DRAWING LIST

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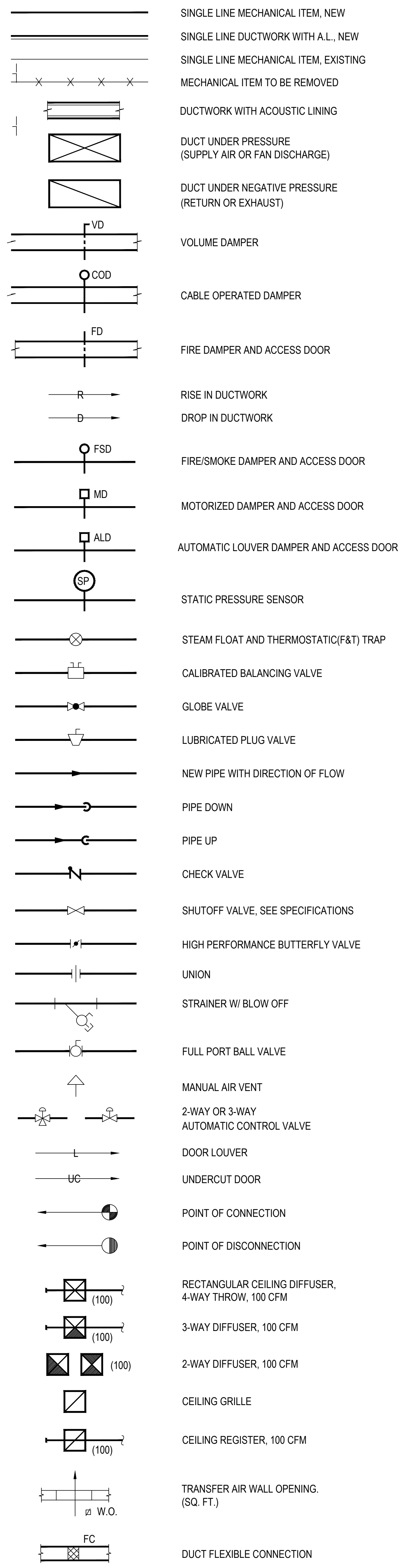
SYMBOL LIST



SINGLE LINE MECHANICAL ITEM, NEW
SINGLE LINE DUCTWORK WITH A.L., NEW
SINGLE LINE MECHANICAL ITEM, EXISTING
MECHANICAL ITEM TO BE REMOVED
DUCTWORK WITH ACOUSTIC LINING
DUCT UNDER PRESSURE (SUPPLY AIR OR FAN DISCHARGE)
DUCT UNDER NEGATIVE PRESSURE (RETURN OR EXHAUST)
VOLUME DAMPER
CABLE OPERATED DAMPER
FIRE DAMPER AND ACCESS DOOR
RISE IN DUCTWORK
DROP IN DUCTWORK
FIRE/SMOKE DAMPER AND ACCESS DOOR
MOTORIZED DAMPER AND ACCESS DOOR
AUTOMATIC LOUVER DAMPER AND ACCESS DOOR
STATIC PRESSURE SENSOR
STEAM FLOAT AND THERMOSTATIC(F&T) TRAP
CALIBRATED BALANCING VALVE
GLOBE VALVE
LUBRICATED PLUG VALVE
NEW PIPE WITH DIRECTION OF FLOW
PIPE DOWN
PIPE UP
CHECK VALVE
SHUTOFF VALVE, SEE SPECIFICATIONS
HIGH PERFORMANCE BUTTERFLY VALVE
UNION
STRAINER W/ BLOW OFF
FULL PORT BALL VALVE
MANUAL AIR VENT
2-WAY OR 3-WAY AUTOMATIC CONTROL VALVE
DOOR LOUVER
UNDERCUT DOOR
POINT OF CONNECTION
POINT OF DISCONNECTION
RECTANGULAR CEILING DIFFUSER, 4-WAY THROW, 100 CFM
3-WAY DIFFUSER, 100 CFM
2-WAY DIFFUSER, 100 CFM
CEILING GRILLE
CEILING REGISTER, 100 CFM
TRANSFER AIR WALL OPENING. (SQ. FT.)
DUCT FLEXIBLE CONNECTION

Ⓗ	HUMIDISTAT
Ⓣ	THERMOSTAT
(Ts)	TEMPERATURE SENSOR
(SD)	SMOKE DETECTOR (DUCT MOUNTED) WITH ACCESS DOOR
PS	PULL STATION
CO	CARBON MONOXIDE SENSOR
CO2	CARBON DIOXIDE SENSOR

ABBREVIATIONS

ACCU	AIR-COOLED CONDENSING UNIT
AC	AIR-CONDITIONING UNIT
AD	ACCESS DOOR
AFF	ABOVE FINISHED FLOOR
AHU	AIR-HANDLING UNIT
AL	ACOUSTICAL LINING
ATC	AUTOMATIC TEMPERATURE CONTROL
BHP	BRAKE HORSEPOWER
BR	BOTTOM REGISTER
BMS	BUILDING MANAGEMENT SYSTEM
BTUH	BTU PER HOUR
CFM	CUBIC FEET PER MINUTE
COD	CABLE OPERATED DAMPER
CP	CONDENSATE PUMP
CD	CEILING DIFFUSER
CG	CEILING GRILLE
CR	CEILING REGISTER
DB	DRY BULB TEMPERATURE
(E)	EXISTING
EWT	ENTERING WATER TEMPERATURE
EAT	ENTERING AIR TEMPERATURE
EF	EXHAUST FAN
ESP	EXTERNAL STATIC PRESSURE
°F	DEGREES FAHRENHEIT
FC	FLEXIBLE CONNECTION
FD	FIRE DAMPER
FLA	FULL LOAD AMPERE
FSD	FIRE SMOKE DAMPER
GPM	GALLONS PER MINUTE
GX	GENERAL EXHAUST
HP	HORSEPOWER
LAT	LEAVING AIR TEMPERATURE
LWT	LEAVING WATER TEMPERATURE
MBH	THOUSAND BTUH
MCA	MINIMUM CIRCUIT AMPACITY
MFS	MAXIMUM FUSE SIZE
(N)	NEW
NO.	NUMBER
PD	PRESSURE DROP
PSI	POUNDS PER SQUARE INCH
PSIG	PSI GAUGE
RPM	REVOLUTIONS PER MINUTE
SP	STATIC PRESSURE
TR	TOP REGISTER
TR GR	TRANSFER GRILLE
TSP	TOTAL STATIC PRESSURE
TX	TOILET EXHAUST
VAV	VARIABLE AIR VOLUME
VD	VOLUME DAMPER
VFD	VARIABLE FREQUENCY DRIVE
WB	WET BULB TEMPERATURE
WMS	WIRE MESH SCREEN

PIPING DESIGNATIONS

CPD	CONDENSATE PUMP DISCHARGE
CW	CITY WATER
D	DRAIN (COOLING COIL CONDENSATE)

A. GENERAL

1. HVAC CONTRACTOR SHALL VISIT THE SITE TO UNDERSTAND THE EXISTING FIELD CONDITIONS AND DETERMINE THE SCOPE OF WORK PRIOR TO SUBMITTING THE BID. NO ALLOWANCE WILL BE MADE AFTER CONTRACT IS AWARDED.
2. REMOVAL AND RELOCATION OF CERTAIN EXISTING WORK WILL BE NECESSARY FOR THE PERFORMANCE OF THE WORK. EXISTING CONDITIONS ARE NOT COMPLETELY DETAILED ON THE DRAWINGS. CONTRACTOR SHALL SURVEY THE SITE AND INCLUDE ALLOWANCE FOR SUCH REMOVALS AND RELOCATIONS.
3. WORK IN THIS BUILDING SHALL BE DONE WHEN AND AS DIRECTED BY BUILDING PERSONNEL AND SHALL BE PERFORMED SO AS TO CAUSE THE LEAST POSSIBLE INCONVENIENCE AND DISTURBANCE TO ITS OCCUPANTS. PLAN INSTALLATION OF NEW WORK AND CONNECTIONS TO EXISTING WORK TO AVOID INTERFERENCE WITH REGULAR OPERATION OF EXISTING FACILITIES.
4. MATERIALS, DOCUMENTATION AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH BUILDING STANDARDS, LOCAL CODES AND AS SPECIFIED. CONTRACTOR SHALL OBTAIN THE LATEST VERSION OF THE ALTERATION SPECIFICATIONS FROM THE BUILDING MANAGEMENT OFFICE.
5. DISCONNECT, REMOVE AND/OR RELOCATE EXISTING MATERIALS, EQUIPMENT AND OTHER WORK AS NOTED OR REQUIRED FOR PROPER INSTALLATION OF NEW WORK.
6. FIREPROOFING AND INSULATION DISTURBED BY NEW CONSTRUCTION SHALL BE RESTORED TO ORIGINAL CONDITION.
7. SUPPORT ALL DUCTWORK AND PIPING FROM BUILDING STRUCTURE AND/OR FRAMING IN AN APPROVED MANNER. WHERE OVERHEAD CONSTRUCTION DOES NOT PERMIT FASTENING OF SUPPORTS FOR EQUIPMENT, FURNISH ADDITIONAL FRAMING.
8. SEAL OPENINGS AROUND DUCTS AND PIPING THROUGH PARTITIONS, WALLS AND FLOORS WITH MINERAL WOOL OR OTHER NON-COMBUSTIBLE MATERIAL.
9. EXACT LOCATIONS AND COLOR OF ALL WALL MOUNTED THERMOSTATS, ALARM PANELS, ETC., SHALL BE SUBJECT TO THE CITY OF NEW YORK'S APPROVAL.
10. BORDER TYPES, COLOR, FINISHES, AND METHOD OF ATTACHMENT FOR ALL DIFFUSERS, GRILLES AND REGISTERS SHALL BE COORDINATED WITH THE ARCHITECTURAL CEILING DETAILS AND SPECIFICATIONS.

B. EQUIPMENT

1. INVESTIGATE PATH THROUGH WHICH EQUIPMENT WILL BE MOVED. EQUIPMENT SHALL BE BROKEN DOWN IN SECTIONS AS NEEDED FOR MOVING THROUGH BUILDING SPACES. ASCERTAIN FROM BUILDING MANAGEMENT WHAT TIMES OF DAY EQUIPMENT MAY BE MOVED.
2. ALL MECHANICAL EQUIPMENT SHALL BE INSTALLED IN FULL COMPLIANCE WITH THE MANUFACTURER'S INSTALLATION INSTRUCTIONS.
3. INSTALL EQUIPMENT AS TO BE READILY ACCESSIBLE FOR OPERATION, MAINTENANCE (INCLUDING FILTER CHANGES) AND REPAIR. MINOR DEVIATIONS FROM DRAWINGS MAY BE REQUIRED TO ACCOMPLISH THIS.
4. CHANGES IN ARCHITECTURAL, STRUCTURAL, ELECTRICAL, MECHANICAL AND PLUMBING REQUIREMENTS FOR SUBSTITUTED EQUIPMENT SHALL BE THE RESPONSIBILITY OF THE BIDDER WISHING TO MAKE THE SUBSTITUTION. THIS SHALL INCLUDE THE COST OF ANY REDESIGN BY THE AFFECTED DESIGNERS AND REFILING IF REQUIRED. ANY ADDITIONAL COST INCURRED BY THE AFFECTED SUBCONTRACTORS SHALL BE THE RESPONSIBILITY OF THIS CONTRACTOR AND NOT THE CITY OF NEW YORK.
5. REFER TO SCHEDULES FOR SELECTIONS OF AC UNITS, AIR OUTLETS, ETC..
6. PROVIDE AUXILIARY PAN WITH LEAK DETECTOR UNDER AC UNIT. DRIP PAN SHALL BE WATER TIGHT WITH 2-INCH LIP HEMMED FOR RIGIDITY AND SMOOTH EDGE. LEAK DETECTORS SHALL BE LIEBERT LT410 WITH 2 INDEPENDENT OUTPUTS. PROVIDE 120/24 VOLTS CONTROL TRANSFORMER FOR EACH LEAK DETECTOR.
7. CONDENSATE PUMP FOR CEILING MOUNTED AC SHALL BE LITTLE GIANT MODEL NO. VCL 24S. 175 GPH AT 15 FEET HEAD, 120 VOLTS/1 PHASE/ 60 HERTZ, WITH HIGH LEVEL ALARM SWITCH INSIDE RECEIVER. PLUG WITH TWISTLOCK BY ELECTRICAL.
8. PROVIDE LOCKING COVERS FOR ALL HIGH LIMIT AND LOW LIMIT THERMOSTATS..
9. ALL HVAC EQUIPMENT AND CONTROL DEVICES ABOVE INACCESSIBLE CEILING SHALL BE PROVIDED WITH ACCESS DOORS AT CEILING FOR SERVICE AND MAINTENANCE.
10. AC THERMOSTAT SHALL BE ELECTRONIC PROGRAMMABLE COOLING.
11. HANG AC UNIT WITH SPRING VIBRATION ISOLATORS TIGHT TO UNDERSIDE OF SLAB AND BETWEEN BEAMS. FIELD LOCATE UNITS SO THAT SUFFICIENT SERVICE CLEARANCES AROUND UNITS CAN BE PROVIDED AS PER UNIT MANUFACTURER'S RECOMMENDATIONS.
12. CHECK AND SET FIRE DAMPERS OPEN AND REPLACE ANY DEFECTIVE FUSIBLE LINKS IN NEW AND EXISTING FIRE DAMPERS.
13. MECHANICAL CONTRACTOR SHALL PROVIDE CONTROLS DESIGN AND CONTROL DEVICES AS REQUIRED PER SPECIFICATIONS. GENERAL CONTRACTOR SHALL COORDINATE BETWEEN SUBCONTRACTORS THE RESPONSIBILITY FOR LOW VOLTAGE WIRING.

C. DUCTWORK

1. HVAC CONTRACTOR SHALL INSPECT ALL EXISTING DUCTWORK FOR SIGNIFICANT AIR LEAKS. PATCH LEAKS WITH NON-HARDENING 3M DUCT SEALANT.
2. DIMENSIONS SHOWN FOR LINED DUCTWORK SHALL BE CLEAR INSIDE DIMENSIONS.
3. DUCTWORK LAYOUT SHOWN ON THIS PLAN IS SCHEMATIC ONLY. ACTUAL RUN SHALL BE FIELD DETERMINED, BASED ON EXISTING BEAM LAYOUT, DUCTWORK LAYOUT, LIGHTING LAYOUT AND SPRINKLER LAYOUT. FULL COORDINATION BETWEEN ALL TRADES (HVAC, ELEC., PLBG., SPKR. AND GENERAL CONTRACTORS) INCLUDING THE PREPARATION OF COORDINATION DRAWINGS IS REQUIRED TO AVOID CONFLICTS DURING CONSTRUCTION. OFFSET NEW DUCTWORK OR PIPING IF REQUIRED TO CLEAR OBSTRUCTIONS.
4. SEALANT SHALL BE APPLIED TO LONGITUDINAL SEAMS IN THE SHOP DURING FABRICATION. FIELD APPLY SEALANT TO TRAVERSE SEAMS AND CONNECTIONS TO BRANCH DUCTWORK AND AIR OUTLETS.
5. FOR EXACT LOCATIONS OF CEILING DIFFUSERS AND REGISTERS, COORDINATE WITH REFLECTED CEILING PLANS PREPARED BY ARCHITECT.
6. ALL DUCT SPLITS AND TAKE-OFFS SHALL BE PROVIDED WITH VOLUME DAMPERS. SPLITTER DAMPERS AND AIR EXTRACTORS ARE NOT ACCEPTABLE. PROVIDE CABLE-OPERATED VOLUME DAMPERS FOR ALL DAMPERS ABOVE INACCESSIBLE CEILING.
7. VOLUME DAMPERS IN BRANCH DUCTS SHALL BE LOCATED AS FAR AS POSSIBLE FROM AIR OUTLET OR INLET IN ORDER TO REDUCE NOISE AND TURBULENCE AT AIR OUTLETS. DAMPERS SHALL INCLUDE RAISED SADDLES FOR LOCKING QUADRANT HANDLE, 3/8 INCH ROD AND SEALED END BEARINGS.
8. ALL DUCT OPENINGS IN EXISTING DUCTWORK NOT IN USE SHALL BE BLANKED OFF AIR TIGHT WITH SHEET METAL PATCH SECURED WITH SHEET METAL SCREWS AND 3M SEALER.
9. RADIUS ELBOWS SHALL BE USED IN ALL DUCT OFFSETS (HORIZONTAL OR VERTICAL). MITERED ELBOWS WITHOUT TURNING VANES ARE NOT ACCEPTABLE.
10. SEE SPECIFICATIONS FOR DUCT CONSTRUCTION STANDARDS.

D. PIPING

1. ALL TRANSITIONS FROM STEEL TO COPPER SHALL BE MADE THROUGH DI-ELECTRIC FITTINGS.
2. PIPING SYSTEMS SHALL BE CLEANED, TESTED AND A CERTIFICATE OF CLEAN WATER SHALL BE SUBMITTED TO THE BUILDING MANAGEMENT PRIOR TO FINAL CONNECTION TO BUILDING SYSTEM. CONTRACTOR SHALL ENGAGE THE SERVICES OF THE BUILDING'S WATER TREATMENT COMPANY.
3. GRAVITY DRAIN PIPING SHALL BE PITCHED DOWN 1/8 INCH PER 20 FEET IN THE DIRECTION OF FLOW.

E. SHEET METAL SKETCHING

1. MECHANICAL CONTRACTOR TO INCLUDE IN THEIR BID PRICE FOR THE SKETCHER TO VISIT THE SITE AND SKETCH WORK AS FOLLOWS UNTIL FINAL DRAWING APPROVAL:
   - I) ONE FIRST VISIT TO SKETCH 100% OF THE WORK;
   - II) ONE SECOND VISIT TO SKETCH 40% OF THE WORK;
   - III) ONE THIRD VISIT TO SKETCH 10% OF THE WORK.

E. AFTER OCCUPANCY OF THE SPACE, AND APPROVAL OF THE BALANCE REPORTS, THE AIR BALANCE COMPANY SHALL RETURN TO PROVIDE COMFORT BALANCE SERVICES. THE AIR BALANCE COMPANY SHALL ADJUST VOLUME DAMPERS AND VAV TERMINAL UNITS MAXIMUM AND MINIMUM SETTINGS IN RESPONSE TO THE OCCUPANTS REQUIREMENTS. CONTRACTOR SHALL INCLUDE IN THEIR PRICE ONE DAY PER FLOOR FOR COMFORT BALANCE SERVICES.

RESPONSIBILITY MATRIX

THIS SCHEDULE IS PROVIDED FOR QUICK REFERENCE ONLY.
THE GENERAL CONTRACTOR IS RESPONSIBLE FOR ALL WORK DESCRIBED IN THE CONSTRUCTION DOCUMENTS.
CONFLICTS BETWEEN THIS SCHEDULE AND THE REST OF THE CONTRACT DOCUMENTS SHALL BE BROUGHT TO THE ARCHITECT'S ATTENTION PRIOR TO BEGINNING WORK.

DESCRIPTION	FURNISHED			INSTALLED			REMARKS
	GENERAL CONTRACTOR	OWNER	LANDLORD	GENERAL CONTRACTOR	OWNER	LANDLORD	
DIVISION 23: HEATING, VENTILATING, AND AIR CONDITIONING							
23.1 HVAC DUCTWORK AND PIPING IDENTIFICATION							
23.1.1 HVAC DUCTWORK SYSTEM IDENTIFICATION	●			●			
23.1.2 PIPING SYSTEM IDENTIFICATION	●			●			
23.1.3 UTILITY SHUT OFF IDENTIFICATION IN KITCHEN	●			●			
23.1.4 VALVE TAGS AND CHART	●			●			
23.1.5 HVAC DAMPER IDENTIFICATION	●			●			
23.2 ROOF CURBS							
23.2.1 EXHAUST FAN CURBS	●			●			GENERAL CONTRACTOR SCOPE OF WORK TO INCLUDE RIGGING, CURBS, AND ACCESSORIES
23.2.2 ROOFTOP UNIT CURBS	●			●			GENERAL CONTRACTOR SCOPE OF WORK TO INCLUDE RIGGING, CURBS, AND ACCESSORIES
23.2.3 CONDENSING UNIT CURBS	●			●			GENERAL CONTRACTOR SCOPE OF WORK TO INCLUDE RIGGING, CURBS, AND ACCESSORIES
23.2.4 MAKE UP AIR AND DOAS UNIT CURBS		●		●			GENERAL CONTRACTOR SCOPE OF WORK TO INCLUDE RIGGING, CURBS, AND ACCESSORIES
23.2.5 KITCHEN EXHAUST FAN CURBS		●		●			GENERAL CONTRACTOR SCOPE OF WORK TO INCLUDE RIGGING, CURBS, AND ACCESSORIES
23.3 HVAC DUCTWORK SYSTEM COMPONENTS							
23.3.1 HVAC DUCTWORK	●			●			
23.3.2 INSULATION AND FIRE WRAP	●			●			GENERAL CONTACTOR SCOPE OF WORK TO INCLUDE TENANT FIT OUT FROM LANDLORD POINT OF CONNECTION
23.3.3 DAMPERS	●			●			
23.3.4 SMOKE DETECTORS	●			●			
23.3.5 SUPPLY, RETURN, AND EXHAUST GRILLS AND REGISTERS	●			●			
23.4 MECHANICAL PIPING SYSTEM COMPONENTS							
23.4.1 WALK-IN COOLER AND FREEZER REFRIGERATION		●			●		WALK-IN COOLER AND FREEZER SUPPLIED BY VENDOR NO. 103 GENERAL CONTRACTOR SCOPE OF WORK TO INCLUDE PIPING INSTALLATION AND FINAL CONNECTION
23.4.2 REFRIGERATION FOR OTHER HVAC EQUIPMENT	●			●			
23.4.3 CHILLED WATER	●			●			
23.4.4 CONDENSER WATER	●			●			
23.4.5 HEATING HOT WATER	●			●			
23.4.6 VALVES AND ACCESSORIES (E.G. AIR VENTS)	●			●			
23.5 HVAC EQUIPMENT							GENERAL CONTRACTOR SCOPE OF WORK TO INCLUDE RIGGING FOR ALL ROOFTOP EQUIPMENT
23.5.1 SUPPLY FAN	●			●			
23.5.2 TOILET EXHAUST FAN	●			●			
23.5.3 KITCHEN EXHAUST FAN		●		●			SUPPLIED BY VENDOR NO. 102
23.5.4 DUCTED AND NON-DUCTED HEATING AND COOLING UNITS	●			●			
23.5.5 MAKE UP AIR AND DOAS UNITS		●		●			SUPPLIED BY VENDOR NO. 102
23.5.6 ELECTRIC PATIO HEATERS	●			●			
23.5.7 HVAC CONDENSING UNITS	●			●			
23.5.8 REFRIGERATION CONDENSING UNITS		●		●			
23.5.9 RGF PHI SYSTEM	●			●			GENERAL CONTRACTOR TO PURCHASE FROM VENDOR NO. 7 VENDOR SUBSTITUTION IS NOT PERMITTED
23.6 KITCHEN EXHAUST WITH FIRE SUPPRESSION SYSTEM							
23.6.1 HOOD CONTROL PANEL		●		●			SUPPLIED BY VENDOR NO. 102
23.6.2 KITCHEN EXHAUST HOOD		●		●			SUPPLIED BY VENDOR NO. 102
23.6.3 STRUCTURAL SUPPORT	●			●			
23.6.4 ELECTRICAL AND CONTROL WIRING	●			●			
23.6.5 ANSUL SYSTEM		●		●			SUPPLIED BY VENDOR NO. 102 GENERAL CONTRACTOR TO COORDINATE AND FACILITATE SYSTEM SIGN-OFF
23.6.6 ANSUAL WIRING AND UTILITIES CONNECTION	●			●			
23.6.7 ANSUAL GAS VALVE		●		●			SUPPLIED BY VENDOR NO. 102
23.7 COMMISSIONING ACTIVITIES							
23.7.1 GREASE EXHAUST WATER LEAKAGE TEST	●			●			GENERAL CONTRACTOR TO PURCHASE FROM VENDOR NO. 6 VENDOR SUBSTITUTION IS NOT PERMITTED
23.7.2 TESTING AIR BALANCE (TAB) REPORT	●			●			GENERAL CONTRACTOR TO PURCHASE FROM VENDOR NO. 7 VENDOR SUBSTITUTION IS NOT PERMITTED

SUBMITTAL MATRIX

GENERAL CONTRACTORS TO ALSO REVIEW ARCHITECTURAL SPECIFICATIONS AS NOTED IN PLANS IN PLAN SECTION 700 OF THE ARCHITECTURAL PACKAGE FOR REQUIRED SUBMITTALS THAT MIGHT NOT BE LISTED BELOW.

SUBMITTAL DESCRIPTION	REQUIRED REVIEW TIME (BUSINESS DAYS)	ARCHITECT OF RECORD	SHAKE SHACK	PHYSICAL SAMPLE REQUIRED	SUBMITTAL FOR RECORD	SUBMITTAL FOR RECORD ONLY
DIFFUSERS, GRILLES AND REGISTERS	5	X				X
DUCTWORK LAYOUT (IF THERE ARE SIGNIFICANT CHANGES IN FIELD)	5	X				X
HVAC EQUIPMENT	5	X				X
MEP TEST, START-UP AND PROGRAMMING REPORTS	5	X				X

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△	Date	Description
	10/14/2022	ISSUED FOR BID AND PERMIT
1	11/18/2022	ADDENDUM 1
3	02/03/2023	ADDENDUM 3
4	03/10/2023	ADDENDUM 4
5	03/31/2023	ADDENDUM 5

NORTH CAROLINA PROFESSIONAL SEAL 053111 ENGINEER YVETTE RICHARDSON

Seal / Signature

Project Name
VILLAGE DISTRICT

Project Number
69.6575.000

Description
MECHANICAL NOTES, SYMBOLS & ABBREVIATIONS

Scale
NONE

M-001

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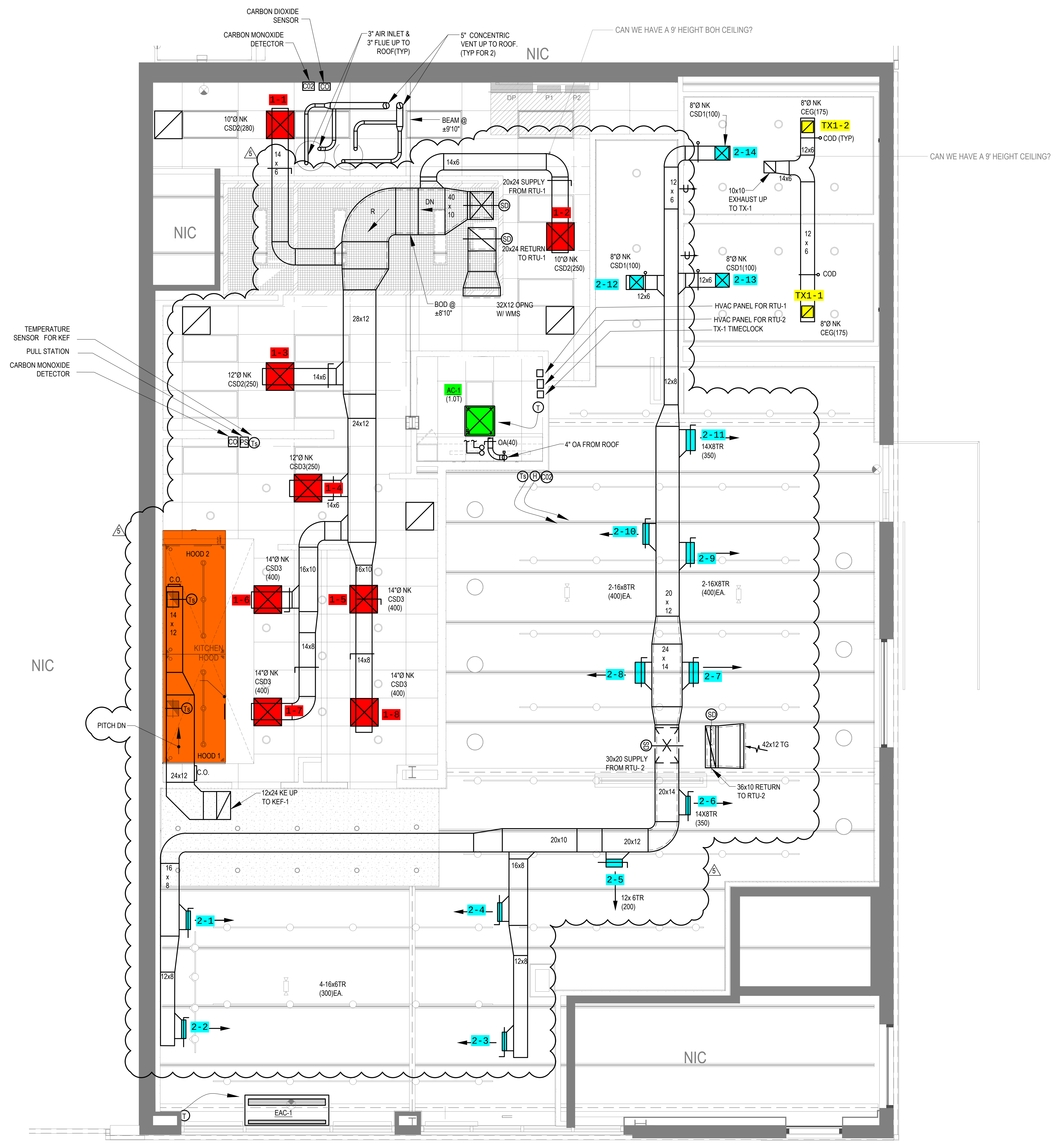

1ST FLOOR HVAC PLAN

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

DRAWING NOTES:

1. PROVIDE ACCESS DOORS FOR MECHANICAL EQUIPMENT, DAMPERS, SMOKE DETECTORS, VALVES, ETC AND SHALL BE COORDINATED WITH ARCHITECT FOR CEILING ACCESS.
2. PROVIDE 1" ACOUSTICAL LINING A MINIMUM 20 FT DOWNSTREAM OF AC UNITS.
3. CONTRACTOR SHALL SUBMIT BALANCING REPORT TO ENGINEER OF ENTIRE FLOOR AT THE END OF CONSTRUCTION.
4. PROVIDE (1) ADDITIONAL DAY OF COMFORT BALANCING AFTER THE BALANCING REPORT HAS BEEN APPROVED.
5. TRANSFER AIR DUCTS TO BE INTERNALLY LINED.
6. ALL EXPOSED DUCT TO BE INTERNALLY LINED.
7. ALL DUCTWORK MUST BE RIGID. FLEX DUCT IS NOT PERMITTED.
8. ALL NEW DUCTWORK UPSTREAM & DOWNSTREAM OF AC UNITS AND EXHAUST FANS SHALL BE CONSTRUCTED AND INSTALLED IN ACCORDANCE WITH THE FUNCTIONAL CRITERIA OF SMACNA STANDARDS FOR LOW PRESSURE DUCTWORK. DIMENSIONS SHOWN FOR LINED DUCTWORK SHALL BE CLEAR INSIDE DIMENSIONS.
9. ALL DUCT SPLITS AND TAKE-OFFS SHALL BE PROVIDED WITH VOLUME DAMPERS. SPLITTER DAMPERS AND AIR EXTRACTORS ARE NOT ACCEPTABLE. PROVIDE CORD-OPERATED VOLUME DAMPERS FOR ALL DAMPERS ABOVE INACCESSIBLE CEILING.
10. VOLUME DAMPERS IN BRANCH DUCTS SHALL BE LOCATED AS FAR AS POSSIBLE FROM AIR OUTLET OR INLET IN ORDER TO REDUCE NOISE AND TURBULENCE. DAMPERS SHALL INCLUDE RAISED SADDLES FOR LOCKING QUADRANT HANDLE, 3/8 INCH ROD AND SEALED END BEARINGS.
11. ALL HVAC EQUIPMENT AND CONTROL DEVICES ABOVE INACCESSIBLE CEILING MUST BE PROVIDED WITH ACCESS DOORS AT CEILING FOR SERVICE AND MAINTENANCE.
13. ALL OUTSIDE AIR DUCT SHALL BE ALUMINUM CONSTRUCTION WITH EXTERNAL RIGID INSULATION.
14. FOR KITCHEN HOOD, MAKE UP AIR AC UNIT, FIRE SUPPRESSION SYSTEM REFER TO CAPTIVE AIRE SHEETS .
15. FOR KITCHEN EXHAUST SYSTEM REFER TO CAPTIVE AIRE SHEET DRAWING.
16. INSTALL THERMOSTAT , TEMPERATURE SENSOR, CARBON MONOXIDE DETECTOR ±48" AFF. PROVIDE LABEL TO MATCH THE UNIT TAG AND CORRESPOND TO THE ELECTRICAL LEGEND IN THE ELECTRICAL PANEL. COORDINATE FINAL LOCATION WITH OWNER REPRESENTATIVE.
17. PROVIDE ANALOX AX60 OR APPROVED EQUAL CARBON DIOXIDE SENSOR WITH REMOTE ALARM REPEATER TO BE MTD 18" AFF. PROVIDE CARBON DIOXIDE SENSOR W/ RELAY . RELAY SHALL BE INTERLOCKED WITH THE BLDG FIRE ALARM SYSTEM. THE SENSOR SHALL BE EQUIPPED WITH A LOCAL AUDIBLE & VISUAL ALARM. THE LOW LEVEL ALARM SHALL ACTIVATE THE LOCAL AUDIBLE AND VISUAL ALARM. THE HIGH LEVEL ALARM SHALL ACTIVATE RELAY. INSTALL SENSOR PER MANUFACTURER'S INSTALLATION INSTRUCTIONS.
   ALARM SET POINTS:
   LOW LEVEL ALARM - 05% = 5,000 PPM
   HIGH LEVEL ALARM - 3.0% = 30,000 PPM
18. INSTALL KITCHEN HOOD FIRE SUPPRESSION MANUAL PULL STATION. COORDINATE EXACT LOCATION WITH THE AUTHORITY HAVING JURISDICTION.
19. ALL DUCTWORK SHALL BE INSTALLED AS HIGH AS POSSIBLE TO THE UNDERSIDE OF STRUCTURE(S). COORDINATE THIS WITH ALL OTHER TRADES INSTALLED ABOVE CEILING. SUBMIT FULLY COORDINATED SHOP DRAWINGS FOR REVIEW AND APPROVAL.

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FAX 919-839-8164

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1	11/18/2022	ADDENDUM 1
3	02/03/2023	ADDENDUM 3
4	03/10/2023	ADDENDUM 4
5	03/31/2023	ADDENDUM 5

SEAL 053111
YVETTE RICHARDSON

Seal / Signature

Project Name
VILLAGE DISTRICT

Project Number
69.6575.000

Description
1ST FLOOR MECHANICAL PLAN

Scale
AS INDICATED

M-101

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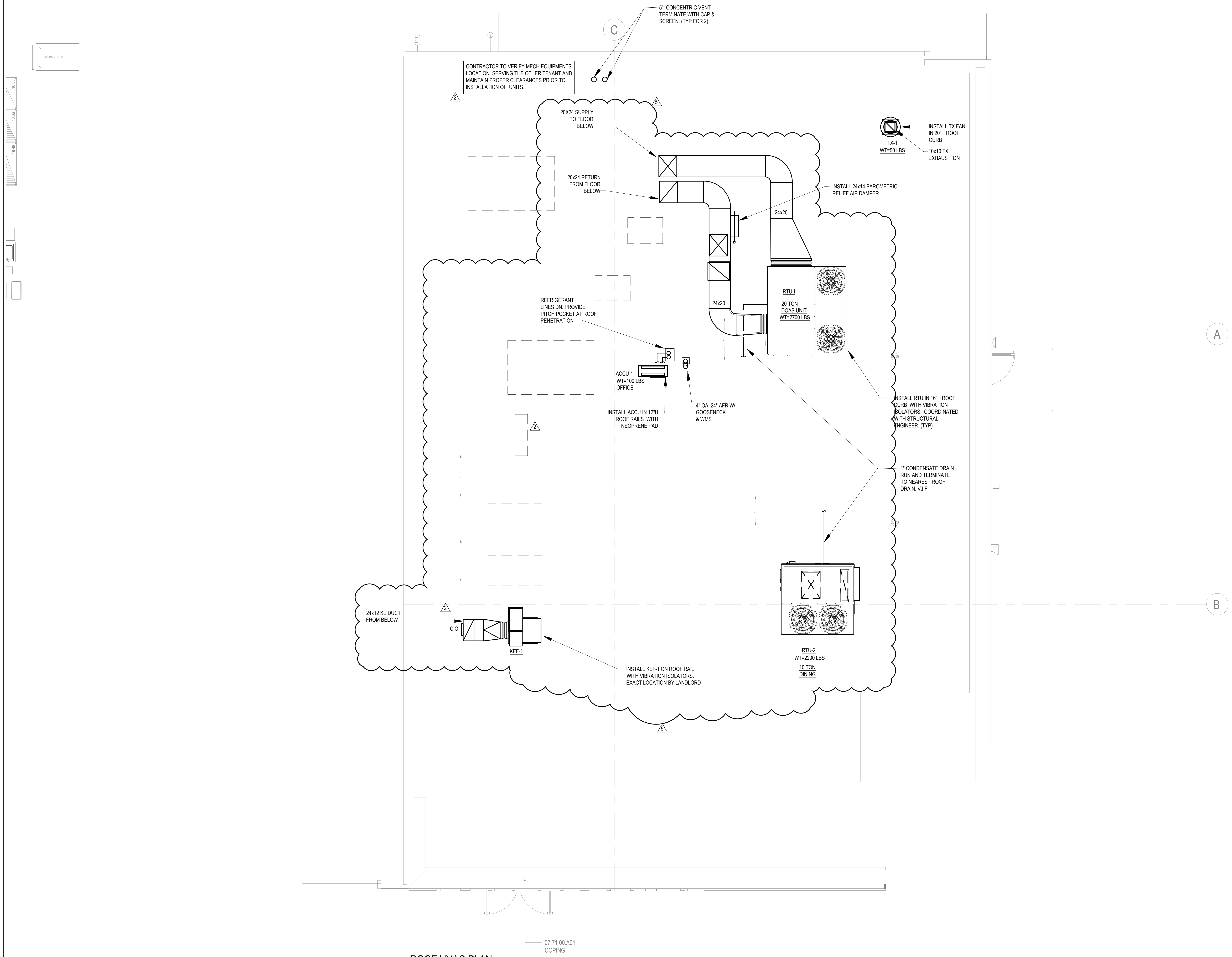
11/9/2023 3:54:49 PM BIM 360://069.6575.000 - Shake Shack_NC 1416_Village District/069.6575.000 - SS NC 1416 - Village District.rvt



ROOF HVAC PLAN

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

1/19/2023 3:54:49 PM

BIM 360://069.6575.000 - Shake Shack_NC 1416_Village District/069.6575.000 - SS NC 1416 - Village District.rvt

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NORTH CAROLINA PROFESSIONAL ENGINEER
SEAL 053111
YVETTE RICHARDSON

Seal / Signature

Project Name
VILLAGE DISTRICT

Project Number
69.6575.000

Description
ROOF
MECHANICAL
PLAN

Scale
AS INDICATED

M-150

3 OF 21

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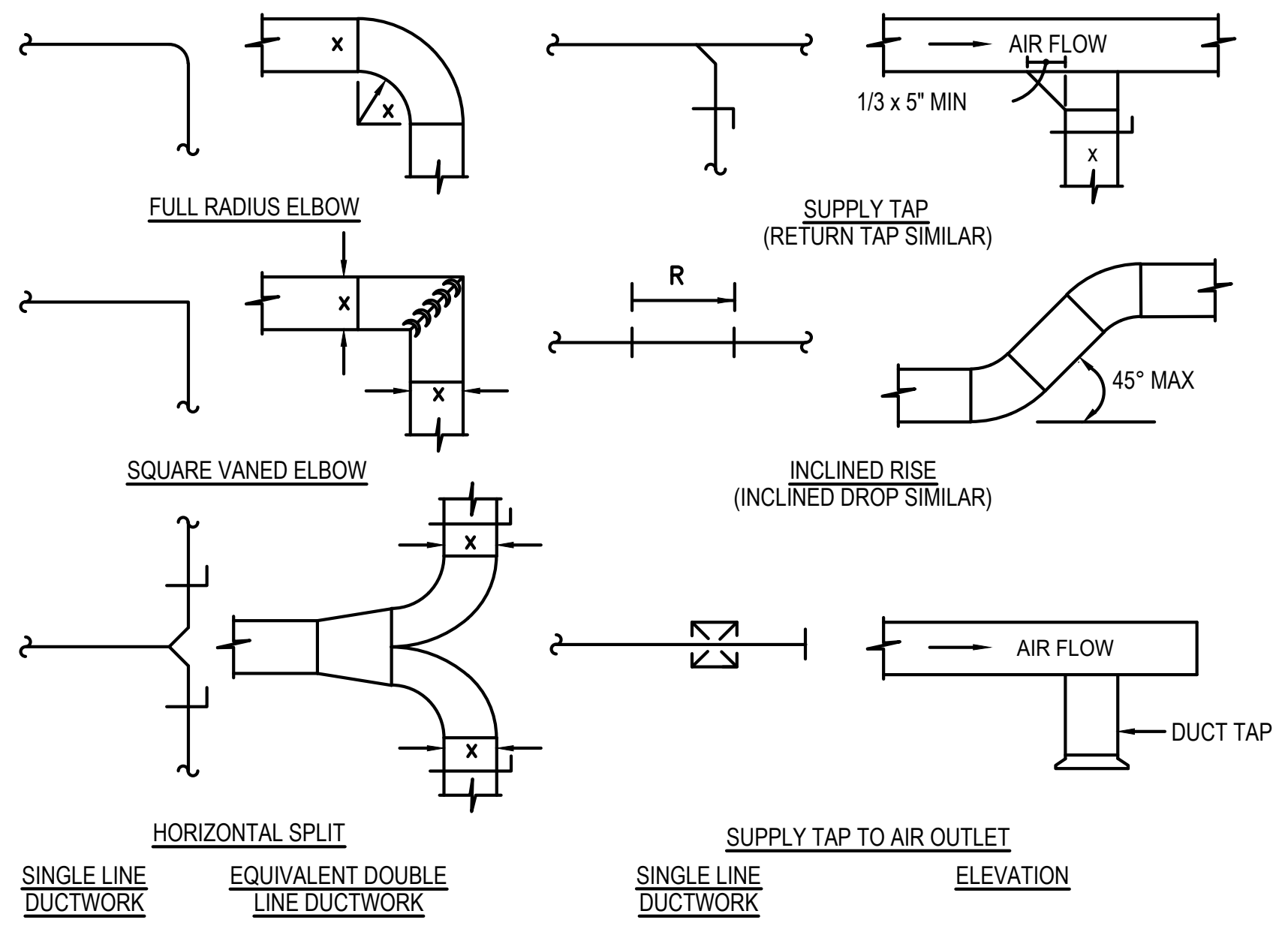
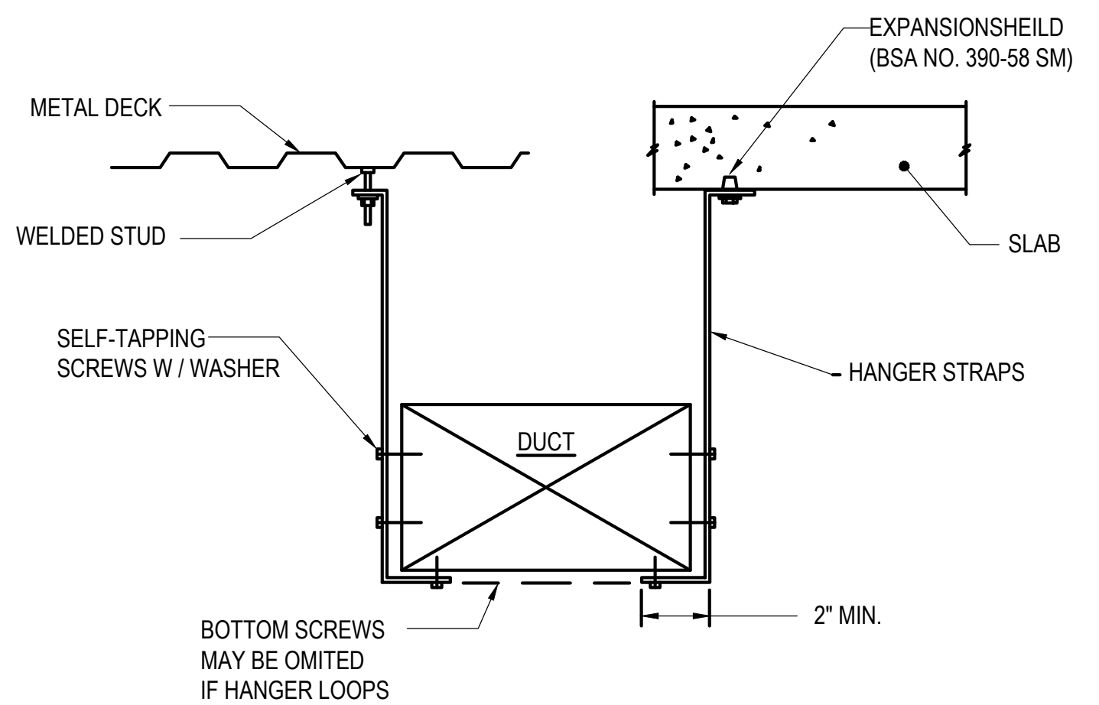


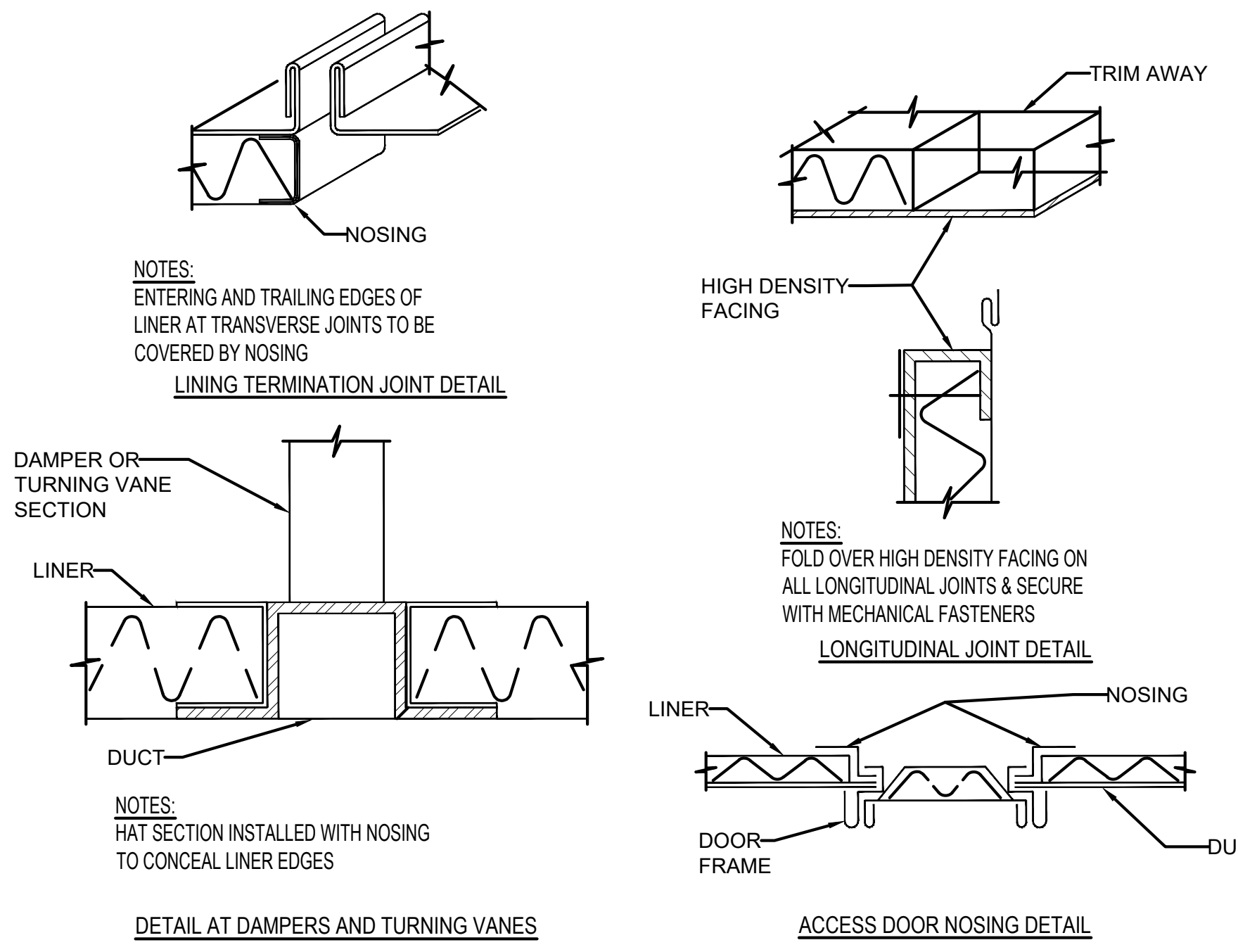
TYPICAL SUPPLY OR EXHAUST DUCT CONNECTION



HANGER STRAP SCHEDULE		
DUCT SIZE	HANGER SIZE	MAXIMUM SPACING
UNDER 2 S.F.	1" x 1/16"	8'-0"
2 S.F. TO 4 S.F.	1" x 1/8"	8'-0"
4 S.F. TO 10 S.F.	1" x 1/8"	6'-0"
OVER 10 S.F.	1" x 1/8"	4'-0"

NOTE: ALL ANCHORS AND INSERTS SHALL HAVE N.Y.C. BOARD OF STANDARDS AND APPEALS APPROVAL.

