shall execute work in a manner as to not interfere with or delay the work of other trades.

### B. EXISTING EQUIPMENT REUSE AND REMOVAL

Remove all unused equipment, ductwork, piping, and associated supports. Cap ductwork and piping at mains and seal air and water tight. Provide items of HVAC systems modification required because of building remodeling, as noted on the drawings or necessary for proper operation. Match existing materials and construction techniques when modifying existing systems unless specified otherwise. Coordinate additional requirements with General Contractor and Architect.

### C. COINCIDENTAL DAMAGE

Repair walls, sidewalks, drives, paving, walls, finishes, and other facilities damaged in the course of the work. Repair materials shall match existing, unless otherwise specified. Repair work shall be equivalent to new work. Restore finished jurisdiction, and meet the satisfaction of the Architect.

### D. CUTTING AND PATCHING

Conform to the requirements in Division 01. Cut walls, floors, ceilings, and other portions of the facility as required to install work under this division. Obtain permission from the Architect prior to cutting. Do not cut or disturb structural members without prior approval from the Architect and Structural Engineer. Make any and all necessary cuts, walls, and ceiling openings at all core drill locations with Architect and Structural Engineer prior to performing any work. Obtain approval from Architect and Structural Engineer for all core drills and penetrations at least four days prior to performing work. Penetrations shall be made in accordance with the building elevations between the building elements. Penetrations shall be made in the system component. Patch openings to match the adjacent construction including fire ratings, if applicable. Repair and retrim areas disturbed by work to the condition of adjoining surfaces in a manner satisfactory to the Architect.

### E. ROUGH-IN

Coordinate without delay all rough-in with other divisions. Conceal piping, conduit, and rough-in except in unfinished areas and where otherwise shown.

### F. STRUCTURAL SUPPORT SYSTEMS

Structural steel used for support of equipment, ductwork and piping shall be new, clean, and conform to ASTM Designation A-36.

Support mechanical components from the building structure. Do not support mechanical components from ceilings, other mechanical or electrical components, and other non-structural elements.

### G. PRE-ENGINEERED ROOF EQUIPMENT SUPPORTS AND CURBS

Provide prefabricated equipment support and roof curbs manufactured by AES Industries, Custom Weld, Inc., Pate Company, Tylzer or approved equal. Provide with fully millered raised cut and step to match roof insulation thickness, welded, minimum 18 gauge galvanized steel sheet, internally reinforced to meet bearing loads of equipment being supported, minimum 1-1/2 inch thick, 3-poured rigid insulation internal to steel to maintain continuous roof insulation wherever required. Factory installed wood roller, and minimum 18 gauge jacket with counterflashing support system that meets or exceeds the equipment support. Provide sloped roof curb with minimum 18x18 inch framing or rubber bands of 1/2 inch wide closed cell polyethylene foam with length to meet SMACNA minimum 8 inches clearance around duct to finished roof surface.

Attach equipment directly to pre-engineered roof equipment support using one of the following methods:

- Roof Curb: Secure equipment to the curb using a minimum of 4 x 6 screws, located along the length of the equipment. Alternatively, secure equipment to the curb using half-down brackets. Minimum minimum 6 inch long, 14 gauge galvanized steel curb and top curb and bottom curb. Provide a minimum of 18x18 inch framing or rubber bands of 1/2 inch wide closed cell polyethylene foam with length to meet SMACNA minimum 8 inches clearance around duct to finished roof surface.

Secure bracket to equipment and curb using a minimum of 8 points of connection per bracket. Provide one bracket at each corner along the length of the unit.

### H. PENETRATIONS

Seal elevated floor, exterior wall and roof penetrations weathertight and weathertight with non-shrink, non-hardening commercial sealant. Pack with mineral wool and seal both ends with minimum of 1/2 inch sealant.

Seal around penetrations of fire rated assemblies. Coordinate fire ratings and locations with the architectural drawings. Refer to architectural specifications for the stoppings. Provide a product brochure for the listing, location, wall or floor rating and installation drawing for each penetration fire stop system.

Provide prefabricated roof curbs where pipes and duct or ductwork penetrate elevated slabs or the roof of the exterior. Provide cover over curb of weather-resistant material and seal duct or pipe penetrations through the cover. Provide pipe or weather-resistant material with stainless steel pipe clamp for piping penetrations.

Provide box frames for rectangular openings welded 12 gauge galvanized steel attached to forms and of a minimum dimension established by the Architect. Nails for the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural drawings.