DUCT HANGING DETAIL



NOTES:
ENTERING AND TRAILING EDGES OF LINER AT TRANSVERSE JOINTS TO BE COVERED BY NOSING

LINING TERMINATION JOINT DETAIL

NOTES:
FOLD OVER HIGH DENSITY FACING ON ALL LONGITUDINAL JOINTS & SECURE WITH MECHANICAL FASTENERS

LONGITUDINAL JOINT DETAIL

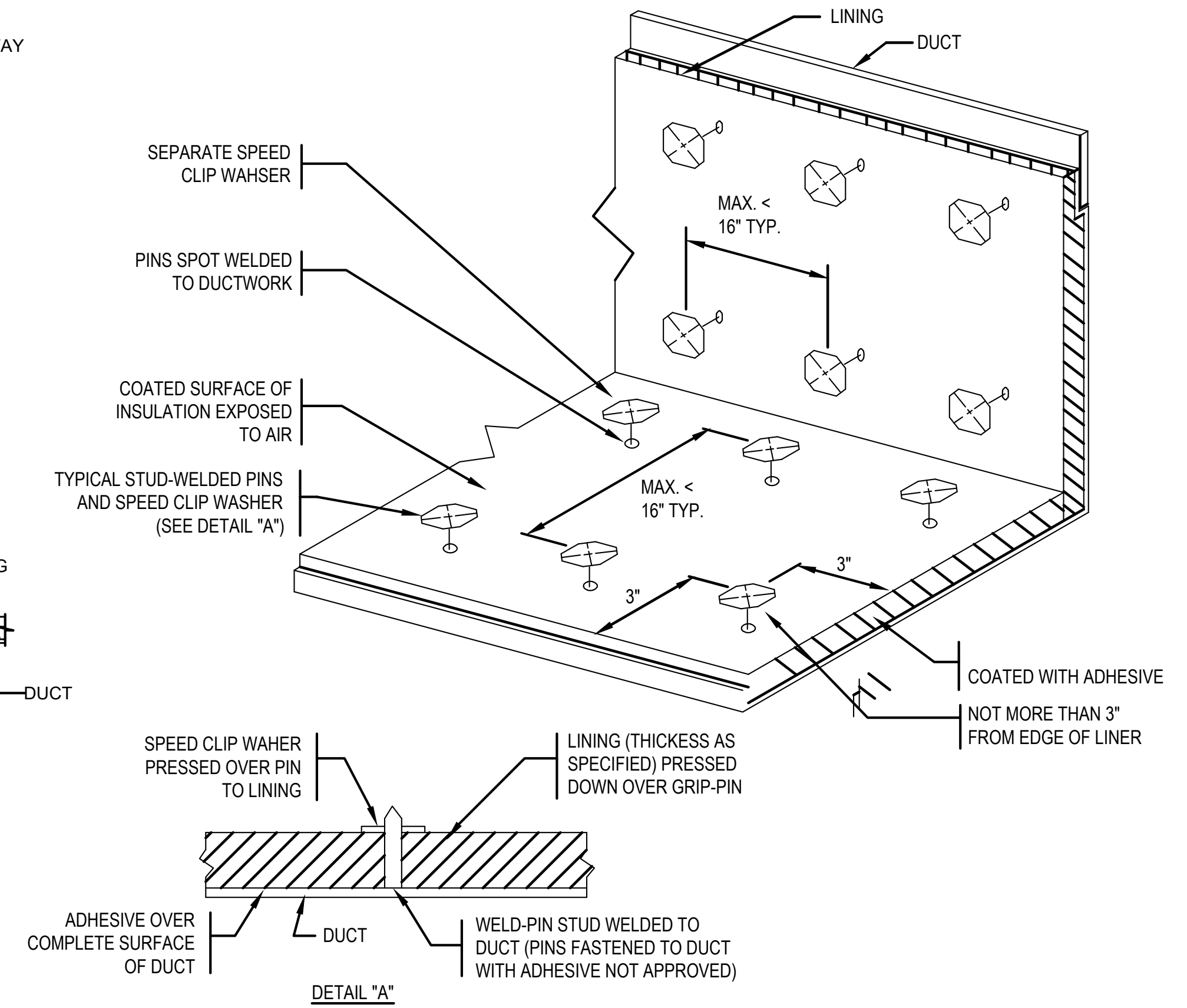
NOTES:
HAT SECTION INSTALLED WITH NOSING TO CONCEAL LINER EDGES

DETAIL AT DAMPERS AND TURNING VANES

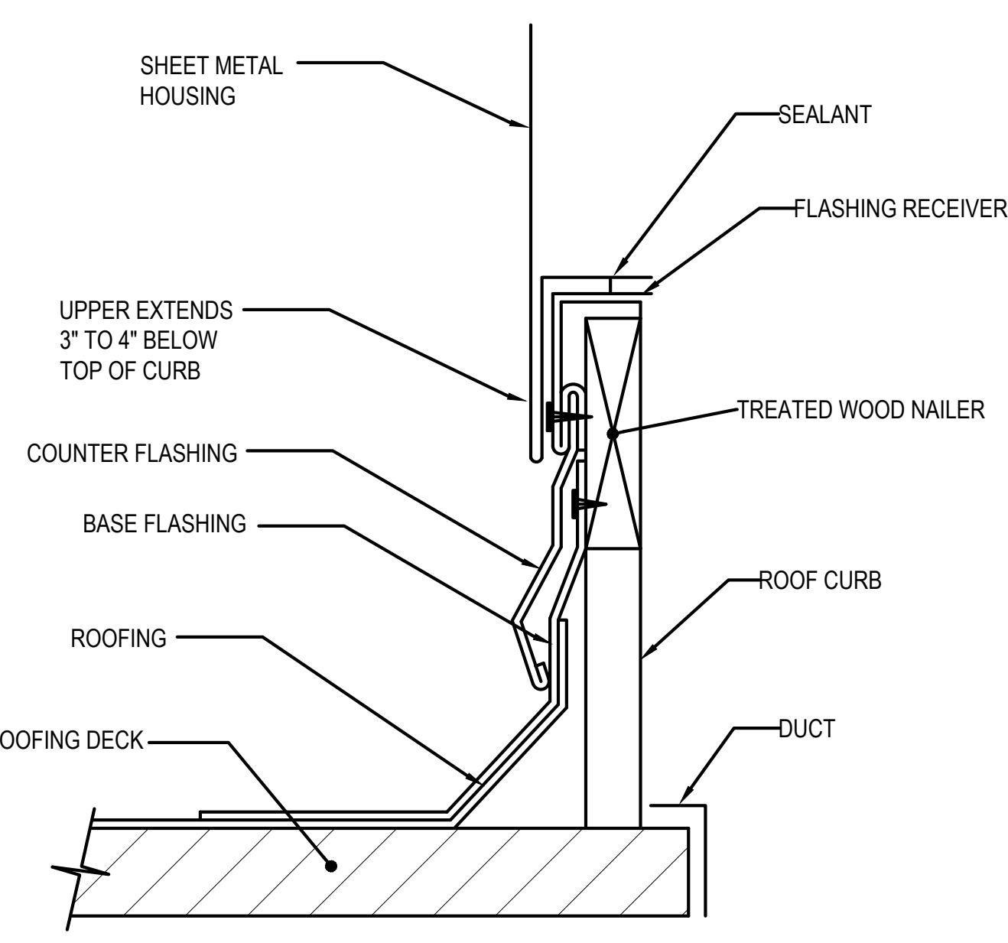
ACCESS DOOR NOSING DETAIL

NOTES:
1. NOSING ATTACHED TO DUCT BY RIVETS SCREW OR WELDS
2. NOSING: 24 GA. UP TO 48"; OVER 48", SAME GA. AS DUCT

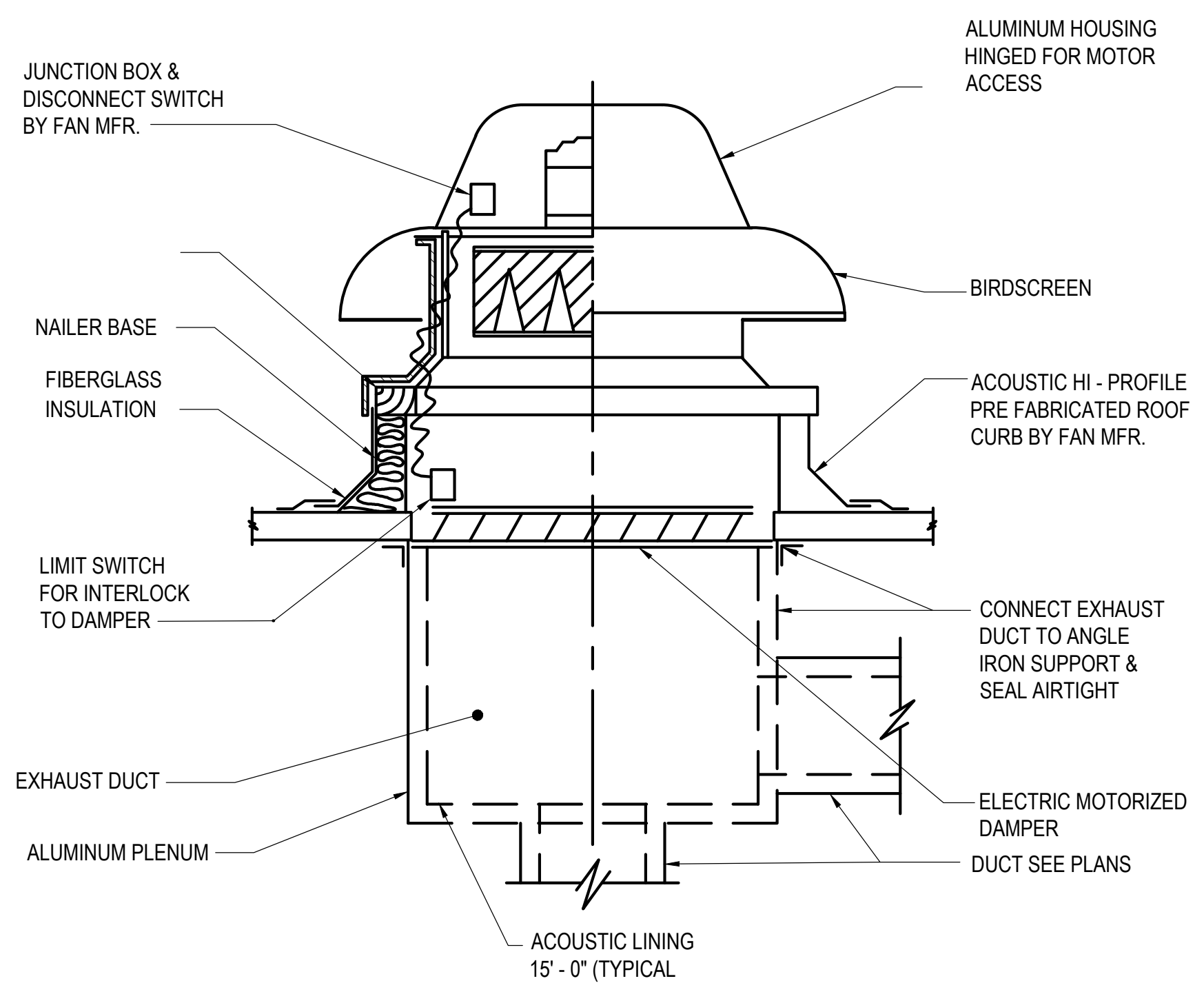
SOUND LINING NOSING DETAIL



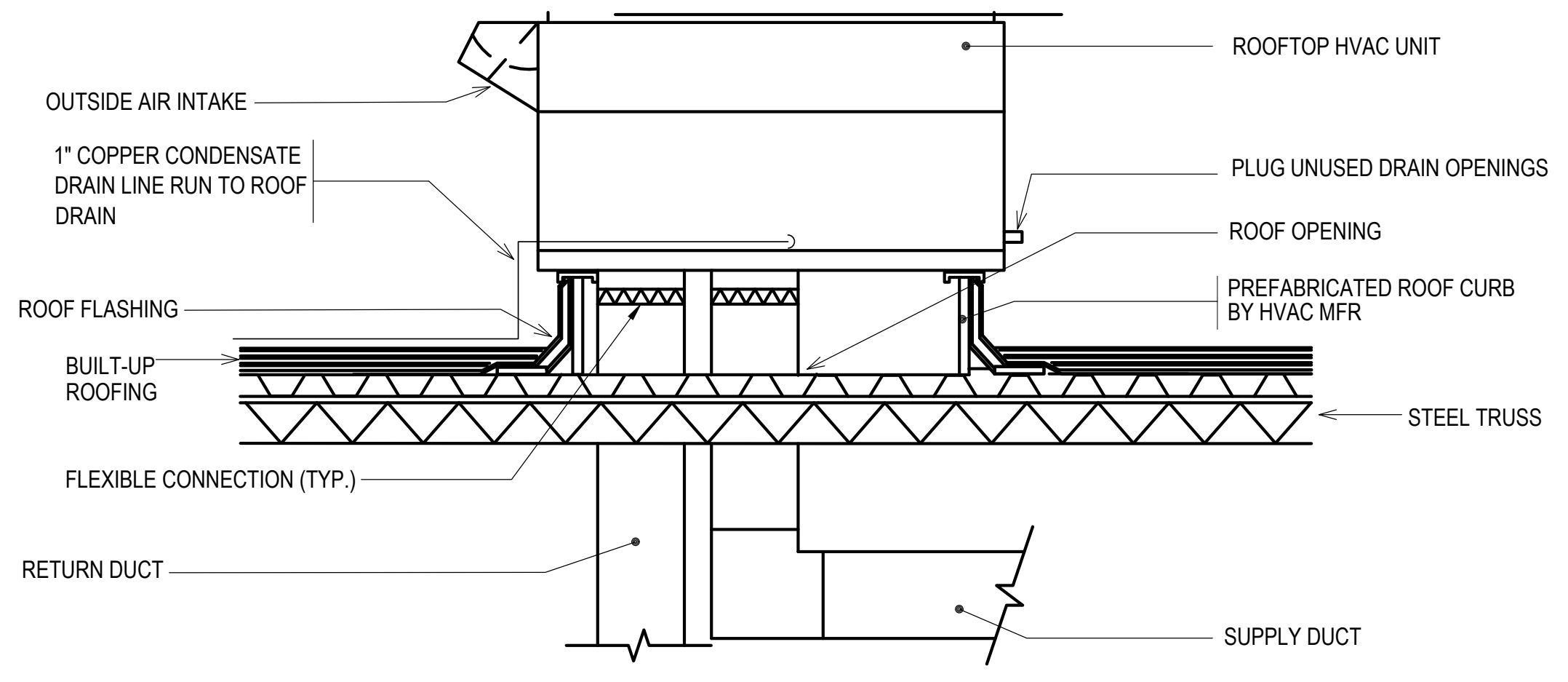
SOUND LINING INSTALLATION DETAIL



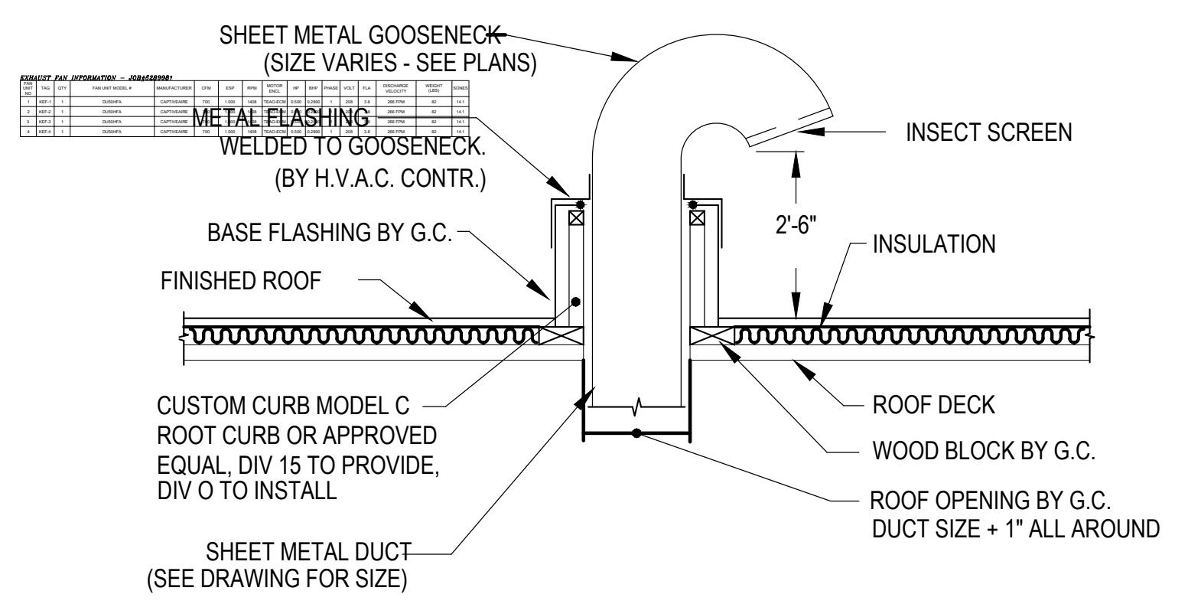
ROOF CURB DETAIL



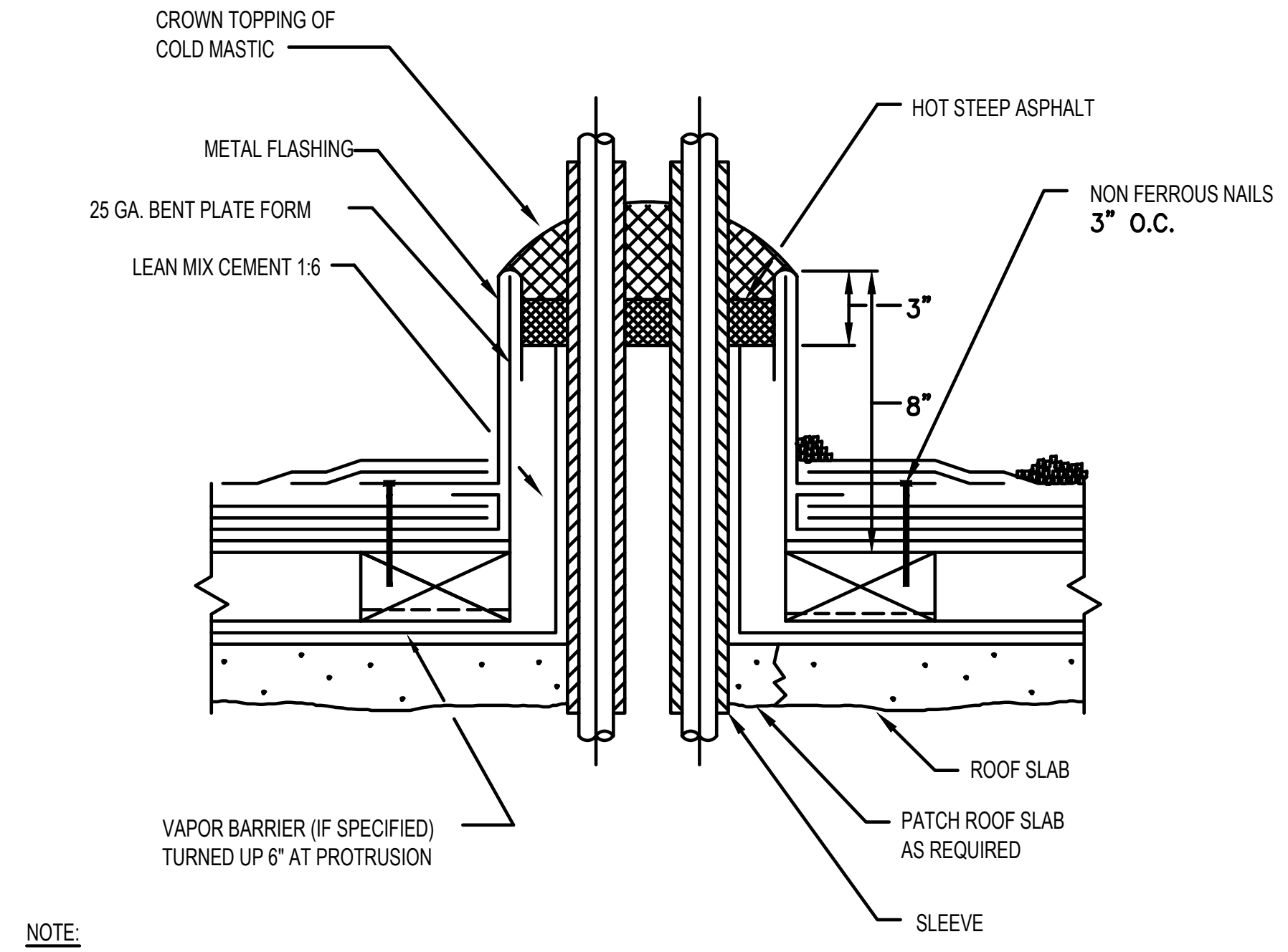
ROOF EXHAUST FAN INSTALLATION



ROOFTOP A.C. UNIT INSTALLATION

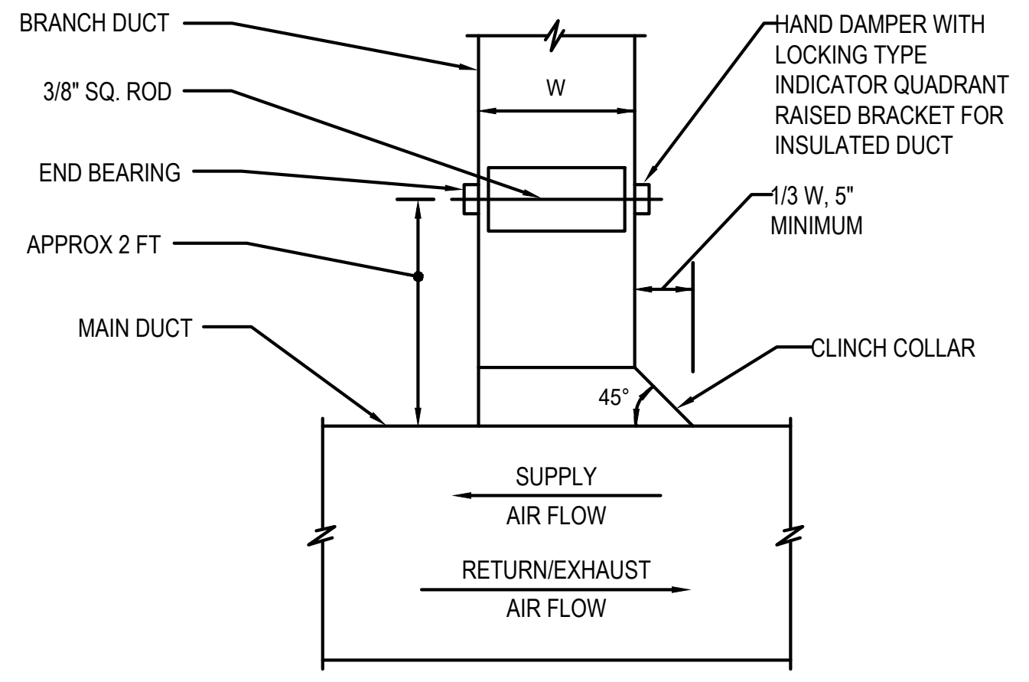


TYPICAL GOOSENECK DETAIL



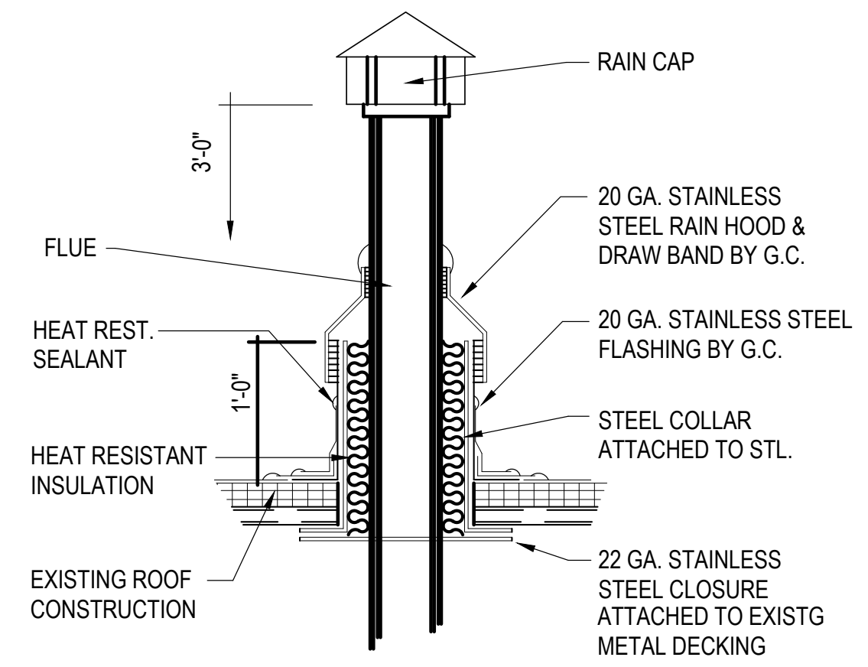
NOTE:
SEE ARCHITECTURAL DRAWINGS AND SPECIFICATIONS FOR THE ROOF CONSTRUCTION.

PIPING THROUGH ROOF



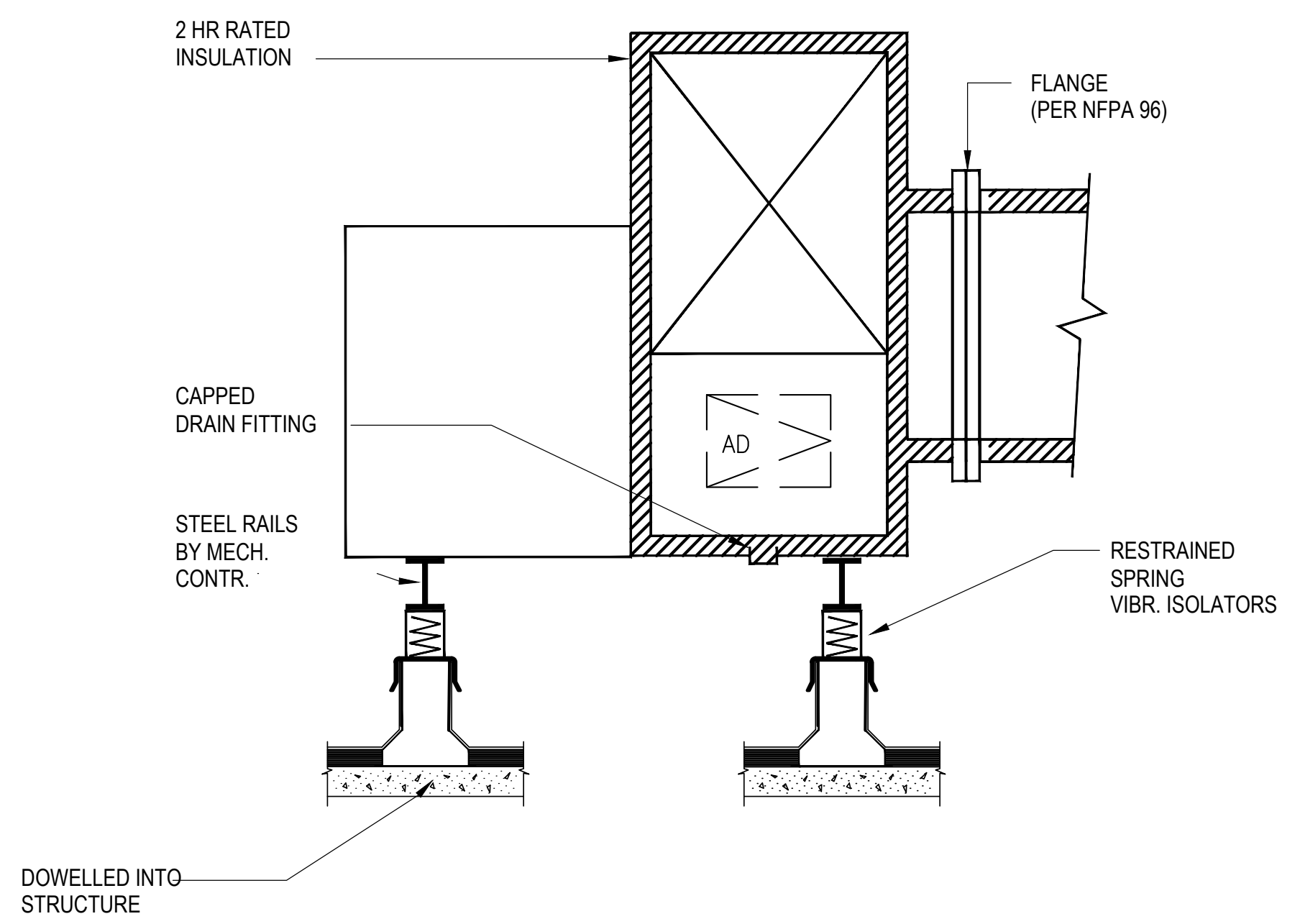
NOTES:
FURNISH THIS TYPE CONNECTION WHEN SINGLE LINE DUCTWORK IS INDICATED AS THIS FOR BRANCHES WITH LESS THAN 25% OF THE TOTAL AIR FLOW

RECTANGULAR DUCT WITH VOLUME DAMPER

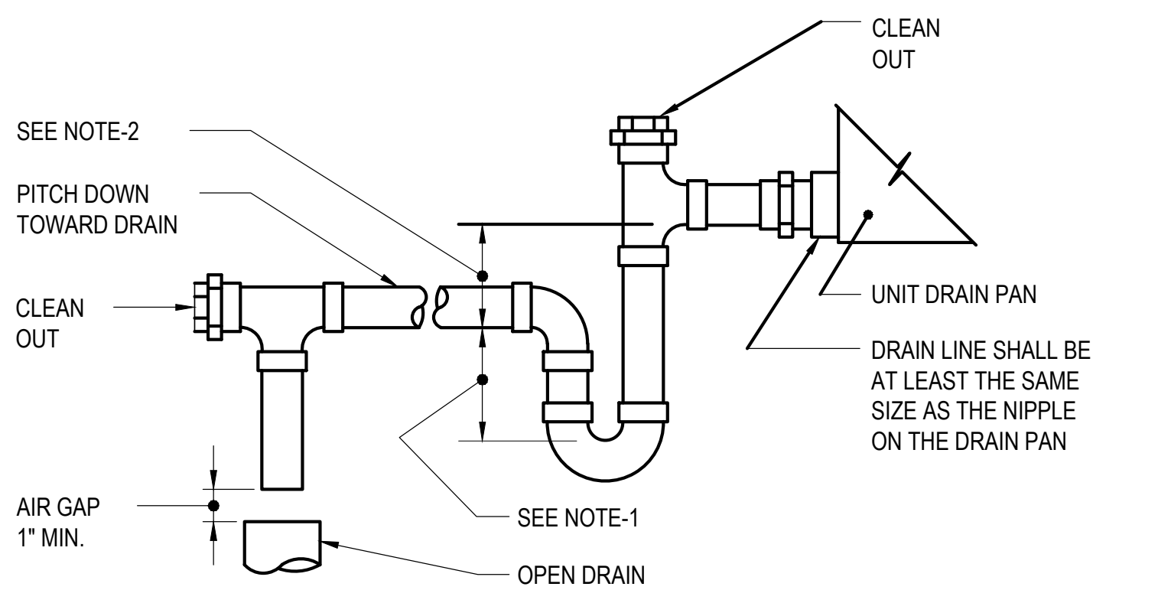


NOTE:
PROVIDE NECESSARY GUYING AND SUPPORT AS REQUIRED BY FLUE HEIGHT.

FLUE THRU ROOF DETAIL

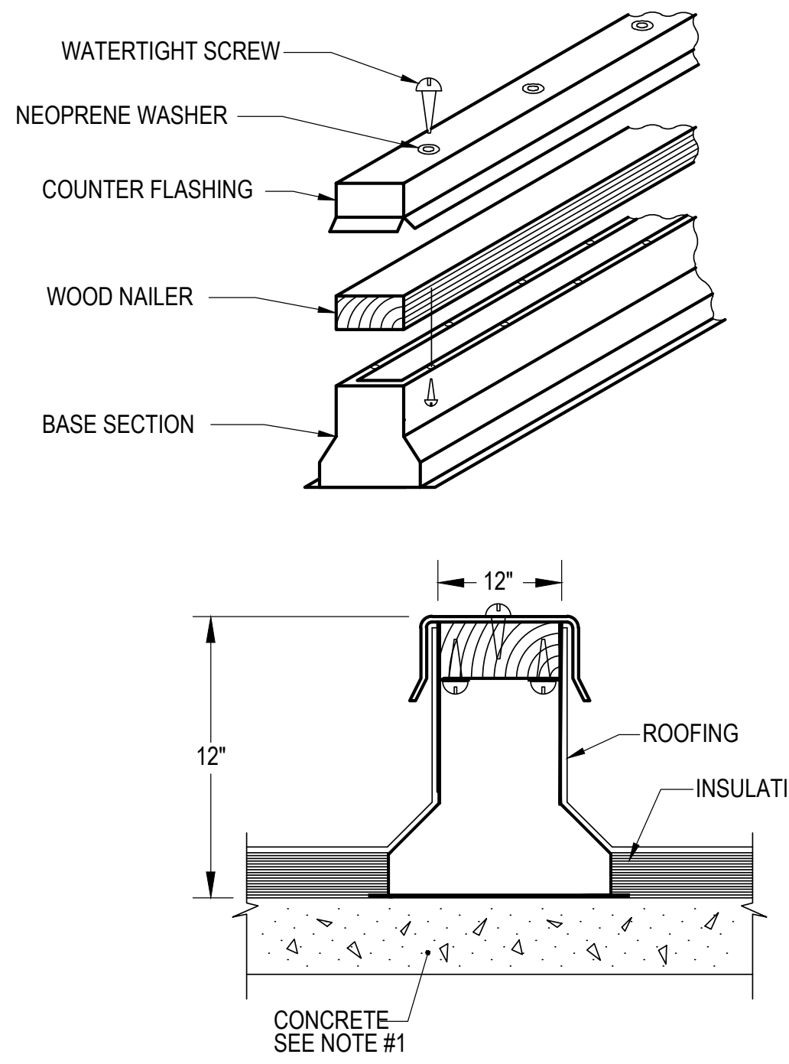


KITCHEN EXHAUST FAN DETAIL



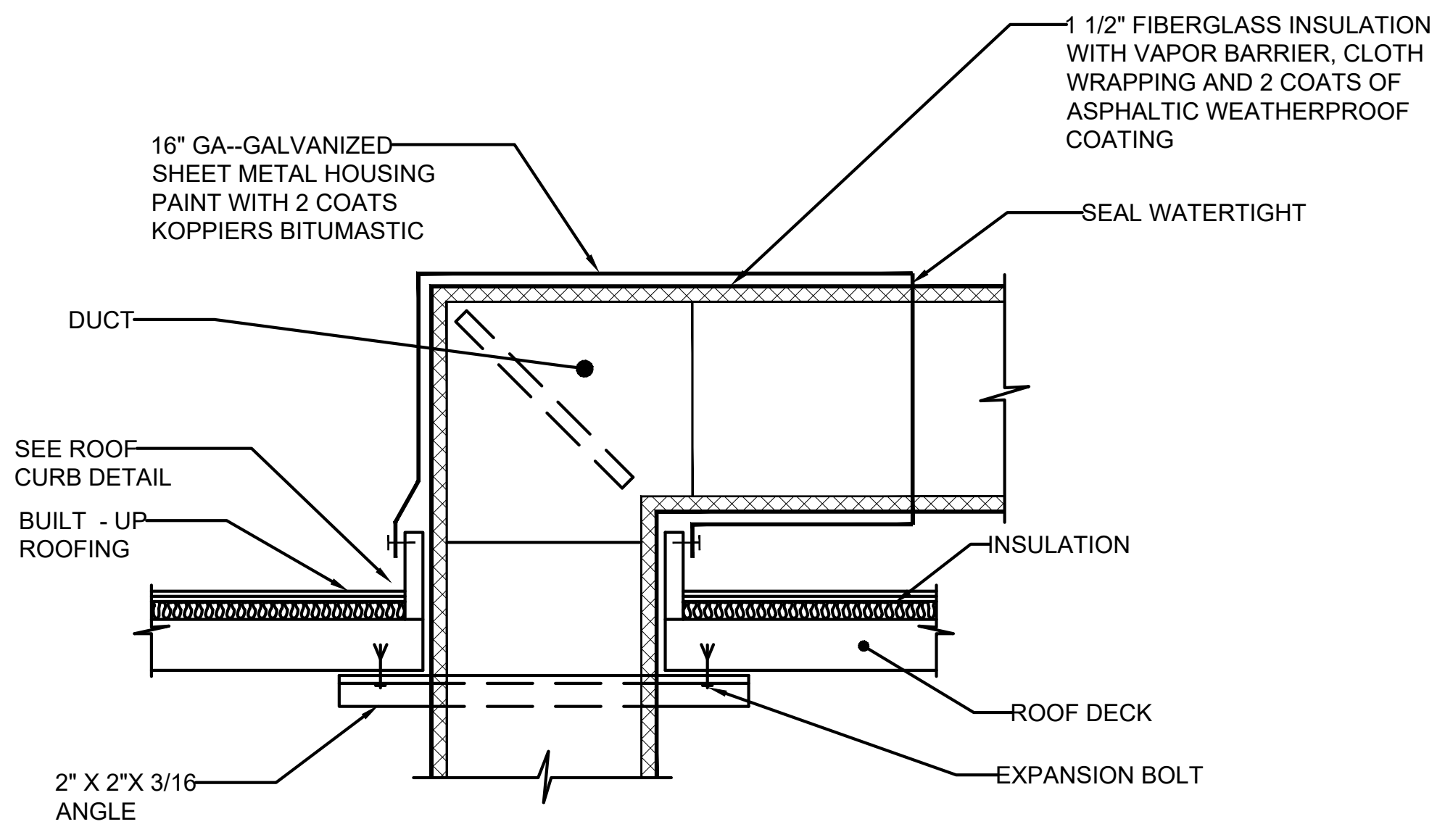
NOTES:
1. ON POSITIVE PRESSURE SYSTEM(E.G. DUCT COILS, BLOW-THRU UNITS, ETC.) DEPTH OF SEAL SHALL BE A MINIMUM OF 1.5 TIMES SYSTEM PRESSURE IN THE DRAIN PAN.
2. ON NEGATIVE PRESSURE SYSTEMS (E.G. DRW-THRU UNITS) DEPTH OF SEAL SHALL BE MINIMUM OF 1.5 TIMES SYSTEM PRESSURE IN THE DRAIN PAN.

TYPICAL CONDENSATE DRAIN TRAP



NOTE:
1. FOR METAL DECK ROOF CONSTRUCTION PROVIDE STEEL SUPPORT UNDER ROOF CURB.

ROOF RAIL CURB DETAIL



INSULATED DUCT PENETRATION THRU ROOF

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SEAL 033141
YVETTE RICHARDSON

Seal / Signature

Project Name
VILLAGE DISTRICT

Project Number
69.6575.000

Description
MECHANICAL DETAILS

Scale
NONE

M-501

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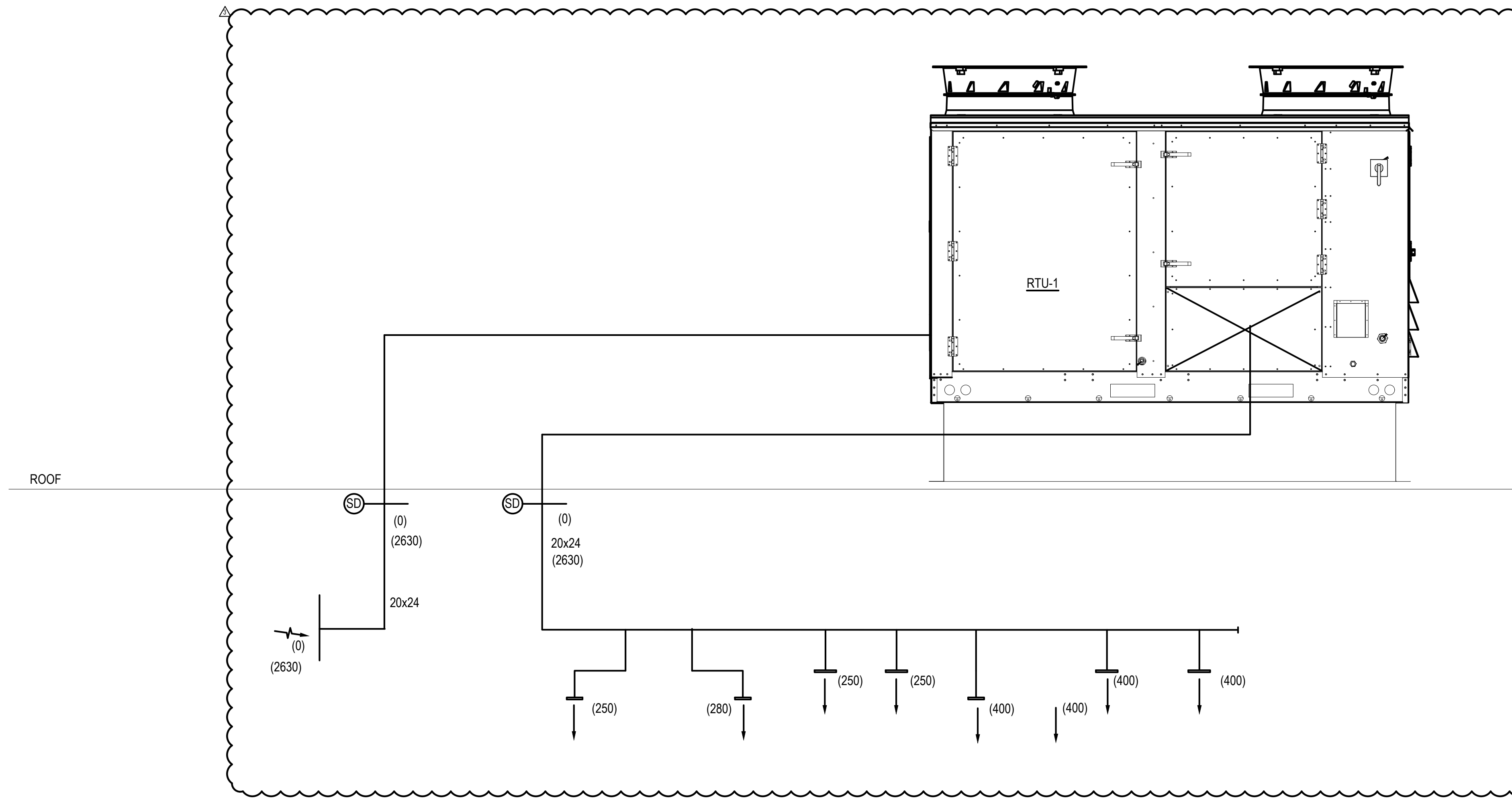


OCCUPIED MODE:

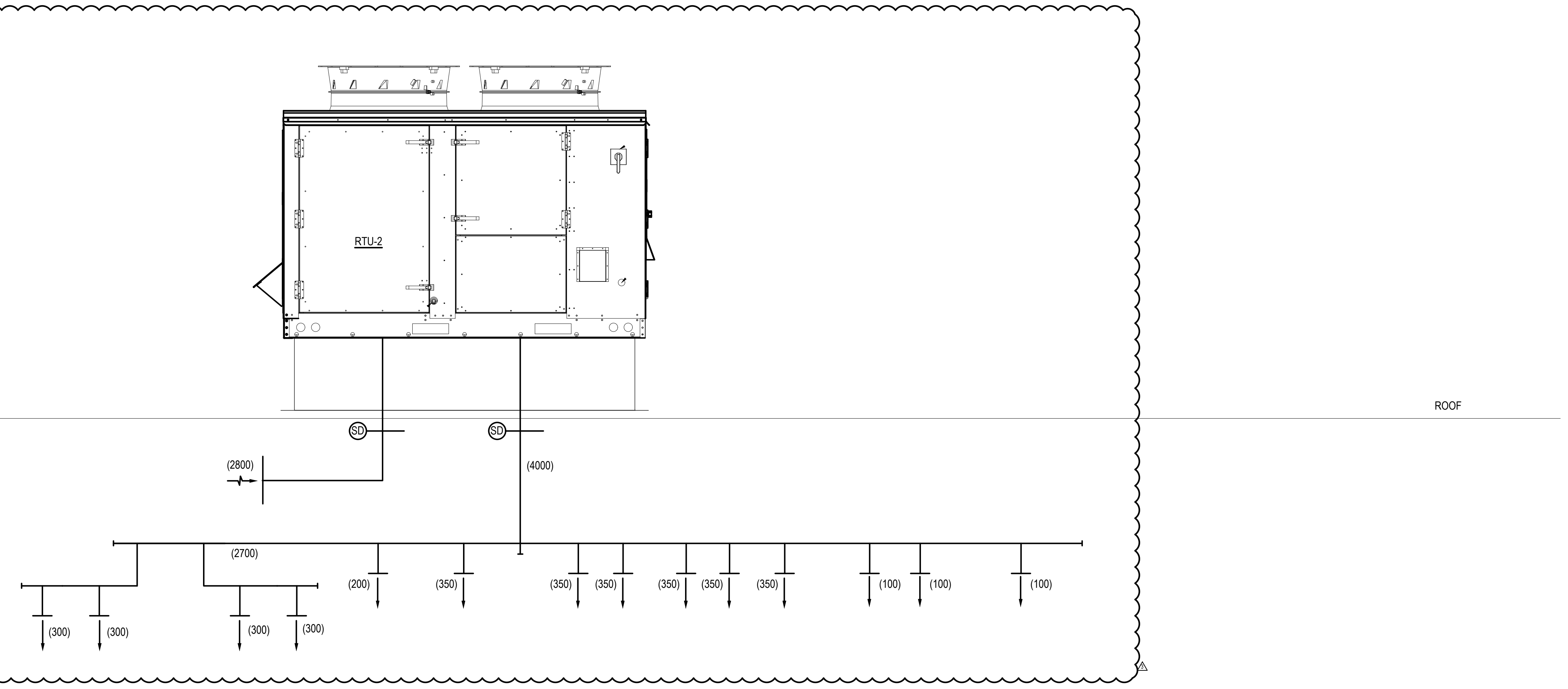
- WHEN KITCHEN IS OCCUPIED AND HOOD EXHAUST IS OFF, RTU-1 WILL PRIMARILY RECIRCULATE AIR TO MAINTAIN KITCHEN HEATING/COOLING SETPOINTS, WITH LOW % OA FOR MINIMUM OCCUPIED VENTILATION REQUIREMENTS (±400 OA CFM MINIMUN).
- WHEN KITCHEN IS OCCUPIED AND HOOD EXHAUST IS ON, RTU-1 MIXING BOX WILL FULLY OPEN THE OA DAMPER AND SUPPLY **2625 CFM** @ 100% OA TO CONDITION THE KITCHEN AND PROVIDE MAKE-UP AIR FOR THE HOOD EXHAUST AT **-650 CFM** DIFFERENTIAL RELATIVE TO THE FRONT OF HOUSE / DINING AREA .

UNOCCUPIED MODE:

- WHEN KITCHEN/BUILDING IS UNOCCUPIED, RTU-1 OA DAMPER WILL BE FULLY CLOSED, RTU-1 WILL CYCLE BLOWER ON/OFF TO MAINTAIN MINIMUM SETBACK TEMPERATURES IN THE SPACE.

1 RTU-1 RISER DIAGRAM

SCALE: NTS



OCCUPIED MODE:

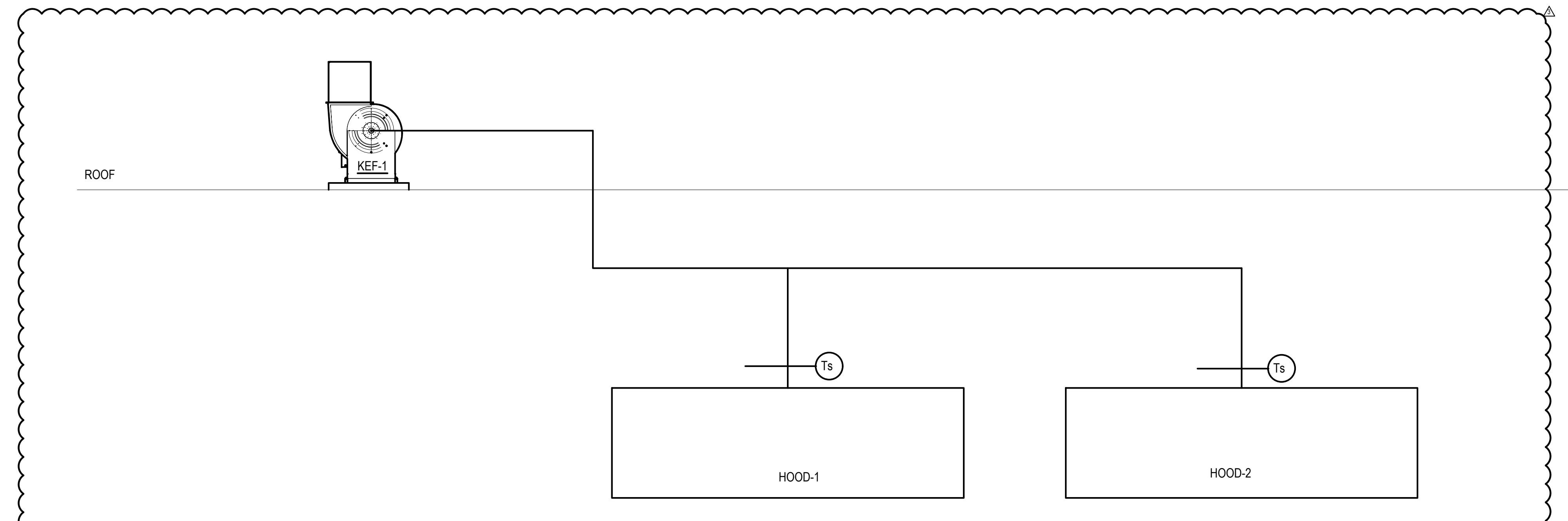
- WHEN DINING AREA IS OCCUPIED BY EMPLOYEE, RTU-2 WILL OPERATE TO RECIRCULATE AIR TO MAINTAIN SPACE HEATING/COOLING SETPOINTS, WITH LOW % OA FOR MINIMUM OCCUPIED VENTILATION REQUIREMENTS (±400 OA CFM MINIMUN).
- WHEN DINING IS OCCUPIED AND OPEN FOR BUSINESS. RTU-2 WILL OPERATE TO MODULATE OPEN THE OA DAMPER AND SUPPLY ± **1200 CFM** @ 30% OA TO CONDITION THE SPACE AND PROVIDE MAKE-UP PRESSURIZATION AIR FOR THE DINING AREA.

UNOCCUPIED MODE:

- WHEN DINING AREA IS UNOCCUPIED, RTU-2 WILL OPERATE AND OA DAMPER WILL BE FULLY CLOSED, RTU-2 WILL CYCLE BLOWER ON/OFF TO MAINTAIN MINIMUM SETBACK TEMPERATURES IN THE SPACE.

2 RTU-2 RISER DIAGRAM

SCALE: NTS

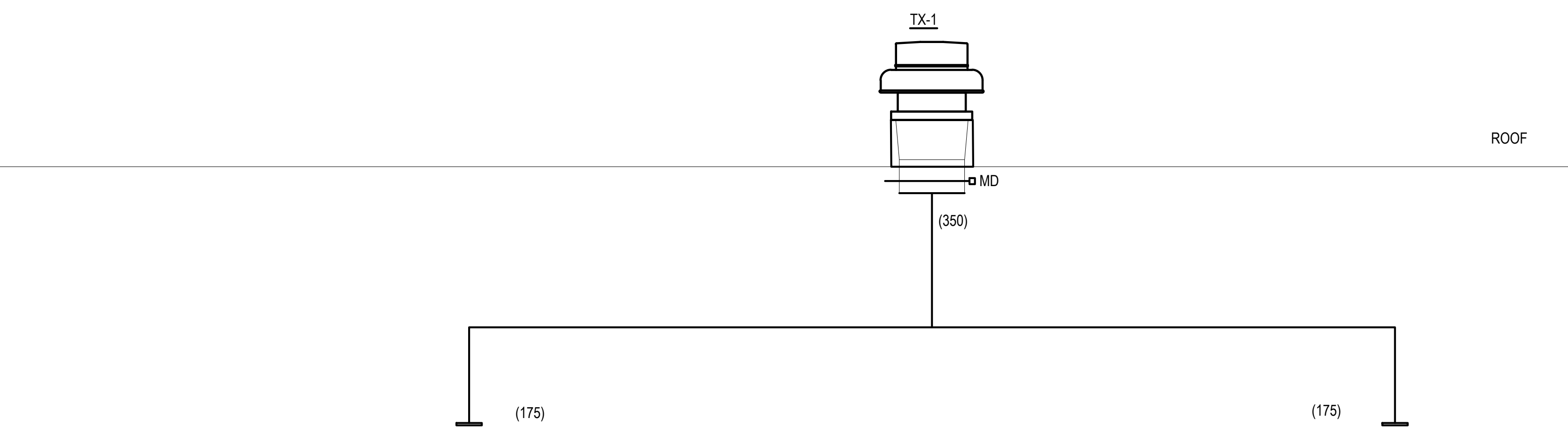


OCCUPIED MODE:

- TEMPERATURE SENSOR MOUNTED IN THE HOOD RISER SHALL ACTIVATE THE EXHAUST FANS WHENEVER ELEVATED TEMPERATURES ARE SENSED IN THE EXHAUST SYSTEM.
- THE TEMPERATURE SENSOR PROVIDED FOR FIELD INSTALLATION IN THE KITCHEN AREA AND THE TEMPERATURE SENSOR IN THE EXHAUST RISER SHALL START THE FAN(S) BASED ON THE TEMPERATURE DIFFERENTIAL BETWEEN THE ROOM AND THE EXHAUST AIR IN THE HOOD DUCT INLET.

3 KITCHEN EXHAUST RISER DIAGRAM (KEF-1)

SCALE: NTS



OCCUPIED MODE:

- THE TOILET EXHAUST (TX-1) SHALL RUN THRU TIME CLOCK.

4 TOILET EXHAUST RISER DIAGRAM (TX-1)

SCALE: NTS

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NORTH CAROLINA PROFESSIONAL ENGINEER
SEAL
053111
YVETTE RICHARDSON

Seal / Signature

Project Name
VILLAGE DISTRICT

Project Number
69.6575.000

Description
MECHANICAL AIR
RISER DIAGRAMS

Scale
NONE

M-502

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TABLE OF CONTENTS:

SECTION 230010 - GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. THIS SECTION DESCRIBES THE GENERAL REQUIREMENTS FOR ALL MECHANICAL ITEMS AND SYSTEMS REQUIRED BY THE CONTRACT DOCUMENTS.
B. COMPLY WITH ALL CONTRACT REQUIREMENTS, GENERAL CONDITIONS, SUPPLEMENTARY CONDITIONS AND DIVISION 1 SECTIONS APPLYING TO OR AFFECTING THE WORK OF DIVISION 23.
C. UNLESS SPECIFICALLY DIMENSIONED, THE WORK SHOWN ON THE DRAWINGS IS IN DIAGRAMMATIC FORM ONLY TO SHOW GENERAL ARRANGEMENT.
D. INCLUDE, IN THE WORK, ALL ACCESSORIES AND APPURTENANCES, NECESSARY AND INTEGRAL, FOR THE INTENDED OPERATION OF ANY SYSTEM, COMPONENT OR DEVICE, AS SUCH SYSTEMS, COMPONENTS AND DEVICES ARE SPECIFIED.
E. DO NOT INSTALL PIPE OR CONDUIT THROUGH DUCTWORK.
F. IF THE PIPE OR DUCT SIZE SHOWN ON THE DRAWINGS DOES NOT MATCH THE CONNECTION SIZE OF THE EQUIPMENT THAT IT IS CONNECTED TO, PROVIDE THE NECESSARY TRANSITION PIECES AT THE PIECE OF EQUIPMENT.
G. DO NOT USE OR ALLOW TO BE USED ASBESTOS OR ASBESTOS-CONTAINING MATERIALS ON THIS PROJECT. BE RIGOROUS IN ASSURING THAT ALL MATERIALS, EQUIPMENT, SYSTEMS AND COMPONENTS THEREOF DO NOT CONTAIN ASBESTOS. ANY DEVIATIONS FROM THIS REQUIREMENT SHALL BE REMEDIED AT THE CONTRACTOR'S EXPENSE WITHOUT REGARD TO PRIOR SUBMITTAL APPROVALS.

1.2 RELATED DOCUMENTS

A. THE GENERAL CONDITIONS AND GENERAL REQUIREMENTS DIVISION 1 APPLY TO THE WORK OF THIS SECTION.

1.3 REFERENCE STANDARDS

A. COMPLIANCE WITH THE FOLLOWING CODES AND STANDARDS SHALL BE REQUIRED:
1. CODES, RULES AND REGULATIONS OF THE LOCAL JURISDICTION.
2. USAS USA STANDARDS INSTITUTE (FORMERLY ASA)
3. AMCA AIR MOVING AND CONDITIONING ASSOCIATION
4. ADC AIR DIFFUSION COUNCIL
5. NEMA NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
7. NFPA NATIONAL FIRE PROTECTION ASSOCIATION
8. ASTM AMERICAN SOCIETY FOR TESTING MATERIALS
9. UL UNDERWRITERS LABORATORIES, INC.
10. NEC NATIONAL ELECTRICAL CODE
11. ASME AMERICAN SOCIETY OF MECHANICAL ENGINEERS
12. ANSI AMERICAN NATIONAL STANDARDS INSTITUTE
13. OSHA OCCUPATIONAL SAFETY AND HEALTH ACT
14. BSA BOARD OF STANDARDS AND APPEALS
15. MEA MATERIALS AND EQUIPMENT ACCEPTANCE
17. ASHRAE AMERICAN SOCIETY OF HEATING, REFRIGERATION AND AIR CONDITIONING ENGINEERS.
19. MSS MANUFACTURER'S STANDARDIZATION SOCIETY OF THE VALVE AND FITTING INDUSTRY
20. ARI AMERICAN REFRIGERATION INSTITUTE
21. SMACNA SHEET METAL AND AIR CONDITIONING CONTRACTOR'S NATION-AL ASSOCIATION
22. ASA ACOUSTICAL SOCIETY OF AMERICA
23. LOCAL BUILDING CODE
24. LOCAL FIRE CODE
25. LOCAL FUEL GAS CODE
26. LOCAL PLUMBING CODE
27. LOCAL ENERGY CONSERVATION CONSTRUCTION CODE
28. LOCAL MECHANICAL CODE
29. IRI INDUSTRIAL RISK INSURERS
30. AGA AMERICAN GAS ASSOCIATION
31. AABC AMERICAN AIR BALANCE COUNCIL
32. NEBB NATIONAL ENVIRONMENTAL BALANCING BUREAU
33. AWS AMERICAN WELDING SOCIETY

1.4 DEFINITIONS

A. "PROVIDE" MEANS FURNISH AND INSTALL, COMPLETE THE SPECIFIED MATERIAL, EQUIPMENT OR OTHER ITEMS AND PERFORM ALL REQUIRED LABOR TO MAKE A FINISHED INSTALLATION.
B. "FURNISH AND INSTALL" HAS THE SAME MEANING AS GIVEN ABOVE FOR "PROVIDE."
C. REFER TO GENERAL CONDITIONS FOR OTHER DEFINITIONS.

1.5 ABBREVIATIONS

A. REFERENCE BY ABBREVIATION MAY BE MADE IN THE SPECIFICATIONS AND THE DRAWINGS IN ACCORDANCE WITH THE FOLLOWING LIST:
1. HVAC HEATING, VENTILATING AND AIR CONDITIONING
2. CM CONSTRUCTION MANAGER
3. AC AIR CONDITIONING
4. H & V HEATING AND VENTILATING
5. AWG AMERICAN WIRE GAUGE
6. BWG BIRMINGHAM WIRE GAUGE
7. USS UNITED STATES STANDARD
8. B & S BROWN & SHARPE
9. OS & Y OUTSIDE SCREW AND YOKE
10. IBBM IRON BODY BRASS MOUNTED
12. PSIG POUNDS PER SQUARE INCH GAUGE
13. PRV PRESSURE REDUCING VALVE
14. GPM GALLONS PER MINUTE
15. MBH THOUSAND BTU PER HOUR
16. BTU BRITISH THERMAL UNITS
17. WG WATER GAGE
18. LB POUND (ALSO SHOWN AS: #)
19. ASME AMERICAN SOCIETY OF MECHANICAL ENGINEERS
20. ASTM AMERICAN SOCIETY FOR TESTING MATERIALS
21. ABMA AMERICAN BOILER MANUFACTURERS ASSOCIATION
22. ASA AMERICAN STANDARDS ASSOCIATES
23. MER MECHANICAL EQUIPMENT ROOM

SEE DRAWINGS FOR ADDITIONAL ABBREVIATIONS

1.6 REVIEW OF CONTRACT DOCUMENTS AND SITE

A. GIVE WRITTEN NOTICE WITH THE SUBMISSION OF BID TO THE ARCHITECT/ENGINEER OF ANY MATERIALS OR APPARATUS BELIEVED INADEQUATE OR UNSUITABLE, IN VIOLATION OF LAWS, ORDINANCES, RULES OR REGULATIONS OF AUTHORITIES HAVING JURISDICTION, AND ANY NECESSARY ITEMS OF WORK OMITTED. IN THE ABSENCE OF SUCH WRITTEN NOTICE IT IS MUTUALLY AGREED THAT THE CONTRACTOR HAS INCLUDED THE COST OF ALL REQUIRED ITEMS IN HIS PROPOSAL FOR A COMPLETE PROJECT.
B. CONTRACTORS SHALL ACKNOWLEDGE THAT THEY HAVE EXAMINED THE PLANS, SPECIFICATIONS AND SITE, AND THAT FROM HIS OWN INVESTIGATIONS HE HAS SATISFIED HIMSELF AS TO THE NATURE AND LOCATION OF THE WORK; THE GENERAL AND LOCAL CONDITIONS, PARTICULARLY THOSE BEARING UPON TRANSPORTATION, DISPOSAL, HANDLING AND STORAGE OF MATERIALS; AVAILABILITY OF LABOR, UTILITIES, ROADS AND UNCERTAINTIES OF WEATHER; THE COMPOSITION AND CONDITION OF THE GROUND; THE CHARACTERS QUALITY AND QUANTITY OF SUBSURFACE MATERIALS TO BE ENCOUNTERED; THE CHARACTER OF EQUIPMENT AND FACILITIES NEEDED PRELIMINARY TO AND DURING THE EXECUTION OF THE WORK; ALL FEDERAL, STATE, COUNTY, TOWNSHIP AND MUNICIPAL LAWS, ORDINANCES AND REGULATIONS PARTICULARLY THOSE RELATING TO EMPLOYMENT OF LABOR, RATES OF WAGES, AND CONSTRUCTION METHODS; AND ALL OTHER MATTERS WHICH CAN IN ANY WAY AFFECT THE WORK OR THE COST THEREOF UNDER THIS CONTRACT. ANY FAILURE BY THE CONTRACTOR TO ACQUAINT HIMSELF WITH THE AVAILABLE INFORMATION CONCERNING THESE CONDITIONS WILL NOT RELIEVE HIM FROM THE RESPONSIBILITY FOR SUCCESSFULLY PERFORMING THE WORK.
C. OWNER ASSUMES NO RESPONSIBILITY FOR ANY UNDERSTANDING OR REPRESENTATION MADE DURING OR PRIOR TO THE NEGOTIATION AND EXECUTION OF THIS CONTRACT UNLESS SUCH UNDERSTANDING OR REPRESENTATIONS ARE EXPRESSLY STATED IN THE CONTRACT AND THE CONTRACT EXPRESSLY PROVIDES THAT THE RESPONSIBILITY, THEREFORE, IS ASSUMED BY THE OWNER.

1.7 MEASUREMENTS

A. BASE ALL MEASUREMENTS, BOTH HORIZONTAL AND VERTICAL FROM ESTABLISHED BENCH MARKS. MAKE ALL WORK AGREE WITH THESE ESTABLISHED LINES AND LEVELS. VERIFY ALL MEASUREMENTS AT SITE; AND CHECK THE CORRECTNESS OF SAME AS RELATED TO THE WORK.

1.8 LABOR AND MATERIALS

A. PROVIDE ALL MATERIALS AND APPARATUS REQUIRED FOR THE WORK OF NEW AND FIRST-CLASS QUALITY. FURNISH, DELIVER, ARRANGE, ERECT, CONNECT AND FINISH ALL MATERIALS AND EQUIPMENT IN EVERY DETAIL, SO SELECTED AND ARRANGED AS TO FIT PROPERLY INTO THE BUILDING SPACES.
B. REMOVE ALL MATERIALS DELIVERED, OR WORK ERECTED, WHICH DOES NOT COMPLY WITH DRAWINGS OR SPECIFICATIONS, AND REPLACE WITH PROPER MATERIALS, OR CORRECT SUCH WORK AS DIRECTED, AT NO ADDITIONAL COST TO THE OWNER.

1.9 COVERING OF WORK

A. DO NOT COVER UP OR HIDE FROM VIEW ANY DUCT, PIPING, FITTING, OR OTHER WORK OF ANY KIND BEFORE IT HAS BEEN EXAMINED OR APPROVED BY THE ARCHITECT/ENGINEER AND/OR OTHER AUTHORITY HAVING JURISDICTION OVER THE SAME. REMOVE AND CORRECT IMMEDIATELY ANY UNACCEPTABLE OR IMPERFECT WORK OR UNAUTHORIZED OR DISAPPROVED MATERIALS DISCOVERED IMMEDIATELY AFTER BEING DISAPPROVED.

1.10 PROTECTION

A. PROTECT THE WORK AND MATERIAL OF ALL TRADES FROM DAMAGE AND REPLACE ALL DAMAGED MATERIAL WITH NEW.
B. PROTECT WORK AND EQUIPMENT UNTIL THE WORK IS FINALLY INSPECTED, TESTED, AND ACCEPTED; PROTECT THE WORK AGAINST THEFT, INJURY OR DAMAGE; AND CAREFULLY STORE MATERIAL AND EQUIPMENT RECEIVED ON SITE WHICH IS NOT IMMEDIATELY INSTALLED; CLOSE OPEN ENDS OF WORK WITH TEMPORARY COVERS OR PLUGS DURING CONSTRUCTION TO PREVENT ENTRY OF FOREIGN MATERIAL.
C. PRESERVE ALL PUBLIC AND PRIVATE PROPERTY, ALONG AND ADJACENT TO THE WORK, AND USE EVERY PRECAUTION NECESSARY TO PREVENT DAMAGE OR INJURY THERETO. USE SUITABLE PRECAUTIONS TO PREVENT DAMAGE TO PIPES, CONDUITS AND OTHER UNDERGROUND STRUCTURES OR UTILITIES, AND CAREFULLY PROTECT FROM DISTURBANCE OR DAMAGE ALL PROPERTY MARKS UNTIL AN AUTHORIZED AGENT HAS WITNESSED OR OTHERWISE REFERENCED THEIR LOCATION, AND DO NOT REMOVE THEM UNTIL DIRECTED.

1.11 CUTTING AND PATCHING

A. PROVIDE ALL CUTTING AND ROUGH PATCHING REQUIRED FOR THE WORK. PERFORM ALL FINISH PATCHING.
B. FURNISH AND LOCATE ALL SLEEVES AND INSERTS REQUIRED BEFORE THE FLOORS AND WALLS ARE BUILT, PAY THE COST OF CUTTING AND PATCHING REQUIRED FOR PIPES WHERE SLEEVES AND INSERTS WERE NOT INSTALLED IN TIME, OR WHERE INCORRECTLY LOCATED. PROVIDE ALL DRILLING REQUIRED FOR THE INSTALLATION OF HANGERS.
C. PUNCH OR DRILL ALL HOLES CUT THROUGH CONCRETE SLABS OR ARCHES FROM THE UNDERSIDE. DO NOT CUT STRUCTURAL MEMBERS WITHOUT THE APPROVAL OF THE ARCHITECT/ENGINEER. PERFORM ALL CUTTING IN A MANNER DIRECTED BY THE ARCHITECT/ENGINEER.
D. DO NOT DO ANY CUTTING THAT MAY IMPAIR STRENGTH OF BUILDING CONSTRUCTION. DO NO DRILL ANY HOLES, EXCEPT FOR SMALL SCREWS, IN BEAMS OR OTHER STRUCTURAL MEMBERS WITHOUT OBTAINING PRIOR APPROVAL. ALL WORK SHALL BE DONE IN A NEAT MANNER BY MECHANICS SKILLED IN THEIR TRADES AND AS APPROVED.

1.12 SUBMITTALS

A. SUBMIT FOR REVIEW, SHOP DRAWINGS FOR ALL MATERIALS AND EQUIPMENT FURNISHED AND INSTALLED UNDER THIS CONTRACT. SUBMISSIONS SHALL INCLUDE BUT NOT BE LIMITED TO:
1. DUCTWORK LAYOUT DRAWINGS, AIR DEVICES AND ACCESSORIES
2. PIPING AND EQUIPMENT LAYOUT DRAWINGS.
3. PIPING MATERIALS, VALVES, HANGERS, SUPPORTS AND ACCESSORIES
4. AUTOMATIC TEMPERATURE CONTROL EQUIPMENT, DIAGRAMS AND CONTROL SEQUENCES
5. EQUIPMENT, FIXTURES, AND APPURTENANCES
6. INSULATION
7. RIGGING PLAN - INCLUDE THE NAME OF THE RIGGING COMPANY; A LAYOUT DRAWING THAT DETAILS THE CRANE WITH ITS OUTRIGGERS EXTENDED OUTWARD. PROVIDE DIMENSIONS SHOWING HOW RIGGING OPERATIONS WILL AFFECT THE ROAD AND PARKING LINES BEING USED, THE TYPE OF CRANE AND ITS SPECIFICATION INCLUDING CRANE ARM HEIGHT, LIFT CAPACITY, CRANE REACH.

B. REPORTS
1. COMPLIANCE WITH LISTINGS AND APPROVALS FOR EQUIPMENT AND FOR FIRE RATINGS.
2. ACCEPTANCE CERTIFICATES FROM INSPECTING AGENCIES.
3. COMPLETE PRINTED AND ILLUSTRATED OPERATING INSTRUCTIONS IN REPORT FORMAT.
4. MANUFACTURER'S PERFORMANCE TESTS OF EQUIPMENT.
5. FIELD PIPE AND DUCT TESTING REPORTS.
6. FIELD OPERATING TEST RESULTS FOR EQUIPMENT.
7. PERFORMANCE REPORT ON THE BALANCING OF AIR SYSTEMS.
8. PERFORMANCE REPORTS FOR VIBRATION ISOLATION EQUIPMENT.
9. MANUFACTURER'S REPORTS ON MOTORIZED EQUIPMENT ALIGNMENT AND INSTALLATION.

C. SPECIFIC REFERENCES TO ANY ARTICLE, DEVICE, PRODUCT OR MATERIAL, FIXTURE OR ITEM OF EQUIPMENT BY NAME, MAKE OR CATALOG NUMBER SHALL BE INTERPRETED AS ESTABLISHING A BASIS OF COST AND A STANDARD OF QUALITY. ALL DEVICES SHALL BE OF THE MAKE AND TYPE LISTED BY SPECIAL AGENCIES, SUCH AS THE UNDERWRITERS' LABORATORIES, AND WHERE REQUIRED, APPROVED BY THE FIRE DEPARTMENT.

1.13 SPACE ALLOTMENTS AND SUBSTITUTIONS

A. THE SPACE ALLOTMENTS AND EQUIPMENT LAYOUTS ON THE DRAWINGS ARE BASED ON THE MANUFACTURER'S MODEL INDICATED OR SCHEDULED AS THE "BASIS OF DESIGN". ENSURE THAT ANY EQUIPMENT THAT IS SUBMITTED OTHER THAN THE "BASIS OF DESIGN" WILL FIT IN THE SPACE ALLOTMENT AND WILL PROVIDE THE NECESSARY MAINTENANCE CLEARANCES AS RECOMMENDED BY THE MANUFACTURER. IF MAINTENANCE CLEARANCES ARE NOT MET, PAY FOR ANY CHANGES SUCH THAT MAINTENANCE CLEARANCES WILL BE MET.
B. BEAR ALL COSTS ASSOCIATED WITH RE-LAYOUT OF THE EQUIPMENT, CHANGES TO PIPING/DUCTWORK, AND OTHER CHANGES AS REQUIRED IF APPROVED EQUIPMENT OTHER THAN THE "BASIS OF DESIGN" EQUIPMENT IS PURCHASED. THIS SHALL ALSO INCLUDE ANY STRUCTURAL STEEL MODIFICATIONS AND STRUCTURAL STEEL DESIGN CHANGES. SUBMIT, AT NO COST TO THE OWNER, A STEEL DESIGN STAMPED BY A STRUCTURAL ENGINEER LICENSED IN THE STATE IN WHICH THE WORK IS TO BE PERFORMED FOR STRUCTURAL MODIFICATIONS THAT MUST BE MADE RESULTING FROM THE USE OF EQUIPMENT OTHER THAN THE "BASIS OF DESIGN" OR NOT SPECIFIED.

1.14 PAINTING

A. PRIME PAINT ALL BARE SUPPLEMENTAL STEEL, SUPPORTS AND HANGERS REQUIRED FOR THE INSTALLATION OF DIVISION 23 WORK IN ACCORDANCE WITH "PAINTING" SPECIFICATION SECTION. TOUCH UP WELDS OF GALVANIZED SURFACES WITH GALVANIZING PRIMER.

1.15 MATERIAL SAFETY DATA SHEETS

A. SUBMIT MATERIAL SAFETY DATA SHEETS (MSDS) FOR ALL CHEMICALS, HYDRAULIC FLUIDS, SEAL OILS, LUBRICATING ILS, GLYCOLS AND ANY OTHER HAZARDOUS MATERIALS USED IN THE PERFORMANCE OF THE WORK, IN ACCORDANCE WITH THE US DEPARTMENT OF LABOR, OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION HAZARD COMMUNICATION AND RIGHT-TO-KNOW REQUIREMENTS STIPULATED IN 29 CFR 1910.1200 (G).

1.16 MOTORS AND STARTERS

A. PROVIDE NEW NEMA STANDARD ELECTRIC MOTORS, SIZED AND DESIGNED TO OPERATE AT FULL LOAD AND FULL SPEED CONTINUOUSLY WITHOUT CAUSING NOISE, VIBRATION, AND TEMPERATURE RISE IN EXCESS OF THEIR RATING. PROVIDE MOTORS WITH A SERVICE FACTOR OF AT LEAST 1.15.
B. EQUIP MOTORS FOR BELT DRIVEN EQUIPMENT WITH RAILS WITH ADJUSTING SCREWS FOR BELT TENSION ADJUSTMENT. WEATHER PROTECT MOTORS EXPOSED TO THE WEATHER.
C. INSTALL HIGH EFFICIENCY ELECTRIC MOTORS FOR AIR HANDLING UNITS, RELIEF FANS, AND EXHAUST FANS.
D. PROVIDE ALL MOTORS FOR USE WITH VARIABLE FREQUENCY DRIVES WITH "HIGH EFFICIENCY INVERTER DUTY" INSULATION CLASS "F" WITH CLASS "B" TEMPERATURE RISE AND THAT CONFORM TO OR EXCEED NYSECC OR THE FEDERAL EP ACT OF 1992 REQUIREMENTS FOR EFFICIENCY.
E. PROVIDE STAINLESS STEEL NAMEPLATES, PERMANENTLY ATTACHED TO THE MOTOR, AND HAVING THE FOLLOWING INFORMATION AS A MINIMUM:
1. MANUFACTURER
2. TYPE
3. MODEL
4. HORSEPOWER
5. SERVICE FACTOR
6. RPM
7. VOLTAGE/PHASE/FREQUENCY
8. ENCLOSURE TYPE
9. FRAME SIZE
10. FULL-LOAD CURRENT
11. UL LABEL (WHERE APPLICABLE)
12. LEAD CONNECTION DIAGRAM
13. BEARING DATA
14. EFFICIENCY AT FULL LOAD.

F. PROVIDE MOTORS WHOSE SOUND POWER LEVELS DO NOT EXCEED THAT RECOMMENDED IN NEMA MG 1-12.49.
G. PROVIDE MOTORS WITH DRIVE SHAFTS LONG ENOUGH TO EXTEND COMPLETELY THROUGH BELT SHEAVES WHEN SHEAVES ARE PROPERLY ALIGNED AND BALANCED.
H. PROTECT MOTOR STARTERS ON EQUIPMENT LOCATED OUTDOORS IN WEATHERPROOF NEMA 4X ENCLOSURES.
I. PROVIDE WEATHERPROOF NEMA 4X DISCONNECT SWITCHES WHEN LOCATED OUTDOORS.
J. MOTOR CHARACTERISTICS:
1. 120V/1/60 HZ, 208V/1/60 HZ OR 240V/1/60 HZ: CAPACITOR START, OPEN DRIP-PROOF TYPE, BALL BEARING, RATED 40 C. CONTINUOUS RISE.
2. 208V/3/60 HZ, 240V/3/60 HZ OR 460/3/60 HZ: NEMA B, NORMAL STARTING TORQUE, SINGLE SPEED, SQUIRREL-CAGE TYPE, OPEN DRIP-PROOF, RATED 40 C CONTINUOUS RISE, WITH BALL BEARINGS RATED FOR B-10 LIFE OF 100,000 HOURS AND FITTED WITH GREASE FITTINGS AND RELIEF PORTS. PROVIDE MOTORS WITH ALUMINUM END BRACKETS WITH STEEL INSERTS IN BEARING CAVITIES.

1.17 ACOUSTICAL PERFORMANCE OF EQUIPMENT AND SYSTEMS

A. INSTALL THE WORK IN SUCH A MANNER THAT NOISE LEVELS FROM OPERATION OF MOTOR DRIVEN EQUIPMENT, WHETHER AIRBORNE OR STRUCTURE-BORNE, AND NOISE LEVELS CREATED BY OR WITHIN AIR HANDLING EQUIPMENT AND AIR DISTRIBUTION AND CONTROL MEDIA, DO NOT TO EXCEED SOUND PRESSURE LEVELS DETERMINED BY THE NOISE CRITERIA CURVES PUBLISHED IN THE ASHRAE GUIDE.
B. ACOUSTICAL TESTS
1. OWNER MAY DIRECT THE CONTRACTOR TO CONDUCT SOUND TESTS FOR THOSE AREAS HE DEEMS TOO NOISY.
2. IF NC LEVEL EXCEEDS THE REQUIREMENTS OF THE CONTRACT DOCUMENTS DUE TO IMPROPER INSTALLATION OR OPERATION OF MECHANICAL SYSTEMS, MAKE CHANGES OR REPAIRS TO BRING NOISE LEVELS TO WITHIN REQUIRED LEVELS.
3. RETEST UNTIL SPECIFIED CRITERIA HAVE BEEN MET.

1.18 OPERATING AND MAINTENANCE INSTRUCTIONS

A. INSTRUCTIONS AND DEMONSTRATION FOR OWNER'S PERSONNEL
1. PROVIDE OPERATING AND MAINTENANCE INSTRUCTION TO THE OWNER WHEN PROJECT IS COMPLETED AND ALL HVAC EQUIPMENT SERVING THE BUILDING IS READY TO BE TURNED OVER TO THE OWNER.
2. TURN OVER THE HVAC EQUIPMENT TO THE OWNER ONLY AFTER THE FINAL TESTING AND PROPER BALANCING OF HVAC SYSTEMS.
3. INSTRUCT THE OWNER'S PERSONNEL IN THE USE, OPERATION AND MAINTENANCE OF ALL EQUIPMENT OF EACH SYSTEM.
4. THE ABOVE INSTRUCTION REQUIREMENTS ARE IN ADDITION TO THAT SPECIFIED FOR SPECIFIC EQUIPMENT OR SYSTEMS. CONFORM TO SPECIFIED REQUIREMENTS IF MORE STRINGENT OR LONGER INSTRUCTION IS SPECIFIED FOR SPECIFIC EQUIPMENT OR SYSTEMS.

1.19 CODES, RULES, PERMITS & FEES

A. GIVE ALL NECESSARY NOTICES, OBTAIN ALL PERMITS AND PAY ALL GOVERNMENT SALES TAXES, FEES, AND OTHER COSTS, IN CONNECTION WITH THE WORK. UNLESS INDICATED OTHERWISE, FEES FOR ALL UTILITY CONNECTIONS, EXTENSIONS, AND TAP FEES FOR WATER, STORM, SEWER, GAS, TELEPHONE, AND ELECTRICITY WILL BE PAID DIRECTLY TO UTILITY COMPANIES AND/OR AGENCIES BY THE OWNER. FILE ALL NECESSARY PLANS, PREPARE ALL DOCUMENTS AND OBTAIN ALL NECESSARY APPROVALS OF ALL GOVERNMENTAL DEPARTMENTS HAVING JURISDICTION; OBTAIN ALL REQUIRED CERTIFICATES OF INSPECTION FOR THE WORK AND DELIVER SAME TO THE OWNER'S REPRESENTATIVE BEFORE REQUEST FOR ACCEPTANCE AND FINAL PAYMENT FOR THE WORK.
B. CONFORM TO THE REQUIREMENTS OF THE NFPA, NEC, FM, UL AND ANY OTHER LOCAL OR STATE CODES WHICH MAY GOVERN.

1.20 RECORD DRAWINGS

A. DURING THE PROGRESS OF THE WORK, MAKE A RECORD SET OF DRAWINGS OF ALL CHANGES BY WHICH THE ACTUAL INSTALLATION DIFFERS FROM THE DRAWINGS.
B. CREATE ALL RECORD DRAWINGS IN AUTOCAD VERSION 2002 OR LATER IN .DWG FORMAT. UPON COMPLETION OF THE WORK, SUBMIT TO THE ARCHITECT/ENGINEER FOR APPROVAL THREE COMPLETE SETS OF HARD COPIES OF THE RECORD DRAWINGS, OF THE SAME SIZE AS THE DRAWINGS FOR APPROVAL. UPON APPROVAL BY THE ARCHITECT/ENGINEER FURNISH THE OWNER A CD COPY OF THE RECORD DRAWINGS ALONG WITH ONE HARD COPY FOR HIS RECORDS.

PART 2 - EXECUTION

3.1 CLEANING AND ADJUSTING

A. CLEANING
1. BLOW OUT, CLEAN AND FLUSH EACH SYSTEM OF PIPING AND EQUIPMENT, TO THOROUGHLY CLEAN THE SYSTEMS.
2. CLEAN ALL MATERIALS AND EQUIPMENT; LEAVE IN CONDITION READY TO OPERATE AND READY TO RECEIVE FINAL FINISHES WHERE REQUIRED.
3. CLEAN THE OPERATING EQUIPMENT AND SYSTEMS TO BE DUST FREE INSIDE AND OUT.
4. CLEAN CONCEALED AND UNOCCUPIED AREAS SUCH AS PLENUMS, PIPE AND DUCT SPACES AND EQUIPMENT ROOMS TO BE FREE OF RUBBISH AND DUST.

B. ADJUSTING
1. ADJUST AND ALIGN EQUIPMENT INTERCONNECTED WITH COUPLINGS OR BELTS.
2. ADJUST VALVES OF ALL TYPES AND OPERATING EQUIPMENT OF ALL TYPES TO PROVIDE PROPER OPERATION.
3. CLEAN ALL STRAINERS AFTER SYSTEM CLEANING AND FLUSHING AND AGAIN BEFORE SYSTEM STARTUP.

C. LUBRICATION
1. LUBRICATE EQUIPMENT AS RECOMMENDED BY THE MANUFACTURER, DURING TEMPORARY CONSTRUCTION USE.
2. PROVIDE COMPLETE LUBRICATION JUST PRIOR TO ACCEPTANCE.

D. PERMANENT EQUIPMENT OPERATING DURING CONSTRUCTION
1. USE ONLY IN SAME SERVICE AS THE PERMANENT APPLICATIONS.
2. USE DISPOSABLE FILTERS DURING TEMPORARY OPERATION.
3. REPLACE EXPENDABLE MEDIA, INCLUDING BELTS USED FOR TEMPORARY OPERATION AND SIMILAR MATERIALS JUST PRIOR TO ACCEPTANCE OF THE WORK.
4. REPACK PACKING IN EQUIPMENT OPERATED DURING CONSTRUCTION JUST PRIOR TO SYSTEM ACCEPTANCE, USING MATERIALS AND METHODS SPECIFIED BY THE EQUIPMENT MANUFACTURER.

E. RETOUCH OR REPAINT EQUIPMENT FURNISHED WITH FACTORY FINISH AS REQUIRED TO PROVIDE SAME APPEARANCE AS NEW.
F. TOOLS
G. 1. PROVIDE ONE SET OF SPECIALIZED OR NON-STANDARD MAINTENANCE TOOLS AND DEVICES REQUIRED FOR SERVICING THE INSTALLED EQUIPMENT.

3.2 EQUIPMENT BASES, PLATFORMS AND SUPPORTS

A. PROVIDE SUPPORTING PLATFORMS, STEEL SUPPORTS, ANCHOR BOLTS, INSERTS, ETC., FOR ALL EQUIPMENT AND APPARATUS PROVIDED.
B. OBTAIN PRIOR APPROVAL FOR INSTALLATION METHOD OF STRUCTURAL STEEL REQUIRED TO FRAME INTO BUILDING STRUCTURAL MEMBERS FOR THE PROPER SUPPORT OF EQUIPMENT, CONDUIT, ETC. WELDING WILL BE PERMITTED ONLY WHEN APPROVED BY THE ARCHITECT/ENGINEER.
C. SUBMIT SHOP DRAWINGS OF SUPPORTS TO THE ARCHITECT/ENGINEER FOR APPROVAL BEFORE FABRICATING OR CONSTRUCTING.
D. PROVIDE LEVELING CHANNELS, ANCHOR BOLTS, COMPLETE WITH NUTS AND WASHERS, FOR ALL APPARATUS AND EQUIPMENT SECURED TO CONCRETE PADS AND FURTHER SUPPLY EXACT INFORMATION AND DIMENSIONS FOR THE LOCATION OF THESE LEVELING CHANNELS, ANCHOR BOLTS, INSERTS, CONCRETE BASES AND PADS.
E. WHERE SUPPORTS ARE ON CONCRETE CONSTRUCTION, TAKE CARE NOT TO WEAKEN CONCRETE OR PENETRATE WATERPROOFING.

3.3 ACCESSIBILITY

A. INSTALL VALVES, DAMPERS AND OTHER ITEMS REQUIRING ACCESS CONVENIENTLY AND ACCESSIBLY LOCATED WITH REFERENCE TO THE FINISHED BUILDING.

3.4 USE OF EQUIPMENT

A. THE USE OF ANY EQUIPMENT, OR ANY PART THEREOF, EVEN WITH THE OWNER'S CONSENT, IS NOT AN INDICATION OF ACCEPTANCE OF THE WORK ON THE PART OF THE OWNER, NOR SHALL IT BE CONSTRUED TO OBLIGATE THE OWNER IN ANY WAY TO ACCEPT IMPROPER WORK OR DEFECTIVE MATERIALS.

3.5 MODIFICATIONS OF EXISTING WORK

A. COORDINATE THE WORK WITH ALL OTHER CONTRACTORS AND PROVIDE NECESSARY DIMENSIONS FOR ALL OPENINGS. PROVIDE ALL CUTS AND OPENINGS WHICH ARE NECESSARY FOR THE WORK FOR PASSAGE OF PIPING AND DUCTWORK
B. UPON COMPLETION, REMOVE ALL TEMPORARY PIPING AND EQUIPMENT, SHORING, SCAFFOLDS, ETC., AND LEAVE ALL AREAS CLEAN AND FREE FROM MATERIAL AND DEBRIS RESULTING FROM THE WORK PERFORMED UNDER THIS SECTION. PROVIDE ROUGH PATCHING IN AREAS REQUIRED.

3.6 EQUIPMENT INSTALLATION

A. LOCATE AND SET EQUIPMENT ANCHOR BOLTS, DOWELS AND ALIGNING DEVICES FOR EQUIPMENT REQUIRING THEM.
B. LEVEL AND SHIM THE EQUIPMENT; COORDINATE AND OVERSEE THE GROUTING WORK.
C. PERFORM FIELD ASSEMBLY, INSTALLATION AND ALIGNMENT OF EQUIPMENT UNDER DIRECT SUPERVISION PROVIDED BY THE MANUFACTURER OR WITH INSPECTIONS, ADJUSTMENTS AND APPROVAL BY THE MANUFACTURER.
D. ALIGNMENT AND LUBRICATION CERTIFICATION FOR MOTOR DRIVEN APPARATUS
1. AFTER PERMANENT INSTALLATION HAS BEEN MADE AND CONNECTIONS HAVE BEEN COMPLETED, BUT BEFORE THE EQUIPMENT IS CONTINUOUSLY OPERATED, HAVE A QUALIFIED REPRESENTATIVE OF THE EQUIPMENT MANUFACTURER INSPECT THE INSTALLATION AND REPORT IN WRITING ON THE MANUFACTURER'S LETTERHEAD ON THE FOLLOWING:
a. WHETHER SHAFT, BEARING, SEAL, COUPLING, AND BELT DRIVE ALIGNMENT AND DOWELING IS WITHIN THE MANUFACTURER'S REQUIRED TOLERANCES SO THAT THE EQUIPMENT WILL REMAIN ALIGNED IN THE NORMAL SERVICE INTENDED BY THE CONTRACT DOCUMENTS AND THAT NO STRAIN OR DISTORTION WILL OCCUR IN NORMAL SERVICE.
b. THAT ALL PARTS OF THE APPARATUS ARE PROPERLY LUBRICATED FOR OPERATION.
c. THAT THE INSTALLATION IS IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.
d. THAT SUITABLE MAINTENANCE AND OPERATING INSTRUCTIONS HAVE BEEN PROVIDED FOR THE OWNER'S USE.
e. MAKE ANY CORRECTIONS TO ITEMS THAT ARE REQUIRED OR RECOMMENDED BASED ON THE MANUFACTURER'S INSPECTION AND HAVE THE EQUIPMENT RE-INSPECTED.

E. BELT DRIVES
1. V-BELT DRIVES - A DRIVING AND DRIVEN SHEAVE GROOVED FOR BELTS OF TRAPEZOIDAL CROSSSECTION. CONSTRUCT BELTS OF FABRIC AND RUBBER SO DESIGNED SO AS NOT TO TOUCH THE BOTTOM OF THE GROOVES, THE POWER BEING TRANSMITTED BY THE CONTACT BETWEEN THE BELTS AND VSHAPED GROOVE SIDES. DESIGN DRIVES FOR A MINIMUM OF 150 PERCENT OF MOTOR HORSEPOWER. PROVIDE COMPANION TYPE DRIVEN SHEAVES.
2. SELECT DRIVES TO PROVIDE FOR 12-1/2 PERCENT VARIATION IN SPEED, PLUS OR MINUS, FROM SPECIFIED SPEED. PROVIDE ALL MOTORS WITH ADJUSTABLE SHEAVES EXCEPT WHERE INDICATED OTHERWISE IN THE SPECIFICATIONS OR ON THE DRAWINGS.
3. INSTALL ALL FANS WITH ADJUSTABLE PITCH SHEAVES ON THEIR DRIVE MOTORS. SELECT SHEAVES TO PROVIDE AIR QUANTITIES UNDER SPECIFIED CONDITIONS. PUT AIR SYSTEMS INTO OPERATION, AND DETERMINE AS A RESULT OF THE COMPLETED AIR BALANCE THE ACTUAL SIZE OF SHEAVES REQUIRED TO PRODUCE SPECIFIED AIR QUANTITIES ON INSTALLED SYSTEMS. THE ADJUSTABLE PITCH SHEAVES SHALL THEN BE REPLACED WITH THE PROPER SIZE FIXED SHEAVES. REMOVE ADJUSTABLE PITCH SHEAVES FROM PREMISES. PROVIDE FIXED MOTOR SHEAVES MANUFACTURED BY WOOD'S.
4. WHERE INDICATED ON THE DRAWINGS OR SPECIFIED, PROVIDE SPARE MOTOR, BEARINGS, AND BELTS.

F. MACHINERY GUARDS
1. PROTECT MOTOR DRIVES BY GUARDS FURNISHED BY THE EQUIPMENT MANUFACTURER OR IN ACCORDANCE WITH THE SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION'S LOW PRESSURE DUCT MANUAL. PROVIDE GUARDS OF ALL TYPES APPROVED AS ACCEPTABLE UNDER OSHA STANDARDS.

G. EQUIPMENT START-UP
1. REQUIRE EACH EQUIPMENT MANUFACTURER TO PROVIDE QUALIFIED PERSONNEL TO INSPECT AND APPROVE EQUIPMENT AND INSTALLATION AND TO SUPERVISE THE START-UP OF THE EQUIPMENT AND TO SUPERVISE THE OPERATING TESTS OF THE EQUIPMENT.
2. IF A MINIMUM NUMBER OF HOURS FOR START-UP AND INSTRUCTION ARE NOT STATED WITH THE EQUIPMENT SPECIFICATIONS, THESE SHALL BE 2 FULL 8-HOUR WORKING DAYS AS A MINIMUM.
3. ADVISE OWNER OF START-UP AT LEAST 72 HOURS IN ADVANCE.

3.7 CLOSEOUT PROCEDURES

A. GENERAL OPERATING AND MAINTENANCE INSTRUCTIONS: ARRANGE FOR EACH INSTALLER OF OPERATING EQUIPMENT AND OTHER WORK THAT REQUIRES REGULAR OR CONTINUING MAINTENANCE, TO MEET AT THE SITE WITH THE OWNER'S PERSONNEL TO PROVIDE NECESSARY BASIC INSTRUCTIONS IN THE PROPER OPERATION AND MAINTENANCE OF THE ENTIRE WORK. WHERE INSTALLERS ARE NOT EXPERT IN THE REQUIRED PROCEDURES, INCLUDE INSTRUCTION BY THE MANUFACTURER'S REPRESENTATIVES.
B. WHERE APPLICABLE, PROVIDE INSTRUCTION AND TRAINING, INCLUDING APPLICATION OF SPECIAL COATINGS SYSTEMS, AT MANUFACTURER'S RECOMMENDATION.
C. PROVIDE A DETAILED REVIEW OF THE FOLLOWING ITEMS:
1. MAINTENANCE MANUALS
2. RECORD DOCUMENTS AND CATALOG CUTS FOR EACH PIECE OF EQUIPMENT.
3. SPARE PARTS AND MATERIALS
4. TOOLS
5. LUBRICANTS
6. FUELS
7. IDENTIFICATION SYSTEMS
8. CONTROL SEQUENCES
9. HAZARDS
10. CLEANING

D. WARRANTIES, BONDS, MAINTENANCE AGREEMENTS, AND SIMILAR CONTINUING COMMITMENTS.
E. DEMONSTRATE THE FOLLOWING PROCEDURES:
1. START-UP
2. SHUT-DOWN
3. EMERGENCY OPERATIONS
4. NOISE AND VIBRATION ADJUSTMENTS
5. SAFETY PROCEDURES
6. ECONOMY AND EFFICIENCY ADJUSTMENTS
7. EFFECTIVE ENERGY UTILIZATION.

F. PREPARE INSTRUCTION PERIODS TO CONSIST OF APPROXIMATELY 50% CLASSROOM INSTRUCTION AND 50% "HANDS-ON" INSTRUCTION. PROVIDE MINIMUM INSTRUCTION PERIODS AS FOLLOWS: SYSTEMS OR EQUIPMENT TRAINING TIME (HOURS) ROOF TOP UNITS 8 HRS. AIR HANDLERS 8 HRS. ALL OTHER EQUIPMENT 4 HRS. (EACH) NOTE: CONSULT INDIVIDUAL EQUIPMENT SPECIFICATION SECTIONS FOR ADDITIONAL TRAINING REQUIREMENTS.
G. PREPARE A WRITTEN AGENDA FOR EACH SESSION AND SUBMIT FOR REVIEW AND APPROVAL. INCLUDE DATE, LOCATION, PURPOSE, SPECIFIC SCOPE, PROPOSED ATTENDANCE AND SESSION DURATION.
H. RECORD TRAINING SESSIONS IN DIGITAL FORMAT, FORMAT AS SELECTED BY THE OWNER. TURN OVER DIGITAL FILES TO THE OWNER AFTER TRAINING HAS BEEN COMPLETED.

SECTION 230529 - PIPE HANGERS AND SUPPORTS

PART 1 - GENERAL DESCRIPTION OF WORK

A. THE WORK COVERED UNDER THIS SECTION CONSISTS OF THE FURNISHING OF ALL NECESSARY LABOR, SUPERVISION, MATERIALS, EQUIPMENT, AND SERVICES TO COMPLETELY EXECUTE THE PIPE HANGER AND SUPPORTS AS DESCRIBED IN THIS SPECIFICATION. SIZE HANGERS AND SUPPORTS TO FIT THE OUTSIDE DIAMETER OF THE ASSOCIATED PIPING

1.2 REFERENCES

A. ASTM B633 - SPECIFICATION FOR ELECTRODEPOSITED COATINGS OF ZINC ON IRON AND STEEL
B. ASTM A123 - SPECIFICATION FOR ZINC (HOT-GALVANIZED) COATINGS ON PRODUCTS FABRICATED FROM ROLLED, PRESSED, AND FORGED STEEL SHAPES, PLATES, BARS, AND STRIP
C. ASTM A653 - SPECIFICATION FOR STEEL SHEET, ZINC-COATED BY THE HOT-DIP PROCESS
D. ASTM A1011 - SPECIFICATION FOR STEEL, SHEET AND STRIP, HOT-ROLLED, CARBON, STRUCTURAL, HIGH-STRENGTH LOW-ALLOY AND HIGH-STRENGTH LOW-ALLOY WITH IMPROVED FORMABILITY (FORMERLY ASTM A570)
E. MSS SP58 - MANUFACTURERS STANDARDIZATION SOCIETY: PIPE HANGERS AND SUPPORTS- MATERIALS, DESIGN, AND MANUFACTURE
F. MSS SP69 - MANUFACTURERS STANDARDIZATION SOCIETY: PIPE HANGERS AND SUPPORTS- SELECTION AND APPLICATION
G. MSS SP89 - PIPE HANGERS AND SUPPORTS - FABRICATION AND INSTALLATION PRACTICES

1.3 QUALITY ASSURANCE

A. PROVIDE HANGERS AND SUPPORTS USED IN FIRE PROTECTION PIPING SYSTEMS LISTED AND LABELED BY UNDERWRITERS LABORATORIES.
B. STEEL PIPE HANGERS AND SUPPORTS SHALL HAVE THE MANUFACTURER'S NAME, PART NUMBER, AND APPLICABLE SIZE STAMPED IN THE PART ITSELF FOR IDENTIFICATION.
C. DESIGN AND MANUFACTURE HANGERS AND SUPPORTS IN CONFORMANCE WITH MSS SP 58.

1.4 SUBMITTALS

A. SUBMIT PRODUCT DATA ON ALL HANGER AND SUPPORT DEVICES, INCLUDING SHIELDS AND ATTACHMENT METHODS. INCLUDE AS A MINIMUM AS PART OF PRODUCT DATA MATERIALS, FINISHES, APPROVALS, LOAD RATINGS, AND DIMENSIONAL INFORMATION.
B. SUBMIT PIPE HANGER AND SUPPORT APPLICATION SCHEDULE.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. HANGERS
1. UNINSULATED PIPES 2 INCH AND SMALLER:
a. ADJUSTABLE STEEL SWIVEL RING (BAND TYPE) HANGER, B-LINE B3170.
b. ADJUSTABLE STEEL SWIVEL J-HANGER, B-LINE B3690.
c. MALLEABLE IRON RING HANGER, B-LINE B3198R OR HINGED RING HANGER, B3198H.
d. MALLEABLE IRON SPLIT-RING HANGER WITH EYE SOCKET, B-LINE B3173 WITH B3222.
e. ADJUSTABLE STEEL CLEVIS HANGER, B-LINE B3104 OR B3100.
2. INSULATED PIPE- COLD OR CHILLED WATER PIPING:
a. 5 INCH AND SMALLER PIPES: USE ADJUSTABLE STEEL CLEVIS WITH GALVANIZED SHEET METAL SHIELD. B-LINE B3100 WITH B3151 SERIES.

B. PIPE CLAMPS
1. M
2. WHEN FLEXIBILITY IN THE HANGER ASSEMBLY IS REQUIRED DUE TO HORIZONTAL MOVEMENT, USE PIPE CLAMPS WITH WELDLESS EYE NUTS, B-LINE B3140 OR B3142 WITH B3200. FOR INSULATED LINES USE DOUBLE BOLTED PIPE CLAMPS, B-LINE B3144 OR B3146 WITH B3200.

C. MULTIPLE OR TRAPEZE HANGER
1. CONSTRUCT TRAPEZE HANGERS FROM 12 GAUGE ROLL FORMED ASTM A1011 SS GRADE 33 STRUCTURAL STEEL CHANNEL, 1-5/8 INCH BY 1-5/8 INCH MINIMUM, B-LINE B22 STRUT OR STRONGER AS REQUIRED.
2. MOUNT PIPES TO TRAPEZE WITH 2 PIECE PIPE STRAPS SIZED FOR OUTSIDE DIAMETER OF PIPE, B-LINE B2000 SERIES.
3. FOR PIPES SUBJECTED TO AXIAL MOVEMENT:
a. STRUT MOUNTED ROLLER SUPPORT, B-LINE B3126. USE PIPE PROTECTION SHIELD OR SADDLES ON INSULATED LINES.
b. STRUT MOUNTED PIPE GUIDE, B-LINE B2417.

D. WALL SUPPORTS
1. PIPES 4 INCH AND SMALLER:
a. CARBON STEEL HOOK, B-LINE B3191.
b. CARBON STEEL J-HANGER, B-LINE B3690.
c. WELDED STEEL BRACKETS, B-LINE B3066 OR B3067, WITH ROLLER CHAIR OR ADJUSTABLE STEEL YOKE PIPE ROLL. B-LINE B3120 OR B3110. USE PIPE PROTECTION SHIELD OR SADDLES ON INSULATED LINES.

E. VERTICAL SUPPORTS
1. STEEL RISER CLAMP SIZED TO FIT OUTSIDE DIAMETER OF PIPE, B-LINE B3373.
2. COPPER TUBING SUPPORTS
a. SIZE HANGERS TO FIT COPPER TUBING OUTSIDE DIAMETERS.
1) ADJUSTABLE STEEL SWIVEL RING (BAND TYPE) HANGER, B-LINE B3170CT.
2) MALLEABLE IRON RING HANGER, B-LINE B3198RCT OR HINGED RING HANGER B3198HCT.
3) MALLEABLE IRON SPLIT-RING HANGER WITH EYE SOCKET, B-LINE B3173CT WITH B3222.
4) ADJUSTABLE STEEL CLEVIS HANGER, B-LINE B3104CT.
b. FOR SUPPORTING VERTICAL RUNS USE EPOXY PAINTED OR PLASTIC COATED RISER CLAMPS, B-LINE B3373CT OR B3373CTC.
c. FOR SUPPORTING COPPER TUBE TO STRUT USE EPOXY PAINTED PIPE STRAPS SIZED FOR COPPER TUBING, B-LINE B2000 SERIES, OR PLASTIC INSERTED VIBRATION ISOLATION CLAMPS, B-LINE BVT SERIES.

F. V-BOTTOM CLEVIS HANGER WITH GALVANIZED 18-GAUGE CONTINUOUS SUPPORT CHANNEL, B-LINE B3106 AND B3106V, TO FORM A CONTINUOUS SUPPORT SYSTEM FOR PLASTIC PIPE OR FLEXIBLE TUBING.
1. SUPPLEMENTARY STRUCTURAL SUPPORTS
a. DESIGN AND FABRICATE SUPPORTS USING STRUCTURAL QUALITY STEEL BOLTED FRAMING MATERIALS AS MANUFACTURED BY COOPER B-LINE. PROVIDE ROLL FORMED CHANNELS, 12 GAUGE ASTM A1011 SS GRADE 33 STEEL, 1-5/8 INCH BY 1-5/8 INCH OR GREATER AS REQUIRED BY LOADING CONDITIONS. SUBMIT DESIGNS FOR PIPE TUNNELS, PIPE GALLERIES, ETC., TO ARCHITECT/ENGINEER FOR APPROVAL. USE CLAMPS AND FITTINGS DESIGNED FOR USE WITH THE STRUT SYSTEM.