### I. EQUIPMENT FURNISHED BY OTHERS

Provide necessary equipment and accessories that are not provided by the equipment supplier or Owner to complete installation of equipment furnished by other divisions as indicated on the drawings, specified herein, or both. Equipment and accessories not provided by the equipment supplier may not include, but not be limited to, fans, vents, intakes, associated roof jacks and caps to outdoors, dampers, etc. Fans, roof fans, and other interlocks, etc., as required for proper operation of the complete system in accordance with the manufacturer's instructions.

Contractor shall be responsible for correct rough-in dimensions and shall verify them with Architect and equipment supplier prior to service installations.

### J. SYSTEM TESTING, ADJUSTING, AND BALANCING

Upon completion of each phase of the installation, test each system in conformance with local code requirements and as noted below. Furnish labor and equipment required to test each system under this contract. Assume all costs involved in making the tests and repairing and/or replacing any damaged resulting therefrom.

Final system testing, balancing and adjustments (TAB) shall be performed by a Contractor certified by the National Environmental Balancing Bureau (NEBB), Associated Air Balance Council (AABC), or Testing, Adjusting and Balancing Bureau (TABJ), TAB shall be performed in accordance with the most current edition of the certified agencies' procedural standard for testing, adjusting and balancing and shall comply with the strictest interpretation of that standard for execution and reporting of all TAB work.

Test, adjust, and balance equipment and systems included in the scope of work. Prepare testing and balancing report log using specified equipment and the standard forms available from the TAB certification standard being followed. Adjust equipment to deliver uniform flow throughout the system under design conditions, entering and leaving dampers to be some lesser than design. Provide close attention to the distance from the damper to the remote operator location. Install piping in branch duct. Do not install in diffuse air. Install remote operator on the back of the offshore frame or side of a flat offshore frame. Support cable assembly to avoid bends and stress in cable at manufacturer's recommended limits. Where approved by architect, a sealing cap with cover plate may be used for access to diffuser control. Provide round access to the diffuser control. The use of square throat, radius head elbows is prohibited. Remove and replace all installed elbows of this type with an approved oval at an additional cost to the owner.

Connect ducts to vibrating equipment and when transitioning between two different metal duct materials (e.g., aluminum to galvanized steel) by means of flexible connectors. Flexible connectors shall be neoprene coated glass cloth convuls connectors, Duo-Dyne, Egan, Ventabloc or equal. Flexible connectors shall have a smooth spread of 25 or less and smoke developed rating not higher than 8A. Make tight joints and install with minimum 1-1/2 inches slack.

Providing balancing dampers, manufactured by Cesco, Greenheck, Louvers & Dampers, Nakor Industries, Poturff, Buskin, Tomco, or approved equal, where shown on drawings, shall be installed in accordance with the manufacturer's instructions. Each damper shall be equipped with quadrants; provide Young Regulator or Ventlok end bearings for the damper rod. Rectangular volume dampers shall be opposed blade interlocking type. Round volume dampers shall be single-blade type consisting of circular blade mounted to a shaft. Provide Flamerator model RT-0 or equal 45 degree rectangular opposed blade type with mode (EQ) damper with locking quadrants and insulation built out to round ductwork branch latches to individual air devices. Provide damper at takeoff fitting where damper is located downstream of takeoff.

Where access to dampers through a hard ceiling is required, provide a concealed, remote cable-actuated, butterfly-type volume damper upstream of fans to meet SMACNA standards relative to gauge, bearing, joints, etc. Provide a minimum of 24 inches clearance around the damper. Seal rest on top of the roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with embedded support fasteners necessary to support the damper. Provide rigid pedestal type supports with minimum 18x18 inch framing or rubber bands of 1/2 inch wide closed cell polyethylene foam with length to meet SMACNA minimum 8 inches clearance around duct to finished roof surface.

Balance air volume to within plus or minus 10 percent for terminal devices and branch lines and plus or minus 5 percent for main ducts and air handling equipment of the amount of air shown on the drawings. TAB Contractor shall record space measurements and make adjustments in accordance with the design intent and to provide complete control of air flow. Splitter dampers shall be controlled by locking quadrants. Balance hydronic systems to provide flow rates within plus or minus 5 percent of design flow. Include fan and test readings, motor voltage and amp draws, etc., and submit six copies of the final completion data of this to the Architect for evaluation and approval before final inspection of the project.

TAB Contractor shall be responsible to calibrate, seal, and adjust automatic temperature control sensors, actuators and control devices. Check proper sequencing of interlock systems, and operation of safety controls, adjust thermostats, and control sensors, limits and time based