G. PIPE SUPPORTS BETWEEN ANCHORS AND PIPE EXPANSION LOOPS
1. PROVIDE SUPPORTS BETWEEN PIPE ANCHORS DESIGNED TO CAUSE MINIMAL RESISTANCE TO PIPING MOVEMENT. PROVIDE ROLLER HANGER SUPPORTS OR SLIDE PLATES BETWEEN ANCHORS.
2. PROVIDE SUPPORTS NEAR THE L BENDS OF PIPE THERMAL EXPANSION LOOPS. NO MORE THAN 12 INCHES FROM EITHER SIDE OF THE HORIZONTAL ELBOW.

2.2 SPRING HANGERS

A. WHERE TRANSFER OF LOAD TO ADJACENT HANGERS OR EQUIPMENT IS NOT CRITICAL, AND WHERE THE VERTICAL MOVEMENT OF THE PIPING IS LESS THAN ¾ INCH, VARIABLE SPRING HANGERS MAY BE USED, PROVIDED THE VARIATION IN SUPPORTING EFFECT DOES NOT EXCEED 25 PERCENT OF THE CALCULATED PIPING LOAD THROUGH ITS TOTAL VERTICAL TRAVEL.
B. THE TOTAL TRAVEL FOR CONSTANT SUPPORT HANGERS SHALL BE EQUAL TO ACTUAL TRAVEL PLUS 20 PERCENT. IN NO CASE SHALL THE DIFFERENCE BETWEEN ACTUAL AND TOTAL TRAVEL BE LESS THAN ONE INCH.
C. FURNISH CONSTANT SUPPORT HANGERS WITH TRAVEL STOPS, WHICH SHALL PREVENT UPWARD AND DOWNWARD MOVEMENT OF THE HANGER. THE TRAVEL STOPS SHALL BE FACTORY INSTALLED SO THAT THE HANGER LEVEL IS AT THE "COLD" POSITION. DESIGN THE TRAVEL STOPS TO PERMIT FUTURE REENGAGEMENT, EVEN IN THE EVENT THE LEVER IS AT A POSITION OTHER THAN "COLD", WITHOUT HAVING TO MAKE HANGER ADJUSTMENTS.
D. FOR LOW TEMPERATURE SYSTEMS WHERE VERTICAL MOVEMENTS ARE ANTICIPATED, USE APPROVED PRECOMPRESSED VARIABLE SPRING HANGERS.

2.3 UPPER ATTACHMENTS

A. BEAM CLAMPS
1. USE BEAM CLAMPS WHERE PIPING IS TO BE SUSPENDED FROM BUILDING STEEL. SELECT CLAMP TYPE ON THE BASIS OF LOAD TO BE SUPPORTED, AND LOAD CONFIGURATION.
2. USE CENTER LOADED BEAM CLAMPS WHERE SPECIFIED. FOR STEEL CLAMPS PROVIDE B-LINE B3050, OR B3055. FOR MALLEABLE IRON OR FORGED STEEL BEAM CLAMPS WITH CROSS BOLT PROVIDE B-LINE B3054 OR B3291-B3297 SERIES AS REQUIRED TO FIT BEAMS.

B. CONCRETE INSERTS
1. USE CAST IN PLACE SPOT CONCRETE INSERTS WHERE APPLICABLE; EITHER STEEL OR MALLEABLE IRON BODY, B-LINE B2500 OR B3014. SELECT SPOT INSERTS TO ALLOW FOR LATERAL ADJUSTMENT AND TO HAVE MEANS FOR ATTACHMENT TO FORMS. SELECT INSERTS TO SUIT THREADED HANGER ROD SIZES, B-LINE N2500 OR B3014N SERIES.
2. USE CONTINUOUS CONCRETE INSERTS WHERE APPLICABLE. PROVIDE 12 GAUGE CHANNELS, ASTM A1011 SS GRADE 33 STRUCTURAL QUALITY CARBON STEEL, COMPLETE WITH STYROFOAM INSERTS AND END CAPS WITH NAIL HOLES FOR ATTACHMENT TO FORMS. PROVIDE CONTINUOUS CONCRETE INSERTS WITH A LOAD RATING OF 2,000 LBS/FT. IN CONCRETE, B-LINE B22I, 32I, OR 52I. SELECT CHANNEL NUTS SUITABLE FOR STRUT AND ROD SIZES.
3. PROVIDE DROP-IN, SHELL TYPE ANCHORS WITH AN INTERNALLY THREADED, ALL-STEEL SHELL WITH EXPANSION CONE INSERT AND FLUSH EMBEDMENT LIP. MANUFACTURE ANCHORS FROM PLATED CARBON STEEL, 18-8 STAINLESS STEEL AND 316 STAINLESS STEEL. INSTALL ANCHORS WITH CARBIDE TIPPED HAMMER DRILL BITS MADE IN ACCORDANCE TO ANSI B212.15-1994 SPECIFICATIONS. TEST ANCHORS TO ASTM E488 CRITERIA AND LISTED BY ICC (FORMERLY ICBO) AND SBCCI. PROVIDE ANCHORS LISTED BY THE FOLLOWING AGENCIES AS REQUIRED BY THE LOCAL BUILDING CODE: UL, FM. SELECT INSERTS TO SUIT THREADED HANGER ROD SIZES, REDHEAD MULTI-SET.

2.4 ACCESSORIES

A. HANGER RODS SHALL BE THREADED BOTH ENDS OR CONTINUOUS THREADED RODS OF CIRCULAR CROSS SECTION. USE ADJUSTING LOCKNUTS AT UPPER ATTACHMENTS AND HANGERS. NO WIRE, CHAIN, OR PERFORATED STRAPS ARE ALLOWED.
B. PROVIDE SHIELDS THAT ARE 180 DEGREE GALVANIZED SHEET METAL, 12 INCH MINIMUM LENGTH, 18 GAUGE MINIMUM THICKNESS, DESIGNED TO MATCH OUTSIDE DIAMETER OF THE INSULATED PIPE, B-LINE B3151.
C. PIPE PROTECTION SADDLES SHALL BE FORMED FROM CARBON STEEL, 1/8 INCH MINIMUM THICKNESS, SIZED FOR INSULATION THICKNESS. SADDLES FOR PIPE SIZES GREATER THAN 12 INCH SHALL HAVE A CENTER SUPPORT RIB.

2.5 FINISHES

A. INDOOR FINISHES
1. COAT HANGERS AND CLAMPS FOR SUPPORT OF BARE COPPER PIPING WITH COPPER COLORED EPOXY PAINT, B-LINE DURA-COPPER®. USE ADDITIONAL PVC COATING OF THE EPOXY PAINTED HANGER WHERE NECESSARY.
2. ZINC PLATE HANGERS FOR OTHER THAN BARE COPPER PIPE IN ACCORDANCE WITH ASTM B633 OR PROVIDE AN ELECTRO-DEPOSITED GREEN EPOXY FINISH, B-LINE DURA-GREEN®.
3. PROVIDE PRE-GALVANIZED STRUT CHANNELS IN ACCORDANCE WITH ASTM A653 SS GRADE 33 G90 OR PROVIDE AN ELECTRO-DEPOSITED GREEN EPOXY FINISH, B-LINE DURA-GREEN®.

B. OUTDOOR AND CORROSIVE AREA FINISHES
1. HOT DIP GALVANIZE HANGERS AND STRUTS LOCATED OUTDOORS AFTER FABRICATION IN ACCORDANCE WITH ASTM A123. PROVIDE ALL HANGER HARDWARE AS HOT DIP GALVANIZED OR STAINLESS STEEL. ZINC PLATED HARDWARE IS NOT ACCEPTABLE FOR OUTDOOR OR CORROSIVE USE.
2. PROVIDE HANGERS AND STRUT MANUFACTURED OF TYPE 304 STAINLESS STEEL WITH STAINLESS STEEL HARDWARE WHERE LOCATED IN CORROSIVE AREAS

PART 3 - EXECUTION

3.1 PIPE HANGERS AND SUPPORTS

A. ADEQUATELY SUPPORT PIPE BY PIPE HANGER AND SUPPORTS SPECIFIED IN PART 2 PRODUCTS. ALLOW FOR FORCES IMPOSED BY EXPANSION JOINTS, SATISFY STRUCTURAL REQUIREMENTS AND MAINTAIN PROPER CLEARANCES WITH RESPECT TO ADJACENT PIPING, EQUIPMENT AND STRUCTURES. SIZE HANGERS FOR INSULATED PIPES SIZED TO ACCOMMODATE INSULATION THICKNESS.
B. KEEP THE DIFFERENT TYPES OF HANGERS TO A MINIMUM AND PROVIDE HANGERS THAT ARE NEAT, WITHOUT COMPLICATED BOLTING AND WITH THE NUMBER OF PARTS OF EACH HANGER AND ITS ANCHOR KEPT TO A MINIMUM.
C. MAKE ACCURATE WEIGHT BALANCE CALCULATIONS TO DETERMINE THE REQUIRED SUPPORTING FORCES AT EACH HANGER OR SUPPORT LOCATION AND THE PIPE WEIGHT LOAD AT EACH EQUIPMENT CONNECTION.
D. PROVIDE PIPE HANGERS CAPABLE OF SUPPORTING THE PIPE IN ALL CONDITIONS OF OPERATION SELECTED TO ALLOW FREE EXPANSION AND CONTRACTION OF THE PIPING, AND PREVENT EXCESSIVE STRESS RESULTING FROM TRANSFERRED WEIGHT BEING INDUCED INTO THE PIPE OR CONNECTED EQUIPMENT.
E. PAINTED OR SHOP PRIME ALL HANGERS AND SUPPORTS THAT ARE NOT GALVANIZED.
F. SUPPORT HORIZONTAL STEEL PIPING IN ACCORDANCE WITH MSS SP-69 TABLES 3 AND 4, EXCERPTS OF WHICH FOLLOW BELOW:

NOMINAL PIPE SIZE (INCHES)	ROD DIAMETER (INCHES)	MAXIMUM SPACING (FEET)
1/2 TO 1-1/4	3/8	6
1-1	3/8	9

G. SUPPORT HORIZONTAL COPPER TUBING IN ACCORDANCE WITH MSS SP-69 TABLES 3 AND 4, EXCERPTS OF WHICH FOLLOW BELOW:

NOMINAL PIPE SIZE (INCHES)	ROD DIAMETER (INCHES)	MAXIMUM SPACING (FEET)
1/2 TO 3/4	3/8	5
1	3/8	6
1-1/4	3/8	6
1-1/2	3/8	8

H. PROVIDE MEANS OF PREVENTING DISSIMILAR METAL CONTACT SUCH AS PLASTIC COATED HANGERS, COPPER COLORED EPOXY PAINT, OR NON ADHESIVE ISOLATION TAPE- B-LINE ISO-PIPE. GALVANIZED FELT ISOLATORS SIZED FOR COPPER TUBING MAY ALSO BE USED, B-LINE B3195CT.
I. INSTALL HANGERS TO PROVIDE A MINIMUM OF 1/2 INCH SPACE BETWEEN FINISHED COVERING AND ADJACENT WORK.
J. PLACE A HANGER WITHIN 12 INCHES OF EACH HORIZONTAL ELBOW.
K. SUPPORT VERTICAL PIPING INDEPENDENTLY OF CONNECTED HORIZONTAL PIPING. SUPPORT VERTICAL PIPES AT EVERY FLOOR. WHEREVER POSSIBLE, LOCATE RISER CLAMPS DIRECTLY BELOW PIPE COUPLINGS OR SHEAR LUGS.
L. WHERE SEVERAL PIPES CAN BE INSTALLED IN PARALLEL AND AT THE SAME ELEVATION, PROVIDE TRAPEZE HANGERS AS SPECIFIED IN SECTION 2.02 C. SPACE TRAPEZE HANGERS ACCORDING TO THE SMALLEST PIPE SIZE, OR INSTALL INTERMEDIATE SUPPORTS ACCORDING TO SCHEDULES IN THIS SECTION.
M. DO NOT SUPPORT PIPING FROM OTHER PIPES, DUCTWORK OR OTHER EQUIPMENT THAT IS NOT BUILDING STRUCTURE.
N. WHERE HORIZONTAL PIPING MOVEMENTS ARE GREATER THAN ½ INCH, OR WHERE THE HANGER ROD ANGULARITY FROM THE VERTICAL IS GREATER THAN FOUR DEGREES FROM THE COLD TO HOT POSITION OF THE PIPE, OFFSET THE HANGER PIPE AND STRUCTURAL ATTACHMENTS IN SUCH A MANNER THAT THE ROD IS VERTICAL IN THE HOT POSITION.
O. IN ANY PART OF THE BUILDING WHICH IS STEEL-FRAMED, ATTACH HANGERS TO THE BUILDING STRUCTURAL STEEL BEAMS WHERE HANGERS DO NOT CORRESPOND WITH THE BUILDING STRUCTURAL STEEL BEAMS, PROVIDE SUPPLEMENTAL STEEL MEMBERS CONTINUOUSLY WELDED OR BOLTED TO THE BUILDING STRUCTURAL STEEL BEAMS. PROVIDE TWO (2) COATS OF PRIMER ON THE SUPPLEMENTAL STEEL. IN ANY PARTS OF THE BUILDING WHICH IS A CONCRETE STRUCTURE, ATTACH HANGERS TO THE CONCRETE STRUCTURE BY INSTALLING ANCHORS INTO THE CONCRETE.

3.2 CONCRETE INSERTS

A. SECURE PIPE HANGERS ATTACHED TO CONCRETE STRUCTURE AND SLABS WITH EMBEDDED INSERTS, ANCHOR BOLTS OR CONCRETE FASTENERS. USE A SAFETY FACTOR OF 5 IN SELECTION OF ALL INSERTS AND EXPANSION BOLTS UNLESS THERE ARE SEISMIC REQUIREMENTS (SEE "SEISMIC RESTRAINT" SPECIFICATION IF APPLICABLE). IN WHICH CASE, THE LARGER OF THE TWO LOADINGS SHALL GOVERN THE DESIGN.
B. PROVIDE INSERTS FOR PLACEMENT IN FORMWORK BEFORE CONCRETE IS POURED.
C. PROVIDE INSERTS FOR SUSPENDING HANGERS FROM REINFORCED CONCRETE SLABS AND SIDES OF REINFORCED CONCRETE BEAMS.
D. WHERE CONCRETE SLABS FORM FINISHED CEILINGS, PROVIDE INSERTS TO BE FLUSH WITH SLAB SURFACE.
E. PROVIDE HOOKED ROD TO CONCRETE REINFORCEMENT SECTION FOR INSERTS CARRYING PIPE OVER 4 INCH.

SECTION 23 05 50 - VIBRATION ISOLATION

PART 1 - PRODUCTS

2.01 STEEL SPRING ISOLATORS

A. TYPES:
1. FREE STANDING SPRINGS: PROVIDE LATERALLY STABLE UNITS, WITHOUT HOUSING, WITH A MINIMUM 1/4 INCH THICK RUBBER OR NEOPRENE SOUND DEADENING PAD BETWEEN SPRING AND ITS SUPPORT. USE FOR ISOLATING EQUIPMENT HAVING A STATIC DEFLECTION IN EXCESS OF 1 INCH, UNLESS OTHERWISE INDICATED.
2. HOUSED SPRINGS: PROVIDE UNITS WITH TELESCOPING CAST IRON OR STEEL HOUSINGS, CONTAINING ONE OR MORE SPRINGS, COMPLETE WITH RESILIENT ALIGNMENT INSERTS AND A MINIMUM 1/4 INCH THICK RUBBER OR NEOPRENE SOUND DEADENING PAD BONDED TO THE BASE OF HOUSING.

B. CONSTRUCTION FEATURES REQUIRED:
1. PROVIDE LIMIT STOPS FOR SPRING ISOLATORS WITH DEFLECTIONS OF 2 INCH OR MORE SO AS TO PREVENT UNDUE MOTION DURING START AND STOP, BUT UNRESTRAINED MOVEMENT DURING NORMAL OPERATION.
2. HOT DIP GALVANIZE ALL STEEL PARTS OF ISOLATORS FOR OUTDOOR USE, WITH THE EXCEPTION OF SPRINGS. CADMIUM PLATE OR NEOPRENE COAT SPRINGS.
3. DO NOT USE ISOLATOR LEVELING BOLTS FOR JACKING SCREWS.

2.03 INTEGRAL STRUCTURAL STEEL OR RAIL TYPE BASES

A. PROVIDE BASES, FACTORY FABRICATED FROM STRUCTURAL STEEL MEMBERS OF SUFFICIENT RIGIDITY TO MAINTAIN DRIVE ALIGNMENT AND RESIST STARTING TORQUE, WITHOUT THE USE OF RESTRAINING SNUBBER DEVICES. PROVIDE BASES COMPLETE WITH RUBBER-IN-SHEAR OR SPRING TYPE ISOLATORS, AS SPECIFIED FOR THE PARTICULAR EQUIPMENT.

2.04 CONCRETE INERTIA BLOCKS

A. TYPE: FACTORY FABRICATED WELDED STRUCTURAL STEEL POURING FRAMES WITH THE FOLLOWING:
1. SHEET METAL CASING A MINIMUM OF 6 INCHES DEEP.
2. INTEGRAL STEEL REINFORCING RODS ON 9 INCH CENTERS IN BOTH DIRECTIONS, WELDED TO STEEL FRAME;
3. HEIGHT SAVING MOUNTING LUGS AND SPRING ISOLATORS DESIGNED TO PROVIDE THE REQUIRED DEFLECTION AND EFFICIENCY.

B. CONFIGURE BASES TO ACCOMMODATE SUPPORTED EQUIPMENT.
1. PROVIDE BASES FOR ISOLATING PUMPS OF PHYSICAL SIZE AND SHAPE AS REQUIRED TO ACCOMMODATE BASE ELBOW SUPPORTS. PROVIDE MOUNTING TEMPLATES.

2.05 VIBRATION ISOLATION BASES

A. TYPE: FACTORY FABRICATED WELDED STRUCTURAL STEEL (ASTM A36) BASES AND RAILS WITH THE FOLLOWING:
1. SUPPORT BRACKETS TO ANCHOR BASE TO VIBRATION ISOLATION.
2. PRE-LOCATED EQUIPMENT ANCHOR BOLTS.
3. AUXILIARY MOTOR SLIDE BASES OR RAILS.
4. STEEL ANGLES WELDED TO FRAME FOR OUTRIGGER ISOLATION MOUNTINGS.
5. FACTORY FINISH: CORROSIVE RESISTANT FINISH.

B. DESIGN BASES TO RESULT IN LOWEST POSSIBLE MOUNTING HEIGHT WITH NOT LESS THAN ONE INCH CLEARANCE ABOVE HOUSEKEEPING PAD OR FLOOR.
C. CONFIGURE BASES TO ACCOMMODATE SUPPORTED EQUIPMENT.
1. PROVIDE BASES FOR ISOLATING PUMPS OF PHYSICAL SIZE AND SHAPE AS REQUIRED TO ACCOMMODATE BASE ELBOW SUPPORTS. PROVIDE MOUNTING TEMPLATES.

PART 3 - EXECUTION

3.01 INSTALLATION

A. JACK EQUIPMENT BASES OR INERTIA BASES INTO POSITION AND BLOCK OR WEDGE BEFORE SPRINGS ARE LOADED. AFTER EQUIPMENT IS BOLTED IN PLACE AND SPRINGS ARE LOADED, BY MEANS OF THE LEVELING BOLTS, REMOVE THE TEMPORARY BLOCKING OR WEDGING.
B. HOUSEKEEPING PADS:
1. COORDINATE SIZE AND LOCATION OF PADS WITH THE WORK OF RELATED CONTRACTS.
2. COORDINATE HOUSE KEEPING PADS WITH RESTRAINT MANUFACTURER TO PROVIDE MINIMUM EDGE DISTANCE OF 10 BOLT DIAMETERS AROUND THE OUTERMOST ANCHOR BOLT TO ALLOW DEVELOPMENT OF FULL DRILL-IN WEDGE ANCHOR RATINGS.
a. IF CAST-IN ANCHORS ARE BEING USED, SIZE HOUSEKEEPING PADS IN ACCORDANCE WITH ACI REQUIREMENTS FOR BOLT COVERAGE AND EMBEDMENT.

C. VIBRATION ISOLATION BASES:
1. COORDINATE SIZE AND LOCATION OF BASES WITH THE WORK OF RELATED CONTRACTS.

3.02 APPLICATION

A. PROVIDE VIBRATION ISOLATORS OR VIBRATION ISOLATION BASES FOR MECHANICAL EQUIPMENT, PIPING AND HIGH VELOCITY DUCTWORK OF TYPE AS SPECIFIED.
B. SELECT ISOLATION DEVICES FOR UNIFORM STATIC DEFLECTION, IN ACCORDANCE WITH THE DISTRIBUTION OF WEIGHT AND FORCES.
1. WHENEVER ROTATIONAL SPEED IS THE CAUSE OF DISTURBING FREQUENCY, UTILIZE THE LOWEST OPERATING SPEED OF THE EQUIPMENT IN DETERMINING THE TYPE OF ISOLATION REQUIRED.
2. SELECTION SHALL RESULT IN UNIFORM LOADING AND DEFLECTION, EVEN WHEN EQUIPMENT WEIGHT IS NOT EVENLY DISTRIBUTED.
3. SELECT SPRINGS FOR A TOTAL DEFLECTION GREATER THAN THE SELECTED STATIC DEFLECTION, TO PROVIDE AN ADEQUATE SAFETY FACTOR.

RPM MINIMUM	DEFLECTION	EFFICIENCY
UP TO 325	3.5	80
326 TO 525	2.0	80-90*
526 TO 575	1.5	90
576 TO 1000	1.25	90-95*
1001 TO 1200	.75	95
1201 AND OVER	.50	95

*LOWER EFFICIENCY AT LOWEST RPM - HIGHER EFFICIENCY AT HIGHEST RPM.

3.03 VIBRATION ISOLATION SCHEDULE

A. FANS AND AIR HANDLING UNITS:
1. EQUIP FANS AND AIR HANDLING UNITS, LOCATED ABOVE THE GROUND FLOOR AND NOT INDICATED TO BE PROVIDED WITH A CONCRETE INERTIA BLOCK OR BE CEILING MOUNTED OR SUSPENDED WITH VIBRATION ELIMINATION EQUIPMENT AS FOLLOWS:
a. PROVIDE AN INTEGRAL STRUCTURAL STEEL BASE WITH A COMMON STEEL MEMBER RUNNING THE FULL LENGTH OF THE FAN AND MOTOR, WITH BUILT-IN MOTOR SLIDE RAILS, SO AS TO FORM A COMMON SUPPORT FOR FAN UNIT AND MOTOR, WITH SPRING TYPE ISOLATORS, UNLESS OTHERWISE INDICATED
b. PROVIDE SPRING UNIT ISOLATORS, OR STEEL RAIL TYPE ISOLATOR BASES WITH SPRING TYPE ISOLATORS, FOR FLOOR MOUNTED UNITS WITH MOTORS MOUNTED ON THE CASINGS OR FRAMES.
2. EQUIP FANS AND HANDLING UNITS LOCATED ON THE GROUND FLOOR, WITH THE EXCEPTION OF MEDIUM OR HIGH PRESSURE UNITS NOT SPECIFIED TO BE PROVIDED WITH A CONCRETE INERTIA BLOCK, OR BE CEILING MOUNTED OR SUSPENDED, WITH UNIT ISOLATORS OR STEEL RAIL TYPE ISOLATOR BASES.
3. FLOOR MOUNTED UTILITY FAN SETS:
a. PROVIDE UNIT ISOLATORS OR STEEL RAIL TYPE ISOLATOR BASES.
b. UTILITY SETS WITH OVERHUNG SCROLLS: PROVIDE STEEL RAIL TYPE ISOLATOR BASES, WITH BUILT-IN REACTION UNITS TO COMPENSATE FOR OVERHANG.
4. CONCRETE INERTIA BLOCKS FOR FANS AND AIR-HANDLING UNITS:
a. PROVIDE INERTIA BLOCKS, 1-1/2 TIMES THE WEIGHT OF SUPPORTED EQUIPMENT, MOTOR AND DRIVE FOR THE FOLLOWING:
1) FANS AND AIR HANDLING UNITS, OPERATING AT A STATIC PRESSURE UP TO 5 INCHES W.G., DRIVEN BY ELECTRIC MOTOR 30 TO 100 HP INCLUSIVE, OR HAVING WHEEL DIAMETERS 45 TO 100 INCHES INCLUSIVE.
2) FANS AND AIR HANDLING UNITS, OPERATING AT A STATIC PRESSURE OF 5 INCHES W.G. OR MORE, DRIVEN BY MOTORS 30 TO 60 HP INCLUSIVE.
b. PROVIDE INERTIA BLOCKS, 2 TIMES THE WEIGHT OF SUPPORTED EQUIPMENT, MOTOR AND DRIVE FOR THE FOLLOWING:
1) FANS AND AIR HANDLING UNITS, OPERATING AT A STATIC PRESSURE UP TO 5 INCHES W.G., DRIVEN BY MOTORS OVER 100 HP.
2) FANS AND AIR HANDLING UNITS, OPERATING AT A STATIC PRESSURE OF 5 INCHES W.G. OR MORE, DRIVEN BY MOTORS 75 HP AND LARGER.
5. CEILING SUSPENDED FANS AND AIR HANDLING UNITS: PROVIDE COMBINATION RUBBER AND SPRING TYPE ISOLATORS, DESIGNED FOR INSERTION IN A SPLIT HANGER ROD. PROVIDE ISOLATORS WITH AN EFFICIENCY AS SPECIFIED UNDER THE PARAGRAPH ENTITLED "APPLICATION" OF THIS SECTION, WITH NO DEFLECTION GREATER THAN 1-1/2 INCHES REQUIRED.

3.03 FIELD QUALITY CONTROL

A. PROVIDE EQUIPMENT AND APPARATUS REQUIRED FOR PERFORMING INSPECTIONS AND TESTS.
1. NOTIFY DIRECTOR'S REPRESENTATIVE A MINIMUM OF 14 DAYS PRIOR TO EQUIPMENT SOUND, VIBRATION, AND SEISMIC TESTING.
2. REBALANCE, ADJUST, OR REPLACE EQUIPMENT WITH NOISE OR VIBRATION LEVELS IN EXCESS OF THOSE GIVEN IN THE EQUIPMENT SPECIFICATIONS, OR EQUIPMENT MANUFACTURER'S DATA.

B. FIELD INSPECTIONS:
1. PRIOR TO INITIAL OPERATION, INSPECT THE VIBRATION ISOLATORS AND SEISMIC SNUBBERS FOR CONFORMANCE TO DRAWINGS, SPECIFICATIONS, AND MANUFACTURER'S DATA AND INSTRUCTIONS.
a. CHECK FOR VIBRATION AND NOISE TRANSMISSION THROUGH CONNECTIONS, PIPING, DUCTWORK, FOUNDATIONS, AND WALLS.
b. CHECK CONNECTOR ALIGNMENT BEFORE AND AFTER FILLING OF SYSTEM AND DURING OPERATION.
c. CORRECT MISALIGNMENT WITHOUT DAMAGE TO CONNECTOR AND IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.

C. SPRING ISOLATOR INSPECTION
1. AFTER INSTALLATION OF SPRING ISOLATORS OR PROTECTED SPRING ISOLATORS, AND SEISMIC RESTRAINT DEVICES, THE EQUIPMENT SHALL ROCK FREELY ON ITS SPRING ISOLATORS WITHIN LIMITS OF STOPS OR SEISMIC RESTRAINT DEVICES. ELIMINATE OR CORRECT ANY INTERFERENCES.

D. TESTS
1. ADJUST, REPAIR, OR REPLACE ISOLATORS AS REQUIRED TO REDUCE VIBRATION AND NOISE TRANSMISSIONS TO SPECIFIED LEVELS.
2. EQUIPMENT VIBRATION TESTS
a. PERFORM VIBRATION TESTS TO DETERMINE CONFORMANCE WITH VIBRATION ISOLATION SCHEDULE SPECIFIED.

SECTION 230594 - BALANCING OF AIR SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. THIS SECTION SPECIFIES REQUIREMENTS FOR TESTING, ADJUSTING, AND BALANCING OF ALL AIR DISTRIBUTION SYSTEMS, INCLUDING THE EQUIPMENT AND DEVICES ASSOCIATED WITH EACH SYSTEM.
B. THE WORK INCLUDES SETTING SPEED AND FLOW, ADJUSTING EQUIPMENT AND DEVICES INSTALLED FOR SYSTEMS, RECORDING DATA, CONDUCTING TESTS, PREPARING AND SUBMITTING REPORTS, AND RECOMMENDING MODIFICATIONS T O THE MECHANICAL INSTALLATIONS SPECIFIED IN OTHER SECTIONS OF THE SPECIFICATIONS.

1.2 RELATED WORK

b. A. DRAWINGS AND GENERAL PROVISIONS OF THE CONTRACT, INCLUDING GENERAL CONDITIONS, ANY SUPPLEMENTAL CONDITIONS AND DIVISION 1 SPECIFICATION SECTIONS, GOVERN THE WORK OF THIS SECTION..

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	10/14/2022	ISSUED FOR BID AND PERMIT
1	11/18/2022	ADDENDUM 1
3	02/03/2023	ADDENDUM 3
4	03/10/2023	ADDENDUM 4
5	03/31/2023	ADDENDUM 5

NORTH CAROLINA PROFESSIONAL ENGINEER
SEAL 053111
YVETTE RICHARDSON

Seal / Signature

Project Name
VILLAGE DISTRICT

Project Number
69.6575.000

Description
MECHANICAL SPECIFICATIONS I

Scale
NONE

M-591

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1.3 SUBMITTALS

B. SUBMIT PROOF THAT THE TESTING, ADJUSTING AND BALANCING AGENCY MEETS THE REQUIREMENTS OF SECTION 1.3 “QUALITY ASSURANCE”, AND ALL OTHER SPECIFIED REQUIREMENTS.

C. PRIOR TO PERFORMING THE WORK, SUBMIT SAMPLE BLANK FORMS OF THE TEST REPORTS THAT WILL BE SUBMITTED BY THE ENTITY PERFORMING WORK OF THIS SECTION, INDICATING ALL DATA AND PARAMETERS INCLUDED.

D. SUBMIT CERTIFIED TEST REPORTS, SIGNED BY THE AUTHORIZED REPRESENTATIVE OF THE TESTING AND BALANCING

E. CERTIFY THE REPORTS TO BE PROOF THAT THE SYSTEMS HAVE BEEN TESTED, ADJUSTED AND BALANCED IN ACCORDANCE WITH THE SELECTED REFERENCE STANDARDS (NEBB OR AABC); ARE AN ACCURATE REPRESENTATION OF HOW THE SYSTEMS HAVE BEEN INSTALLED; ARE A TRUE REPRESENTATION OF HOW THE SYSTEMS ARE OPERATING AT COMPLETION OF THE TESTING, ADJUSTING AND BALANCING PROCEDURES; AND ARE AN ACCURATE RECORD OF ALL FINAL QUANTITIES MEASURED, TO ESTABLISH NORMAL OPERATING VALUES OF THE SYSTEMS. SUBMITTAL OF TEST REPORT SHALL BE IN THE FOLLOWING FORMAT:

1. DRAFT REPORT: UPON COMPLETION OF TESTING, ADJUSTING AND BALANCING PROCEDURES, PREPARE DRAFT REPORTS ON THE APPROVED FORMS. DRAFT REPORT MAY BE HANDWRITTEN, BUT MUST BE COMPLETE, FACTUAL, ACCURATE AND LEGIBLE. ORGANIZE AND FORMAT DRAFT REPORTS IN THE SAME MANNER SPECIFIED HEREIN FOR THE FINAL REPORTS. SUBMIT TWO COMPLETE SETS OF DRAFT REPORTS. ONLY ONE COMPLETE SET OF DRAFT REPORTS WILL BE RETURNED.

2. FINAL REPORT: UPON VERIFICATION AND APPROVAL OF DRAFT REPORTS, PREPARE FINAL REPORTS, TYPE WRITTEN AND ORGANIZED AND FORMATTED AS DESCRIBED HEREIN. SUBMIT TWO COMPLETE SETS OF FINAL REPORTS.

a. REPORT FORMAT: SUBMIT REPORTS USING THE STANDARD FORMS PREPARED BY THE REFERENCED STANDARD FOR EACH RESPECTIVE ITEM AND SYSTEM TO BE TESTED, ADJUSTED AND BALANCED. INCLUDE SCHEMATIC SYSTEMS DIAGRAMS. ENCLOSE THE REPORT CONTENTS IN A 3-RING BINDER. DIVIDE THE CONTENTS INTO THE BELOW LISTED DIVISIONS, SEPARATING THEM BY DIVIDER TABS WITH TITLES DESCRIPTIVE OF THE CONTENTS:

1) GENERAL INFORMATION AND SUMMARY.

2) AIR SYSTEMS.

b. REPORT CONTENTS: PROVIDE THE FOLLOWING MINIMUM INFORMATION, FORMS AND DATA:

1) GENERAL INFORMATION AND SUMMARY: IDENTIFY THE TESTING, ADJUSTING AND BALANCING AGENCY, CONTRACTOR, OWNER, ARCHITECT/ENGINEER, AND PROJECT ON THE INSIDE COVER SHEET. INCLUDE ADDRESSES, AND CONTACT NAMES AND TELEPHONE NUMBERS. INCLUDE A CERTIFICATION SHEET CONTAINING THE SEAL AND NAME, ADDRESS, TELEPHONE NUMBER AND SIGNATURE OF THE AGENCY’S RESPONSIBLE CERTIFIED TEST AND BALANCE ENGINEER. INCLUDE IN THIS DIVISION A LISTING OF THE INSTRUMENTATION USED FOR THE PROCEDURES, ALONG WITH THE PROOF OF CALIBRATIONS. INCLUDE IN THE REMAINDER OF THE REPORTS THE APPROPRIATE FORMS CONTAINING, AS A MINIMUM, THE INFORMATION INDICATED ON THE STANDARD REPORT FORMS PREPARED BY AABC OR NEBB, FOR EACH ITEM OF EQUIPMENT AND SYSTEM. PREPARE A SCHEMATIC DIAGRAM FOR EACH ITEM OF EQUIPMENT AND SYSTEM, TO ACCOMPANY EACH RESPECTIVE REPORT FORM.

c. CALIBRATION REPORTS: SUBMIT PROOF THAT ALL REQUIRED INSTRUMENTATION HAS BEEN CALIBRATED TO TOLERANCES SPECIFIED IN THE REFERENCED STANDARDS WITHIN A PERIOD NOT EXCEEDING SIX MONTHS PRIOR TO CONDUCTING THE TEST PROCEDURES.

1.4 QUALITY ASSURANCE

A. TEST, ADJUST AND BALANCE SYSTEMS AND EQUIPMENT BY USING COMPETENT MECHANICS REGULARLY EMPLOYED BY A TESTING, ADJUSTING AND BALANCING SUBCONTRACTOR WHOSE PRIMARY BUSINESS IS THE TESTING, ADJUSTING AND BALANCING OF BUILDING MECHANICAL SYSTEMS. THE TESTING, ADJUSTING AND BALANCING SUBCONTRACTOR SHALL BE A BUSINESS ESTABLISHED FOR A MINIMUM OF 10 YEARS.

B. THE TESTING, ADJUSTING, AND BALANCING SUBCONTRACTOR SHALL BE CERTIFIED BY THE ASSOCIATED AIR BALANCE COUNCIL (AABC) OR THE NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB).

C. INSTRUMENTATION TYPE, QUANTITY, AND ACCURACY SHALL BE AS DESCRIBED IN AABC’S “NATIONAL STANDARDS FOR FIELD MEASUREMENT AND INSTRUMENTATION, OR TOTAL SYSTEM BALANCE, OR NEBB'S "PROCEDURAL STANDARDS FOR TESTING, ADJUSTING, AND BALANCING OF ENVIRONMENTAL SYSTEMS."

D. ALL INSTRUMENTATION SHALL BE CALIBRATED AT LEAST EVERY 6 MONTHS OR MORE FREQUENTLY IF REQUIRED BY THE INSTRUMENT MANUFACTURER.

1.5 PERFORMANCE REQUIREMENTS

A. A. COMPLY WITH ALL APPLICABLE FEDERAL, STATE AND LOCAL LAWS, ORDINANCES, REGULATIONS AND CODES, AND THE LATEST INDUSTRY STANDARDS INCLUDING, BUT NOT LIMITED TO THE ENTITIES LISTED BELOW FOR PROCEDURES, MEASUREMENTS, INSTRUMENTS AND TEST REPORTS FOR TESTING, ADJUSTING AND BALANCING WORK:

1. AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)
2. SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA)
3. NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)
4. ASSOCIATED AIR BALANCE COUNCIL (AABC)

B. SET THE AIR DELIVERY OR INTAKE OF EACH DIFFUSER, GRILLE AND REGISTER TO BE AS DESIGNED OR WITHIN FIVE PERCENT OF THE AIR FLOW RATES SHOWN ON THE DRAWINGS.

C. C. SET THE FAN AIR FLOW RATE AND STATIC PRESSURE RISE ACROSS THE FAN TO BE WITHIN 10 PERCENT ABOVE THE DESIGN VALUE AT DESIGN SPEED.

1.6 JOB CONDITIONS

A. REQUIRE THE TESTING AND BALANCING SPECIALIST TO REVIEW HIS WORK WITH THE RESPECTIVE MANUFACTURERS OF THE EQUIPMENT AND DEVICES INVOLVED, AND COORDINATE AND SCHEDULE ALL WORK.

B. FURNISH AND INSTALL BALANCING DAMPERS, PRESSURE TAPS, GAUGES, AND OTHER COMPONENTS AS REQUIRED FOR A PROPERLY BALANCED SYSTEM, WHETHER OR NOT SPECIFIED HEREIN OR SHOWN ON THE DRAWINGS, ALL AT NO ADDITIONAL COST TO THE OWNER. MAKE ALL ADJUSTMENT OR REPLACEMENT PARTS RECOMMENDED BY THE TESTING AND BALANCING SPECIALIST IN STRICT ACCORDANCE WITH THE RESPECTIVE EQUIPMENT MANUFACTURER’S RECOMMENDATIONS.

C. C. COORDINATE WITH THE CONTROL MANUFACTURER’S REPRESENTATIVE TO SET THE ADJUSTMENT OF THE AUTOMATICALLY OPERATED DAMPERS TO OPERATE AS REQUIRED.

1.7 GENERAL

PERIOD. THE OWNER WILL OCCUPY THE BUILDING DURING THE ENTIRE TESTING, ADJUSTING, AND BALANCING COOPERATE WITH THE OWNER DURING TESTING, ADJUSTING, AND BALANCING OPERATIONS TO MINIMIZE CONFLICTS WITH THE OWNER'S OPERATIONS.

B. COMPLETE ALL TESTS SPECIFIED HEREIN TO THE SATISFACTION OF THE ARCHITECT/ENGINEER BEFORE FINAL ACCEPTANCE.

C. THE ARCHITECT/ENGINEER, OR HIS REPRESENTATIVE, IS THE SOLE JUDGE OF THE ACCEPTABILITY OF THE TESTS. THE ARCHITECT/ENGINEER MAY DIRECT THE PERFORMANCE OF ANY SUCH ADDITIONAL TESTS, AS HE DEEMS NECESSARY IN ORDER TO DETERMINE THE ACCEPTABILITY OF THE SYSTEMS, EQUIPMENT, MATERIAL AND WORKMANSHIP. NO ADDITIONAL PAYMENT WILL BE MADE FOR ANY TEST REQUIRED BY THE ARCHITECT/ENGINEER.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

3.1 EXAMINATION

A. OBTAIN DESIGN DRAWINGS AND SPECIFICATIONS AND BECOME THOROUGHLY ACQUAINTED WITH THE DESIGN INTENT.

B. OBTAIN COPIES OF APPROVED SHOP DRAWINGS OF ALL AIR HANDLING EQUIPMENT, AIR OUTLETS (SUPPLY, RETURN AND EXHAUST), AND THE TEMPERATURE CONTROL DIAGRAMS, INCLUDING INTENDED SEQUENCE OF OPERATIONS.

C. EXAMINE INSTALLED WORK AND CONDITIONS UNDER WHICH TESTING IS TO BE DONE TO ENSURE THAT WORK HAS BEE N COMPLETED, CLEANED, AND IS OPERABLE. DO NOT PROCEED WITH TESTING, ADJUSTING AND BALANCING UNTIL UNSATISFACTORY CONDITIONS HAVE BEEN CORRECTED IN A MANNER APPROVED BY THE TESTING AND BALANCING SPECIALIST.

D. EXAMINE THE AIR SYSTEMS TO SEE THAT THEY ARE FREE FROM OBSTRUCTIONS. DETERMINE THAT ALL DAMPERS AND REGISTERS ARE OPEN, MOVING EQUIPMENT IS LUBRICATED, CLEAN FILTERS ARE INSTALLED, AND AUTOMATIC CONTROLS ARE FUNCTIONING; AND PERFORM OTHER INSPECTIONS AND MAINTENANCE ACTIVITIES NECESSARY FOR PROPER OPERATION OF THE SYSTEMS.

E. WHERE EXISTING SYSTEMS ARE TO BE MODIFIED OR ADDED TO ENSURE THAT ALL FILTERS ARE CLEAN AND ANY OPERATIONAL PROBLEMS THAT WILL PREVENT SYSTEM BALANCE HAVE BEEN BROUGHT TO THE ATTENTION OF THE OWNER AND REPAIRED.

3.2 TESTING, ADJUSTING AND BALANCING

A. NOTIFY THE OWNER 48 HOURS IN ADVANCE OF STARTING ANY TESTS. DO NOT PERFORM ANY TESTS UNTIL ACKNOWLEDGMENT OF NOTIFICATION AND APPROVAL HAS BEEN RECEIVED FROM THE OWNER.

B. PROVIDE ALL NECESSARY INSTRUMENTS AND PERSONNEL FOR THE TESTS. IF, IN THE OPINION OF THE ARCHITECT/ENGINEER, THE RESULTS OF SUCH TESTS SHOW THAT THE WORK HAS NOT COMPLIED WITH THE REQUIREMENTS OF THE CONTRACT DOCUMENTS, MAKE ALL ADDITIONS OR CHANGES NECESSARY TO PUT THE SYSTEM IN PROPER WORKING CONDITION AND PAY ALL EXPENSES FOR ALL SUBSEQUENT TESTS WHICH ARE NECESSARY TO DETERMINE WHETHER THE WORK IS SATISFACTORY. ANY ADDITIONAL WORK OR SUBSEQUENT TESTS SHALL BE CARRIED OUT AT THE CONVENIENCE OF THE ARCHITECT/ENGINEER.

C. TEST ALL PACKAGED EQUIPMENT IN STRICT ACCORDANCE WITH THE EQUIPMENT MANUFACTURER’S REQUIREMENTS.

D. PERFORM ANY AND ALL OTHER TESTS THAT MAY BE REQUIRED BY THE LOCAL MUNICIPALITY OR OTHER GOVERNING BODY, BOARD OR AGENCY HAVING JURISDICTION.

E. PERFORM TESTING, ADJUSTING, AND BALANCING AFTER LEAKAGE AND PRESSURE TESTS ON AIR DISTRIBUTION SYSTEMS HAVE BEEN SATISFACTORILY COMPLETED.

F. ACTUATE ALL SAFETY DEVICES IN A MANNER THAT CLEARLY DEMONSTRATES THEIR WORKABILITY AND OPERATION.

G. CUT INSULATION AND DUCTWORK FOR INSTALLATION OF TEST PROBES TO THE MINIMUM EXTENT NECESSARY TO ALLOW ADEQUATE PERFORMANCE OF TEST PROCEDURE.

H. PERFORM TESTS AND COMPILE TEST DATA FOR ALL AIR SYSTEMS.

I. INCLUDE A SCHEMATIC DIAGRAM LOCATING THE AIR INLETS, OUTLETS, FANS, EQUIPMENT, DAMPERS AND REGULATING DEVICES FOR AIR SYSTEMS.

J. ALL INSTRUMENTS USED SHALL BE PROVIDED BY THE ENTITY PERFORMING THE WORK OF THIS SECTION, AND SHALL BE ACCURATELY CALIBRATED AND MAINTAINED IN GOOD WORKING ORDER.

K. AIR SYSTEMS

L. PERFORM THE TESTING, ADJUSTING AND BALANCING OF AIR SYSTEMS IN ACCORDANCE WITH THE DETAILED PROCEDURES OUTLINED IN THE REFERENCED STANDARDS; INCLUDING BUT NOT BE LIMITED TO THE FOLLOWING:

1. TEST, RECORD AND ADJUST FAN RPM TO DESIGN REQUIREMENTS.
2. TEST AND RECORD MOTOR FULL LOAD AMPERES.
3. MAKE A PITOT TUBE TRAVERSE OF MAIN SUPPLY DUCTS AND OBTAIN DESIGN FLOW RATE AT FANS.
4. TEST AND RECORD SYSTEM STATIC PRESSURE, VELOCITY PRESSURE AND TOTAL PRESSURE.
5. TEST AND ADJUST SYSTEM FOR DESIGN SUPPLY, TRANSFER AND RETURN AIR FLOW RATE.
6. TEST AND ADJUST SYSTEM FOR MINIMUM AND MAXIMUM DESIGN FLOW RATES OF OUTSIDE AIR.
7. TEST AND RECORD RETURN AIR TEMPERATURES.
8. TEST AND RECORD COIL AND FAN LEAVING AIR TEMPERATURES.
9. ADJUST ALL MAIN SUPPLY, RETURN, RELIEF, AND EXHAUST AIR DUCTS TO PROPER DESIGN FLOW RATE.
10. ADJUST ALL ZONES TO PROPER DESIGN FLOW RATE FOR SUPPLY, RETURN, TRANSFER, RELIEF AND EXHAUST AIR.
11. TEST AND ADJUST EACH DIFFUSER, GRILLE AND REGISTER. IDENTIFY EACH GRILLE, DIFFUSER AND REGISTER AS TO LOCATION AND AREA ON THE SCHEMATIC DIAGRAM. IDENTIFY AND LIST IN THE FINAL REPORT SIZE, TYPE AND MANUFACTURER OF DIFFUSERS, GRILLES AND REGISTERS AND ALL TESTED EQUIPMENT. USE MANUFACTURER’S DATA ON ALL EQUIPMENT TO MAKE REQUIRED CALCULATIONS FOR TESTING, ADJUSTING AND BALANCING. INCLUDE DESIGN REQUIRED VELOCITY AND TEST RESULTANT VELOCITY, REQUIRED FLOW RATE AND TEST RESULTANT FLOW RATE AFTER ADJUSTMENT AS PART OF READINGS AND TESTS OF DIFFUSERS, GRILLES AND REGISTERS.
12. ADJUST ALL DIFFUSERS, GRILLES AND REGISTERS TO MINIMIZE DRAFTS IN ALL AREAS.
13. PERMANENTLY MARK ALL DAMPERS AFTER AIR BALANCE IS COMPLETE SO THAT THEY CAN BE RESTORED TO THEIR CORRECT POSITION, IF DISTURBED LATER.

M. 14. SEAL OPENINGS IN DUCTWORK FOR PITOT TUBE INSERTION WITH SNAP-IN PLUGS AFTER AIR BALANCE IS COMPLETE.

SECTION 230700 - HVAC INSULATION

PART 1 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. SURFACE-BURNING CHARACTERISTICS:

1. INDOOR INSULATION AND RELATED MATERIALS: TO BE FACTORY LABELED DESIGNATING MAXIMUM FLAME-SPREAD INDEX OF 25 OR LESS, AND SMOKE-DEVELOPED INDEX OF 50 OR LESS ACCORDING TO ASTM E 84.
2. OUTDOOR INSULATION AND RELATED MATERIALS: TO BE FACTORY LABELED DESIGNATING MAXIMUM
3. FLAME-SPREAD INDEX OF 75 OR LESS, AND SMOKE-DEVELOPED INDEX OF 150 OR LESS ACCORDING TO ASTM E 84.

2.2 INSULATION MATERIALS

A. FOAM INSULATION MATERIALS SHALL NOT USE CFC OR HCFC BLOWING AGENTS IN THE MANUFACTURING PROCESS.

B. FLEXIBLE ELASTOMERIC: CLOSED-CELL, SPONGE- OR EXPANDED-RUBBER MATERIALS. COMPLY WITH ASTM C 534, TYPE I FOR TUBULAR MATERIALS AND TYPE II FOR SHEET MATERIALS.

C. MINERAL-FIBER BLANKET INSULATION: COMPLY WITH ASTM C 553, TYPE II AND ASTM C 1290, TYPE I.

D. MINERAL-FIBER BOARD INSULATION: COMPLY WITH ASTM C 612, TYPE IA OR TYPE IB. FOR DUCT AND PLENUM APPLICATIONS, PROVIDE INSULATION WITH FACTORY-APPLIED FSK JACKET.

E. MINERAL-FIBER, PREFORMED PIPE INSULATION: COMPLY WITH ASTM C 547, TYPE I, GRADE A, WITH FACTORY-APPLIED ASJ.

F. MINERAL-FIBER, PIPE AND TANK INSULATION: COMPLYING WITH ASTM C 1393, TYPE II OR TYPE IIIA CATEGORY 2, OR WITH PROPERTIES SIMILAR TO ASTM C 612, TYPE IB; AND HAVING FACTORY-APPLIED ASJ OR FSK JACKET. NOMINAL DENSITY IS 2.5 LB/CU. FT. OR MORE. THERMAL CONDUCTIVITY (K-VALUE) AT 100 DEG F IS 0.29 BTU X IN./H X SQ. FT. X DEG F OR LESS.

G. POLYOLEFIN INSULATION: UNICELLULAR, POLYETHYLENE THERMAL PLASTIC INSULATION. COMPLY WITH ASTM C 534 OR ASTM C 1427, TYPE I, GRADE 1 FOR TUBULAR MATERIALS AND TYPE II, GRADE 1 FOR SHEET MATERIALS.

H. FLEXIBLE ELASTOMERIC AND POLYOLEFIN ADHESIVE: COMPLY WITH MIL-A-24179A, TYPE II, CLASS I. FOR INDOOR APPLICATIONS, ADHESIVE SHALL HAVE A VOC CONTENT OF 50 G/L OR LESS WHEN CALCULATED ACCORDING TO 40 CFR 59, SUBPART D (EPA METHOD 24).

I. MINERAL-FIBER ADHESIVE: COMPLY WITH MIL-A-3316C, CLASS 2, GRADE A.

1. FOR INDOOR APPLICATIONS, ADHESIVE SHALL HAVE A VOC CONTENT OF 80 G/L OR LESS WHEN CALCULATED ACCORDING TO 40 CFR 59, SUBPART D (EPA METHOD 24).

J. VAPOR-BARRIER MASTIC: WATER BASED; SUITABLE FOR INDOOR AND OUTDOOR USE ON BELOW AMBIENT SERVICES; COMPLY WITH MIL-PRF-19565C, TYPE II.

1. FOR INDOOR APPLICATIONS, USE MASTICS THAT HAVE A VOC CONTENT OF 50 G/L OR LESS WHEN CALCULATED ACCORDING TO 40 CFR 59, SUBPART D (EPA METHOD 24).

K. FACTORY-APPLIED JACKETS: WHEN FACTORY-APPLIED JACKETS ARE INDICATED, COMPLY WITH THE FOLLOWING:

1. ASJ: WHITE, KRAFT-PAPER, FIBERGLASS-REINFORCED SCRIM WITH ALUMINUM-FOIL BACKING; COMPLYING WITH ASTM C 1136, TYPE I.
2. FSK JACKET: ALUMINUM-FOIL, FIBERGLASS-REINFORCED SCRIM WITH KRAFT-PAPER BACKING; COMPLYING WITH ASTM C 1136, TYPE II.

L. ASJ TAPE: WHITE VAPOR-RETARDER TAPE MATCHING FACTORY-APPLIED JACKET WITH ACRYLIC ADHESIVE, COMPLYING WITH ASTM C 1136.

M. FSK TAPE: FOIL-FACE, VAPOR-RETARDER TAPE MATCHING FACTORY-APPLIED JACKET WITH ACRYLIC ADHESIVE; COMPLYING WITH ASTM C 1136.

PART 3 - EXECUTION

3.1 INSULATION INSTALLATION

A. COMPLY WITH REQUIREMENTS OF THE MIDWEST INSULATION CONTRACTORS ASSOCIATION'S "NATIONAL COMMERCIAL & INDUSTRIAL INSULATION STANDARDS" FOR INSULATION INSTALLATION ON PIPES AND EQUIPMENT.

B. INSULATION INSTALLATION AT INTERIOR WALL AND PARTITION PENETRATIONS (THAT ARE NOT FIRE RATED): INSTALL INSULATION CONTINUOUSLY THROUGH WALLS AND PARTITIONS.

C. INSULATION INSTALLATION AT FIRE-RATED WALL, PARTITION, AND FLOOR PENETRATIONS: INSTALL INSULATION CONTINUOUSLY THROUGH PENETRATIONS. SEAL PENETRATIONS. COMPLY WITH REQUIREMENTS IN SECTION 078413 "PENETRATION FIRESTOPPING."

D. FLEXIBLE ELASTOMERIC INSULATION INSTALLATION:

1. SEAL LONGITUDINAL SEAMS AND END JOINTS WITH ADHESIVE TO ELIMINATE OPENINGS IN INSULATION THAT ALLOW PASSAGE OF AIR TO SURFACE BEING INSULATED.
2. INSULATION INSTALLATION ON PIPE FITTINGS AND ELBOWS: INSTALL MITERED SECTIONS OF PIPE INSULATION. SECURE INSULATION MATERIALS AND SEAL SEAMS WITH ADHESIVE TO ELIMINATE OPENINGS IN INSULATION THAT ALLOW PASSAGE OF AIR TO SURFACE BEING INSULATED.

E. MINERAL-FIBER INSULATION INSTALLATION:

1. INSULATION INSTALLATION ON STRAIGHT PIPES AND TUBES: WHERE VAPOR BARRIERS ARE INDICATED, SEAL LONGITUDINAL SEAMS, END JOINTS, AND PROTRUSIONS WITH VAPOR-BARRIER MASTIC AND JOINT SEALANT.
2. INSULATION WITH FACTORY-APPLIED JACKETS ON ABOVE AMBIENT SURFACES, SECURE LAPS WITH OUTWARD CLINCHED STAPLES AT 6 INCHES O.C.
3. FOR INSULATION WITH FACTORY-APPLIED JACKETS ON BELOW AMBIENT SURFACES, DO NOT STAPLE LONGITUDINAL TABS BUT SECURE TABS WITH ADDITIONAL ADHESIVE AS RECOMMENDED BY INSULATIFOR ON MATERIAL MANUFACTURER AND SEAL WITH VAPOR-BARRIER MASTIC AND FLASHING SEALANT.
4. BLANKET AND BOARD INSULATION INSTALLATION ON DUCTS AND PLENUMS: SECURE WITH ADHESIVE AND INSULATION PINS.
5. FOR DUCTS AND PLENUMS WITH SURFACE TEMPERATURES BELOW AMBIENT, INSTALL A CONTINUOUS UNBROKEN VAPOR BARRIER.

F. POLYOLEFIN INSULATION INSTALLATION:

1. SEAL SPLIT-TUBE LONGITUDINAL SEAMS AND END JOINTS WITH ADHESIVE TO ELIMINATE OPENINGS IN INSULATION THAT ALLOW PASSAGE OF AIR TO SURFACE BEING INSULATED.
2. INSULATION INSTALLATION ON PIPE FITTINGS AND ELBOWS: INSTALL MITERED SECTIONS OF POLYOLEFIN PIPE INSULATION. SECURE INSULATION MATERIALS AND SEAL SEAMS WITH ADHESIVE TO ELIMINATE OPENINGS IN INSULATION THAT ALLOW PASSAGE OF AIR TO SURFACE BEING INSULATED.

G. PLENUMS AND DUCTS REQUIRING INSULATION:

1. CONCEALED AND EXPOSED SUPPLY AND OUTDOOR AIR.
2. CONCEALED AND EXPOSED RETURN AIR LOCATED IN NONCONDITIONED SPACE.
3. CONCEALED AND EXPOSED EXHAUST BETWEEN ISOLATION DAMPER AND PENETRATION OF BUILDING EXTERIOR.

H. PLENUMS AND DUCTS NOT INSULATED:

1. METAL DUCTS WITH DUCT LINER.
2. FACTORY-INSULATED PLENUMS AND CASINGS.
3. FLEXIBLE CONNECTORS.
4. VIBRATION-CONTROL DEVICES.
5. FACTORY-INSULATED ACCESS PANELS AND DOORS.

I. PIPING NOT INSULATED: UNLESS OTHERWISE INDICATED, DO NOT INSTALL INSULATION ON THE FOLLOWING:

1. DRAINAGE PIPING LOCATED IN CRAWLSPACES.
2. UNDERGROUND PIPING.
3. CHROME-PLATED PIPES AND FITTINGS UNLESS THERE IS A POTENTIAL FOR PERSONNEL INJURY.

3.2 DUCT AND PLENUM INSULATION SCHEDULE

A. CONCEALED DUCT INSULATION SHALL BE ONE OF THE FOLLOWING:

1. FLEXIBLE ELASTOMERIC: 1,75 INCHES THICK.
2. MINERAL-FIBER BLANKET: 1.75 INCHES THICK AND 0.75-LB/CU. FT NOMINAL DENSITY.
3. MINERAL-FIBER BOARD: 1.75 INCHES THICK AND (32-KG/CU. M) NOMINAL DENSITY.

3.3 HVAC PIPING INSULATION SCHEDULE

A. REFRIGERANT SUCTION AND HOT-GAS PIPING: INSULATION SHALL BE ONE OF THE FOLLOWING:

1. FLEXIBLE ELASTOMERIC: 1.75 INCHES THICK.
2. MINERAL-FIBER, PREFORMED PIPE INSULATION, TYPE I: 1.75 INCHES THICK

SECTION 230800 - COMMISSIONING OF MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. GENERAL PROVISIONS AND OTHER MECHANICAL SYSTEMS ARE SPECIFIED IN OTHER SECTIONS OF DIVISION 23.

B. COMMISSIONING IS AN ONGOING PROCESS AND SHALL BE PERFORMED THROUGHOUT CONSTRUCTION. COMMISSIONING REQUIRES THE PARTICIPATION OF DIVISION 23 TO ENSURE THAT ALL SYSTEMS ARE OPERATING IN A MANNER CONSISTENT WITH THE CONTRACT DOCUMENTS. DIVISION 23 SHALL BE FAMILIAR WITH THE COMMISSIONING PLAN ISSUED BY THE COMMISSIONING AUTHORITY (CA) AS IT APPLIES TO THE WORK OF DIVISION 23 AND SHALL EXECUTE ALL COMMISSIONING RESPONSIBILITIES ASSIGNED TO THEM IN THE CONTRACT DOCUMENTS. THE CONTRACTORS SHOULD ALSO REVIEW SPECIFICATIONS SECTION 019113 FOR ADDITIONAL INFORMATION.

C. COMMISSIONING SHALL CONCLUDE WITH THE COMPLETION OF ALL REQUIRED DEFERRED TESTING, TRAINING AND SYSTEM DOCUMENTATION AS SPECIFIED AND REQUIRED TO ENSURE THE PROPER OPERATION OF THE MECHANICAL EQUIPMENT AND SYSTEMS PROVIDED BY THIS DIVISION.

D. THIS SECTION COVERS MECHANICAL SYSTEMS COMMISSIONING, AS REQUIRED TO DEMONSTRATE THAT THE EQUIPMENT AND SYSTEMS OF DIVISION 23 ARE READY FOR SAFE AND SATISFACTORY OPERATION, AS DEFINED BY PROJECT DOCUMENTS. COMMISSIONING SHALL INCLUDE, BUT SHALL NOT BE LIMITED TO, IDENTIFICATION OF PIPING AND EQUIPMENT, CLEANING, LUBRICATION, START-UP, CHECK-OUT, AND TESTING, ADJUSTING, AND BALANCING OF SYSTEMS, PREPARATION OF EQUIPMENT AND SYSTEMS DOCUMENTATION AND OF MAINTENANCE AND OPERATION MANUALS, OWNER TRAINING, AND PREPARATION OF RECORD DRAWINGS.

E. THIS SECTION DOES NOT ALTER THE COMMISSIONING REQUIREMENTS INDICATED IN SECTION 019113 OF THE GENERAL COMMISSIONING REQUIREMENTS. THIS SECTION IS TO HELP DEFINE/SUPPLEMENT THE REQUIREMENTS OF SECTION 019113 WHERE APPLICABLE.

1.2 QUALITY ASSURANCE

A. THE MECHANICAL CONTRACTOR SHALL IDENTIFY A MECHANICAL COMMISSIONING SUPERVISOR. THE MECHANICAL COMMISSIONING SUPERVISOR SHOULD HAVE A MINIMUM OF TEN YEARS EXPERIENCE IN MECHANICAL CONTRACTING. THE MECHANICAL COMMISSIONING SUPERVISOR SHALL BECOME FAMILIAR WITH THE DESIGN INTENT AND THE REQUIREMENTS OF THE COMMISSIONING PROCESS AS DEFINED IN THIS SECTION.

THE MECHANICAL COMMISSIONING SUPERVISOR SHALL ATTEND ALL COMMISSIONING MEETINGS AND COORDINATE THE COMMISSIONING SCHEDULE AS OUTLINED BY THE CA. THE MECHANICAL COMMISSIONING SUPERVISOR SHALL ASSIST THE CA IN COORDINATING AND EXECUTING THE REQUIRED COMMISSIONING ACTIVITIES.

1.3 MECHANICAL, PLUMBING, AND FIRE PROTECTION CONTRACTOR RESPONSIBILITIES

A. INCLUDE AND ITEMIZE THE COST OF COMMISSIONING IN THE CONTRACT PRICE WITH AN ESTIMATED BREAKDOWN OF HOURS FOR MEETING AND FUNCTIONAL TESTING REQUIREMENTS.

B. THE MECHANICAL COMMISSIONING SUPERVISOR SHALL BE RESPONSIBLE FOR SCHEDULING, SUPERVISING, AND

COORDINATING THE STARTUP, TESTING AND COMMISSIONING ACTIVITIES AS SPECIFIED HEREIN WITH THE CA. SPECIFIC REQUIREMENTS OF THE MECHANICAL CONTRACTOR AND ASSOCIATED SUBCONTRACTORS ARE IDENTIFIED

IN THIS SECTION AND IN OTHER SECTIONS OF THIS DIVISION.

C. THE CA SHALL CONDUCT INDEPENDENT VERIFICATION OF INSTALLATION, PRE-FUNCTIONAL, START-UP AND FUNCTIONAL TESTING AS PER SECTION 019113.

D. MECHANICAL COMMISSIONING SHALL TAKE PLACE IN THREE PHASES. COMMISSIONING REQUIREMENTS FOR EACH PHASE ARE AS FOLLOWS:

1. CONSTRUCTION PHASE

a. THE CONTRACTOR SHALL ATTEND A COMMISSIONING SCOPING MEETING AND ADDITIONAL COMMISSIONING MEETINGS AS REQUIRED THROUGHOUT THE COMMISSIONING PROCESS. THESE COMMISSIONING MEETINGS WILL BE MONTHLY DURING EARLY CONSTRUCTION AND MAY INCREASE IN FREQUENCY TO WEEKLY DURING THE START-UP, PRE-FUNCTIONAL AND FUNCTIONAL TESTING PHASES. THE CONTRACTOR SHALL ASSURE THAT ALL SUBCONTRACTORS WHO HAVE COMMISSIONING RESPONSIBILITIES ATTEND THE COMMISSIONING SCOPING MEETING AND OTHER COMMISSIONING MEETINGS, AS APPROPRIATE, DURING THE CONSTRUCTION PROCESS.

b. THE CONTRACTOR SHALL REPORT, IN WRITING, TO THE CA AT LEAST AS OFTEN AS COMMISSIONING MEETINGS ARE SCHEDULED CONCERNING THE STATUS OF HIS ACTIVITIES AS THEY AFFECT THE COMMISSIONING PROCESS, THE STATUS OF EACH DISCREPANCY IDENTIFIED, THE PRE-FUNCTIONAL AND FUNCTIONAL TESTING PROCESS, EXPLANATIONS OF ANY DISAGREEMENTS WITH THE IDENTIFIED DEFICIENCIES, AND PROPOSED RESOLUTION AND SCHEDULE.

c, THE CONTRACTOR SHALL PROVIDE THE CA WITH NORMAL CUT SHEETS AND SHOP DRAWING SUBMITTALS OF EQUIPMENT THAT IS TO BE COMMISSIONED.

d, THE CONTRACTOR SHALL PROVIDE DOCUMENTATION TO THE CA FOR DEVELOPMENT OF PRE-FUNCTIONAL AND FUNCTIONAL PERFORMANCE TESTING PROCEDURES, PRIOR TO NORMAL O&M MANUAL SUBMITTALS. THIS DOCUMENTATION SHALL INCLUDE DETAILED MANUFACTURER INSTALLATION, START-UP, OPERATING, TROUBLESHOOTING AND MAINTENANCE PROCEDURES; FULL DETAILS OF ANY OWNER-CONTRACTED TESTS; FAN AND PUMP CURVES; FULL FACTORY TESTING REPORTS, IF ANY; AND FULL WARRANTY INFORMATION, INCLUDING ALL RESPONSIBILITIES OF THE OWNER TO KEEP THE WARRANTY IN FORCE CLEARLY IDENTIFIED. IN ADDITION, THE INSTALLATION, START-UP AND CHECKOUT MATERIALS THAT ARE ACTUALLY SHIPPED INSIDE THE EQUIPMENT AND THE ACTUAL FIELD CHECKOUT SHEET FORMS TO BE USED BY THE FACTORY OR FIELD TECHNICIANS SHALL BE SUBMITTED TO THE CA. THE CA MAY REQUEST FURTHER DOCUMENTATION NECESSARY FOR THE DEVELOPMENT OF FUNCTIONAL PERFORMANCE TESTING AND THE COMMISSIONING PROCESS. THIS DATA REQUEST MAY BE MADE PRIOR TO NORMAL SUBMITTALS.

e. THE CONTRACTOR SHALL DEVELOP AND SUBMIT TO CA, FOR REVIEW PRIOR TO EQUIPMENT OR SYSTEM STARTUP, A COMPLETE STARTUP AND INITIAL CHECKOUT PLAN USING MANUFACTURER’S START-UP PROCEDURES.

f. THE CONTRACTOR SHALL REVIEW AND COMPLETE THE CA’S PRE-FUNCTIONAL CHECK-SHEETS AND SIGN-OFF ON THE APPROPRIATE AREAS WHEN THE CONTRACTOR AND SUB-CONTRACTORS ARE COMPLETE. THE PRE-FUNCTIONAL TEST SHEETS WILL BE DEVELOPED BY THE CA. THE CA MAY CONDUCT THEIR OWN PRE-FUNCTIONAL TESTING CHECK IN PARALLEL WITH THE CONTRACTORS OR VERIFY THE CONTRACTORS COMPLETED PRE-FUNCTIONAL FORMS AFTER SUBMISSION.

g. THE CONTRACTOR SHALL PROVIDE A COPY OF THE O&M MANUALS AND SUBMITTALS OF COMMISSIONED EQUIPMENT, THROUGH NORMAL CHANNELS, TO THE CA FOR REVIEW.

h. THE CONTRACTOR SHALL ASSIST IN CLARIFYING THE PROPOSED OPERATION AND CONTROL OF COMMISSIONED EQUIPMENT IN AREAS WHERE THE SPECIFICATIONS, CONTROL DRAWINGS OR EQUIPMENT DOCUMENTATION IS NOT SUFFICIENT FOR WRITING DETAILED TESTING PROCEDURES.

i. THE CA SHALL PREPARE THE SPECIFIC FUNCTIONAL TEST PROCEDURES AS SPECIFIED HEREIN. THE CONTRACTORS SHALL REVIEW THE CA’S PROPOSED FUNCTIONAL PERFORMANCE TEST PROCEDURES TO ENSURE FEASIBILITY, SAFETY AND EQUIPMENT PROTECTION AND PROVIDE NECESSARY WRITTEN ALARM LIMITS TO BE USED DURING THE TESTS.

j. CONTRACTOR SHALL PREPARE A PRELIMINARY SCHEDULE FOR DIVISION 23 COMMISSIONING ACTIVITIES, TO INCLUDE PIPE AND DUCT SYSTEM TESTING, FLUSHING AND CLEANING, EQUIPMENT START-UP, AND TAB START AND COMPLETION, FOR USE BY THE CA AND SHALL UPDATE THE SCHEDULE AS APPROPRIATE. CA WILL ASSIST IN PROVIDING EXPECTED TIME DURATIONS FOR CX ACTIVITIES.

k. THE CONTRACTOR SHALL UPDATE THE COMMISSIONING ACTIVITIES AND NOTIFY ANY DELAYS IN THE PROGRESS MEETINGS. CONTRACTOR SHALL NOTIFY THE CA DURING THE COMMISSIONING MEETINGS WHEN COMMISSIONING ACTIVITIES NOT YET PERFORMED OR NOT YET SCHEDULED WILL DELAY CONSTRUCTION. MECHANICAL EQUIPMENT START-UP SHALL NOT BE INITIATED UNTIL THE COMPLETE SIGN-OFF OF THE PRE-FUNCTIONAL CHECK-SHEETS AS DEVELOPED BY THE CA AS SPECIFIED IN OTHER SECTIONS OF DIVISION 23.

l. THE CONTRACTOR SHALL PROVIDE STARTUP TESTING FOR ALL HVAC EQUIPMENT, INCLUDING THE BUILDING AUTOMATION CONTROL SYSTEM AND SHALL EXECUTE THE MECHANICAL-RELATED PORTIONS OF THE PRE-FUNCTIONAL CHECKLISTS FOR ALL COMMISSIONED EQUIPMENT DURING THE STARTUP AND INITIAL CHECKOUT PROCESS. THE CA SHALL CONDUCT AN INDEPENDENT START-UP ONCE THE CONTRACTOR IS COMPLETE WITH THEIR REQUIREMENTS.

m. THE CONTRACTOR SHALL PERFORM AND CLEARLY DOCUMENT ALL COMPLETED START-UP AND SYSTEM OPERATIONAL CHECKOUT PROCEDURES, PROVIDING A COPY TO THE CA.

n. THE CONTRACTOR SHALL CORRECT CURRENT A/E PUNCH LIST AND CA DEFICIENCY ITEMS BEFORE FUNCTIONAL PERFORMANCE TESTING CAN BEGIN. AIR AND WATER TAB SHALL BE COMPLETED WITH DISCREPANCIES AND PROBLEMS REMEDIED BEFORE FUNCTIONAL TESTING OF THE RESPECTIVE AIR OR WATER RELATED SYSTEMS.

o. THE CA SHALL GENERATE THE FUNCTIONAL TESTING PROCEDURE AND RECORD TO THE MECHANICAL CONTRACTOR. THE MECHANICAL CONTRACTOR SHALL REVIEW AND PROVIDE SUPPORT TO THE FUNCTIONAL TESTING PROCESS. CONTRACTOR SHALL OPERATE BOILERS, PUMPS, ETC., AND SYSTEMS IN ACCORDANCE WITH THE CA REQUIREMENTS, OPEN AND CLOSE DISCONNECTS AND SWITCH NORMAL AND EMERGENCY POWER REQUIREMENTS AS DIRECTED BY THE CA AND THE FUNCTIONAL TESTING PROCEDURES.

p. THE CONTRACTOR SHALL REPORT IN WRITING TO THE CA AT LEAST AS OFTEN AS COMMISSIONING MEETINGS ARE BEING SCHEDULED CONCERNING THE STATUS OF EACH OUTSTANDING DISCREPANCY IDENTIFIED DURING COMMISSIONING, PRE-FUNCTIONAL AND FUNCTIONAL PERFORMANCE TESTING. REPORT SHALL INCLUDE DESCRIPTION OF THE IDENTIFIED DISCREPANCY, EXPLANATIONS OF ANY DISAGREEMENTS, AND PROPOSALS AND SCHEDULE FOR CORRECTION OF THE DISCREPANCY.

1) ACCEPTANCE PHASE. THE CONTRACTOR SHALL ASSIST AND COOPERATE WITH THE CA IN THE COMMISSIONING PROCESS BY:

(a) PUTTING ALL HVAC EQUIPMENT AND SYSTEMS INTO OPERATION AND CONTINUING THE OPERATION DURING EACH WORKING DAY OF THE TEST AND BALANCE AND COMMISSIONING EFFORT, AS REQUIRED.

(b) FOR A GIVEN AREA, HAVE ALL REQUIRED PRE-FUNCTIONAL CHECKLISTS, CALIBRATIONS, STARTUP AND SELECTED FUNCTIONAL TESTS OF THE MECHANICAL SYSTEM AND ASSOCIATED CONTROLS COMPLETED AND APPROVED BY THE CA PRIOR TO BEGINNING THE TEST AND BALANCE PROCESS.

(c) PROVIDE A QUALIFIED TECHNICIAN TO OPERATE THE CONTROLS AS REQUIRED TO ASSIST THE TAB CONTRACTOR IN PERFORMING TAB, OR PROVIDE SUFFICIENT TRAINING FOR TAB TO OPERATE THE SYSTEM WITHOUT ASSISTANCE.

(d) PROVIDE A TAB REPRESENTATIVE TO ASSIST THE CA ON CONDUCTING A RANDOM 10% CHECK OF THE AIR AND WATER DISTRIBUTION REQUIREMENTS.

(e) INCLUDING COST OF SHEAVES AND BELTS THAT MAY BE REQUIRED TO OBTAIN REQUIRED EQUIPMENT PERFORMANCE, AS MEASURED BY THE TEST AND BALANCE EFFORT.

(f) PROVIDING TEST HOLES IN DUCTS AND PLENUMS WHERE DIRECTED BY TAB TO ALLOW AIR MEASUREMENTS AND AIR BALANCING. PROVIDING AN APPROVED PLUG.

(g) PROVIDING TEMPERATURE AND PRESSURE TAPS ACCORDING TO THE CONSTRUCTION DOCUMENTS FOR TAB AND COMMISSIONING TESTING.

(h) INSTALLING A P/T PLUG AT EACH WATER SENSOR THAT IS AN INPUT POINT TO THE CONTROL SYSTEM.

(i) PROVIDING SKILLED TECHNICIANS TO EXECUTE STARTING AND OPERATION OF EQUIPMENT.

(j) THE CA WILL CONDUCT FUNCTIONAL PERFORMANCE TESTING. THE CONTRACTOR MAY BE REQUIRED TO HAVE A SKILLED TECHNICIAN PRESENT DURING FUNCTIONAL TESTING, ALTHOUGH IT IS SUGGESTED THAT ONE BE AVAILABLE TO MAKE ADJUSTMENTS OR ASSIST IN PROBLEM-SOLVING.

(k) THE CA WILL REQUIRE FULL AND PART LOAD PERFORMANCE VERIFICATIONS AS WELL AS SEASONAL AND SIMULATED TESTING REQUIREMENTS. THE CONTRACTOR SHALL BE PREPARED TO OPERATE DIFFERENT COMPONENTS OF VARIOUS SYSTEMS (EXAMPLE, DX AND HOT WATER SYSTEMS TO GENERATE LOADING STRATEGIES) DURING THE FUNCTIONAL TESTING.

(l) CORRECT DEFICIENCIES (DIFFERENCES BETWEEN SPECIFIED AND OBSERVED PRFORMANCE) AS INTERPRETED BY THE CA AND A/E.

(m) PREPARE O&M MANUALS ACCORDING TO THE CONTRACTOR DOCUMENTS, INCLUDING CLARIFYING AND UPDATING THE ORIGINAL SEQUENCE OF OPERATION TO AS-BUILT CONDITIONS.

(n) MAINTAIN ON SITE REDLINE AS BUILT DRAWINGS AND PRODUCE FINAL “AS-BUILT” DRAWINGS FOR ALL PROJECT DRAWINGS AND CONTRACTOR-GENERATED COORDINATION DRAWINGS. LIST AND CLEARLY IDENTIFY ON THE AS-BUILT DRAWINGS THE LOCATIONS OF ALL AIRFLOW STATIONS AND SENSOR INSTALLATIONS THAT ARE NOT EQUIPMENT MOUNTED.

(o) PROVIDE SPECIFIED TRAINING OF THE OWNER’S OPERATING PERSONNEL IN ACCORDANCE WITH THE CA’S OVERVIEW AND OUTLINE.

(p) COORDINATE WITH EQUIPMENT MANUFACTURERS TO DETERMINE SPECIFIC REQUIREMENTS TO MAINTAIN THE VALIDITY OF THE WARRANTY.

(q) PROVIDE UPDATED DIAGRAMMATICAL LOGIC FOR ALL TAB ADJUSTMENTS TO THE SYSTEM.

2) WARRANTY PERIOD. DURING THE WARRANTY PERIOD, THE CONTRACTOR SHALL:

(a) BE AVAILABLE DURING SEASONAL OR DEFERRED FUNCTIONAL PERFORMANCE TESTING CONDUCTED BY THE CA, ACCORDING TO THE SPECIFICATIONS.

(b) CORRECT DEFICIENCIES AND MAKE NECESSARY ADJUSTMENTS TO O&M MANUALS AND AS-BUILT DRAWINGS FOR APPLICABLE ISSUES IDENTIFIED IN ANY SEASONAL TESTING.

1.4 TAB CONTRACTOR RESPONSIBILITIES

A. SIX WEEKS PRIOR TO THE STARTING OF THE T&B, SUBMIT TO THE CA, THE QUALIFICATIONS OF THE SITE TECHNICIAN(S) FOR THE PROJECT, INCLUDING THREE (3) NAMES OF CONTRACTORS AND FACILITY MANAGERS OF RECENT PROJECTS ON WHICH THE PERSONNEL WERE IN CHARGE. THE OWNER AND CA WILL APPROVE THE SITE TECHNICIAN FOR THIS JOB.

B. THREE MONTHS PRIOR TO THE START OF THE TAB, SUBMIT A TAB PLAN AND APPROACH FOR EACH SYSTEM. HE PLAN SHALL BE REVIEWED BY THE TAB AND THE CA FOR REVIEW AND APPROVAL. THE SUBMITTED PLAN HALL INCLUDE:

1. CERTIFICATION THAT THE TAB CONTRACTOR HAS REVIEWED THE CONSTRUCTION DOCUMENTS AND THE SYSTEMS WITH THE DESIGN ENGINEERS AND CONTRACTORS TO SUFFICIENTLY UNDERSTAND THE DESIGN INTENT FOR EACH SYSTEM.
2. AN EXPLANATION OF THE INTENDED USE OF THE BUILDING CONTROL SYSTEM.
3. ALL FIELD CHECK-OUT SHEETS AND LOGS TO BE USED THAT LISTS EACH PIECE OF EQUIPMENT TO BE TESTED ADJUSTED AND BALANCED WITH THE DATA CELLS TO BE GATHERED FOR EACH.
4. FINAL TEST REPORT FORMS TO BE USED DURING THIS PROCESS:

a. DETAILED STEP BY STEP PROCEDURES FOR TAB WORK FOR EACH SYSTEM AND ISSUE: TERMINAL FLOW CALIBRATION; DIFFUSER PROPORTIONING; BRANCH AND SUBMAIN PROPORTIONING; TOTAL FLOW CALCULATIONS; AND RECHECKING DIVERSITY ISSUES.

b. LIST ALL AIR FLOW, WATER FLOW, SOUND LEVEL, SYSTEM CAPACITY AND EFFICIENCY MEASUREMENTS TO BE PERFORMED AND A DESCRIPTION OF EACH OF THE TEST PROCEDURES, PARAMETERS AND FORMULAS TO BE USED.

c. DETAILS OF HOW TOTAL FLOW WILL BE DETERMINED (AIR: SUM OF TERMINAL FLOWS VIA BMS CALIBRATED READINGS OR VIA HOOD, PITOT TUBE OR FLOW STATIONS). DETAILS OF HOW TOTAL WATER FLOW WILL BE DETERMINED (WATER: PUMP CURVES, CIRCUIT SETTERS, FLOW STATION, ULTRASONIC, ETC.).

d. THE IDENTIFICATION AND TYPES OF MEASUREMENT INSTRUMENTS TO BE USED AND THEIR MOST RECENT CALIBRATION DATE.

e. SPECIFIC PROCEDURES THAT WILL ENSURE THAT BOTH AIR AND WATERSIDES WILL BE OPERATING AT THERE LOWEST POSSIBLE PRESSURE AT THE POINT WHERE THE SYSTEM WILL OPERATE.

f. CONFIRMATION THAT THE TAB CONTRACTOR UNDERSTANDS THE OUTSIDE AIR VENTILATION CRITERIA UNDER ALL CONDITIONS AND HOW THIS WILL BE MEASURED DURING NORMAL, ECONOMIZER AND UNOCCUPIED CONDITIONS.

g. DETAILS OF HOW BUILDING STATIC, ROOM STATIC AND EXHAUST FAN CAPACITY WILL BE CHECKED.

h. PROPOSED SELECTION POINTS FOR TRAVERSE MEASUREMENT LOCATIONS ON THE AS-BUILT DOCUMENTS. REVIEW THE PLACEMENT OF THE HVAC MEASUREMENT DEVICES FOR PROPER STRAIGHT RUNS AND ACCURACY.

i. SUBMIT A PLAN FOR TESTING AND CHECKING THE FUME HOOD SYSTEM EXHAUST REQUIREMENTS.

j. PLAN FOR FORMAL PROGRESS REPORTS INCLUDING SCOPE AND FREQUENCY.

k. PLAN FOR FORMAL DEFICIENCY REPORTS INCLUDING SCOPE AND FREQUENCY.

1) TAB CONTRACTOR SHALL ATTEND COMMISSIONING MEETINGS AS DIRECTED BY THE CA AND THE GENERAL CONTRACTOR.

2) TAB CONTRACTOR SHALL COMMUNICATE IN WRITING TO THE CONTROLS CONTRACTOR AND THE CA ALL SETPOINT AND PARAMETER CHANGES MADE OR PROBLEMS AND DISCREPANCIES IDENTIFIED DURING THE TAB PROCESS THAT WOULD AFFECT THE CONTROL LOOP SYSTEM SET-UP AND OPERATION.

l. 3) SUBMIT WRITTEN REPORT OF DISCREPANCIES, DEFICIT OR UNCOMPLETED WORK BY OTHERS, CONTRACT INTERPRETATION REQUESTS AND LIST OF COMPLETED TESTS TO THE CA AT LEAST ONCE PER WEEK.

14) AFTER THE TAB PLAN IS ACCEPTED AND TWO-WEEKS PRIOR TO TAB WORK, THE CONTRACTOR SHALL CONDUCT A PRE-BALANCING CONFERENCE. PRIOR TO THE PRE-BALANCING CONFERENCE, THE TAB CONTRACTOR SHALL INSPECT THE SYSTEM READINESS FOR TESTING AND BALANCING. THE TAB CONTRACTOR SHALL PREPARE A LIST OF DEFICIENCIES AND UNCOMPLETED WORK THAT WILL AFFECT THE TAB PROCESS. THIS LIST SHALL BE SUBMITTED TO THE CA AND THE GENERAL CONTRACTOR.

15) THE TAB CONTRACTOR SHALL REVIEW THE PROJECTED SCHEDULE AND PROVIDE, IN WRITING, TO THE CA AND CM ANY DELAYS IN THE SCHEDULE AND WHAT ITEMS WILL REQUIRE COMPLETION PRIOR TO THE TAB WORK.

16) THE CA AGENT SHALL CONDUCT INDEPENDENT VERIFICATION OF 10% OF AIR AND WATER END-DEVICES FOR ACCEPTANCE AFTER THE TAB CONTRACTOR STATES IN WRITING THAT THEY ARE COMPLETE WITH TESTING & BALANCING. THE TAB CONTRACTOR SHALL PROVIDE A MECHANIC TO ASSIST THE CA IN THIS VERIFICATION AND SHALL INCLUDE THIS IN THE SCOPE AND PRICE OF THE WORK.

17) THE TAB AGENT SHALL SUBMIT THE TAB REPORT TO THE CA FOR HIS REVIEW AND COMMENT. ALL DATA CONTAINED SHALL BE RE-VERIFIED IN THE FIELD BY THE CA. A MINIMUM OF TEN PERCENT OF THE AIRFLOW READINGS SHALL BE VERIFIED BY THE CA USING HIS OWN EQUIPMENT. ALL SELECTION POINTS SHALL BE RANDOM. TOTAL AIRFLOW SHALL BE VERIFIED ON ALL MAINS IN THE SUPPLY AND THE EXHAUST DUCTS.

1.5 CONTROL CONTRACTOR RESPONSIBILITIES

A. INCLUDE AND ITEMIZE THE COST OF COMMISSIONING IN THE CONTRACT PRICE WITH AN ESTIMATED BREAKDOWN OF HOURS FOR MEETING AND FUNCTIONAL TESTING REQUIREMENTS.

B. THE CONTROLS COMMISSIONING SUPERVISOR SHALL BE RESPONSIBLE FOR SCHEDULING, SUPERVISING, AND COORDINATING THE STARTUP, TESTING AND COMMISSIONING ACTIVITIES AS SPECIFIED HEREIN WITH THE CA. SPECIFIC REQUIREMENTS OF THE CONTROLS CONTRACTOR AND ASSOCIATED SUBCONTRACTORS ARE IDENTIFIED IN THIS SECTION AND IN OTHER SECTIONS OF THIS DIVISION.

C. THE CA SHALL CONDUCT INDEPENDENT VERIFICATION OF INSTALLATION, PRE-FUNCTIONAL, START-UP AND FUNCTIONAL TESTING AS PER SECTION 019113.

D. CONTROLS COMMISSIONING SHALL TAKE PLACE IN THREE PHASES. COMMISSIONING REQUIREMENTS FOR EACH PHASE ARE AS FOLLOWS:

1. CONSTRUCTION PHASE

a. CONTRACTOR SHALL ATTEND A COMMISSIONING SCOPE MEETING AND ADDITIONAL COMMISSIONING MEETINGS AS REQUIRED THROUGHOUT THE COMMISSIONING PROCESS. THESE COMMISSIONING MEETINGS WILL BE MONTHLY DURING EARLY CONSTRUCTION AND INCREASE IN FREQUENCY TO WEEKLY DURING THE START-UP, PRE-FUNCTIONAL AND FUNCTIONAL TESTING PHASES. CONTRACTOR SHALL ASSURE THAT ALL SUBCONTRACTORS WHO HAVE COMMISSIONING RESPONSIBILITIES ATTEND THE COMMISSIONING SCOPE MEETING AND OTHER COMMISSIONING MEETINGS, AS APPROPRIATE, DURING THE CONSTRUCTION PROCESS.

b. CONTRACTOR SHALL REPORT, IN WRITING, TO THE CA AT LEAST AS OFTEN AS COMMISSIONING MEETINGS ARE SCHEDULED CONCERNING THE STATUS OF HIS ACTIVITIES AS THEY AFFECT THE COMMISSIONING PROCESS, THE STATUS OF EACH DISCREPANCY IDENTIFIED, THE PRE-FUNCTIONAL AND FUNCTIONAL TESTING PROCESS, EXPLANATIONS OF ANY DISAGREEMENTS WITH THE IDENTIFIED DEFICIENCIES, AND PROPOSED RESOLUTION AND SCHEDULE.

c. CONTRACTOR SHALL PROVIDE THE CA WITH NORMAL CUT SHEETS AND SHOP DRAWING SUBMITTALS OF EQUIPMENT THAT IS TO BE COMMISSIONED.

d. CONTRACTOR SHALL PROVIDE DOCUMENTATION TO THE CA FOR DEVELOPMENT OF PRE-FUNCTIONAL AND FUNCTIONAL PERFORMANCE TESTING PROCEDURES, PRIOR TO NORMAL O&M MANUAL SUBMITTALS. THIS DOCUMENTATION SHALL INCLUDE DETAILED MANUFACTURER INSTALLATION, START-UP, OPERATING, TROUBLESHOOTING AND MAINTENANCE PROCEDURES; FULL DETAILS OF ANY OWNER-CONTRACTED TESTS; POINTS LISTING; FULL FACTORY TESTING REPORTS, IF ANY; AND FULL WARRANTY INFORMATION, INCLUDING ALL RESPONSIBILITIES OF THE OWNER TO KEEP THE WARRANTY IN FORCE CLEARLY IDENTIFIED. IN ADDITION, THE INSTALLATION, START-UP AND CHECKOUT MATERIALS THAT ARE ACTUALLY SHIPPED INSIDE THE EQUIPMENT AND THE ACTUAL FIELD CHECKOUT SHEET FORMS TO BE USED BY THE FACTORY OR FIELD TECHNICIANS SHALL BE SUBMITTED TO THE CA. THE CA MAY REQUEST FURTHER DOCUMENTATION NECESSARY FOR THE DEVELOPMENT OF FUNCTIONAL PERFORMANCE TESTING AND THE COMMISSIONING PROCESS. THIS DATA REQUEST MAY BE MADE PRIOR TO NORMAL SUBMITTALS.

e. THE CONTRACTOR SHALL DEVELOP AND SUBMIT TO CA, FOR REVIEW PRIOR TO EQUIPMENT OR SYSTEM STARTUP, A COMPLETE STARTUP AND INITIAL CHECKOUT PLAN USING MANUFACTURER’S START-UP PROCEDURES.

f. THE CONTRACTOR SHALL REVIEW AND COMPLETE THE CA’S PRE-FUNCTIONAL CHECK-SHEETS AND SIGN-OFF ON THE APPROPRIATE AREAS WHEN THE CONTRACTOR AND SUB-CONTRACTORS ARE COMPLETE. THE PRE-FUNCTIONAL TEST SHEETS WILL BE DEVELOPED BY THE CA. THE CA MAY CONDUCT THEIR OWN PRE-FUNCTIONAL TESTING CHECK IN PARALLEL WITH THE CONTRACTORS OR VERIFY THE CONTRACTORS COMPLETED PRE-FUNCTIONAL FORMS AFTER SUBMISSION.

g. CONTRACTOR SHALL PROVIDE A COPY OF THE O&M MANUALS AND SUBMITTALS OF COMMISSIONED EQUIPMENT, THROUGH NORMAL CHANNELS, TO THE CA FOR REVIEW.

h. CONTRACTOR SHALL ASSIST IN CLARIFYING THE PROPOSED OPERATION AND CONTROL OF COMMISSIONED EQUIPMENT IN AREAS WHERE THE SPECIFICATIONS, CONTROL DRAWINGS OR EQUIPMENT DOCUMENTATION IS NOT SUFFICIENT FOR WRITING DETAILED TESTING PROCEDURES.

i. CA SHALL PREPARE FOR THE SPECIFIC FUNCTIONAL TEST PROCEDURES AS SPECIFIED HEREIN. THE CONTRACTORS SHALL REVIEW THE CA’S PROPOSED FUNCTIONAL PERFORMANCE TEST PROCEDURES TO ENSURE FEASIBILITY, SAFETY AND EQUIPMENT PROTECTION AND PROVIDE NECESSARY WRITTEN ALARM LIMITS TO BE USED DURING THE TESTS.

j. CONTROLS CONTRACTOR SHALL PREPARE A PRELIMINARY SCHEDULE FOR THEIR COMMISSIONING ACTIVITIES, TO INCLUDE WIRING, INSTRUMENT INSTALLATION, CALIBRATION, POINT-TO-POINT VERIFICATION, SEQUENCE OF OPERATION TESTING AND EMERGENCY OPERATING PROCEDURAL TESTING FOR USE BY THE CA AND SHALL UPDATE THE SCHEDULE AS APPROPRIATE. THE CONTRACTOR SHALL UPDATE THE COMMISSIONING ACTIVITIES AND NOTIFY ANY DELAYS IN THE PROGRESS MEETINGS. CONTRACTOR SHALL NOTIFY THE CA DURING THE COMMISSIONING MEETINGS WHEN COMMISSIONING ACTIVITIES NOT YET PERFORMED OR NOT YET SCHEDULED WILL DELAY CONSTRUCTION.

k. CONTROLS INSTRUMENT AND EQUIPMENT START-UP SHALL NOT BE INITIATED UNTIL THE COMPLETE SIGN-OFF OF THE PRE-FUNCTIONAL CHECK-SHEETS AS DEVELOPED BY THE CA AS SPECIFIED IN OTHER SECTIONS OF DIVISION 23.

l. CONTRACTOR SHALL PROVIDE STARTUP TESTING FOR ALL HVAC EQUIPMENT, INCLUDING THE BUILDING AUTOMATION CONTROL SYSTEM AND SHALL EXECUTE THE MECHANICAL/CONTROLS-RELATED PORTIONS OF THE PRE-FUNCTIONAL CHECKLISTS FOR ALL COMMISSIONED EQUIPMENT DURING THE STARTUP AND INITIAL CHECKOUT PROCESS. THE CA SHALL CONDUCT AN INDEPENDENT START-UP ONCE THE CONTRACTOR IS COMPLETE WITH THEIR REQUIREMENTS.

m. CONTRACTOR SHALL PERFORM AND CLEARLY DOCUMENT ALL COMPLETED STARTUP AND SYSTEM OPERATIONAL CHECKOUT PROCEDURES, PROVIDING A COPY TO THE CA.

n. CONTRACTOR SHALL CORRECT CURRENT A/E PUNCH LIST AND CA DEFICIENCY ITEMS BEFORE FUNCTIONAL PERFORMANCE TESTING CAN BEGIN. POINT-TO-POINT VERIFICATION SHALL BE COMPLETED WITH DISCREPANCIES AND PROBLEMS REMEDIED BEFORE FUNCTIONAL TESTING OF THE RESPECTIVE CONTROLS RELATED SYSTEMS.

o. THE CA SHALL GENERATE THE FUNCTIONAL TESTING PROCEDURE AND RECORD TO THE CONTROLS CONTRACTOR. THE CONTROLS CONTRACTOR SHALL REVIEW AND PROVIDE SUPPORT TO THE FUNCTIONAL

TESTING PROCESS. CONTRACTOR SHALL AID IN OPERATING BOILERS, PUMPS, ETC., AND SYSTEMS IN ACCORDANCE WITH THE CA REQUIREMENTS, TURN ON AND OFF NORMAL AND EMERGENCY POWER REQUIREMENTS AS DIRECTED BY THE CA AND THE FUNCTIONAL TESTING PROCEDURES.

p. CONTRACTOR SHALL REPORT, IN WRITING, TO THE CA AT LEAST AS OFTEN AS COMMISSIONING MEETINGS ARE BEING SCHEDULED CONCERNING THE STATUS OF EACH OUTSTANDING DISCREPANCY IDENTIFIED DURING COMMISSIONING, PRE-FUNCTIONAL AND FUNCTIONAL PERFORMANCE TESTING. REPORT SHALL INCLUDE DESCRIPTION OF THE IDENTIFIED DISCREPANCY, EXPLANATIONS OF ANY DISAGREEMENTS, AND PROPOSALS AND SCHEDULE FOR CORRECTION OF THE DISCREPANCY.

1) ACCEPTANCE PHASE. CONTRACTOR SHALL ASSIST AND COOPERATE WITH THE CA IN THE COMMISSIONING PROCESS BY:

(a) PUTTING ALL HVAC EQUIPMENT AND SYSTEMS INTO OPERATION AND CONTINUING THE OPERATION DURING EACH WORKING DAY OF THE TEST AND BALANCE AND COMMISSIONING EFFORT, AS REQUIRED.

(b) FOR A GIVEN AREA, HAVE ALL REQUIRED, PRE-FUNCTIONAL CHECKLISTS, CALIBRATIONS, STARTUP AND SELECTED FUNCTIONAL TESTS OF THE MECHANICAL SYSTEM AND ASSOCIATED CONTROLS COMPLETED AND APPROVED BY THE CA PRIOR TO BEGINNING THE TEST AND BALANCE PROCESS.

(c) PROVIDE A QUALIFIED TECHNICIAN TO OPERATE THE CONTROLS AS REQUIRED TO ASSIST THE TAB CONTRACTOR IN PERFORMING TAB, OR PROVIDE SUFFICIENT TRAINING FOR TAB TO OPERATE THE SYSTEM WITHOUT ASSISTANCE.

(d) PROVIDE A CONTROLS REPRESENTATIVE TO ASSIST THE CA ON CONDUCTING A RANDOM 10% CHECK OF THE AIR AND WATER DISTRIBUTION REQUIREMENTS.

(e) PROVIDING SKILLED TECHNICIANS TO EXECUTE STARTING AND OPERATION OF EQUIPMENT.

(f) THE CA WILL CONDUCT FUNCTIONAL PERFORMANCE TESTING. THE CONTRACTOR MAY BE REQUIRED TO HAVE A SKILLED TECHNICIAN PRESENT DURING FUNCTIONAL TESTING, ALTHOUGH IT IS SUGGESTED THAT ONE BE AVAILABLE TO MAKE ADJUSTMENTS OR ASSIST IN PROBLEM-SOLVING.

(g) THE CA WILL REQUIRE FULL AND PART LOAD PERFORMANCE VERIFICATIONS AS WELL AS SEASONAL AND SIMULATED TESTING REQUIREMENTS. THE CONTRACTOR SHALL BE PREPARED TO OPERATE DIFFERENT COMPONENTS OF VARIOUS SYSTEMS (EXAMPLE, CHILLED WATER AND HOT WATER SYSTEMS TO GENERATE LOADING STRATEGIES) DURING THE FUNCTIONAL TESTING.

(h) CORRECT DEFICIENCIES (DIFFERENCES BETWEEN SPECIFIED AND OBSERVED PERFORMANCE) AS INTERPRETED BY THE CA AND A/E.

(i) PREPARE O&M MANUALS ACCORDING TO THE CONTRACTOR DOCUMENTS, INCLUDING CLARIFYING AND UPDATING THE ORIGINAL SEQUENCE OF OPERATION TO AS-BUILT CONDITIONS.

(j) MAINTAIN ON SITE REDLINE AS BUILT DRAWINGS AND PRODUCE FINAL “AS-BUILT” DRAWINGS FOR ALL PROJECT DRAWINGS AND CONTRACTOR-GENERATED COORDINATION DRAWINGS. LIST AND CLEARLY IDENTIFY ON THE AS-BUILT DRAWINGS THE LOCATIONS OF ALL AIRFLOW STATIONS AND SENSOR INSTALLATIONS THAT ARE NOT EQUIPMENT MOUNTED.

(k) PROVIDE SPECIFIED TRAINING OF THE OWNER’S OPERATING PERSONNEL IN ACCORDANCE WITH THE CA’S OVERVIEW AND OUTLINE.

(l) COORDINATE WITH EQUIPMENT MANUFACTURERS TO DETERMINE SPECIFIC REQUIREMENTS TO MAINTAIN THE VALIDITY OF THE WARRANTY.

(m) PROVIDE A DETAILED MARKED UP DRAWINGS OF ALL THE INSTRUMENTS AND THEIR INSTALLED LOCATION (P&ID) FOR INSTRUMENTS AND COMPONENTS.

2) WARRANTY PERIOD. DURING THE WARRANTY PERIOD, THE CONTRACTOR SHALL:

(a) BE AVAILABLE DURING SEASONAL OR DEFERRED FUNCTIONAL PERFORMANCE TESTING CONDUCTED BY THE CA, ACCORDING TO THE SPECIFICATIONS. CORRECT DEFICIENCIES AND MAKE NECESSARY ADJUSTMENTS TO O&M MANUALS AND AS-BUILT DRAWINGS FOR APPLICABLE ISSUES IDENTIFIED IN ANY SEASONAL TESTING.

PART 2 - PRODUCTS

2.1 SYSTEMS TO BE COMMISSIONED

A. THE FOLLOWING ARE SYSTEMS TO BE COMMISSIONED:

1. INDOOR AIR HANDLING UNITS
2. EXHAUST FANS (L-EF 3,5,6,7&8)
3. STEAM CONDENSATE PUMP (L-P-6)
4. CHILLED AND HOT WATER PUMPS (L-P-1,2,3,4&5)
5. STEAM TO HOT WATER HX (L-HX-1&2)
6. AIR OUTLETS (8 TYPES 526 UNITS – TEST 10%)
7. VAV WITH HW COIL (63 UNITS – TEST 10%)
8. CV UNITS WITH HW COIL (3 UNITS TEST 100%)
9. LIGHTING CONTROL SYSTEM
10. ATC SYSTEM (TEST FUNCTIONALITY AS IT HAS BEEN MODIFIED BY SYSTEMS ABOVE)

2.2 TEST EQUIPMENT

A. ALL STANDARD TESTING EQUIPMENT REQUIRED TO THE MECHANICAL PORTION STARTUP, INITIAL CHECKOUT SHALL BE PROVIDED BY THE CONTRACTOR RESPONSIBLE FOR THE EQUIPMENT OR SYSTEM BEING TESTED. THIS INCLUDES TAB AND CONTROLS VERIFICATION.

B. THE CA SHALL PERFORM THEIR OWN SYSTEM VERIFICATION AND PERFORMANCE CHECK-OUT. THE CA SHALL PROVIDE THEIR OWN CALIBRATED EQUIPMENT AS REQUIRED FOR THIS TESTING.

C. ALL TESTING EQUIPMENT ASSOCIATED WITH FUNCTIONAL PERFORMANCE VERIFICATION AND POINT-TO-POINT REQUIRED BY THE CA SHALL BE THE RESPONSIBILITY OF THE CA. ALL TESTING EQUIPMENT ASSOCIATED WITH THE CONTROL’S CONTRACTOR POINT-TO-POINT VERIFICATION SHALL BE THE RESPONSIBILITY OF THE CONTROL’S CONTRACTOR.

D. SPECIAL EQUIPMENT, TOOLS AND INSTRUMENTS (ONLY AVAILABLE FROM VENDOR OR SPECIFIC TO A PIECE OF EQUIPMENT) REQUIRED FOR THE FUNCTIONAL TESTING OF THAT EQUIPMENT, ACCORDING TO THE REQUIREMENTS OF THE CONTRACT DOCUMENTS AND THE FUNCTIONAL TEST PROCEDURES SHALL BE PROVIDED TO THE CA BY THE INSTALLING CONTRACTOR AND SHALL BECOME THE PROPERTY OF THE OWNER AT PROJECT COMPLETION AS INDICATED IN THE SPECIFICATION.

E. PROPRIETARY TEST EQUIPMENT AND SOFTWARE REQUIRED BY ANY MANUFACTURER FOR PROGRAMMING AND/OR START-UP, WHETHER SPECIFIED OR NOT, SHALL BE PROVIDED BY THE MANUFACTURER OF THE EQUIPMENT. MANUFACTURER SHALL PROVIDE TEST EQUIPMENT, DEMONSTRATE ITS USE AND ASSIST IN THE COMMISSIONING PROCESS AS NEEDED. PROPRIETARY TEST EQUIPMENT (AND SOFTWARE) SHALL BECOME THE PROPERTY OF THE OWNER UPON SUCCESSFUL COMPLETION OF THE COMMISSIONING PROCESS AS REQUIRED IN THE SPECIFICATIONS.

PART 3 - EXECUTION

3.1 SUBMITTALS

A. DIVISION 23 SHALL PROVIDE SUBMITTAL DOCUMENTATION RELATIVE TO COMMISSIONING AS REQUIRED IN THIS SECTION.

3.2 STARTUP PLAN AND PREFUNCTIONAL TESTING

A. THE MECHANICAL CONTRACTOR AND ASSOCIATED SUBCONTRACTORS SHALL BE RESPONSIBLE FOR THE INSTALLATION OF COMPLETE SYSTEMS AND SUB-SYSTEMS, FULLY FUNCTIONAL, MEETING THE DESIGN OBJECTIVES OF THE CONTRACT DOCUMENTS. CONTRACTOR SHALL FOLLOW THE APPROVED START-UP, INITIAL CHECKOUT, AND PRE-FUNCTIONAL TESTING PROCEDURES. THE COMMISSIONING PROCEDURES AND FUNCTIONAL TESTING DO NOT RELIEVE OR LESSEN THIS RESPONSIBILITY OR SHIFT THAT RESPONSIBILITY TO THE CA OR OWNER.

B. PRE-FUNCTIONAL TESTING AS DIRECTED AND PERFORMED BY THE CONTRACTOR SHALL BE REQUIRED FOR EACH PIECE OF EQUIPMENT TO ENSURE THAT THE EQUIPMENT AND SYSTEMS ARE PROPERLY INSTALLED AND READY FOR OPERATION, SO THAT FUNCTIONAL PERFORMANCE TESTING TO MAY PROCEED WITHOUT DELAYS. SAMPLING STRATEGIES SHALL NOT BE USED FOR PRE-FUNCTIONAL TESTING. THE PRE-FUNCTIONAL TESTING FOR ALL EQUIPMENT AND SUBSYSTEMS OF A GIVEN SYSTEM SHALL BE SUCCESSFULLY COMPLETED AND DOCUMENTED PRIOR TO FUNCTIONAL PERFORMANCE TESTING OF THE SYSTEM. THE MECHANICAL CONTRACTOR AND SUB-CONTRACTORS SHALL SIGN OFF ON THE CA’S PRE-FUNCTIONAL TEST SHEETS THAT THEY ARE COMPLETE AND THE SYSTEM IS READY. THE CA WILL VERIFY AND CONDUCT THEIR OWN INDEPENDENT VERIFICATION AND START-UP IN PARALLEL TO THE CONTRACTOR’S VERIFICATION. ANY DEFICIENCIES IDENTIFIED DURING THIS PROCESS SHALL BE NOTED AND REVIEWED BY THE CONTRACTORS. START-UP AND FUNCTIONAL TESTING SHALL NOT PROCEED UNTIL ALL THE DEFICIENCIES ARE CORRECTED AND VERIFIED BY THE CA.

C. THE FOLLOWING PROCEDURES SHALL APPLY TO ALL EQUIPMENT AND SYSTEMS TO BE COMMISSIONED.

1. START-UP AND INITIAL CHECKOUT PLAN. THE CONTRACTOR SHALL DEVELOP THE DETAILED START-UP AND PRE-FUNCTIONAL TESTING PLANS FOR ALL EQUIPMENT TO BE REVIEWED BY THE CA. THE PRIMARY ROLE OF THE CA IN THIS PROCESS SHALL BE TO REVIEW THE INSTALLATION FOR CONSTRUCTION COMPLETENESS AND ENSURE THAT ALL COMPONENTS HAVE BEEN INSTALLED AS PER THE DESIGN DOCUMENTS. ONLY WHEN PRE-FUNCTIONAL TESTING IS COMPLETE AND SIGNED OFF BY ALL CONTRACTORS, SHALL THE CONTRACTOR START-UP THE EQUIPMENT. EQUIPMENT AND SYSTEMS TO BE COMMISSIONED ARE IDENTIFIED IN THIS SECTION PART 2.

2. THE START-UP AND INITIAL CHECKOUT PLAN SHALL CONSIST OF THE FOLLOWING AS A MINIMUM:

a. THE MANUFACTURER’S STANDARD WRITTEN START-UP AND CHECKOUT PROCEDURES COPIED FROM THE INSTALLATION MANUALS AND MANUFACTURER’S NORMALLY USED FIELD CHECKOUT SHEETS. THE PLAN SHALL INCLUDE CHECKLISTS AND PROCEDURES WITH SPECIFIC BOXES OR LINES FOR RECORDING AND DOCUMENTING THE CHECKING AND INSPECTIONS OF EACH PROCEDURE AND A SUMMARY STATEMENT WITH A SIGNATURE BLOCK AT THE END OF THE PLAN.

b. FIRST-RUN CHECKLIST FOR EQUIPMENT, TO INCLUDE:

1) EQUIPMENT PROPERLY SET.
2) ALIGNMENT OF SHAFTS AND COUPLINGS.
3) ADJUSTMENT OF VIBRATION ISOLATORS.
4) PIPING AND EQUIPMENT PROPERLY CONNECTED.
5) COMPLETION OF INITIAL LUBRICATION PROCEDURES.
6) CLEAN FILTERS IN PLACE, AS APPROPRIATE.
7) WIRING PROPERLY CONNECTED.
8) ELECTRICAL OVERLOAD RELAYS APPROPRIATE FOR LOAD.
9) ELECTRICAL ACCESSORIES PROPERLY INSTALLED AND ADJUSTED.
10) CONTROLS, SAFETIES, AND TIME SWITCHES PROPERLY CALIBRATED AND SET-UP.
11) VERIFICATION OF DIRECTION OF MOTOR ROTATION AFTER FINAL ELECTRICAL CONNECTIONS BY JOGGING MOTOR.
12) MEASUREMENTS OF AMPERE DRAW OF ELECTRIC MOTORS AND COMPARISON WITH NAMEPLATE RATING AND WITH OVERLOAD HEATER RATINGS.
13) THE CONTRACTOR SHALL SUBMIT THE START-UP REPORTS TO THE CA FOR REVIEW.

D. THE CA SHALL REVIEW AND APPROVE THE PROCEDURES AND THE FORMAT FOR DOCUMENTING THEM, NOTING ANY PROCEDURES THAT NEED TO BE ADDED. TWO WEEKS PRIOR OR STARTUP, THE CONTRACTOR SHALL SCHEDULE START-UP AND CHECKOUT WITH THE OWNER AND CA. THE EXECUTION OF THE START-UP AND CHECKOUT SHALL BE DIRECTED AND PERFORMED BY THE CONTRACTOR, IN ACCORDANCE WITH MANUFACTURER’S PUBLISHED PROCEDURES AND WITH THE APPROVED PROCEDURES. THE CA MAY BE PRESENT FOR THE CONTRACTOR’S REQUIRED STARTUP AND CHECKOUT OF ALLSYSTEMS AND EQUIPMENT TO BE COMMISSIONED.

E. SENSOR CALIBRATION. CALIBRATION OF ALL SENSORS SHALL BE INCLUDED AS PART OF THE PRE-FUNCTIONAL TESTING AND LISTED ON THE APPROPRIATE TEST CHECKLISTS AND REPORTS, ACCORDING TO THE SPECIFIED PROCEDURES AND ACCURACIES FOR THE DEVICES AND SYSTEMS BEING TESTED.

F. ALL CONTRACTOR RESPONSIBLE START-UP, CHECKOUT FORMS SHALL BE COMPLETED AND SUBMITTED TO THE CA FOR REVIEW.

3.3 FUNCTIONAL PERFORMANCE TESTS

A. FUNCTIONAL PERFORMANCE VERIFICATION (FPV) IS THE DYNAMIC TESTING OF SYSTEMS (RATHER THAN JUST INDIVIDUAL COMPONENTS) UNDER FULL, PART AND SEASONAL REQUIREMENTS. SYSTEMS ARE TESTED UNDER VARIOUS LOADS AND CONTROL SEQUENCES, SUCH AS LOW COOLING AND HEATING LOADS, COMPONENT FAILURES, UNOCCUPIED MODES, FIRE ALARM, ETC. THE SYSTEMS ARE RUN THROUGH ALL THE CONTROL SEQUENCES OF OPERATION AND COMPONENTS ARE VERIFIED TO BE RESPONDING AS THE DESIGN INTENT AND DOCUMENTS. FPV SHALL INCLUDE; TESTING ALL SEQUENCES OF OPERATIONS, VERIFICATION OF SYSTEM CAPACITY, GENERATING SIMULATED SIGNALS TO SIMULATE SENSOR VALUES, CONDUCTING SIMULATED CONDITIONS TO TESTS ALL LOADS AND VERIFY SYSTEM PERFORMANCE DURING ALL CONDITIONS OF OPERATION AND VERIFYING DESIGN INTENT. IN ADDITION, EACH SYSTEM SHALL BE TESTED THROUGH ALL MODES OF OPERATION (SEASONAL, OCCUPIED, UNOCCUPIED, WARM-UP, COOL-DOWN, PART AND FULL LOAD). PROPER RESPONSES SUCH AS POWER FAILURES, FREEZE CONDITIONS, LOW-OIL PRESSURES, EQUIPMENT FAILURES, ETC. SHALL ALSO BE TESTED. THE CA DEVELOPS THE FUNCTIONAL TEST SHEETS AND PROCEDURES IN SEQUENTIAL WRITTEN FORM, COORDINATES THE TESTING, CONDUCTS THE TESTING AND DOCUMENTS THE TESTING. EACH CONTRACTOR IS REQUIRED IS SUPPLY PERSONNEL TO ASSIST DURING THE FUNCTIONAL PERFORMANCE TESTING WHERE APPLICABLE.

B. NO SYSTEM, EQUIPMENT OR COMPONENT THEREOF SHALL BE TESTED UNTIL THE CONTRACTOR AND THE CM HAS CERTIFIED, IN WRITING, THAT THE SYSTEM, EQUIPMENT AND / OR COMPONENTS ARE COMPLETE, HAVE BEEN TESTED, ADJUSTED AND BALANCED AND ARE READY FOR VALIDATING AND PERFORMANCE TESTING. FPV IS SCHEDULED BY THE CA AFTER THE PRE-FUNCTIONAL TESTING REQUIREMENTS ARE COMPLETE AND SIGNED-OFF BY THE CM AND THE CA. FPV WILL NOT BE CONDUCTED UNTIL A WRITTEN NOTICE OF COMPLETION BY THE CM CONFIRMING THAT THE SYSTEM IS READY FOR FPV. THE AIR BALANCING AND WATER BALANCING MUST BE COMPLETE AND THE CONTROLS MUST BE DEBUGGED PRIOR TO THE PERFORMANCE VERIFICATION.

C. FUNCTIONAL TESTING SHALL BE CONDUCTED BY THE CA. FUNCTIONAL TESTING MAY NOT PROCEED UNTIL THE SYSTEMS HAVE BEEN PROPERLY INSTALLED, STARTED-UP AND ALL DEFICIENCIES HAVE BEEN CORRECTED.

D. FUNCTIONAL TESTING IS INTENDED TO BEGIN UPON COMPLETION OF A SYSTEM. FUNCTIONAL TESTING MAY PROCEED PRIOR TO THE COMPLETION OF SYSTEMS OR SUB-SYSTEMS AT THE DISCRETION OF THE CA AND CM. BEGINNING SYSTEM TESTING BEFORE FULL COMPLETION SHALL NOT RELIEVE THE CONTRACTOR FROM FULLY COMPLETING THE SYSTEM, INCLUDING ALL PRE-FUNCTIONAL CHECKLISTS.

E. THE CONTRACTOR SHALL PROVIDE PERSONNEL TO OPERATE THE SYSTEMS WHILE FUNCTIONAL PERFORMANCE TESTING IS COMMENCING. THIS SHALL INCLUDE BUT NOT BE LIMITED TO; STARTING AND STOPPING OF SYSTEMS, OPENING AND CLOSING VALVES TO CREATE FALSE LOADS ON THE SYSTEM (WITH THE CAPABILITIES OF THE EXISTING SYSTEM) AND ALLOWING THE CA TO MANIPULATE THE BUILDING AUTOMATION SYSTEMS TO MODULATE THE SYSTEM REQUIREMENTS.

F. THE CONTRACTOR SHALL REVIEW THE COMMISSIONING FUNCTIONAL PERFORMANCE TESTING PROCEDURE SUPPLIED BY THE CA. AFTER FUNCTIONAL TESTING COMMENCES, THE CONTRACTOR AND THE CA SHALL SIGN THE FUNCTIONAL TEST RECORD AND PROVIDE THE OWNER AND THE CM A COPY TO REVIEW. ALL DEFICIENCIES EITHER CORRECTED IN THE FIELD OR OUTSTANDING SHALL BE DOCUMENTED ON THE FUNCTIONAL TEST FORMS FOR REVIEW BY ALL PARTIES.

G. ALL FUNCTIONAL TESTING MUST BE COMPLETED AND APPROVED BY THE CA AND THE OWNER BEFORE THE PROJECT WILL BE CONSIDERED SUBSTANTIALLY COMPLETE.

3.4 DEFERRED TESTING

A. DEFERRED TESTING. THE CONTRACTOR SHALL BE AVAILABLE TO ASSIST IN SEASONAL TESTING (SUMMER, WINTER AND INTERMEDIATE), TESTS DELAYED UNTIL WEATHER OR OTHER CONDITIONS UNTIL BUILDING CONSTRUCTION IS COMPLETED, REQUIRED BUILDING OCCUPANCY OR LOADING, OR OTHER CONDITIONS ARE SUITABLE FOR THE DEMONSTRATION OF EQUIPMENT OR SYSTEM’S PERFORMANCE, AS SPECIFIED. THESE DEFERRED TESTS SHALL BE CONDUCTED IN THE SAME MANNER AS THE SEASONAL TESTS AS SOON AS POSSIBLE. DEFERRED TESTING SHALL BE EXECUTED, DOCUMENTED AND DEFICIENCIES CORRECTED AS SPECIFIED HEREIN FOR FUNCTIONAL PERFORMANCE TESTING. ANY ADJUSTMENTS OR CORRECTIONS TO THE O&M MANUALS AND “AS BUILT” DOCUMENTS REQUIRED BY THE RESULTS OF THE TESTING SHALL BE MADE BEFORE THE SEASONAL TESTING PROCESS IS CONSIDERED COMPLETE.

3.5 TESTING DOCUMENTATION, NON-CONFORMANCE AND APPROVALS

A. THE CA SHALL CLEARLY LIST ANY OUTSTANDING ITEMS OF THE INITIAL START-UP AND PRE-FUNCTIONAL PROCEDURES THAT WERE NOT COMPLETED SUCCESSFULLY. THE TESTING FORM AND ANY OUTSTANDING

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	10/14/2022	ISSUED FOR BID AND PERMIT
1	11/18/2022	ADDENDUM 1
3	02/03/2023	ADDENDUM 3
4	03/10/2023	ADDENDUM 4
5	03/31/2023	ADDENDUM 5

SEAL 053111
YVETTE RICHARDSON

Seal / Signature

Project Name
VILLAGE DISTRICT

Project Number
69.6575.000

Description
MECHANICAL SPECIFICATIONS II

Scale
NONE

M-592

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DEFICIENCIES SHALL BE PROVIDED TO THE CM/OWNER WITHIN TWO DAYS OF TEST COMPLETION. THE CA SHALL REVIEW THE CONTRACTOR'S STARTUP TESTING REPORTS AND SHALL SUBMIT EITHER A NON-COMPLIANCE REPORT OR AN APPROVAL FORM TO THE CONTRACTOR. THE CA SHALL WORK WITH THE CONTRACTOR AND OTHERS AS NECESSARY, TO CORRECT AND RETEST DEFICIENCIES OR UNCOMPLETED ITEMS. THE CONTRACTOR SHALL CORRECT ALL AREAS THAT ARE DEFICIENT OR INCOMPLETE IN THE CHECKLISTS AND TESTS IN A TIMELY MANNER, AND SHALL NOTIFY THE CA AS SOON AS OUTSTANDING ITEMS HAVE BEEN CORRECTED AND RESUBMIT AN UPDATED START-UP REPORT WITH A STATEMENT OF CORRECTION ON THE ORIGINAL NON-COMPLIANCE REPORT. WHEN ALL REQUIREMENTS ARE SATISFACTORILY COMPLETED, THE CA SHALL RECOMMEND APPROVAL OF THE STARTUP AND PRE-FUNCTIONAL TESTING OF EACH SYSTEM AND SCHEDULE THE FUNCTIONAL TESTING OF THE EQUIPMENT OR SYSTEM.

B. AS FUNCTIONAL PERFORMANCE TESTING PROGRESSES AND A DEFICIENCY IS IDENTIFIED, THE CA SHALL DISCUSS THE ISSUE WITH THE EXECUTING CONTRACTOR AND THE COMMISSIONING TEAM.
1. WHEN THERE IS NO DISPUTE OF THE DEFICIENCY AND THE CONTRACTOR ACCEPTS RESPONSIBILITY FOR CORRECTING IT, THE CA SHALL DOCUMENT THE DEFICIENCY AND THE CONTRACTOR'S RESPONSE AND INTENTIONS AND THE TESTING SHALL PROCEED, IF POSSIBLE. CORRECTIONS OF MINOR DEFICIENCIES IDENTIFIED MAY BE MADE BY THE CONTRACTOR DURING THE FUNCTIONAL PERFORMANCE TESTING, AT THE DISCRETION OF THE CA. EVERY EFFORT SHALL BE MADE OR EXPEDITE THE TESTING PROCESS AND MINIMIZE UNNECESSARY DELAYS, WHILE NOT COMPROMISING THE INTEGRITY OF THE COMMISSIONING EFFORT.
2. WHEN THE IDENTIFIED DEFICIENCY IS CORRECTED, THE CONTRACTOR SHALL SIGN THE STATEMENT OF CORRECTION AT THE BOTTOM OF THE NON-COMPLIANCE FORM, CERTIFYING THAT THE EQUIPMENT IS READY TO BE RETESTED, AND RETURN THE FORM TO THE CA. THE CA SHALL SCHEDULE THE RETEST OF THE EQUIPMENT OR SYSTEM INVOLVED.
3. IF THERE IS A DISPUTE ABOUT AN IDENTIFIED DEFICIENCY, THE CA SHALL DOCUMENT THE DEFICIENCY AND THE CONTRACTOR'S RESPONSE, AND PROVIDE A COPY TO THE CONTRACTOR. EVERY ATTEMPT SHALL BE MADE TO RESOLVE THE DISPUTE AT THE LOWEST MANAGEMENT LEVEL POSSIBLE. WHEN THE DISPUTE RESOLUTION HAS BEEN DECIDED, THE APPROPRIATE PARTY CORRECTS THE DEFICIENCY, SIGNS THE STATEMENT OF CORRECTION ON THE NON-COMPLIANCE FORM AND RETURNS THE FORM TO THE CA. THE CA SHALL SCHEDULE THE RETEST OF THE EQUIPMENT OR SYSTEM INVOLVED. FINAL INTERPRETIVE AUTHORITY SHALL BE THE A/E. FINAL ACCEPTANCE AUTHORITY SHALL BE THE OWNER.

C. DURING THE FUNCTIONAL PERFORMANCE TESTING OF MULTIPLE UNITS OF SIMILAR EQUIPMENT, THE CA WILL TEST ALL OF THE INSTALLED EQUIPMENT AND COMPONENTS IDENTIFIED. IF, UNDER SUCH A TESTING PROCEDURE, THREE OR MORE IDENTICAL PIECES OF EQUIPMENT (SIZE ALONG DOES NOT CONSTITUTE DIFFERENCE) FAIL TO PERFORM TO THE REQUIREMENTS OF THE CONTRACT DOCUMENTS (MECHANICALLY OR SUBSTANTIVELY) DUE TO MANUFACTURING OR INSTALLATION DEFECTS NOT ALLOWING IT TO MEET ITS SUBMITTED PERFORMANCE SPEC, ALL IDENTICAL UNITS MAY BE CONSIDERED UNACCEPTABLE BY THE CA. IN SUCH A CASE, THE CONTRACTOR SHALL PROVIDE THE CA WITH THE FOLLOWING:
1. WITHIN ONE WEEK OF NOTIFICATION FROM THE CA, THE CONTRACTOR OR MANUFACTURER'S REPRESENTATIVE SHALL EXAMINE ALL OTHER IDENTICAL UNITS MAKING A RECORD OF THE FINDINGS. THE FINDINGS SHALL BE PROVIDED TO THE CA WITHIN TWO WEEKS OF THE ORIGINAL NOTICE.
2. WITHIN TWO WEEKS OF THE ORIGINAL NOTIFICATION, THE CONTRACTOR SHALL PROVIDE THE CA AND THE A/E A SIGNED AND DATED, WRITTEN EXPLANATION OF THE PROBLEM, CAUSE OF FAILURES, ETC., AND PROPOSED SOLUTION, INCLUDING FULL EQUIPMENT SUBMITTALS FOR CORRECTIVE OR REPLACEMENT EQUIPMENT, IF APPROPRIATE. THE PROPOSED SOLUTION SHALL NOT BE FOR LESS THAN THE SPECIFICATION REQUIREMENTS OF THE ORIGINAL INSTALLATION.
3. WHEN APPROVED, TWO EXAMPLES OF THE PROPOSED SOLUTION SHALL BE INSTALLED BY THE CONTRACTOR AND THE CA SHALL SCHEDULE AND CONDUCT FUNCTIONAL TESTING OF THE PROPOSED SOLUTION. UPON COMPLETION OF THE FUNCTIONAL TESTING OF THE PROPOSED SOLUTION, THE CA SHALL RECOMMEND THE ACCEPTANCE OR DISAPPROVAL OF THE PROPOSED SOLUTION TO THE OWNER.
4. UPON ACCEPTANCE OF THE PROPOSED SOLUTION BY THE OWNER, THE CONTRACTOR SHALL REPLACE OR REPAIR ALL IDENTICAL ITEMS, AT THEIR EXPENSES AND EXTEND THE WARRANTY ACCORDINGLY, IF THE ORIGINAL EQUIPMENT WARRANTY HAD BEGUN. THE REPLACEMENT/REPAIR WORK SHALL PROCEED WITH REASONABLE SPEED BEGINNING WITHIN ONE WEEK OF APPROVAL OF THE PROPOSED SOLUTION.
5. COST OF RETESTING
a. THE COST FOR CA AND/OR OWNER PERSONNEL TO CONDUCT THE RETESTING OF A FUNCTIONAL PERFORMANCE TESTING REQUIREMENTS NECESSITATED BECAUSE A SPECIFIC PRE-FUNCTIONAL OR START-UP TEST ITEM, REPORTED TO HAVE BEEN SUCCESSFULLY COMPLETED, BUT FOUND TO BE INCOMPLETE OR FAULTY, SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.
b. FOR A DEFICIENCY IDENTIFIED DURING THE FUNCTIONAL TESTING, NOT RELATED TO ANY PRE-FUNCTIONAL CHECKLIST OR START-UP FAULT, THE CA AND OWNER SHALL DIRECT THE RETESTING OF THE EQUIPMENT ONCE AT "NO CHARGE" FOR THEIR TIME. HOWEVER, ALL COSTS FOR ANY SUBSEQUENT RETESTING SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.
c. ITEMS LEFT INCOMPLETE, WHICH LATER CAUSE DEFICIENCIES OR DELAYS DURING FUNCTIONAL TESTING MAY RESULT IN BACK-CHARGES TO THE RESPONSIBLE PARTY.

3.6 OPERATION AND MAINTENANCE (O&M) MANUALS
A. THE FOLLOWING O&M MANUAL REQUIREMENTS DO NOT REPLACE O&M MANUAL DOCUMENTATION REQUIREMENTS ELSEWHERE IN THESE SPECIFICATIONS. A DETAILED LISTING OF O&M REQUIREMENTS IS LISTED IN SECTION 019113.
B. DIVISION 23 SHALL COMPILE AND PREPARE DOCUMENTATION FOR ALL EQUIPMENT AND SYSTEMS COVERED IN DIVISION 23 AND DELIVER THIS DOCUMENTATION TO THE CM FOR INCLUSION IN THE O&M MANUALS, ACCORDING TO THIS SECTION AND SECTION 019113, PRIOR TO THE TRAINING OF OWNER PERSONNEL.
C. THE CA SHALL RECEIVE A COPY OF THE O&M MANUALS FOR REVIEW.
D. OPERATION AND MAINTENANCE DOCUMENTATION, IN HARDBACK 3-RING LOOSE-LEAF BINDERS EXCEPT FULL SIZE DRAWINGS AND DISKETTES, SHALL COVER ALL MECHANICAL SYSTEMS. DOCUMENTATION SHALL INCLUDE THE FOLLOWING: OPERATIONS AND MAINTENANCE DOCUMENTATION DIRECTORY; EMERGENCY INFORMATION; OPERATING MANUAL; EMERGENCY INFORMATION; MAINTENANCE MANUAL; TEST REPORTS; AND CONSTRUCTION DOCUMENTS.THE OPERATION AND MAINTENANCE DOCUMENTATION PACKAGE SHALL BE SUBMITTED AS ONE COMPREHENSIVE PACKAGE TO THE OWNER AND CA BEFORE SYSTEMS START-UP AND COMMISSIONING, AND SHALL BE UPDATED, REVISED AND COMPLETED DURING, AND AT COMPLETION OF, COMMISSIONING.

3.7 TRAINING OF OWNER PERSONNEL
A. THE MECHANICAL COMMISSIONING SUPERVISOR SHALL BE RESPONSIBLE FOR TRAINING COORDINATION AND SCHEDULING OF REQUIRED TRAINING AND FOR ENSURING THAT ALL REQUIRED TRAINING IS COMPLETED. THE CA SHALL OVERSEE THE CONTENT AND ADEQUACY OF THE TRAINING OF OWNER PERSONNEL.
B. PREPARE AND SUBMIT A SYLLABUS DESCRIBING AN OVERVIEW OF THE PROGRAM, DESCRIBING HOW THE PROGRAM WILL BE CONDUCTED, WHEN AND WHERE MEETINGS ARE TO BE HELD, NAMES AND COMPANY AFFILIATIONS OF LECTURERS, DESCRIPTION OF CONTENTS AND OUTLINE FOR EACH LECTURE, AND RECOMMENDED REFERENCE MATERIAL AND OUTSIDE READING. OBTAIN DIRECTION FROM THE OWNER ON WHICH OPERATING PERSONNEL SHALL BE INSTRUCTED IN EACH SYSTEM. PROPOSED TRAINING SCHEDULES, MATERIALS, AND LESSON PLANS SHALL BE SUBMITTED TO THE CA FOR REVIEW OF THE CONTENT AND ADEQUACY OF THE TRAINING OF OWNER PERSONNEL FOR COMMISSIONED EQUIPMENT OR SYSTEMS.
C. MECHANICAL CONTRACTOR. THE MECHANICAL CONTRACTOR SHALL HAVE THE FOLLOWING TRAINING RESPONSIBILITIES:
1. PROVIDE THE CA WITH TRAINING PLAN ONE WEEK BEFORE THE PLANNED TRAINING.
2. PROVIDE DESIGNATED OWNER PERSONNEL WITH COMPREHENSIVE ORIENTATION AND TRAINING IN THE UNDERSTANDING OF THE SYSTEMS AND THE OPERATION AND MAINTENANCE OF EACH PIECE OF EQUIPMENT.
3. TRAINING SHALL NORMALLY START WITH CLASSROOM SESSIONS FOLLOWED BY HANDS-ON TRAINING ON EACH PIECE OF EQUIPMENT.
4. DURING ANY DEMONSTRATION, SHOULD THE SYSTEM FAIL TO PERFORM IN ACCORDANCE WITH THE REQUIREMENTS OF THE O&M MANUAL OR SEQUENCE OF OPERATIONS, THE SYSTEM WILL BE REPAIRED OR ADJUSTED AS NECESSARY AND THE DEMONSTRATION REPEATED.
5. THE APPROPRIATE TRADE OR MANUFACTURER'S REPRESENTATIVE SHALL PROVIDE THE INSTRUCTIONS ON EACH MAJOR PIECE OF EQUIPMENT. THIS PERSON MAY BE THE START-UP TECHNICIAN FOR THE PIECE OF EQUIPMENT, THE INSTALLING CONTRACTOR OR MANUFACTURER'S REPRESENTATIVE. PRACTICAL BUILDING OPERATING EXPERTISE, AS WELL AS IN-DEPTH KNOWLEDGE OF ALL MODES OF OPERATION OF THE SPECIFIC PIECE OF EQUIPMENT, IS REQUIRED. MORE THAN ONE PARTY MAY BE REQUIRED TO EXECUTE THE TRAINING.
6. THE CONTROLS CONTRACTOR SHALL ATTEND SESSIONS OTHER THAN THE CONTROLS TRAINING, FOR EACH TYPE OF EQUIPMENT CONTROLLED BY THE BAS, TO DISCUSS THE INTERACTION OF THE BAS AS IT RELATES TO THE EQUIPMENT BEING DISCUSSED.
7. THE TRAINING SESSIONS SHALL FOLLOW THE OUTLINE IN THE TABLE OF CONTENTS OF THE OPERATION AND MAINTENANCE MANUAL AND ILLUSTRATE WHENEVER POSSIBLE THE USE OF THE O&M MANUALS FOR REFERENCE.

3.8 WRITTEN WORK PRODUCTS
A. WRITTEN WORK PRODUCTS OF CONTRACTORS SHALL CONSIST OF THE START-UP AND INITIAL CHECKOUT PLAN AND THE FILLED OUT START-UP, INITIAL CHECKOUT AND PRE-FUNCTIONAL CHECKLISTS.

SECTION 230993 - SEQUENCE OF OPERATION

1. VARIABLE CAPACITY SPLIT SYSTEM
A. DUCTLESS SPLIT SYSTEM SHALL BE PROVIDED WITH A WALL MOUNTED DIGITAL THERMOSTAT. SEE FLOOR PLAN DRAWINGS AND SCHEDULE FOR OUTDOOR CONDENSING UNITS THAT SERVE INDOOR UNITS.COOLING: THE COOLING SET POINT TEMPERATURE SHALL BE 75°F (ADJUSTABLE). UPON A DEMAND FOR MECHANICAL COOLING, THE ASSOCIATED CONDENSING UNIT SHALL BE ENERGIZED AND THE COOLING COIL SHALL BE CONTROLLED TO MAINTAIN SPACE TEMPERATURE.
B. THE HEATING SET POINT TEMPERATURE SHALL BE 70°F (ADJUSTABLE). WHEN THE SPACE TEMPERATURE FALLS BELOW THE SET POINT TEMPERATURE THE HEATING UNIT SHALL STAGE ON IN ORDER TO MAINTAIN THE SET POINT TEMPERATURE.
2. TOILET EXHAUST FAN.
A. FAN SHALL BE STARTED AND STOPPED FROM TIMECLOCK LOCATED IN THE MANAGER OFFICE.
3. ROOFTOP UNIT AC UNIT
A. REFER TO RTU'S CONTROL MATRIX ON SHEET M6011 FOR REQUIRED ROOFTOP CONTROL OPTIONS
4. ELECTRIC UNIT HEATER .
A. UNIT HEATER SHALL BE ACTIVATED BY UNIT MOUNTED THERMOSTAT TO MAINTAIN ROOM TEMPERATURE SETPOINT ±60°F (ADJUSTABLE)
5. KITCHEN EXHAUST FANS
A. REFER TO CAPTIVE AIRE DWG M707 FOR SEQUENCE OF OPERATION
6. ELECTRIC AIR CURTAIN
A. THE AIR CURTAIN SHALL BE PROVIDED WITH A REMOTE, WALL MOUNTED THERMOSTAT
B. THE HEATING SET POINT TEMPERATURE SHALL BE 68 DEGREES. WHEN THE SPACE TEMPERATURE FALLS BELOW THE SET POINT TEMPERATURE, THE AIR CURTAIN SHALL TURN ON IN ORDER TO MAINTAIN THE SET POINT TEMPERATURE.
C. CONTRACTOR SHALL PROVIDE DOOR SWITCH. AIR CURTAIN SHALL OPERATE WHENEVER DOOR OPENS AND RUN FOR PRESET PERIOD OF TIME AND SHUT OFF.

SECTION 232001 - CONDENSATE DRAIN PIPING

PART 1 - NOT USED
PART 2 - PRODUCTS
2.1 CONDENSATE DRAIN PIPING (DIAMETER LESS THAN OR EQUAL TO 1")
A. PVC SCHEDULE 40 PRESSURE PIPE AND FITTING SYSTEM.
B. PIPE AND FITTINGS SHALL BE MANUFACTURED FROM VIRGIN RIGID PVC (POLYVINYL CHLORIDE) VINYL COMPOUNDS WITH A CELL CLASS OF 12454 PER ASTM D 1784.
C. PVC SCHEDULE 40 PIPE SHALL BE IRON PIPE SIZE (IPS) CONFORMING TO ASTM D 1785.
D. PVC SCHEDULE 40 FITTINGS SHALL CONFORM TO ASTM D 2466.
E. PIPE AND FITTINGS SHALL BE MANUFACTURED AS A SYSTEM AND BE THE PRODUCT OF ONE MANUFACTURER.
F. PIPE AND FITTINGS SHALL CONFORM TO NATIONAL SANITATION FOUNDATION (NSF) STANDARD 61 OR THE HEALTH EFFECTS PORTION OF NSF STANDARD 14.
G. TESTING WITH OR TRANSPORT/STORAGE OF COMPRESSED AIR OR GAS IN PVC PIPE OR FITTINGS SHALL NOT BE PERMITTED.BURIED PIPE SHALL BE INSTALLED IN ACCORDANCE WITH ASTM F 1668 AND ASTM D 2774.
H. SOLVENT CEMENT JOINTS SHALL BE MADE IN A TWO STEP PROCESS WITH PRIMER MANUFACTURED FOR THERMOPLASTIC PIPING SYSTEMS AND SOLVENT CEMENT CONFORMING TO ASTM D 2564.
I. PRIMER SHALL CONFORM TO ASTM F 656.
J. THE SYSTEM SHALL BE PROTECTED FROM CHEMICAL AGENTS, FIRE STOPPING MATERIALS, THREAD SEALANT, PLASTICIZED VINYL PRODUCTS, OR OTHER AGGRESSIVE CHEMICAL AGENTS NOT COMPATIBLE WITH PVC COMPOUNDS.
K. THE SYSTEM IS INTENDED FOR PRESSURE DRAINAGE APPLICATIONS WHERE THE TEMPERATURE WILL NO EXCEED 140°F.
2.2 CONDENSATE DRAIN PIPING (DIAMETER GREATER THAN 1")
2.3 PVC SCHEDULE 40 SOLID WALL PIPE AND PVC DWV FITTING SYSTEM.
A. PIPE AND FITTINGS SHALL BE MANUFACTURED FROM VIRGIN RIGID PVC (POLYVINYL CHLORIDE) VINYL COMPOUNDS WITH A CELL CLASS OF 12454 PER ASTM D 1784.
B. PVC SCHEDULE 40 PIPE SHALL BE IRON PIPE SIZE (IPS) CONFORMING TO ASTM D 1785 AND ASTM D 2665.
C. INJECTION MOLDED PVC DWV FITTINGS SHALL CONFORM TO ASTM D 2665. FABRICATED PVC DWV FITTINGS SHALL CONFORM TO ASTM F 1866.
D. PIPE AND FITTINGS SHALL BE MANUFACTURED AS A SYSTEM AND BE THE PRODUCT OF ONE MANUFACTURER.
E. PIPE AND FITTINGS SHALL CONFORM TO NATIONAL SANITATION FOUNDATION (NSF) STANDARD 14.
F. TESTING WITH OR TRANSPORT/STORAGE OF COMPRESSED AIR OR GAS IN PVC PIPE OR FITTINGS SHALL NOT BE PERMITTED.
G. BURIED PIPE SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D 2321 AND ASTM F 1668.
H. SOLVENT CEMENT JOINTS SHALL BE MADE IN A TWO STEP PROCESS WITH PRIMER MANUFACTURED FOR THERMOPLASTIC PIPING SYSTEMS AND SOLVENT CEMENT CONFORMING TO ASTM D 2564.
I. PRIMER SHALL CONFORM TO ASTM F 656.
J. THE SYSTEM SHALL BE PROTECTED FROM CHEMICAL AGENTS, FIRE STOPPING MATERIALS, THREAD SEALANT, PLASTICIZED VINYL PRODUCTS, OR OTHER AGGRESSIVE CHEMICAL AGENTS NOT COMPATIBLE WITH PVC COMPOUNDS.
K. THE SYSTEM IS INTENDED FOR NON-PRESSURE DRAINAGE APPLICATIONS WHERE THE TEMPERATURE WILL NOT EXCEED 140°F.
PART 3 - EXECUTION
3.1 EXAMINATION
A. SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION: VERIFICATION OF EXISTING CONDITIONS BEFORE STARTING WORK.
3.2 PREPARATION
A. REAM PIPE AND TUBE ENDS. REMOVE BURRS.
B. REMOVE SCALE AND DIRT, ON INSIDE AND OUTSIDE, BEFORE ASSEMBLY.
C. PREPARE PIPING CONNECTIONS TO EQUIPMENT WITH FLANGES OR UNIONS.
3.3 INSTALLATION
A. INSTALL IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS AND THE REQUIREMENTS OF THE PLUMBING CODE OF LOCAL JURISDICTION.
B. ROUTE PIPING IN ORDERLY MANNER AND MAINTAIN GRADIENT. ROUTE PARALLEL AND PERPENDICULAR TO WALLS EFFECT CHANGES IN SIZE WITH REDUCING FITTINGS. INSTALL PIPING TO MAINTAIN HEADROOM, CONSERVE SPACE, AND NOT INTERFERE WITH USE OF SPACE.
C. GROUP PIPING WHENEVER PRACTICAL AT COMMON ELEVATIONS.
D. PROVIDE CLEARANCE IN HANGERS AND FROM STRUCTURE AND OTHER EQUIPMENT FOR INSTALLATION OF INSULATION AND ACCESS TO FITTINGS. REFER TO SECTION 230700.
E. PROVIDE ACCESS WHERE VALVES AND FITTINGS ARE NOT EXPOSED. COORDINATE SIZE AND LOCATION OF ACCESS DOORS WITH SECTION 083100 - ACCESS DOORS AND PANELS.
F. WHERE PIPE SUPPORT MEMBERS ARE WELDED TO STRUCTURAL BUILDING FRAMING, SCRAPE, BRUSH CLEAN, AND APPLY ONE COAT OF ZINC RICH PRIMER TO WELDING.
G. SLEEVE PIPES PASSING THROUGH PARTITIONS, WALLS AND FLOORS.
H. IDENTIFY PIPING UNDER PROVISIONS OF SECTION 223555.
3.4 APPLICATION
A. INSTALL UNIONS DOWNSTREAM AT EQUIPMENT OR APPARATUS CONNECTIONS.
3.5 ERECTION TOLERANCES
A. SECTION 014500 - QUALITY CONTROL: TOLERANCES.
B. ESTABLISH INVERT ELEVATIONS, SLOPES FOR DRAINAGE TO ¼ INCH PER FOOT MINIMUM. MAINTAIN GRADIENTS.
3.6 FIELD QUALITY CONTROL
A. DRAINAGE SYSTEM: TEST PLUG OPENING TO PERMIT SYSTEM TO BE FILLED WITH WATER AND SUBJECT SYSTEM TO 10 FOOT HEAD OF WATER PRESSURE. SYSTEM SHALL HOLD WATER FOR 30 MINUTES WITH A DROP-IN WATER LEVEL NOT TO EXCEED 4 INCHES IN A 4-INCH DIAMETER STANDPIPE, AND WITHOUT VISIBLE LEAKAGE.

SECTION 232300 - REFRIGERANT PIPING

PART 1 - PRODUCTS
2.1 PERFORMANCE REQUIRMENTS
A. LINE TEST PRESSURE FOR REFRIGERANT R-410A:
20. SUCTION LINES FOR AIR-CONDITIONING APPLICATIONS: 300 PSIG.
21. SUCTION LINES FOR HEAT-PUMP APPLICATIONS: 535 PSIG.
22. HOT-GAS AND LIQUID LINES: 535 PSIG.
B. COMPLY WITH ASME B31.5, "REFRIGERANT PIPING," AND WITH ASHRAE 15, "SAFETY CODE FOR MECHANICAL REFRIGERATION."
2.2 TUBES AND FITTINGS
A. COPPER TUBE: ASTM B 88, TYPES K AND L (ASTM B 88M, TYPES A AND B) AND ASTM B 280, TYPE ACR.
B. WROUGHT-COPPER FITTINGS AND UNIONS: ASME B16.22.
C. SOLDER FILLER METALS: ASTM B 32. USE 95-5 TIN ANTIMONY OR ALLOY HB SOLDER TO JOIN COPPER SOCKET FITTINGS ON COPPER PIPE.
D. BRAZING FILLER METALS: AWS A5.8.
E. FLEXIBLE CONNECTORS:
1. BODY: TIN-BRONZE BELLOWS WITH WOVEN, FLEXIBLE, TINNED-BRONZE-WIRE-REINFORCED PROTECTIVE JACKET.
2. END CONNECTIONS: SOCKET ENDS.
3. OFFSET PERFORMANCE: CAPABLE OF MINIMUM 3/4-INCH (20-MM) MISALIGNMENT IN MINIMUM 7- INCH- (180-MM-) LONG ASSEMBLY.
4. WORKING PRESSURE RATING: FACTORY TEST AT MINIMUM 500 PSIG (3450 KPA).
5. MAXIMUM OPERATING TEMPERATURE: 250 DEG F (121 DEG C).
2.3 VALVES AND SPECIALTIES
A. DIAPHRAGM PACKLESS VALVES:
1. BODY AND BONNET: FORGED BRASS OR CAST BRONZE; GLOBE DESIGN WITH STRAIGHT-THROUGH OR ANGLE PATTERN.
2. DIAPHRAGM: PHOSPHOR BRONZE AND STAINLESS STEEL WITH STAINLESS-STEEL SPRING.
3. OPERATOR: RISING STEM AND HAND WHEEL.
4. SEAT: NYLON.
5. END CONNECTIONS: SOCKET, UNION, OR FLANGED.
6. WORKING PRESSURE RATING: 500 PSIG (3450 KPA).
7. MAXIMUM OPERATING TEMPERATURE: 275 DEG F (135 DEG C).
B. PACKED-ANGLE VALVES:
1. BODY AND BONNET: FORGED BRASS OR CAST BRONZE.
2. PACKING: MOLDED STEM, BACK SEATING, AND REPLACEABLE UNDER PRESSURE.
3. OPERATOR: RISING STEM.
4. SEAT: NONROTATING, SELF-ALIGNING POLYTETRAFLUOROETHYLENE.
5. SEAL CAP: FORGED-BRASS OR VALOX HEX CAP.
6. END CONNECTIONS: SOCKET, UNION, THREADED, OR FLANGED.
7. WORKING PRESSURE RATING: 500 PSIG (3450 KPA).
8. MAXIMUM OPERATING TEMPERATURE: 275 DEG F (135 DEG C).
C. CHECK VALVES:
1. BODY: DUCTILE IRON, FORGED BRASS, OR CAST BRONZE; GLOBE PATTERN.
2. BONNET: BOLTED DUCTILE IRON, FORGED BRASS, OR CAST BRONZE; OR BRASS HEX PLUG.
3. PISTON: REMOVABLE POLYTETRAFLUOROETHYLENE SEAT.
4. CLOSING SPRING: STAINLESS STEEL.
5. MANUAL OPENING STEM: SEAL CAP, PLATED-STEEL STEM, AND GRAPHITE SEAL.
6. END CONNECTIONS: SOCKET, UNION, THREADED, OR FLANGED.
7. MAXIMUM OPENING PRESSURE: 0.50 PSIG (3.4 KPA).
8. WORKING PRESSURE RATING: 500 PSIG (3450 KPA).
9. MAXIMUM OPERATING TEMPERATURE: 275 DEG F (135 DEG C).
D. SERVICE VALVES:
1. BODY: FORGED BRASS WITH BRASS CAP INCLUDING KEY END TO REMOVE CORE.
2. CORE: REMOVABLE BALL-TYPE CHECK VALVE WITH STAINLESS-STEEL SPRING.
3. SEAT: POLYTETRAFLUOROETHYLENE.
4. END CONNECTIONS: COPPER SPRING.
5. WORKING PRESSURE RATING: 500 PSIG (3450 KPA).
E. SOLENOID VALVES: COMPLY WITH AHRI 760 AND UL 429; LISTED AND LABELED BY A NATIONAL RECOGNIZED TESTING LABORATORY (NRTL).
1. BODY AND BONNET: PLATED STEEL.
2. SOLENOID TUBE, PLUNGER, CLOSING SPRING, AND SEAT ORIFICE: STAINLESS STEEL.
3. SEAT: POLYTETRAFLUOROETHYLENE.
4. END CONNECTIONS: THREADED.
5. ELECTRICAL: MOLDED, WATERTIGHT COIL IN NEMA 250 ENCLOSURE OF TYPE REQUIRED BY LOCATION WITH 1/2-INCH (16-GRC) CONDUIT ADAPTER, AND 24-V AC COIL.
6. WORKING PRESSURE RATING: 400 PSIG (2760 KPA).
7. MAXIMUM OPERATING TEMPERATURE: 240 DEG F (116 DEG C).
F. SAFETY RELIEF VALVES: COMPLY WITH 2010 ASME BOILER AND PRESSURE VESSEL CODE; LISTED AND LABELED BY AN NRTL.
1. BODY AND BONNET: DUCTILE IRON AND STEEL, WITH NEOPRENE O-RING SEAL.
2. PISTON, CLOSING SPRING, AND SEAT INSERT: STAINLESS STEEL.
3. SEAT: POLYTETRAFLUOROETHYLENE.
4. END CONNECTIONS: THREADED.
5. WORKING PRESSURE RATING: 400 PSIG (2760 KPA).
6. MAXIMUM OPERATING TEMPERATURE: 240 DEG F (116 DEG C).
G. THERMOSTATIC EXPANSION VALVES: COMPLY WITH AHRI 750.
1. BODY, BONNET, AND SEAL CAP: FORGED BRASS OR STEEL.
2. DIAPHRAGM, PISTON, CLOSING SPRING, AND SEAT INSERT: STAINLESS STEEL.
3. PACKING AND GASKETS: NON-ASBESTOS.
4. CAPILLARY AND BULB: COPPER TUBING FILLED WITH REFRIGERANT CHARGE.
5. SUCTION TEMPERATURE: [40 DEG F (4.4 DEG C)]
6. SUPERHEAT: ADJUSTABLE
7. REVERSE-FLOW OPTION (FOR HEAT-PUMP APPLICATIONS).
8. END CONNECTIONS: SOCKET, FLARE, OR THREADED UNION.
9. WORKING PRESSURE RATING: 700 PSIG (4820 KPA)
H. HOT-GAS BYPASS VALVES: COMPLY WITH UL 429; LISTED AND LABELED BY AN NRTL.
1. BODY, BONNET, AND SEAL CAP: DUCTILE IRON OR STEEL.
2. DIAPHRAGM, PISTON, CLOSING SPRING, AND SEAT INSERT: STAINLESS STEEL.
3. PACKING AND GASKETS: NON-ASBESTOS.
4. SOLENOID TUBE, PLUNGER, CLOSING SPRING, AND SEAT ORIFICE: STAINLESS STEEL.
5. SEAT: POLYTETRAFLUOROETHYLENE.
6. EQUALIZER: INTERNAL
7. ELECTRICAL: MOLDED, WATERTIGHT COIL IN NEMA 250 ENCLOSURE OF TYPE REQUIRED BY LOCATION WITH 1/2-INCH (16-GRC) CONDUIT ADAPTER AND 24V AC COIL.
8. END CONNECTIONS: SOCKET.
9. SET PRESSURE: <INSERT PSIG (KPA)>.
10. THROTTLING RANGE: MAXIMUM 5 PSIG (34 KPA).
11. WORKING PRESSURE RATING: 500 PSIG (3450 KPA).
12. MAXIMUM OPERATING TEMPERATURE: 240 DEG F (116 DEG C).
I. STRAIGHT-TYPE STRAINERS:
1. BODY: WELDED STEEL WITH CORROSION-RESISTANT COATING.
2. SCREEN: 100-MESH STAINLESS STEEL.
3. END CONNECTIONS: SOCKET OR FLARE.
4. WORKING PRESSURE RATING: 500 PSIG (3450 KPA).
5. MAXIMUM OPERATING TEMPERATURE: 275 DEG F (135 DEG C).
J. ANGLE-TYPE STRAINERS:
1. BODY: FORGED BRASS OR CAST BRONZE.
2. DRAIN PLUG: BRASS HEX PLUG.
3. SCREEN: 100-MESH MONEL.
4. END CONNECTIONS: SOCKET OR FLARE.
5. WORKING PRESSURE RATING: 500 PSIG (3450 KPA).
6. MAXIMUM OPERATING TEMPERATURE: 275 DEG F (135 DEG C).
K. MOISTURE/LIQUID INDICATORS:
1. BODY: FORGED BRASS.
2. WINDOW: REPLACEABLE, CLEAR, FUSED GLASS WINDOW WITH INDICATING ELEMENT PROTECTED BYFILTER SCREEN.
3. INDICATOR: COLOR CODED TO SHOW MOISTURE CONTENT IN PARTS PER MILLION (PPM).
4. MINIMUM MOISTURE INDICATOR SENSITIVITY: INDICATE MOISTURE ABOVE 60 PPM.
5. END CONNECTIONS: SOCKET OR FLARE.
6. WORKING PRESSURE RATING: 500 PSIG (3450 KPA).
7. MAXIMUM OPERATING TEMPERATURE: 240 DEG F (116 DEG C).
L. REPLACEABLE-CORE FILTER DRYERS: COMPLY WITH AHRI 730.
1. BODY AND COVER: PAINTED-STEEL SHELL WITH DUCTILE-IRON COVER, STAINLESS-STEEL SCREWS, AND NEOPRENE GASKETS.
2. FILTER MEDIA: 10 MICRON, PLEATED WITH INTEGRAL END RINGS; STAINLESS-STEEL SUPPORT.
3. DESICCANT MEDIA: ACTIVATED ALUMINA
4. ACCESS PORTS: NPS 1/4 (DN 8) CONNECTIONS AT ENTERING AND LEAVING SIDES FOR PRESSURE DIFFERENTIAL MEASUREMENT.
5. MAXIMUM PRESSURE LOSS: [2 PSIG (14 KPA)]
6. RATED FLOW: <INSERT TONS (KW)>.
7. WORKING PRESSURE RATING: 500 PSIG (3450 KPA).
8. MAXIMUM OPERATING TEMPERATURE: 240 DEG F (116 DEG C).
M. PERMANENT FILTER DRYERS: COMPLY WITH AHRI 730.
1. BODY AND COVER: PAINTED-STEEL SHELL.
2. FILTER MEDIA: 10 MICRON, PLEATED WITH INTEGRAL END RINGS; STAINLESS-STEEL SUPPORT.
3. DESICCANT MEDIA: ACTIVATED ALUMINA
4. ACCESS PORTS: NPS 1/4 (DN 8) CONNECTIONS AT ENTERING AND LEAVING SIDES FOR PRESSURE DIFFERENTIAL MEASUREMENT.
5. MAXIMUM PRESSURE LOSS: [2 PSIG (14 KPA)]
6. RATED FLOW: <INSERT TONS (KW)>.
7. WORKING PRESSURE RATING: 500 PSIG (3450 KPA).
8. MAXIMUM OPERATING TEMPERATURE: 240 DEG F (116 DEG C).
2.4 REFRIGERANTS
A. ASHRAE 34, R-410A: PENTAFLUOROETHANE/DIFLUOROMETHANE.
PART 2 - EXECUTION
3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A
A. SUCTION LINES: COPPER, TYPE ACR OR TYPE L, ANNEALED- OR DRAWN-TEMPER TUBING AND WROUGHTCOPPER FITTINGS WITH BRAZED JOINTS.
B. HOT-GAS AND LIQUID LINES: COPPER, TYPE ACR OR TYPE L, ANNEALED- OR DRAWN-TEMPER TUBING AND WROUGHT-COPPER FITTINGS WITH BRAZED JOINTS.
3.2 VALVE AND SPECIALTY APPLICATIONS
A. INSTALL DIAPHRAGM PACKLESS VALVES IN SUCTION AND DISCHARGE LINES OF COMPRESSOR.
B. INSTALL SERVICE VALVES FOR GAGE TAPS AT INLET AND OUTLET OF HOT-GAS BYPASS VALVES AND STRAINERS IF THEY ARE NOT AN INTEGRAL PART OF VALVES AND STRAINERS.
C. INSTALL A CHECK VALVE AT THE COMPRESSOR DISCHARGE AND A LIQUID ACCUMULATOR AT THE COMPRESSOR SUCTION CONNECTION.
D. EXCEPT AS OTHERWISE INDICATED, INSTALL DIAPHRAGM PACKLESS VALVES ON INLET AND OUTLET SIDE OF FILTER DRYERS.
E. INSTALL A FULL-SIZE, THREE-VALVE BYPASS AROUND FILTER DRYERS.
F. INSTALL SOLENOID VALVES UPSTREAM FROM EACH EXPANSION VALVE AND HOT-GAS BYPASS VALVE. INSTALL SOLENOID VALVES IN HORIZONTAL LINES WITH COIL AT TOP.
G. INSTALL THERMOSTATIC EXPANSION VALVES AS CLOSE AS POSSIBLE TO DISTRIBUTORS ON EVAPORATORS.
1. INSTALL VALVE SO DIAPHRAGM CASE IS WARMER THAN BULB.
2. SECURE BULB TO CLEAN, STRAIGHT, HORIZONTAL SECTION OF SUCTION LINE USING TWO BULB STRAPS. DO NOT MOUNT BULB IN A TRAP OR AT BOTTOM OF THE LINE.
3. IF EXTERNAL EQUALIZER LINES ARE REQUIRED, MAKE CONNECTION WHERE IT WILL REFLECT SUCTION-LINE PRESSURE AT BULB LOCATION.
H. INSTALL SAFETY RELIEF VALVES WHERE REQUIRED BY 2010 ASME BOILER AND PRESSURE VESSEL CODE. PIPE SAFETY-RELIEF-VALVE DISCHARGE LINE TO OUTSIDE ACCORDING TO ASHRAE 15.
I. INSTALL MOISTURE/LIQUID INDICATORS IN LIQUID LINE AT THE INLET OF THE THERMOSTATIC EXPANSION VALVE OR AT THE INLET OF THE EVAPORATOR COIL CAPILLARY TUBE.
J. INSTALL STRAINERS UPSTREAM FROM AND ADJACENT TO THE FOLLOWING UNLESS THEY ARE FURNISHED AS AN INTEGRAL ASSEMBLY FOR THE DEVICE BEING PROTECTED:
1. SOLENOID VALVES.
2. THERMOSTATIC EXPANSION VALVES.
3. HOT-GAS BYPASS VALVES.
4. COMPRESSOR.
K. INSTALL FILTER DRYERS IN LIQUID LINE BETWEEN COMPRESSOR AND THERMOSTATIC EXPANSION VALVE, AND IN THE SUCTION LINE AT THE COMPRESSOR.
L. INSTALL FLEXIBLE CONNECTORS AT COMPRESSORS.
3.3 INSTALLATION
A. DRAWING PLANS, SCHEMATICS, AND DIAGRAMS INDICATE GENERAL LOCATION AND ARRANGEMENT OF PIPING SYSTEMS; INDICATED LOCATIONS AND ARRANGEMENTS WERE USED TO SIZE PIPE AND CALCULATE FRICTION LOSS, EXPANSION, PUMP SIZING, AND OTHER DESIGN CONSIDERATIONS. INSTALL PIPING AS INDICATED UNLESS DEVIATIONS TO LAYOUT ARE APPROVED ON SHOP DRAWINGS.
B. INSTALL REFRIGERANT PIPING ACCORDING TO ASHRAE 15.
C. INSTALL PIPING IN CONCEALED LOCATIONS UNLESS OTHERWISE INDICATED AND EXCEPT IN EQUIPMENT ROOMS AND SERVICE AREAS.
D. INSTALL PIPING INDICATED TO BE EXPOSED AND PIPING IN EQUIPMENT ROOMS AND SERVICE AREAS AT RIGHT ANGLES OR PARALLEL TO BUILDING WALLS. DIAGONAL RUNS ARE PROHIBITED UNLESS SPECIFICALLY INDICATED OTHERWISE.
E. INSTALL PIPING ABOVE ACCESSIBLE CEILINGS TO ALLOW SUFFICIENT SPACE FOR CEILING PANEL REMOVAL.
F. INSTALL PIPING ADJACENT TO MACHINES TO ALLOW SERVICE AND MAINTENANCE.
G. INSTALL PIPING FREE OF SAGS AND BENDS.
H. INSTALL FITTINGS FOR CHANGES IN DIRECTION AND BRANCH CONNECTIONS.
I. SELECT SYSTEM COMPONENTS WITH PRESSURE RATING EQUAL TO OR GREATER THAN SYSTEM OPERATING PRESSURE.
J. REFER TO SECTION 230923 "DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC" AND SECTION 230993.11 "SEQUENCE OF OPERATIONS FOR HVAC DDC" FOR SOLENOID VALVE CONTROLLERS, CONTROL WIRING, AND SEQUENCE OF OPERATION.
K. INSTALL PIPING AS SHORT AND DIRECT AS POSSIBLE, WITH A MINIMUM NUMBER OF JOINTS, ELBOWS, AND FITTINGS.
L. ARRANGE PIPING TO ALLOW INSPECTION AND SERVICE OF REFRIGERATION EQUIPMENT. INSTALL VALVES AND SPECIALTIES IN ACCESSIBLE LOCATIONS TO ALLOW FOR SERVICE AND INSPECTION. INSTALL ACCESS DOORS OR PANELS AS SPECIFIED IN SECTION 083113 "ACCESS DOORS AND FRAMES" IF VALVES OR EQUIPMENT REQUIRING MAINTENANCE IS CONCEALED BEHIND FINISHED SURFACES.
M. INSTALL REFRIGERANT PIPING IN PROTECTIVE CONDUIT WHERE INSTALLED BELOWGROUND.
N. INSTALL REFRIGERANT PIPING IN RIGID OR FLEXIBLE CONDUIT IN LOCATIONS WHERE EXPOSED TO MECHANICAL INJURY.
O. SLOPE REFRIGERANT PIPING AS FOLLOWS:
1. INSTALL HORIZONTAL HOT-GAS DISCHARGE PIPING WITH A UNIFORM SLOPE DOWNWARD AWAY FROM COMPRESSOR.
2. INSTALL HORIZONTAL SUCTION LINES WITH A UNIFORM SLOPE DOWNWARD TO COMPRESSOR.
3. INSTALL TRAPS AND DOUBLE RISERS TO ENTRAIN OIL IN VERTICAL RUNS.
4. LIQUID LINES MAY BE INSTALLED LEVEL.
P. WHEN BRAZING OR SOLDERING, REMOVE SOLENOID-VALVE COILS AND SIGHT GLASSES; ALSO REMOVE VALVE STEMS, SEATS, AND PACKING, AND ACCESSIBLE INTERNAL PARTS OF REFRIGERANT SPECIALTIES. DO NOT APPLY HEAT NEAR EXPANSION-VALVE BULB.
Q. INSTALL PIPING WITH ADEQUATE CLEARANCE BETWEEN PIPE AND ADJACENT WALLS AND HANGERS OR BETWEEN PIPES FOR INSULATION INSTALLATION.
R. IDENTIFY REFRIGERANT PIPING AND VALVES ACCORDING TO SECTION 230553 "IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT."
S. INSTALL SLEEVES FOR PIPING PENETRATIONS OF WALLS, CEILINGS, AND FLOORS. COMPLY WITH REQUIREMENTS FOR SLEEVES SPECIFIED IN SECTION 230517 "SLEEVES AND SLEEVE SEALS FOR HVAC PIPING."
T. INSTALL SLEEVE SEALS FOR PIPING PENETRATIONS OF CONCRETE WALLS AND SLABS. COMPLY WITH REQUIREMENTS FOR SLEEVE SEALS SPECIFIED IN SECTION 230517 "SLEEVES AND SLEEVE SEALS FOR HVAC PIPING."
U. INSTALL ESCUTCHEONS FOR PIPING PENETRATIONS OF WALLS, CEILINGS, AND FLOORS. COMPLY WITH REQUIREMENTS FOR ESCUTCHEONS SPECIFIED IN SECTION 230518 "ESCUTCHEONS FOR HVAC PIPING."
3.4 PIPE JOINT CONSTRUCTION
A. REAM ENDS OF PIPES AND TUBES AND REMOVE BURRS.
B. REMOVE SCALE, SLAG, DIRT, AND DEBRIS FROM INSIDE AND OUTSIDE OF PIPE AND FITTINGS BEFORE ASSEMBLY.
C. SOLDERED JOINTS: CONSTRUCT JOINTS ACCORDING TO ASTM B 828 OR CDA'S "COPPER TUBE HANDBOOK."
D. BRAZED JOINTS: CONSTRUCT JOINTS ACCORDING TO AWS'S "BRAZING HANDBOOK," CHAPTER "PIPE AND TUBE."
1. USE TYPE BCUP (COPPER-PHOSPHORUS) ALLOY FOR JOINING COPPER SOCKET FITTINGS WITH COPPER PIPE.
2. USE TYPE BAG (CADMIUM-FREE SILVER) ALLOY FOR JOINING COPPER WITH BRONZE OR STEEL.
3.5 HANGERS AND SUPPORTS
A. COMPLY WITH REQUIREMENTS FOR PIPE HANGERS AND SUPPORTS SPECIFIED IN SECTION 230529 "HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT."
B. INSTALL THE FOLLOWING PIPE ATTACHMENTS:
1. ADJUSTABLE STEEL CLEVIS HANGERS FOR INDIVIDUAL HORIZONTAL RUNS LESS THAN 20 FEET (6 M) LONG.
2. ROLLER HANGERS AND SPRING HANGERS FOR INDIVIDUAL HORIZONTAL RUNS 20 FEET (6 M) OR LONGER.
3. PIPE ROLLER: MSS SP-58, TYPE 44 FOR MULTIPLE HORIZONTAL PIPING 20 FEET (6 M) OR LONGER, SUPPORTED ON A TRAPEZE.
4. SPRING HANGERS TO SUPPORT VERTICAL RUNS.
5. COPPER-CLAD HANGERS AND SUPPORTS FOR HANGERS AND SUPPORTS IN DIRECT CONTACT WITH COPPER PIPE.
C. INSTALL HANGERS FOR COPPER TUBING WITH THE FOLLOWING MAXIMUM SPACING AND MINIMUM ROD DIAMETERS:
1. NPS 1/2 (DN 15): MAXIMUM SPAN, 60 INCHES (1500 MM); MINIMUM ROD, 1/4 INCH (6.4 MM).
2. NPS 5/8 (DN 18): MAXIMUM SPAN, 60 INCHES (1500 MM); MINIMUM ROD, 1/4 INCH (6.4 MM).
3. NPS 1 (DN 25): MAXIMUM SPAN, 72 INCHES (1800 MM); MINIMUM ROD, 1/4 INCH (6.4 MM).
D. SUPPORT MULTIFLOOR VERTICAL RUNS AT LEAST AT EACH FLOOR.
3.6 FIELD QUALITY CONTROL
A. PERFORM THE FOLLOWING TESTS AND INSPECTIONS:
1. COMPLY WITH ASME B31.5, CHAPTER VI.
2. TEST REFRIGERANT PIPING, SPECIALTIES, AND RECEIVERS. ISOLATE COMPRESSOR, CONDENSER, EVAPORATOR, AND SAFETY DEVICES FROM TEST PRESSURE IF THEY ARE NOT RATED ABOVE THE TEST PRESSURE.
3. TEST HIGH- AND LOW-PRESSURE SIDE PIPING OF EACH SYSTEM SEPARATELY AT NOT LESS THAN THE PRESSURES INDICATED IN "PERFORMANCE REQUIREMENTS" ARTICLE.
agency. FILL SYSTEM WITH NITROGEN TO THE REQUIRED TEST PRESSURE.
agencz. SYSTEM SHALL MAINTAIN TEST PRESSURE AT THE MANIFOLD GAGE THROUGHOUT DURATION OF TEST.
agenda. TEST JOINTS AND FITTINGS WITH ELECTRONIC LEAK DETECTOR OR BY BRUSHING A SMALL AMOUNT OF SOAP AND GLYCERIN SOLUTION OVER JOINTS.
agendb. REMAKE LEAKING JOINTS USING NEW MATERIALS, AND RETEST UNTIL SATISFACTORY RESULTS ARE ACHIEVED.
B. PREPARE TEST AND INSPECTION REPORTS.
3.7 SYSTEM CHARGING
A. CHARGE SYSTEM USING THE FOLLOWING PROCEDURES:
1. INSTALL CORE IN FILTER DRYERS AFTER LEAK TEST BUT BEFORE EVACUATION.
2. EVACUATE ENTIRE REFRIGERANT SYSTEM WITH A VACUUM PUMP TO 500 MICROMETERS (67 PA). IF VACUUM HOLDS FOR 12 HOURS, SYSTEM IS READY FOR CHARGING.
3. BREAK VACUUM WITH REFRIGERANT GAS, ALLOWING PRESSURE TO BUILD UP TO 2 PSIG (14 KPA).
4. CHARGE SYSTEM WITH A NEW FILTER-DRYER CORE IN CHARGING LINE.
3.8 ADJUSTING
A. ADJUST THERMOSTATIC EXPANSION VALVE TO OBTAIN PROPER EVAPORATOR SUPERHEAT.
B. ADJUST HIGH- AND LOW-PRESSURE SWITCH SETTINGS TO AVOID SHORT CYCLING IN RESPONSE TO FLUCTUATING SUCTION PRESSURE.
C. ADJUST SET-POINT TEMPERATURE OF AIR-CONDITIONING OR CHILLED-WATER CONTROLLERS TO THE SYSTEM DESIGN TEMPERATURE.
D. PERFORM THE FOLLOWING ADJUSTMENTS BEFORE OPERATING THE REFRIGERATION SYSTEM, ACCORDING TO MANUFACTURER'S WRITTEN INSTRUCTIONS:
1. OPEN SHUTOFF VALVES IN CONDENSER WATER CIRCUIT.
2. VERIFY THAT COMPRESSOR OIL LEVEL IS CORRECT.
3. OPEN COMPRESSOR SUCTION AND DISCHARGE VALVES.
4. OPEN REFRIGERANT VALVES EXCEPT BYPASS VALVES THAT ARE USED FOR OTHER PURPOSES.
5. CHECK OPEN COMPRESSOR-MOTOR ALIGNMENT AND VERIFY LUBRICATION FOR MOTORS AND BEARINGS.
E. REPLACE CORE OF REPLACEABLE FILTER DRYER AFTER SYSTEM HAS BEEN ADJUSTED AND AFTER DESIGN FLOW RATES AND PRESSURES ARE ESTABLISHED.
F. COMPLY WITH REQUIREMENTS IN SECTION 230500 "COMMON WORK RESULTS FOR HVAC" FOR BASIC PIPING INSTALLATION REQUIREMENTS.
G. INSTALL WALL PENETRATION SYSTEM AT EACH PIPE PENETRATION THROUGH FOUNDATION WALL. MAKE INSTALLATION WATERTIGHT. COMPLY WITH REQUIREMENTS IN SECTION 230500 "COMMON WORK RESULTS FOR HVAC" FOR WALL PENETRATION SYSTEMS.
H. INSTALL REFRIGERANT PIPING AND CHARGE WITH REFRIGERANT ACCORDING TO ASHRAE 15.
I. INSULATE SUCTION LINES TO COMPLY WITH SECTION 230700 "HVAC INSULATION."
J. SLOPE REFRIGERANT PIPING AS FOLLOWS:
1. INSTALL HORIZONTAL HOT-GAS DISCHARGE PIPING WITH A UNIFORM SLOPE DOWNWARD AWAY FROM COMPRESSOR.
2. INSTALL HORIZONTAL SUCTION LINES WITH A UNIFORM SLOPE DOWNWARD TO COMPRESSOR.
3. INSTALL TRAPS AND DOUBLE RISERS TO ENTRAIN OIL IN VERTICAL RUNS.
4. LIQUID LINES MAY BE INSTALLED LEVEL.
K. INSTALL SOLENOID VALVES UPSTREAM FROM EACH THERMOSTATIC EXPANSION VALVE. INSTALL SOLENOID VALVES IN HORIZONTAL LINES WITH COIL AT TOP.
L. INSTALL THERMOSTATIC EXPANSION VALVES AS CLOSE AS POSSIBLE TO DISTRIBUTORS ON EVAPORATOR COILS.
M. INSTALL MOISTURE/LIQUID INDICATORS IN LIQUID LINE AT THE INLET OF THE THERMOSTATIC EXPANSION VALVE OR AT THE INLET OF THE EVAPORATOR COIL CAPILLARY TUBE. INSTALL STRAINERS UPSTREAM FROM AND ADJACENT TO SOLENOID VALVES, THERMOSTATIC EXPANSION VALVES, AND COMPRESSORS UNLESS THEY ARE FURNISHED AS AN INTEGRAL ASSEMBLY FOR DEVICE BEING PROTECTED:
N. INSTALL PIPING AS SHORT AND DIRECT AS POSSIBLE, WITH A MINIMUM NUMBER OF JOINTS, ELBOWS, AND FITTINGS.

SECTION 233100 - HVAC DUCTS AND CASINGS

PART 1 - PRODUCTS
2.1 PERFORMANCE REQUIREMENTS
A. COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE."
B. STRUCTURAL PERFORMANCE: DUCT HANGERS AND SUPPORTS SHALL WITHSTAND THE EFFECTS OF GRAVITY LOADS AND STRESSES WITHIN LIMITS AND UNDER CONDITIONS DESCRIBED IN SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE"
C. AIRSTREAM SURFACES: SURFACES IN CONTACT WITH THE AIRSTREAM SHALL COMPLY WITH REQUIREMENTS IN ASHRAE 62.1.
D. ASHRAE COMPLIANCE: APPLICABLE REQUIREMENTS IN ASHRAE 62.1, SECTION 5 - "SYSTEMS AND EQUIPMENT" AND SECTION 7 - "CONSTRUCTION AND SYSTEM START-UP."
E. ASHRAE/IESNA COMPLIANCE: APPLICABLE REQUIREMENTS IN ASHRAE/IESNA 90.1, SECTION 6.4.4 - "HVAC SYSTEM CONSTRUCTION AND INSULATION."
F. COMPLY WITH NFPA 90A, "INSTALLATION OF AIR CONDITIONING AND VENTILATING SYSTEMS," AND WITH NFPA 90B, "INSTALLATION OF WARM AIR HEATING AND AIR CONDITIONING SYSTEMS."
G. COMPLY WITH NFPA 96 FOR DUCTS CONNECTED TO COMMERCIAL KITCHEN HOODS.
H. COMPLY WITH UL 181 FOR DUCTS AND CLOSURES.
2.2 DUCTS
A. GALVANIZED-STEEL SHEET: ASTM A 653/A 653M, WITH G60 HOT-DIP GALVANIZED COATING.
1. GALVANIZED COATING DESIGNATION: G60.
2. FINISHES FOR SURFACES EXPOSED TO VIEW: MILL PHOSPHATIZED.
B. CARBON-STEEL SHEETS: ASTM A 1008/A 1008M; WITH OILED, MATTE FINISH FOR EXPOSED DUCTS.
C. STAINLESS STEEL: ASTM A 480/A 480M, TYPE 304, WITH A NO. 2D FINISH FOR CONCEALED DUCTS AND NO. 4 FINISH FOR EXPOSED DUCTS.
D. FIBROUS-GLASS DUCT BOARD: COMPLY WITH UL 181, CLASS 1, THICK, FIBROUS GLASS WITH FIRE-RESISTANT, REINFORCED FOIL-SCRIM-KRAFT BARRIER, AND HAVING THE AIR-SIDE SURFACE TREATED TO PREVENT EROSION.
E. JOINT AND SEAM TAPE, AND SEALANT: COMPLY WITH UL 181A.
F. RECTANGULAR METAL DUCT FABRICATION: COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE."
G. FIBROUS-GLASS DUCT FABRICATION: COMPLY WITH SMACNA'S "FIBROUS GLASS DUCT CONSTRUCTION STANDARD."
H. FIBROUS-GLASS LINER: COMPLY WITH NFPA 90A OR NFPA 90B AND WITH NAIMA AH124.
1. THICKNESS: 1 INCH
2. AIRSTREAM SURFACE COATED WITH AN ANTIMICROBIAL EROSION-RESISTANT COATING.
3. LINER ADHESIVE: COMPLY WITH NFPA 90A OR NFPA 90B AND WITH ASTM C 916.
4. MECHANICAL FASTENERS: GALVANIZED STEEL SUITABLE FOR ADHESIVE ATTACHMENT, MECHANICAL ATTACHMENT, OR WELDING ATTACHMENT.
2.3 ACCESSORIES
A. VOLUME DAMPERS AND CONTROL DAMPERS: SINGLE-BLADE AND MULTIPLE OPPOSED-BLADE DAMPERS, STANDARD LEAKAGE RATING, AND SUITABLE FOR HORIZONTAL OR VERTICAL APPLICATIONS; FACTORY FABRICATED AND COMPLETE WITH REQUIRED HARDWARE AND ACCESSORIES.
B. FIRE DAMPERS: RATED AND LABELED ACCORDING TO UL 555 BY AN NRTL; FACTORY FABRICATED ANDCOMPLETE WITH REQUIRED HARDWARE AND ACCESSORIES.
C. CEILING FIRE DAMPERS: LABELED ACCORDING TO UL 555C BY AN NRTL AND COMPLYING WITH CONSTRUCTION DETAILS FOR TESTED FLOOR- AND ROOF-CEILING ASSEMBLIES AS INDICATED IN UL'S "FIRE RESISTANCE DIRECTORY." PROVIDE FACTORY-FABRICATED UNITS COMPLETE WITH REQUIRED HARDWARE AND ACCESSORIES.
D. SMOKE DAMPERS: LABELED ACCORDING TO UL 555S BY AN NRTL. COMBINATION FIRE AND SMOKE DAMPERS SHALL ALSO BE RATED AND LABELED ACCORDING TO UL 555. PROVIDE FACTORY-FABRICATED UNITS COMPLETE WITH REQUIRED HARDWARE AND ACCESSORIES.
E. FLEXIBLE CONNECTORS: FLAME-RETARDED OR NONCOMBUSTIBLE FABRICS, COATINGS, AND ADHESIVES COMPLYING WITH UL 181, CLASS 1.
F. FLEXIBLE DUCTS: FACTORY-FABRICATED, INSULATED, ROUND DUCT, WITH AN OUTER JACKET ENCLOSING 1-INCHTHICK, GLASS-FIBER INSULATION AROUND A CONTINUOUS INNER LINER COMPLYING WITH UL 181, CLASS 1.
PART 2 - EXECUTION
3.1 INSTALLATION
A. INSTALL DUCTS ACCORDING TO SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE" UNLESS OTHERWISE INDICATED.
B. SEAL DUCTS TO THE FOLLOWING SEAL CLASSES ACCORDING TO SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE"
1. CONDITIONED SPACE, SUPPLY-AIR DUCTS IN PRESSURE CLASSES 2-INCH WG AND LOWER: SEAL CLASS C.
2. CONDITIONED SPACE, SUPPLY-AIR DUCTS IN PRESSURE CLASSES HIGHER THAN 2-INCH WG: SEAL CLASS B.
3. CONDITIONED SPACE, EXHAUST DUCTS: SEAL CLASS B.
4. CONDITIONED SPACE, RETURN-AIR DUCTS: SEAL CLASS C.
C. CONCEAL DUCTS FROM VIEW IN FINISHED AND OCCUPIED SPACES.
D. AVOID PASSING THROUGH ELECTRICAL EQUIPMENT SPACES AND ENCLOSURES.
E. SUPPORT DUCTS TO COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE," CH. 4, "HANGERS AND SUPPORTS."
F. INSTALL DUCT ACCESSORIES ACCORDING TO APPLICABLE DETAILS IN SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE" FOR METAL DUCTS AND IN NAIMA AH116, "FIBROUS GLASS DUCT CONSTRUCTION STANDARDS," FOR FIBROUS-GLASS DUCTS.
G. INSTALL VOLUME AND CONTROL DAMPERS IN LINED DUCT WITH METHODS TO AVOID DAMAGE TO LINER AND TO AVOID EROSION OF DUCT LINER.
H. INSTALL FIRE AND SMOKE DAMPERS ACCORDING TO UL LISTING.
I. INSTALL FUSIBLE LINKS IN FIRE DAMPERS.
J. CLEAN NEW DUCT SYSTEM(S) BEFORE TESTING, ADJUSTING, AND BALANCING.
3.2 TESTING, ADJUSTING, AND BALANCING
A. BALANCE AIRFLOW WITHIN DISTRIBUTION SYSTEMS, INCLUDING SUBMAINS, BRANCHES, AND TERMINALS TO INDICATED QUANTITIES.

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - PRODUCTS
2.1 OUTLETS AND INLETS
A. DIFFUSERS:
1. BASIS-OF-DESIGN PRODUCT: PRODUCT INDICATED ON DRAWINGS OR A COMPARABLE PRODUCT OF ONE OF THE FOLLOWING:
a. ANEMOSTAT PRODUCTS; A MESTEK COMPANY.
b. NAILOR INDUSTRIES INC.
c. TITUS
d. E.H.PRICE.
2. MATERIAL: STEEL
3. FINISH: BAKED ENAMEL, COLOR SELECTED BY ARCHITECT
4. MOUNTING: AS INDICATED ON PLANS
B. WALL AND GRILLES:
1. BASIS-OF-DESIGN PRODUCT: TITUS OR A COMPARABLE PRODUCT OF ONE OF THE FOLLOWING:
a. ANEMOSTAT PRODUCTS; A MESTEK COMPANY.
b. NAILOR INDUSTRIES INC.
c. TITUS.
d. E.H. PRICE
2. MATERIAL: STEEL
3. FINISH: BAKED ENAMEL, COLOR SELECTED BY ARCHITECT
4. MOUNTING: COUNTERSUNK SCREW OR AS OTHERWISE NOTED
PART 2 - EXECUTION
3.1 INSTALLATION
A. INSTALL DIFFUSERS, REGISTERS, AND GRILLES LEVEL AND PLUMB
B. CEILING-MOUNTED OUTLETS AND INLETS: DRAWINGS INDICATE GENERAL ARRANGEMENT OF DUCTS, FITTINGS, AND ACCESSORIES. MAKE FINAL LOCATIONS WHERE INDICATED, AS MUCH AS PRACTICAL. FOR UNITS INSTALLED IN LAY-IN CEILING PANELS, LOCATE UNITS IN THE CENTER OF PANEL UNLESS OTHERWISE INDICATED. WHERE ARCHITECTURAL FEATURES OR OTHER ITEMS CONFLICT WITH INSTALLATION, NOTIFY ARCHITECT FOR A DETERMINATION OF FINAL LOCATION.
C. AFTER INSTALLATION, ADJUST DIFFUSERS, REGISTERS, AND GRILLES TO AIR PATTERNS INDICATED, OR AS DIRECTED, BEFORE STARTING AIR BALANCING.

SECTION 233433.13 - COMMERCIAL AIR CURTAINS

PART 1 - GENERAL
1.1 SUMMARY
A. SECTION INCLUDES COMMERCIAL AIR-CURTAIN UNIT.
1.2 ACTION SUBMITTALS
A. PRODUCT DATA: FOR EACH TYPE OF PRODUCT.
B. SHOP DRAWINGS: FOR AIR CURTAIN UNITS.
1. INCLUDE PLANS, ELEVATIONS, SECTIONS, AND ATTACHMENT DETAILS.
2. INCLUDE DETAILS OF EQUIPMENT ASSEMBLIES. INDICATE DIMENSIONS, WEIGHTS, LOADS, REQUIRED CLEARANCES, METHOD OF FIELD ASSEMBLY, COMPONENTS, AND LOCATION AND SIZE OF EACH FIELD CONNECTION.
3. INCLUDE DIAGRAMS FOR POWER, SIGNAL, AND CONTROL WIRING.
C. DELEGATED DESIGN SUBMITTAL: FOR AIR CURTAIN UNITS INDICATED TO COMPLY WITH PERFORMANCE REQUIREMENTS AND DESIGN CRITERIA, INCLUDING ANALYSIS DATA SIGNED AND SEALED BY A QUALIFIED PROFESSIONAL ENGINEER RESPONSIBLE FOR THEIR PREPARATION.
1. DETAIL FABRICATION AND ASSEMBLY OF AIR-CURTAIN UNIT MOUNTING ASSEMBLIES.
2. INCLUDE DESIGN CALCULATIONS FOR SELECTING VIBRATION ISOLATORS.
1.3 INFORMATIONAL SUBMITTALS
A. SAMPLE WARRANTIES.
1.4 CLOSEOUT SUBMITTALS
A. OPERATION AND MAINTENANCE DATA.
1.5 WARRANTY
A. SPECIAL WARRANTY: MANUFACTURER AGREES TO REPAIR OR REPLACE COMPONENTS OF AIR CURTAINS THAT FAIL IN MATERIALS OR WORKMANSHIP WITHIN SPECIFIED WARRANTY PERIOD.
1. WARRANTY PERIOD (ELECTRIC HEATING UNITS): 24 MONTHS.
PART 2 - PRODUCTS
A. CAPACITIES AND CHARACTERISTICS:
1. APPLICATION: THERMAL BARRIER & FLY AND INSECT CONTROL.
2. MOUNTING TYPE: SUSPENSION, WALL BRACKETS, OR KEYHOLE WALL MOUNT.
3. DISCHARGE DIRECTION: VERTICAL.
4. NOZZLE VELOCITY: 1800 FPM.
5. AVERAGE OUTLET VELOCITY: 1800 FPM.
6. AIRFLOW: 900-1800 CFM (L/S).
7. INTAKE: INTERNAL.
8. FAN MOTOR:
a. ELECTRICAL CHARACTERISTICS:
1) HORSEPOWER: 1/6 HP.
2) VOLTS: 208 V.
3) PHASE: 3
4) HERTZ: 60 HZ.
5) FULL-LOAD AMPERES: 28-37 A.
9. SOUND LEVEL MEASURED 49-53 DBA.
10. ELECTRIC HEATER:
a. CAPACITY: 10-13 KW
b. VOLTS: 208 V.
c. PHASE: THREE.
d. HERTZ: 60 HZ.
2.2 COMMERCIAL AIR-CURTAIN UNIT
A. HOUSING:
1. GALVANIZED STEEL: GALVANIZED STEEL WITH ELECTROSTATICALLY APPLIED, EPOXY-ENAMEL, POWDER-COAT FINISH.
2. DISCHARGE NOZZLE: INTEGRAL TO HOUSING, CONTAINING ADJUSTABLE AIR-DIRECTIONAL VANES WITH 40-DEGREE SWEEP FRONT TO BACK.
B. MOUNTING BRACKETS: GALVANIZED STEEL, FOR WALL AND CEILING MOUNTING.
C. AIR-INTAKE GRILLES:
1. GRILLES: INTEGRAL TO, AND SAME MATERIAL AS, HOUSING.
D. FANS:
1. CENTRIFUGAL, FORWARD CURVED, DOUBLE WIDTH, DOUBLE INLET.
2. GALVANIZED STEEL
3. STATICALLY AND DYNAMICALLY BALANCED.
4. DIRECT DRIVE.
E. MOTORS: COMPLY WITH NEMA DESIGNATION, TEMPERATURE RATING, SERVICE FACTOR, ENCLOSURE TYPE, AND EFFICIENCY REQUIREMENTS FOR MOTORS SPECIFIED IN SECTION 230513 "COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT."
F. ELECTRIC-RESISTANCE COILS:
1. COIL ASSEMBLY: COMPLY WITH UL 1995.
2. FRAME: GALVANIZED-STEEL FRAME.
3. HEATING ELEMENTS: OPEN-COIL RESISTANCE WIRE OF 80 PERCENT NICKEL AND 20 PERCENT CHROMIUM, SUPPORTED AND INSULATED BY FLOATING CERAMIC BUSHINGS RECESSED INTO CASING OPENINGS, FASTENED TO SUPPORTING BRACKETS, AND MOUNTED IN GALVANIZED-STEEL FRAME.
4. OVERTEMPERATURE PROTECTION: DISK-TYPE, AUTOMATICALLY RESET, THERMAL-CUTOUT, SAFETY DEVICE; SERVICEABLE THROUGH TERMINAL BOX WITHOUT REMOVING HEATER FROM DUCT OR UNIT.
a. SECONDARY PROTECTION: LOAD-CARRYING, MANUALLY RESET OR MANUALLY REPLACEABLE, THERMAL CUTOUTS; FACTORY WIRED IN SERIES WITH EACH HEATER STAGE.
5. CONTROL PANEL: UNIT MOUNTED WITH DISCONNECTING MEANS AND OVERCURRENT PROTECTION. INCLUDE THE FOLLOWING CONTROLS:
a. MAGNETIC CONTACTOR.
b. SOLID-STATE STEPLESS PULSE CONTROLLER.
c. TIME-DELAY RELAY.
d. PILOT LIGHTS; ONE PER STEP.
e. AIRFLOW-PROVING SWITCH.
G. FILTERS:
1. DISPOSABLE PANEL FILTERS: FACTORY-FABRICATED, VISCOUS-COATED, FLAT-PANEL-TYPE, DISPOSABLE AIR FILTERS WITH GLASS-FIBER MEDIA SPRAYED WITH NONFLAMMABLE ADHESIVE IN [CARDBOARD] FRAME.
f. 2. MOUNTING FRAMES: WELDED, GALVANIZED STEEL WITH GASKETS AND FASTENERS AND SUITABLE FOR BOLTING TOGETHER INTO BUILT-UP FILTER BANKS.

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	10/14/2022	ISSUED FOR BID AND PERMIT
1	11/18/2022	ADDENDUM 1
3	02/03/2023	ADDENDUM 3
4	03/10/2023	ADDENDUM 4
5	03/31/2023	ADDENDUM 5

NORTH CAROLINA PROFESSIONAL SEAL 053111 ENGINEER YVETTE RICHARDSON

Seal / Signature

Project Name
VILLAGE DISTRICT

Project Number
69.6575.000

Description
MECHANICAL SPECIFICATIONS I

Scale
NONE

M-593

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H. CONTROLS:
3. REMOTE, FIELD-INSTALLED THERMOSTAT: 24 V, FACTORY INSTALLED AND WIRED TO JUNCTION BOX ON AIR CURTAIN.
4. AUTOMATIC DOOR SWITCH: ROLLER TYPE, INSTALLED IN DOOR AREA TO ACTIVATE AIR CURTAIN WHEN DOOR OPENS AND TO DEACTIVATE AIR CURTAIN WHEN DOOR CLOSES.
5. START-STOP, PUSH-BUTTON SWITCH: MANUALLY ACTIVATES AND DEACTIVATES AIR CURTAIN.
6. THREE-SPEED SWITCH: MANUALLY ACTIVATES, DEACTIVATES, AND CONTROLS AIR-CURTAIN FAN SPEED.
7. TIME-DELAY RELAY: FACTORY INSTALLED AND ADJUSTABLE TO ALLOW AIR CURTAIN TO OPERATE FROM 0.5 SECONDS TO 10 HOURS.
8. MOTOR-CONTROL PANEL: COMPLETE WITH MOTOR STARTER, 115-V AC TRANSFORMER WITH PRIMARY AND SECONDARY FUSES, TERMINAL STRIP, AND NEMA 250, TYPE 1ENCLOSURE WITH DOOR-MOUNTED, HAND-OFF-AUTO SWITCH.

I. ACCESSORIES:
1. MOUNTING BRACKETS: ADJUSTABLE MOUNTING BRACKETS FOR WALL OR TOP MOUNTING.
2. DISCHARGE EXTENSION NECK: FOR CEILING-RECESSED INSTALLATION.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL
A. INSTALL AIR CURTAINS WITH CLEARANCE FOR EQUIPMENT SERVICE AND MAINTENANCE.
B. EQUIPMENT INSTALLATION: INSTALL AIR CURTAINS WITH SEISMIC-RESTRAINT DEVICES. COMPLY WITH REQUIREMENTS FOR SEISMIC-RESTRAINT DEVICES SPECIFIED IN SECTION 230548 "VIBRATION AND SEISMIC CONTROLS FOR HVAC."
C. COMPLY WITH REQUIREMENTS FOR HANGERS AND SUPPORTS SPECIFIED IN SECTION 230529 "HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT."

3.2 ELECTRICAL CONNECTIONS
A. CONNECT WIRING IN ACCORDANCE WITH SECTION 260519 "LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES."
B. GROUND EQUIPMENT IN ACCORDANCE WITH SECTION 260526 "GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS."
C. INSTALL ELECTRICAL DEVICES FURNISHED BY MANUFACTURER, BUT NOT FACTORY MOUNTED, IN ACCORDANCE WITH NFPA 70 AND NECA 1.
D. INSTALL NAMEPLATE FOR EACH ELECTRICAL CONNECTION, INDICATING ELECTRICAL EQUIPMENT DESIGNATION AND CIRCUIT NUMBER FEEDING CONNECTION.
1. NAMEPLATE SHALL BE LAMINATED ACRYLIC OR MELAMINE PLASTIC SIGNS, AS SPECIFIED IN SECTION 260553 "IDENTIFICATION FOR ELECTRICAL SYSTEMS."
2. NAMEPLATE SHALL BE LAMINATED ACRYLIC OR MELAMINE PLASTIC SIGNS WITH A BLACK BACKGROUND AND ENGRAVED WHITE LETTERS AT LEAST 1/2 INCH (13 MM) HIGH.

3.3 CONTROL CONNECTIONS
A. INSTALL CONTROL AND ELECTRICAL POWER WIRING TO FIELD-MOUNTED CONTROL DEVICES.
B. CONNECT CONTROL WIRING IN ACCORDANCE WITH SECTION 260523 "CONTROL-VOLTAGE ELECTRICAL POWER CABLES."

3.4 ADJUSTING
A. ADJUST MOTOR SPEED TO ACHIEVE SPECIFIED AIRFLOW.
B. ADJUST DISCHARGE LOUVER AND DAMPERS TO REGULATE AIRFLOW.
C. ADJUST AIR-DIRECTIONAL VANES.

3.5 FIELD QUALITY CONTROL
A. TESTING AGENCY: CONTRACTOR WILL ENGAGE A QUALIFIED TESTING AGENCY TO PERFORM TESTS AND INSPECTIONS.
B. PERFORM TESTS AND INSPECTIONS WITH THE ASSISTANCE OF A FACTORY-AUTHORIZED SERVICE REPRESENTATIVE.
C. TESTS AND INSPECTIONS:
1. AFTER INSTALLING AIR CURTAINS COMPLETELY, PERFORM VISUAL AND MECHANICAL CHECK OF INDIVIDUAL COMPONENTS.
2. AFTER ELECTRICAL CIRCUITRY HAS BEEN ENERGIZED, START UNIT TO CONFIRM MOTOR ROTATION AND UNIT OPERATION. CERTIFY COMPLIANCE WITH TEST PARAMETERS.
3. INSPECT FOR WATER LEAKS.
4. TEST AND ADJUST CONTROLS AND SAFETIES. REPLACE DAMAGED AND MALFUNCTIONING CONTROLS AND EQUIPMENT.

D. AIR-CURTAIN UNIT WILL BE CONSIDERED DEFECTIVE IF IT DOES NOT PASS TESTS AND INSPECTIONS.
E. PREPARE TEST AND INSPECTION REPORTS.

SECTION 233813 - KITCHEN HOOD SYSTEMS

PART 1 - PRODUCTS

2.1 COOKING EQUIPMENT KITCHEN HOOD
A. ACCEPTABLE MANUFACTURERS:
B. CAPTIVE AIRE ND-2 SERIES WITH PSP ACCESSORY OR APPROVED EQUAL.
C. THE EXHAUST ONLY CANOPY HOOD SHALL BE RATED FOR ALL TYPES OF COOKING EQUIPMENT. THE HOOD SHALL HAVE THE SIZE, SHAPE AND PERFORMANCE SPECIFIED ON DRAWINGS. CONSTRUCTION SHALL BE TYPE 430 STAINLESS STEEL WITH A #3 OR #4 POLISH WHERE EXPOSED. INDIVIDUAL COMPONENT CONSTRUCTION SHALL BE DETERMINED BY THE MANUFACTURER AND ETL. CONSTRUCTION SHALL BE DEPENDENT ON THE STRUCTURAL APPLICATION TO MINIMIZE DISTORTION AND OTHER DEFECTS. ALL SEAMS, JOINTS AND PENETRATIONS OF THE HOOD ENCLOSURE TO THE LOWER OUTERMOST PERIMETER THAT DIRECTS AND CAPTURES GREASE-LADEN VAPOR AND EXHAUST GASES SHALL HAVE A LIQUID-TIGHT CONTINUOUS EXTERNAL WELD IN ACCORDANCE WITH NFPA 96. HOOD SHALL BE WALL TYPE WITH A MINIMUM OF FOUR CONNECTIONS FOR HANGER RODS. CORNER HANGING ANGLES HAVE A 5/8" X 1-1/2" SLOT PRE-PUNCHED AT THE FACTORY, ALLOWING HANGING RODS TO BE USED FOR QUICK AND SAFE INSTALLATION.
D. VENTILATOR SHALL BE FURNISHED WITH U.L. CLASSIFIED HIGH EFFICIENCY STAINLESS STEEL BAFFLE FILTERS, SUPPLIED IN SIZE AND QUANTITY AS REQUIRED BY VENTILATOR. THE FILTERS SHALL EXTEND THE FULL LENGTH OF THE HOOD AND THE FILLER PANELS SHALL NOT BE MORE THAN 6" IN WIDTH.
E. THE HOOD MANUFACTURER SHALL SUPPLY COMPLETE COMPUTER GENERATED SUBMITTAL DRAWINGS INCLUDING HOOD SECTIONS VIEW(S) AND HOOD PLAN VIEW(S). THESE DRAWINGS MUST BE AVAILABLE TO THE ENGINEER, ARCHITECT AND OWNER FOR THEIR USE IN CONSTRUCTION, OPERATION AND MAINTENANCE.
F. EXHAUST DUCT COLLAR TO BE 4" HIGH WITH 1" FLANGE. DUCT SIZES, CFM AND STATIC PRESSURE REQUIREMENTS SHALL BE AS SHOWN ON DRAWINGS. STATIC PRESSURE REQUIREMENTS SHALL BE PRECISE AND ACCURATE; AIR VELOCITY AND VOLUME INFORMATION SHALL BE ACCURATE WITHIN 1-FT INCREMENTS ALONG THE LENGTH OF THE VENTILATOR.
G. U.L. INCANDESCENT LIGHT FIXTURES AND GLOBES SHALL BE INSTALLED AND PRE-WIRED TO A JUNCTION BOX. THE LIGHT FIXTURES SHALL BE INSTALLED WITH A MAXIMUM OF 4'0" SPACING ON CENTER AND ALLOW UP TO A 100 WATT STANDARD LIGHT BULB.
H. THE HOOD SHALL HAVE:
1. A DOUBLE WALL INSULATED FRONT. THE INSULATION SHALL HAVE A FLEXURAL MODULUS OF 475 EI, MEET UL 181 REQUIREMENTS AND BE IN ACCORDANCE WITH NFPA 90A AND 90B.
2. AN INTEGRAL FRONT BAFFLE TO DIRECT GREASE LADEN VAPORS TOWARD THE EXHAUST FILTER BANK.
3. A BUILT-IN WIRING CHASE PROVIDED FOR OUTLETS AND ELECTRICAL CONTROLS ON THE HOOD FACE AND SHALL NOT PENETRATE THE CAPTURE AREA OR REQUIRE AN EXTERNAL CHASEWAY.
4. REMOVABLE GREASE CUP FOR EASY CLEANING.

J. THE HOOD SHALL BE ETL LISTED AS "EXHAUST HOOD WITHOUT EXHAUST DAMPER", ETL SANITATION LISTED AND BUILT IN ACCORDANCE WITH NFPA 96. THE HOOD SHALL BE LISTED FOR 600°F COOKING SURFACES AT 200 CFM/FT. THE HOOD SHALL BE ETL LISTED AS "EXHAUST HOOD WITHOUT EXHAUST DAMPER".
K. REFER TO DRAWINGS FOR ADDITIONAL ACCESSORIES.

2.2 ANSUL R-102 RESTAURANT FIRE SUPPRESSION SYSTEM
A. THE RESTAURANT FIRE SUPPRESSION SYSTEM SHALL BE AN AUTOMATIC FIRE SUPPRESSION SYSTEM USING A WET CHEMICAL AGENT FOR GREASE RELATED FIRES.
B. THE SYSTEM SHALL BE PRE-ENGINEERED IN ACCORDANCE WITH UL GUIDELINES.
C. THE SYSTEM SHALL BE INSTALLED AND SERVICED BY PERSONNEL TRAINED BY THE MANUFACTURER.
D. THE SYSTEM SHALL BE CAPABLE OF PROTECTING COOKING APPLIANCES BY UTILIZING EITHER DEDICATED APPLIANCE PROTECTION AND/OR OVERLAPPING APPLIANCE PROTECTION.
E. THE SYSTEM SHALL CONSIST OF A REGULATED RELEASE ASSEMBLY THAT INCLUDES A REGULATED RELEASE MECHANISM AND A WET CHEMICAL STORAGE TANK HOUSED WITHIN A SINGLE ENCLOSURE. NOZZLES, BLOW-OFF CAPS, DETECTORS, CARTRIDGES, AGENT, FUSIBLE LINKS, AND PULLEY ELBOWS SHALL BE PROVIDED IN THE QUANTITIES NEEDED FOR FIRE SUPPRESSION SYSTEM ARRANGEMENTS. ADDITIONAL EQUIPMENT SHALL INCLUDE REMOTE MANUAL PULL STATION, MECHANICAL AND ELECTRICAL GAS VALVES, PRESSURE SWITCHES, AND ELECTRICAL SWITCHES FOR AUTOMATIC EQUIPMENT AND GAS LINE SHUT-OFF.
F. WET CHEMICAL AGENT:
1. THE EXTINGUISHING AGENT SHALL BE AN AQUEOUS SOLUTION OF ORGANIC SALTS WITH A PH RANGE BETWEEN 7.8 - 8.2, DESIGNED FOR FLAME KNOCKDOWN AND FOAM SECUREMENT OF GREASE RELATED FIRES.

G. AGENT TANK:
1. THE AGENT TANKS SHALL BE INSTALLED IN A STAINLESS STEEL ENCLOSURE OR WALL BRACKET. THE TANK SHALL BE CONSTRUCTED OF STAINLESS STEEL. THE TANK SHALL INCLUDE AN ADAPTOR/TUBE ASSEMBLY CONTAINING A BURST DISC UNION.

H. REGULATED RELEASE MECHANISM:
1. THE REGULATED RELEASE MECHANISM SHALL BE A SPRING-LOADED, MECHANICAL/PNEUMATIC TYPE CAPABLE OF PROVIDING THE EXPELLANT GAS SUPPLY TO THE AGENT TANK(S). IT SHALL CONTAIN A FACTORY INSTALLED REGULATOR.
2. IT SHALL HAVE AUTOMATIC ACTUATION BY A FUSIBLE LINK DETECTION SYSTEM AND REMOTE MANUAL ACTUATION BY A MECHANICAL PULL STATION.
3. THE REGULATED RELEASE MECHANISM SHALL CONTAIN A RELEASE ASSEMBLY, REGULATOR, EXPELLANT GAS HOSE, AND AGENT STORAGE TANK HOUSED IN A STAINLESS STEEL ENCLOSURE WITH COVER. THE ENCLOSURE SHALL CONTAIN KNOCK-OUTS FOR CONDUIT. THE COVER SHALL CONTAIN AN OPENING FOR A VISUAL STATUS INDICATOR.
4. THE REGULATED RELEASE MECHANISM SHALL BE COMPATIBLE WITH MECHANICAL GAS SHUT-OFF DEVICES; OR, WHEN EQUIPPED WITH A FIELD OR FACTORY-INSTALLED SWITCH, IT SHALL BE COMPATIBLE WITH ELECTRIC GAS LINE OR APPLIANCE SHUT-OFF DEVICES.

I. REGULATED ACTUATOR ASSEMBLY:
1. WHEN MORE THAN TWO AGENT TANKS ARE REQUIRED, THE REGULATED ACTUATOR SHALL BE AVAILABLE TO PROVIDE EXPELLANT GAS FOR ADDITIONAL TANKS. IT SHALL BE CONNECTED TO THE CARTRIDGE RECEIVER OUTLET OF THE REGULATED RELEASE MECHANISM PROVIDING SIMULTANEOUS AGENT DISCHARGE. THE REGULATOR ACTUATOR ASSEMBLY SHALL CONTAIN A REGULATED ACTUATOR, REGULATOR, EXPELLANT GAS HOSE, AND AGENT TANK HOUSED IN A STAINLESS STEEL ENCLOSURE WITH COVER. THE ENCLOSURE SHALL CONTAIN KNOCKOUTS TO PERMIT INSTALLATION OF THE EXPELLANT GAS LINE.

J. DISCHARGE NOZZLES:
1. EACH DISCHARGE NOZZLE SHALL BE TESTED AND LISTED WITH THE R-102 SYSTEM FOR THE SPECIFIC APPLICATION. NOZZLE TIPS SHALL BE STAMPED WITH THE FLOW NUMBER DESIGNATION. EACH NOZZLE SHALL HAVE A METAL OR RUBBER BLOW-OFF CAP TO KEEP THE NOZZLE TIP ORIFICE FREE OF COOKING GREASE BUILD-UP.

K. DISTRIBUTION PIPING:
1. SHALL BE SCHEDULE 40 BLACK IRON, CHROME-PLATED, OR STAINLESS STEEL PIPE CONFORMING TO ASTM A120, A53, OR A106.

L. DETECTORS:
1. SHALL BE THE OF THE FUSIBLE LINK STYLE DESIGNED TO SEPARATE AT A SPECIFIC TEMPERATURE.

M. CARTRIDGES:
1. SHALL BE A SEALED STEEL PRESSURE VESSEL CONTAINING EITHER CARBON DIOXIDE OR NITROGEN GAS.THE CARTRIDGE SEAL SHALL BE DESIGNED TO BE PUNCTURED BY THE RELEASING DEVICE SUPPLYING THE REQUIRED PRESSURE TO EXPEL WET CHEMICAL AGENT FROM THE STORAGE TANK.

N. AGENT DISTRIBUTION HOSE:
1. KITCHEN APPLIANCES MANUFACTURED WITH OR RESTING ON CASTERS (WHEELS/ROLLERS), WHICH HAVE THE FIRE SUPPRESSION SYSTEM HARD PIPED, SHALL INCLUDE A UL LISTED AGENT DISTRIBUTION HOSE AS A COMPONENT OF THE SUPPRESSION SYSTEM. HOSE ASSEMBLY SHALL INCLUDE A RESTRAINING CABLE KIT.

O. PULL STATION ASSEMBLY:
1. THE FIRE SUPPRESSION SYSTEM SHALL INCLUDE A REMOTE PULL STATION FOR MANUAL SYSTEM ACTUATION. THE PULL STATION SHALL BE DESIGNED TO INCLUDE A BUILT-IN GUARD FOR PULL HANDLE PROTECTION. THE PULL STATION SHALL BE RED IN COLOR.

P. THE ANSUL SYSTEM SHALL BE MANUFACTURED BY TYCO FIRE SUPPRESSION & BUILDING PRODUCTS OR APPROVED EQUAL.

2.3 KITCHEN HOOD CENTRIFUGAL UTILITY SET EXHAUST FANS
A. UTILITY SET EXHAUST FAN SHALL BE SUITABLE FOR USE WITH A TYPE I KITCHEN HOOD SERVING COOKING EQUIPMENT THAT PRODUCES GREASE LADEN VAPORS. FAN SHALL BE UL762 LISTED FOR RESTAURANT DUTY.
B. FAN SHALL HAVE A VENTED MOTOR COVER. FAN HOUSING SHALL BE CONTINUOUSLY WELDED.
C. FAN SHALL HAVE A CLEAN OUT DOOR.
D. FAN SHALL HAVE A GREASE DRAIN.
E. PROVIDE EXHAUST FAN MODEL BI-CARM BY CAPTIVEAIRE OR APPROVED EQUAL.
F.

2.4 KITCHEN HOOD CONTROLS
A. EMS SERIES CONTROL SYSTEM BY CAPTIVEAIRE.
B. CONTROLS SHALL BE LISTED BY ETL (UL 508A).
C. THE ENERGY MANAGEMENT SYSTEM (EMS) SHALL BE CAPABLE OF SAVING ENERGY DURING IDLE COOKING PERIODS. THE EMS SHALL BE DESIGNED TO AUTOMATICALLY REDUCE EXHAUST AND SUPPLY AIRFLOW QUANTITIES WHILE ENSURING HOOD PERFORMANCE IS MAINTAINED. THE EMS SHALL USE HIGH AND LOW SPEEDS THAT SHALL BE ADJUSTED BY VARIABLE FREQUENCY DRIVES. A TEMPERATURE SWITCH IN THE EXHAUST DUCT SHALL CONTROL AIRFLOW SET POINTS AND MODULATE THE FANS DURING COOKING OPERATION TO MAXIMIZE ENERGY SAVINGS. A 100% AIRFLOW OVERRIDE BUTTON SHALL BE SUPPLIED WITH AN ADJUSTABLE TIMER.
D. THE CONTROL INTERFACE SHALL INCLUDE (1) FAN SWITCH, (1) HOOD LIGHT SWITCH, (1) 100% AIRFLOW OVERRIDE PUSH BUTTON AND INDICATOR LIGHTS. INDICATOR LIGHTS SHALL INCLUDE A "POWER" LIGHT, A "FANS ON" LIGHT, AND A "100% AIRFLOW OVERRIDE" LIGHT. THE CONTROL INTERFACE SHALL BE SCREEN PRINTED ON STAINLESS STEEL AND BE ABLE TO BE INSTALLED ON THE FACE OF THE HOOD, FACE OF THE UTILITY CABINET, OR ON THE FACE OF THE CONTROL ENCLOSURE.
E. THE CONTROL ENCLOSURE SHALL BE NEMA 1 RATED AND LISTED FOR INSTALLATION INSIDE OF THE EXHAUST HOOD UTILITY CABINET. THE CONTROL ENCLOSURE MAY BE CONSTRUCTED OF STAINLESS STEEL OR PAINTED STEEL.
F. VARIABLE FREQUENCY DRIVES SHALL ALLOW FULL ADJUSTMENT OF HIGH SPEED AND LOW SPEED AIRFLOWS FOR PROPER KITCHEN BALANCE. DRIVES SHALL CONTAIN MOTOR THERMAL OVERLOAD PROTECTION AND CONTROL INPUTS FOR UP TO 7 PRESET SPEEDS. ACCELERATION AND DECELERATION TIMES SHALL BE FULLY ADJUSTABLE AS WELL AS FAN SPEED AT EACH OF THE 7 DIFFERENT INPUTS. DRIVES SHALL ALSO ALLOW FOR A MINIMUM AND MAXIMUM FREQUENCY SET-POINT. DRIVES ARE CAPABLE OF CONTROLLING UP TO 5 HP EACH.
G. ADJUSTABLE TEMPERATURE SWITCH SHALL BE MOUNTED IN THE EXHAUST HOOD RISER. ONE SENSOR SHALL BE INSTALLED PER EXHAUST FAN. THE TEMPERATURE SENSOR SHALL BE OF THE DIGITAL RESISTANCE TEMPERATURE DETECTOR (RTD) TYPE. TEMPERATURE PROBE SHALL BE CONSTRUCTED OF STAINLESS STEEL. TEMPERATURE SWITCH SHALL BE FACTORY SET AT 130°F FOR 600°F COOKING APPLICATIONS AND 90°F FOR 400°F COOKING APPLICATIONS. THE TEMPERATURE SENSOR SHALL BE FULLY MODULATING AND SHALL ADJUST ON TEMPERATURE CHANGES. THE RISER MOUNTED TEMPERATURE SENSOR SHALL CONSTANTLY MONITOR THE EXHAUST AIR TEMPERATURE AND WORK IN CONJUNCTION WITH A PANEL MOUNTED TEMPERATURE CONTROLLER TO MODULATE THE SYSTEM BASED ON THE TEMPERATURE.
H. THE TIMER SHALL CONTAIN ONE INSTANTANEOUS CONTACT AND ONE DELAYED CONTACT. TIME SHALL BE\ ADJUSTABLE FROM .05 SECONDS TO 30 DAYS. TIMER IS ENERGIZED WITH THE 100% AIRFLOW OVERRIDE BUTTON WHEN BUTTON IS DEPRESSED, TIME STARTS AND FANS GO TO HIGH SPEED. UPON TIMEOUT, FANS RETURN TO LOW SPEED OR SPEED DICTATED BY TEMPERATURE SWITCH.
I. THE EMS SHALL BE PROVIDED WITH A FACTORY PRE-WIRED PANEL CAPABLE OF CONTROLLING UP TO FOUR INVERTER DUTY MOTORS. THE CONTROL PANEL SHALL BE FACTORY PRE-WIRED TO SHUT DOWN THE SUPPLY FANS IN A FIRE CONDITION.

2.5 ROOF MOUNTED, BELT DRIVE, UPBLAST CENTRIFUGAL EXHAUST FAN
A. SPUN ALUMINUM CENTRIFUGAL ROOF EXHAUSTERS ARE ENGINEERED TO DISCHARGE GREASE LADEN VAPORS, FUMES AND OTHER CONTAMINANTS VERTICALLY AWAY FROM THE BUILDING.
B. ALL MODELS SHALL BE ETL LISTED AND COMPLY WITH UL705 (ELECTRICAL) AND UL762 STANDARDS AND CSA STD C22.2, NO 113. FAN SHALL BEAR THE AMCA CERTIFIED RATINGS SEAL FOR SOUND AND AIR PERFORMANCE
C. HOUSING: THE FAN WINDBAND SHALL BE CONSTRUCTED OF HEAVY GAUGE ALUMINUM AND SHALL BE SPUN ON AN AUTOMATIC LATHE TO PROVIDE CONSISTENT DIMENSIONS. HORIZONTAL AND VERTICAL INTERNAL SUPPORTS SHALL BE USED TO SECURELY FASTEN THE WINDBAND TO THE DISCHARGE APRON TO PROVIDE RIGIDITY FOR HINGING AND ADDED STRENGTH TO REDUCE SHIPPING DAMAGE. THE DISCHARGE APRON SHALL HAVE A ROLLED BEAD FOR ADDED STRENGTH.
D. BASE: THE BASE SHALL BE CONSTRUCTED OF GALVANIZED STEEL FOR IMPROVED RIGIDITY. BASE CORNERS SHALL BE WELDED TO PROVIDE STRENGTH AND SUPPORT FOR HINGING AND CLEANING AND TO PREVENT LEAKAGE INTO THE BUILDING.
E. WHEEL: THE FAN WHEEL SHALL BE CENTRIFUGAL BACKWARD INCLINED AND NON-OVERLOADING. WHEELS SHALL BE BALANCED IN TWO PLANES AND DONE IN ACCORDANCE WITH AMCA STANDARD 204-96, BALANCE QUALITY AND VIBRATION LEVELS FOR FANS. THE WHEEL BLADES SHALL BE AERODYNAMICALLY DESIGNED TO MINIMIZE TURBULENCE, INCREASE EFFICIENCY AND REDUCE NOISE. THE WHEEL BLADES SHALL BE WELDED TO THE WHEEL INLET CONE. IN THE EVENT THAT BALANCING WEIGHTS ARE REQUIRED THEY SHALL BE RIVETED TO THE BLADES OR WHEEL. THE WHEEL INLET SHALL OVERLAP THE FAN BASE INLET FOR MAXIMUM PERFORMANCE AND EFFICIENCY. THE WHEEL SHALL BE FIRMLY ATTACHED TO THE MOTOR SHAFT WITH TWO SET SCREWS.
F. MOTOR AND MOTOR COMPARTMENT: MOTORS SHALL BE HEAVY DUTY BALL BEARING TYPE, MOUNTED OUT OF THE AIRSTREAM AND FURNISHED AT THE SPECIFIED VOLTAGE, PHASE AND ENCLOSURE. MOTOR MOUNTING PLATE SHALL BE CONSTRUCTED OF HEAVY GAUGE GALVANIZED STEEL AND ISOLATED FROM THE FAN STRUCTURE WITH VIBRATION ISOLATORS. THE MOTOR COMPARTMENT SHALL BE COOLED BY OUTSIDE AIR DRAWN THROUGH AN EXTRUDED ALUMINUM CONDUIT TUBE. TO SEAL THE CONDUIT TUBE PASSAGE AND PREVENT NOISE SILICONE RUBBER GROMMETS SHALL ISOLATE THE CONDUIT TUBE FROM THE FAN HOUSING. THE MOTOR COMPARTMENT SHALL BE OF A TWO-PIECE CONSTRUCTION WITH THE TOP CAP HAVING QUICK RELEASE CLIPS TO PROVIDE QUICK AND EASY ACCESS TO THE MOTOR COMPARTMENT.
G. SHAFT AND BEARINGS: SHAFTS SHALL BE PRECISION GROUND AND POLISHED. HEAVY DUTY, PRE-LUBRICATED BEARINGS SHALL BE SELECTED FOR A MINIMUM (L50) LIFE IN EXCESS OF 200,000 HOURS OF OPERATION AT MAXIMUM CATALOGED OPERATING SPEED. THEY SHALL BE DESIGNED FOR AND INDIVIDUALLY TESTED SPECIFICALLY FOR USE IN AIR HANDLING APPLICATIONS.
H. BELTS AND DRIVES: BELTS SHALL BE OIL AND HEAT RESISTANT, NON-STATIC TYPE. DRIVES SHALL BE CAST TYPE, PRECISION MACHINED AND KEYED AND SECURED ATTACHED TO THE FAN AND MOTOR SHAFTS. DRIVES SHALL BE SIZED FOR A MINIMUM OF 150% OF THE INSTALLED MOTOR HORSEPOWER. FAN OPERATING SPEED SHALL BE FACTORY SET USING ADJUSTABLE PITCH MOTOR PULLEYS.
I. GREASE SPOUT: A GREASE SPOUT MADE OF ALUMINUM TUBING SHALL BE WELDED TO THE FAN HOUSING. THE WELD SHALL BE FACTORY TESTED TO ENSURE IT WILL NOT LEAK.
J. NYLON WASHERS: TO PROVIDE A TIGHT SEAL ALL FASTENERS IN THE FAN HOUSING SHALL BE BACKED WITH NYLON WASHERS.
K. SAFETY DISCONNECT SWITCH: A SAFETY DISCONNECT SWITCH SHALL BE STANDARD ON ALL NCA-FA UNITS WITH OPEN DRIP PROOF MOTORS. SWITCHES SHALL BE INSTALLED IN A NEMA3R ENCLOSURE AND MOUNTED TO EXTERIOR OF WINDBAND FOR EASY ACCESS.
L. PROVIDE EXHAUST FAN MODEL NCA-FA BY CAPTIVEAIRE.

2.8 INLINE DIRECT GAS FIRED HEATED MAKE UP AIR UNIT
A. A MODULAR PACKAGED HEATING, COOLING AND VENTILATING UNIT(S), AS INDICATED ON THE DRAWINGS SHALL BE FURNISHED. DIRECT FIRED GAS UNIT(S) SHALL BE TESTED IN ACCORDANCE WITH ANSI STANDARD Z83.4A-2001/CSA 3.7A-2001, AND SHALL BEAR THE ETL LABEL. ORIENTATION SHALL BE HORIZONTAL, DOWN OR SIDE DISCHARGE. UNIT(S) SHALL BE FACTORY ASSEMBLED, TESTED AND SHIPPED AS A COMPLETE PACKAGED ASSEMBLY, FOR OUTDOOR MOUNTING, CONSISTING OF THE FOLLOWING:
1. GAS BURNER
2. CENTRIFUGAL BLOWER (FORWARD-CURVED DOUBLE WIDTH/DOUBLE INLET)
3. MOTOR STARTER WITH THERMAL OVERLOAD PROTECTION
4. MOTOR AND DRIVE ASSEMBLY
5. FUEL BURNING AND SAFETY EQUIPMENT
6. TEMPERATURE CONTROL SYSTEM
7. GAS PIPING
8. PRE-PIPED AND CHARGED CONDENSER(S)

B. HOUSING:
1. UNIT HOUSING SHALL BE CONSTRUCTED OF 20 GAUGE G-90 GALVANIZED STEEL. THE WALL PANELS AND ROOF PANELS SHALL BE FABRICATED BY FORMING DOUBLE-STANDING, SELF-LOCKING SEAMS THAT REQUIRE NO ADDITIONAL SUPPORT. THE FLOOR AND WALL PANELS SHALL BE CAULKED AIR TIGHT WITH A SILICONE BUTTON. ALL CASING PANELS SHALL BE ATTACHED WITH SHEET METAL SCREWS OR RIVETS, WHICH CAN BE REMOVED TO FIELD SERVICE LARGE COMPONENTS. THE UNIT BASE SHALL BE SUITABLE FOR CURB OR FLAT BUTTON. HOUSING CONSTRUCTION SHOULD BE SUITABLE FOR OUTDOOR INSTALLATION.
2. AN OBSERVATION PORT SHALL BE LOCATED ON THE EXTERIOR OF THE UNIT FOR OBSERVATION OF THE MAIN FLAME AND PILOT FLAME. ALL CONTROLS, GAS VALVES, MODULATING CONTROLS AND ELECTRICAL COMPONENTS SHALL BE MOUNTED WITHIN THE BURNER VESTIBULE. THE BURNER VESTIBULE SHALL BE AN INTEGRAL PART OF THE UNIT AND NOT EXTEND OUTSIDE THE EXTERIOR CASING OF THE UNIT AND NOT EXPOSED TO THE MAIN AIR STREAM. THE VESTIBULE FULL-SIZE DOOR SHALL PROVIDE EASY ACCESS TO CONTROLS AND GAS-TRAIN COMPONENTS. BLOWER DOOR SHALL PROVIDE EASY ACCESS TO BLOWER, MOTOR AND DRIVES. ACCESS DOORS SHALL BE PROVIDED ON BOTH FRONT AND BACKSIDE OF UNIT PROVIDING FULL ACCESS TO EVERY PART OF THE UNIT.
3. INTERNAL RIDGED BOARD 1" X 1.5" FOIL FACE INSTALLATION SHALL BE INSTALLED ON ROOF, WALLS AND BASE OF CASING.

C. BASE:
1. THE BASE SHALL BE CONSTRUCTED OF GALVANIZED STEEL FOR IMPROVED RIGIDITY. BASE SHALL BE STRUCTURALLY REINFORCED TO ACCOMMODATE THE BLOWER ASSEMBLY AND BURNER.

D. BLOWER:
1. BLOWER(S) SHALL BE FORWARD-CURVED, CENTRIFUGAL, CLASS I OR II (DEPENDING ON APPLICATION REQUIREMENTS), DOUBLE WIDTH, DOUBLE INLET, CONSTRUCTED G-90 GALVANIZED STEEL. UNIT SHALL AVE A HEAVY-DUTY, SOLID-STEEL SHAFT. WHEELS SHALL BE BALANCED IN TWO PLANES AND DONE IN ACCORDANCE WITH AMCA STANDARD 204-96, BALANCE QUALITY AND VIBRATION LEVELS FOR FANS. THE WHEEL BLADES SHALL BE AERODYNAMICALLY DESIGNED TO MINIMIZE TURBULENCE, INCREASE EFFICIENCY AND REDUCE NOISE. THE WHEEL BLADES SHALL BE SECURELY ATTACHED TO THE WHEEL INLET BUTTON. THE WHEEL SHALL BE FIRMLY ATTACHED TO THE FAN SHAFT WITH SETSCREWS AND KEYS. THE BLOWER ASSEMBLY SHALL BE ISOLATED FROM THE FAN STRUCTURE WITH VIBRATION ISOLATORS.
2. BLOWER CAPACITY SHALL BE AS NOTED ON THE DRAWINGS.
3. ALL BLOWERS SHALL BE TESTED AND SET AT RATED SPEED AFTER BEING INSTALLED IN THE FACTORY-ASSEMBLED UNIT.

E. MOTOR AND MOTOR COMPARTMENT:
1. MOTORS SHALL BE HEAVY-DUTY BALL BEARING TYPE AND FURNISHED AT THE SPECIFIED VOLTAGE, PHASE AND ENCLOSURE. MOTOR MOUNTING PLATE SHALL BE CONSTRUCTED OF HEAVY GAUGE GALVANIZED STEEL AND SHALL BE DESIGNED TO PROVIDE EASY ADJUSTMENT OF THE BELT TENSION. BLOWER MOTOR SHALL BE OPEN DRIP PROOF.

F. SHAFT AND BEARINGS:
1. SHAFTS SHALL BE PRECISION GROUND AND POLISHED. HEAVY DUTY, PRE-LUBRICATED BEARINGS SHALL BE SELECTED FOR A MINIMUM (L50) LIFE IN EXCESS OF 200,000 HOURS OF OPERATION AT MAXIMUM CATALOGED OPERATING SPEED. THEY SHALL BE DESIGNED FOR, AND INDIVIDUALLY TESTED, SPECIFICALLY FOR USE IN AIR HANDLING APPLICATIONS.

G. BELTS AND DRIVES:
1. BELTS SHALL BE OIL AND HEAT RESISTANT, NON-STATIC, GRIP-NOTCH TYPE. DRIVES SHALL BE CAST TYPE, PRECISION MACHINED AND KEYED, AND SECURED ATTACHED TO THE FAN AND MOTOR SHAFTS. FAN OPERATING SPEED SHALL BE FACTORY SET USING ADJUSTABLE PITCH MOTOR PULLEYS. ALL DRIVES SHALL BE A MINIMUM OF 2 GROOVES ABOVE 2 HP.

H. BURNER:
1. THE GAS BURNER SHALL BE DIRECT-FIRED, DRAW-THROUGH TYPE, SIZED TO PROVIDE THE OUTPUT CAPACITY NOTED ON THE DRAWINGS USING NATURAL GAS.
2. THE BURNER SHALL BURN OVER ITS ENTIRE LENGTH AT ALL TIMES WHEN THE SYSTEM IS IN OPERATION.
3. THE BURNER SHALL HAVE NON-CLOGGING, 4302B STAINLESS-STEEL COMBUSTION BAFFLES ATTACHED TO A DUCTILE ALUMINUM GAS-SUPPLY SECTION WITH NO MOVING PARTS TO WEAR OUT OR FAIL. THE BURNER SHALL BE CAPABLE OF 92% COMBUSTION EFFICIENCY WITH A MAXIMUM TURN DOWN RATIO OF UP TO 30 TO 1.
4. THE GAS BURNER SHALL BE FURNISHED WITH A PILOT PACKAGE ARRANGED SO THAT THE PILOT FLAME LIGHTS THE BURNER WITH INSTANTANEOUS IGNITION. PILOT ASSEMBLY INCLUDES A FLAME ROD, SPARK ROD AND PILOT, WHICH IS AUTOMATICALLY IGNITED BY IGNITION TRANSFORMER. A FLAME-ROD RECTIFICATION SYSTEM SHALL BE USED TO PROVE PILOT AND MAIN FLAME.
5. REAR ACCESS DOORS WILL PROVIDE COMPLETE ACCESS TO BURNER AND PILOT ASSEMBLY.
6. BURNER PROFILE PLATES SHALL BE SELF-ADJUSTING TO OPERATE ACROSS THE COMPLETE CFM RANGE OF EACH MODEL HEATER. EVERY UNIT SHALL BE DESIGNED FOR VARIABLE AIR VOLUME CAPABILITIES.

I. COOLING EQUIPMENT:
1. ALL COOLING EQUIPMENT SHOULD CONFORM TO LOCAL CODE REQUIREMENTS. ALL GAS MANIFOLD COMPONENTS SHALL BE PIPED AND WIRED AT THE FACTORY.
2. COMPONENTS SHALL INCLUDE:
   a. 14 SEER MINIMUM CONDENSER
   b. THERMAL EXPANSION VALVE
   c. FILTER/DRYER
   d. HARD START KIT FOR CONDENSER
   e. INSULATED SUCTION LINES
   f. MULTIPLE STAGES WHERE REQUIRED
   g. PRE CHARGED SYSTEM
   h. R-410A REFRIGERANT

J. GAS EQUIPMENT:
1. ALL GAS EQUIPMENT SHOULD CONFORM TO LOCAL CODE REQUIREMENTS. ALL GAS MANIFOLD COMPONENTS SHALL BE PIPED AND WIRED AT THE FACTORY.
2. COMPONENTS SHALL INCLUDE:
   a. PILOT-GAS SHUT-OFF VALVE
   b. PILOT-GAS REGULATOR
   c. PILOT-GAS VALVE
   d. MAIN-GAS SHUT-OFF VALVE
   e. MAIN-GAS REGULATOR
   f. TWO SOLENOID VALVES
   g. MODULATING-GAS VALVE
   h. BURNER ON GAS EQUIPMENT

K. SAFETY CONTROLS:
1. SAFETY CONTROLS SHALL INCLUDE:
   a. MOTOR STARTER WITH ADJUSTABLE OVERLOADS
   b. AIR-FLOW SAFETY SWITCH
   c. ELECTRONIC FLAME-SAFETY RELAY
   d. HIGH-TEMPERATURE LIMIT SWITCH
   e. MAIN-GAS REGULATOR
   f. TWO SAFETY SHUTOFF VALVES
   g. MODULATING-GAS VALVE
   h. STAINLESS STEEL BURNER
   i. ADJUSTABLE BURNER ON/OFF INLET AIR DUCT-STAT TO SHUT OFF HEAT WHEN INLET AIR IS SUFFICIENTLY WARM TO MAINTAIN SPACE TEMPERATURE
   j. NON-FUSED DISCONNECT
   k. CASING INSULATION SHALL BE 1" X 1.5" DENSITY WITH A FOIL FACE
   l. LOW GAS-PRESSURE SWITCH

L. ACCESSORIES SHALL INCLUDE, BUT NOT BE LIMITED TO, THE FOLLOWING:
1. INLET DAMPERS: MANUFACTURER SHALL PROVIDE AND INSTALL ON UNIT, WHEN POSSIBLE, A TWO-POSITION, MOTOR-OPERATED DAMPER WITH INTERNAL END SWITCH TO ENERGIZE THE BLOWER-STARTER CIRCUIT, WHEN DAMPER IS 80% OPEN. BLADES SHALL BE A MAXIMUM OF 6" WIDE 16-GAUGE G-90 GALVANIZED STEEL AND SHALL BE MADE TO GUARANTEE THE ABSENCE OF NOTICEABLE VIBRATION AT DESIGN AIR VELOCITIES. DAMPER BLADES ARE TO BE MOUNTED ON FRICTION-FREE SYNTHETIC BEARINGS. DAMPER EDGES SHALL HAVE PVC COATED POLYESTER FABRIC MECHANICALLY LOCKED INTO BLADE EDGE. JAMB SEALS USED ARE FLEXIBLE METAL, COMPRESSION TYPE.
2. FRESH-AIR INLET HOOD/FILTER COMBINATION: SHALL BE CONSTRUCTED OF G-90 GALVANIZED STEEL WITH BIRD SCREEN AND (2") CLEANABLE FILTERS SUPPORTED BY INTERNAL SLIDES MOUNTED IN THE INLET FACE OF THE HOOD.
3. CURB: 20" CURB SHALL BE CONSTRUCTED OF 18-GAUGE ALUMINIZED STEEL AS A COMPLETED WELDED ASSEMBLY.
4. COOLING COIL SECTION: COOLING COIL SECTION SHALL BE FIELD BOLTED DIRECTLY TO DISCHARGE OF BLOWER SECTION. COIL SECTION TO BE DESIGNED TO FIT ONTO COMMON CURB WITH MAIN UNIT. BASE OF COIL SECTION TO BE CONSTRUCTED WITH DOUBLE PITCH STAINLESS STEEL DRAIN PAN FOR COIL, SAME AS MAIN UNIT. CASING AND ROOF TO BE 20-GAUGE G-90 GALVANIZED CONSTRUCTION. INSIDE OF SECTION TO BE FULLY INSULATED WITH FOIL BACK INSULATION. DX OR CHILLED WATER COIL TO MEET SCHEDULED REQUIREMENTS.

M. TEMPERATURE CONTROL SYSTEMS:
1. DISCHARGE TEMPERATURE CONTROL: USE FOR BUILDING EXHAUST-AIR REPLACEMENT TO MAINTAIN A CONSTANT DISCHARGE TEMPERATURE OF SUPPLY AIR. THE BURNER FLAME MODULATES TO COMPENSATE FOR OUTDOOR TEMPERATURES. THE OPTIONAL MANUAL SUMMER-OFF/WINTER SELECTOR SWITCH AND EXHAUST SYSTEM INTERLOCK CONTROLS THE HEATER-BLOWER OPERATION. SUPPLIED WITH OPTIONAL REMOTE-CONTROL PANEL WITH TEMPERATURE SELECTOR DIAL AND SUMMER-OFF/WINTER SELECTOR.

N. WIRING AND ELECTRICAL:
1. EACH CONDENSER SHALL HAVE A SEPARATE CIRCUIT ENABLING THE SUPPLY FAN MOTOR TO ACCEPT SIGNALS FROM A VFD WITHOUT INTERFERING WITH CONDENSER OPERATION.
2. UNIT(S) SHALL BE COMPLETE WITH ALL ITEMS SUCH AS RELAYS, STARTERS, SWITCHES, SAFETY CONTROLS, CONDUIT AND WIRE AS PREVIOUSLY MENTIONED, AND AS REQUIRED FOR PROPER OPERATION. ALL FACTORY-MOUNTED CONTROLS SHALL BE FACTORY PRE-WIRED TO THE UNIT CONTROL PANEL. A SAFETY DISCONNECT SWITCH SHALL BE STANDARD ON ALL UNITS AND SHALL BE SIZED ACCORDING TO THE UNIT.

O. UNIT(S) SHALL BE OPERATED, TESTED AND SET AT THE FACTORY USING JOB-SITE CONDITIONS FOR ELECTRICAL AND GAS INPUT. ALL OPERATING AND SAFETY CONTROLS SHALL BE TESTED AND SET AT THE FACTORY. ADJUSTABLE OR FIXED SHEAVES SHALL BE SET FOR PROPER RPM AT SPECIFIED CONDITIONS. GAS-PRESSURE REGULATOR SHALL BE SET FOR SPECIFIED BURNING RATE AT SPECIFIED INLET PRESSURE.
P. THE SUPPLIER SHALL FURNISH AS BUILT WIRING CONNECTION AND CONTROL-CIRCUIT DIAGRAMS, DIMENSION SHEETS AND A FULL DESCRIPTION OF THE UNIT(S). SERVICE MANUALS, SHOWING SERVICE AND MAINTENANCE REQUIREMENTS, SHALL BE PROVIDED WITH EACH UNIT.
Q. MODULAR PACKAGED COOLING UNIT WITH DIRECT-FIRED HEATED FOR 100% OUTDOOR AIR APPLICATIONS SHALL BE MODEL A3-D.500-G18 BY CAPTIVEAIRE.

PART 2 - EXECUTION

3.1 INSTALLATION
A. INSTALL KITCHEN HOOD IN LOCATIONS SHOWN ON DRAWINGS.
B. INSTALLATION TO BE IN ACCORDANCE WITH MANUFACTURER'S PUBLISHED RECOMMENDATIONS AS WELL AS APPLICABLE SECTIONS OF SMACNA MANUAL AND AS SPECIFIED ABOVE.
C. PROVIDE ALL STEEL STRUCTURAL SUPPORT SCREWS, BOLTS, NUTS, INSERTS, AND MATERIAL REQUIRED FOR INSTALLATION OF THE HOOD AGAINST THE WALL AND FOR ATTACHING EXHAUST AND SUPPLY DUCTS TO THE HOOD.
D. INSTALL COMPLETE FIRE SUPPRESSION SYSTEM FOR EACH HOOD.
E. PROVIDE ALL INTERLOCKS BETWEEN SUPPRESSION SYSTEM, EXHAUST FANS, AND MAKE-UP AIR FANS. ELECTRICAL CONTRACTOR SHALL PROVIDE ALL RELAYS BETWEEN FIRE SUPPRESSION SYSTEM AND FIRE ALARM PANEL.

3.2 EXHAUST FANS
A. ENSURE ENOUGH CLEARANCES ARE AROUND UNIT AS RECOMMENDED BY THE MANUFACTURER AND NFPA STANDARD.
B. CONNECT DUCT TO FANS TO ALLOW FOR STRAIGHT AND SMOOTH AIRFLOW.
C. PROVIDE HARD CONNECTION TO DUCT WORK. THE FAN SHALL BE CONNECTED TO THE DUCTWORK BY FLANGES SECURELY BOLTED. DO NOT USE FLEXIBLE CONNECTORS. CONNECTIONS SHALL BE MADE AS PER NFPA 96. USE 1500 DEG F RATED GASKETS.

3.3 INLINE MAKE UP AIR UNIT
A. ENSURE ENOUGH CLEARANCES ARE AROUND UNIT AS RECOMMENDED BY THE MANUFACTURER AND NFPA STANDARD.
B. AVOID TRANSITIONS AND TURNS NEAR THE OUTLET OF THE FAN.

3.4 TESTING
A. CHECK WORK FOR SATISFACTORY INSTALLATION AND PERFORMANCE.
B. CHECK DUCT CONNECTIONS FOR LEAKAGE OR CONDENSATION. CORRECT ANY DEFICIENCIES.
C. TEST THE PERFORMANCE OF KITCHEN EXHAUST SYSTEM. ADJUST DAMPERS FOR PROPER DIRECTION OF AIR FLOW. CONDUCT FINAL TEST OF HOOD AND HOOD FIRE SUPPRESSION SYSTEM IN THE PRESENCE OF THE ENGINEER.

SECTION 23 74 33 - FACTORY FABRICATED PACKAGED, 100% OUTDOOR, HEATING AND COOLING MAKEUP AIR UNITS

PART 1 - GENERAL

1.1 SUMMARY
A. THIS SECTION INCLUDES PACKAGED HEATING AND COOLING UNITS CAPABLE OF SUPPLYING UP TO 100 PERCENT OUTDOOR AIR.

1.2 SUBMITTALS
A. THE MANUFACTURER ASSUMES NO LIABILITY FOR THE USE OR RESULTS OF USE OF THIS DOCUMENT. THIS SPECIFICATION IS TO BE REVIEWED BY THE ENGINEER TO CONFIRM REQUIREMENTS OF THE PROJECT AND BUILDING CODES ARE MET.
B. AS THE MANUFACTURER CONTINUES PRODUCT DEVELOPMENT, IT RESERVES THE RIGHT TO CHANGE DESIGN AND SPECIFICATIONS WITHOUT NOTICE.

1.3 WIND LOAD DESIGN
A. REFER TO SECTION 23 00 01, SEISMIC, WIND, FLOOD LOAD DESIGN FOR ADDITIONAL REQUIREMENTS.
B. MIAMI DADE RATED UP TO ±150PSF PER TAS 201, 202 & 203 PAIRED WITH 20" CURB OR SHORTER.

1.4 QUALITY ASSURANCE
A. ALL MODELS SHALL BE ETL LISTED AND COMPLY WITH SAFETY STANDARDS UL 1995, AND CSA STD. C22.2, NO. 236-11. UNITS OUTFITTED WITH INDIRECT FIRED HEATERS SHALL ALSO COMPLY WITH ANSI Z83.8-2013, AND CSA 2.6-2013.

1.5 WARRANTY
A. ALL UNITS SHALL BE PROVIDED WITH THE FOLLOWING STANDARD WARRANTIES:
1. 10-YEAR (NON-PRORATED) PARTS WARRANTY COVERING THE ENTIRE UNIT WHEN ACCOMPANIED BY A COMPANY PROVIDED SERVICE PLAN. 5-YEAR (NON-PRORATED) PARTS WARRANTY COVERING THE ENTIRE UNIT OTHERWISE.
2. 25-YEAR (NON-PRORATED) PARTS WARRANTY FOR SS HEAT EXCHANGER ON INDIRECT FIRED UNITS. REVISED MAY 22, 2019

B. THIS WARRANTY SHALL NOT APPLY IF:
1. THE EQUIPMENT IS NOT INSTALLED BY A QUALIFIED INSTALLER PER THE MANUFACTURER'S INSTALLATION INSTRUCTIONS SHIPPED WITH THE PRODUCT.
2. THE EQUIPMENT IS NOT INSTALLED IN ACCORDANCE WITH FEDERAL, STATE AND LOCAL CODES AND REGULATIONS.
3. THE EQUIPMENT IS MISUSED OR NEGLECTED, OR NOT MAINTAINED PER THE MANUFACTURER'S MAINTENANCE INSTRUCTIONS.
4. THE EQUIPMENT IS NOT OPERATED WITHIN ITS PUBLISHED CAPACITY.
5. THE INVOICE IS NOT PAID WITHIN THE TERMS OF THE SALES AGREEMENT.

C. THE MANUFACTURER SHALL NOT BE LIABLE FOR INCIDENTAL AND CONSEQUENTIAL LOSSES AND DAMAGES POTENTIALLY ATTRIBUTABLE TO MALFUNCTIONING EQUIPMENT. SHOULD ANY PART OF THE EQUIPMENT PROVE TO BE DEFECTIVE IN MATERIAL OR WORKMANSHIP WITHIN THE 10 YEAR PERIOD, UPON EXAMINATION BY THE MANUFACTURER, SUCH PART WILL BE REPAIRED OR REPLACED BY MANUFACTURER AT NO CHARGE. THE BUYER SHALL PAY ALL LABOR COSTS INCURRED IN CONNECTION WITH SUCH REPAIR OR REPLACEMENT. EQUIPMENT SHALL NOT BE RETURNED WITHOUT MANUFACTURER'S PRIOR AUTHORIZATION AND ALL RETURNED EQUIPMENT SHALL BE SHIPPED BY THE BUYER, FREIGHT PREPAID TO A DESTINATION DETERMINED BY THE MANUFACTURER.

PART 2 - PRODUCTS

2.1 GENERAL
A. SUPPLY SINGLE ZONE ONE PIECE PACKAGED UNITS THAT ARE COMPLETE AS PER THE FOLLOWING SPECIFICATION, DELIVER ALL CAPACITIES SCHEDULED, AND CONFORM TO DESIGN INDICATED HEREIN. ALTERNATE LAYOUTS OR DIMENSIONAL CHANGES WILL NOT BE ACCEPTED.

2.2 CABINET
A. UNIT(S) SHALL BE CONSTRUCTED OF MINIMUM 20GA. G-90 GALVANIZED STEEL RIVETED TOGETHER VIA STRUCTURAL POP-RIVETS. ALL METAL SHALL BE CNC BENT FOR PRECISE ASSEMBLY.
1. RIGGING PROVISIONS: THE UNIT SHALL HAVE A STRUCTURAL BASE CONSTRUCTED OF MINIMUM 14GA. G-90 GALVANIZED STEEL, AND INCLUDE FULL SIZED FORK POCKETS AND LIFTING POINTS ON ALL FOUR SIDES.
2. ROOF CONSTRUCTION: THE LIDS SHALL BE FABRICATED BY FORMING A DOUBLE-STANDING, SELF-LOCKING SEAM THAT REQUIRES NO ADDITIONAL SUPPORT. ROOF SHALL BE PITCHED TO ALLOW FOR PROPER DRAINAGE.
3. EXTERIOR WALL CONSTRUCTION: ALL EXTERIOR WALLS SHALL CONSIST OF A DOUBLE WALL, G-90 GALVANIZED STEEL CONSTRUCTION INSULATED WITH 2IN. THICK, FOIL-FACED, R13 CLOSED CELL FOAM.
4. SERVICE ACCESS DOORS: ALL DOOR JAMBS SHALL BE GASKETED AROUND THEIR PERIMETER, AND ALLOW FOR DOORS TO BE MOUNTED VIA REMOVABLE, SPRING ACTUATED, STAINLESS STEEL HINGES WITH STAINLESS STEEL RIVETS, AND SELF-COMPRESSING LATCHES. EACH COMPARTMENT SHALL HAVE REMOVABLE ACCESS PANELS TO ALLOW FOR EASE OF SERVICE AND MAINTAINABILITY. REVISED MAY 22, 2019 ELECTRICAL CABINET ACCESS DOORS SHALL HAVE A DOOR HOLD INSTALLED TO PROP DOORS OPEN. ALL DOORS SHALL HAVE STAINLESS STEEL LATCHES WHICH ARE PAD LOCKABLE. ELECTRICAL CABINET DOORS SHALL BE OUTFITTED WITH SCHEMATIC/MANUAL POUCHES FORMED INTO THE DOOR, ALONG WITH WIRING DIAGRAM ATTACHED TO THE INDOOR OF THE DOOR FROM THE FACTORY.

B. ENTIRE INTERIOR AND EXTERIOR CASING SHALL BE CONSTRUCTED OF MINIMUM 20 GA G90 GALVANIZED STEEL WITH NO PAINTING, AND SHALL HAVE SURPASSED A SALT SPRAY CORROSION TEST AS PER ASTM B 117.
C. ENTIRE UNIT SHALL BE MIAMI-DADE WIND RATED UP TO ±150PSF PER TAS 201, 202 & 203 ON ANY UNITS UTILIZING A 20" OR SHORTER FACTORY PROVIDED ROOF CURB.

2.3 AIRFLOW CONFIGURATIONS
A. UNIT SHALL BE CONFIGURABLE FOR BOTH DOWN (VERTICAL) DISCHARGE THROUGH BASE OF UNIT, OR SIDE THROUGH THE CABINET. UNIT SHALL ALSO BE CONFIGURABLE TO BOTH DOWN (VERTICAL) RETURN OR SIDE RETURN INTO THE CABINET.
B. UNIT INTAKE AIRFLOW CONFIGURATION SHALL BE THROUGH USDISCHARGE E OF A FRESH/OUTDOOR AND RETURN AIR DAMPER.
1. DAMPER: SHALL EXCEED AMCA CLASS 1A STANDARD FOR LOW LEAKAGE. DAMPER ASSEMBLY SHALL BE A SINGLE ASSEMBLY, AND OUTFITTED WITH AN INTEGRAL BIRD SCREEN AND LOUVER/GUTTER SYSTEM TO DIVERT ANY DRAINAGE THROUGH THE BASE OF THE UNIT - INTAKE AIR HOOD NOT REQUIRED.
2. ACTUATOR: A SINGLE DIRECT DRIVE DAMPER ACTUATOR SHALL BE USED WITH SPRING RETURN TO ENSURE THAT THE OUTDOOR AIR SECTION CLOSES WHEN NOT POWERED.

2.4 SUPPLY AIR BLOWER AND MOTOR
A. ALL SUPPLY FANS SHALL BE DIRECT DRIVE (BELT-DRIVEN NOT ACCEPTABLE) VARIABLE SPEED PLENUM FANS.
B. BLOWER MOTOR: MOTOR SHALL BE A PREMIUM EFFICIENCY MOTOR AVAILABLE AS:
1. OPEN DRIP PROOF (ODP) OR TOTALLY ENCLOSED FAN COOLED (TEFC) MOTOR DRIVEN BY A VARIABLE FREQUENCY DRIVE.
2. ELECTRONICALLY COMMUTATED MOTOR (ECM).

C. FANS TO BE SELECTED AT OR NEAR EFFICIENCY PEAK. (SUBMIT FAN CURVES.)
D. BLOWER AND MOTOR ASSEMBLY SHALL BE DYNAMICALLY BALANCED. THE ENTIRE BLOWER AND MOTOR ASSEMBLY SHALL BE MOUNTED ON RUBBER VIBRATION ISOLATORS. WHEELS BALANCED AS PER AMCA 204+96, BALANCE QUALITY AND VIBRATION LEVELS FOR FANS.

2.5 REFRIGERATION SYSTEM
A. UNIT SHALL UTILIZE A VARIABLE SPEED INVERTER DUTY SCROLL COMPRESSOR WITH THE FOLLOWING FEATURES:
1. MODULATION: COMPRESSOR SHALL BE CAPABLE OF COMPRESSOR SPEED MODULATION FROM 15%-100% ON 8, 10, & 12.5 TON UNITS, AND 25%-100% ON 15, 20, 22, 25, & 30 TON UNITS. REVISED MAY 22, 2019 REFRIGERANT: UNIT SHALL BE FACTORY CHARGED WITH R410A REFRIGERANT.
2. VIBRATION ISOLATION: COMPRESSOR SHALL BE MOUNTED ON RUBBER VIBRATION ISOLATORS TO REDUCE TRANSMISSION OF VIBRATION TO THE BUILDING STRUCTURE.
3. INTERNAL OVERLOAD PROTECTION: COMPRESSOR SHALL INCLUDE INTERNAL THERMAL OVERLOAD PRODUCTION TO PROTECT AGAINST EXCESSIVE MOTOR TEMPERATURES.
4. CRANKCASE HEATER: COMPRESSOR SHALL INCLUDE A CRANKCASE HEATER TO PROTECT AGAINST LIQUID FLOOD-BACK AND ELIMINATION OF OIL FOAMING ON STARTUP. THE CRANKCASE HEATER MUST REMAIN POWERED WHEN COMPRESSOR IS NOT IN OPERATION.
5. OIL MANAGEMENT: UNIT SHALL UTILIZE BOTH PASSIVE AND ACTIVE OIL RETURN MANAGEMENT USING OIL LEVEL SENSOR AND SCHEDULED OIL BOOSTS.
6. MONITORED ENVELOPE: UNIT SHALL MONITOR ALL CRITICAL REFRIGERATION POINTS TO ENSURE COMPRESSOR DOES NOT OPERATE OUTSIDE OF SAFE OPERATING ENVELOPE.
7. THROTTLING LOGIC: UNIT SHALL ALLOW FOR HIGH HEAD PRESSURE MONITORING THROTTLE MODE FOR HIGH AMBIENT OPERATION, AND LOW SUCTION PRESSURE THROTTLE MODE FOR LOW CAPACITY OPERATION OR ANY CONDITIONS RESULTING IN LOW SUCTION PRESSURE.
8. PUMP-DOWN: ACTIVE PUMP-DOWN MODE WITH DISCHARGE LINE CHECK VALVE TO PROTECT AGAINST LIQUID MIGRATION INTO COMPRESSOR DURING IDLE TIMES.
9. DEFROST MODE IN OPTIONAL HEAT PUMP: WHEN OUTDOOR COILS ARE DEEMED AT RISK OF FREEZING, THE UNIT SHALL SIMULTANEOUSLY TURN ON AUXILIARY HEAT WHILE RUNNING THE HEAT PUMP IN "COOLING" MODE TO HELP DEFROST OUTDOOR COILS AS NEEDED WHILE STILL MAINTAIN DESIRED LEAVING AIR TEMPERATURES.

B. THE UNIT SHALL BE OUTFITTED WITH THE FOLLOWING:
1. INDOOR COIL: INDOOR COIL SHALL BE A HIGH EFFICIENCY 5-7 ROW COIL DESIGN WITH ALUMINUM FINS MECHANICALLY BONDED TO COPPER TUBES. COIL IS STAGGERED TO INCREASE TURBULENCE, REDUCE THE COIL BYPASS FACTOR, AND ULTIMATELY THE TIME THE AIR STAYS WITHIN THE COIL.
2. ELECTRONIC EXPANSION VALVE: EACH REFRIGERATION CIRCUIT WILL BE OUTFITTED WITH AN ELECTRONIC EXPANSION VALVE METERING DEVICE WHICH CAN BE THROTTLED FROM 0-100% OPEN TO ALLOW FOR PRECISE SUPERHEAT CONTROL.
3. INDOOR COIL DRAIN PAN: THE INDOOR COIL SHALL BE OUTFITTED WITH A SLOPED STAINLESS STEEL DRAIN PAN. THIS PAN SHALL BE INSULATED ALONG THE ENTIRE BASE TO PREVENT CONDENSATION, AND OUTFITTED WITH A SAFETY OVERFLOW SWITCH WHICH WILL AUTOMATICALLY SHUT DOWN COOLING OPERATION PRIOR TO WATER OVERFLOWING THE DRAIN PAN IN THE EVENT OF A DRAIN CLOG. THE ENTIRE DRAIN PAN SHALL BE 20 GA STAINLESS STEEL CONSTRUCTION AND WRAP BENEATH THE ENTIRE COIL WITH FLASHING ON ENTERING SIDE OF COIL TO ENSURE CAPTURE OF ALL CONDENSATE. DRAIN PAN DISCHARGE PIPE SHALL ALSO BE STAINLESS STEEL CONSTRUCTION. DRAIN PAN SHALL BE PITCHED TO EXCEED ASHRAE 62.1 STANDARD.
4. BASE OF THE CONDENSING COIL CABINET SHALL BE PITCHED AWAY FROM THE UNIT AS A SAFETY TO ENSURE ALL DRAINING EXITS AWAY FROM THE CURB.
5. OPTIONAL HOT GAS REHEAT COIL: THE UNIT SHALL INCLUDE AN OPTIONAL COPPER TUBE AND ALUMINUM FIN HOT GAS REHEAT COIL MOUNTED DOWNSTREAM OF THE INDOOR COIL. THIS COIL SHALL BE CONTROLLED VIA FULLY MODULATING HOT GAS REHEAT VALVE TO PROVIDE PRECISE REHEAT TEMPERATURE CONTROL. THIS COIL SHALL INCLUDE THE ADDITION OF AN EVAPORATIVE COIL LEAVING CONDITION SENSOR TO MAINTAIN A COIL DEW POINT. THIS ALSO PREVENTS OPERATION OF A DEHUMIDIFICATION CALL WHEN INTAKE DEW POINT CONDITIONS ARE FOUND TO BE BELOW SPACE DEW POINT CONDITIONS, PREVENTING WASTED ENERGY.
6. OUTDOOR (CONDENSER) COIL: OUTDOOR COIL SHALL BE A HIGH EFFICIENCY COIL DESIGN WITH ALUMINUM FINS MECHANICALLY BONDED TO COPPER TUBES. THE COIL SHALL BE DOWNWARD SLOPED TO PROTECT COIL FROM HAIL DAMAGE. OPTIONAL HAIL GUARDS MAY ALSO BE OUTFITTED TO THE OUTDOOR COIL FOR ADDED PROTECTION FROM HAIL BOUNCING OFF OF THE ROOF OF THE UNIT UP THE COIL.
7. OUTDOOR FANS: THE OUTDOOR COIL SHALL HAVE A VERTICAL DISCHARGE OUTFITTED WITH QUIET, EFFICIENT, FULLY MODULATING ELECTRONICALLY COMMUTATED MOTOR (ECM) CONDENSING FANS. THESE FANS SHALL MODULATE TO MAINTAIN A TEMPERATURE DIFFERENTIAL BETWEEN OUTSIDE AIR AND THE OUTDOOR COIL.

C. TO HELP MITIGATE ANY LONG-TERM POTENTIAL FOR LEAKS OR HARDWARE FAILURES, THE UNIT SHALL BE OUTFITTED WITH THE FOLLOWING PROTECTION MEASURES:
1. SUCTION LINE ACCUMULATOR FOR ADDED PROTECTION AGAINST LIQUID ENTERING SUCTION LINE OF COMPRESSOR.
2. BI-FLOW, LOW PRESSURE DROP, FILTER DRIER.
3. ELECTRONIC EXPANSION VALVE (EEV) FOR PRECISE SUPERHEAT CONTROL. EEV SHALL OPEN PARTIALLY ALLOWING SYSTEM PRESSURE EQUALIZATION PRIOR TO ACTIVATION OF THE COMPRESSOR.
4. ON OPTIONAL HEAT PUMP UNITS, USE OF A SINGLE 3-WAY REHEAT VALVE TO PREVENT OBSTRUCTIONS DUE TO VALVE FAILURE.
5. PROTECTIVE RUBBER SLEEVES INSTALLED ON ALL DISTRIBUTION LINES OF INDOOR COIL TO PREVENT WEAR FROM RUBBING.
6. ALL REFRIGERATION PORTS SHALL BE SHORT-STUB ASSEMBLY AND ANY ACCESS PORT WITH A TRANSDUCER OR SWITCH IS MOUNTED VERTICALLY TO MITIGATE RISK OF BENT/CRACKED STUB JOINTS.
7. REFRIGERATION CIRCUIT SHALL BE MECHANICALLY CNC PRE-BENT TUBING WHEREVER POSSIBLE WITH MINIMAL BRAZED JOINTS TO MINIMIZE POINTS FOR POTENTIAL REFRIGERATION LEAKS.
8. FACTORY TESTED FOR LEAKS VIA HIGH PRESSURE NITROGEN DECAY AND HELIUM TRACER GAS TESTING.
9. SUCTION LINE TEMPERATURE SENSOR FAILURE DETECTION.
10. PREVENTATIVE FAILURE ALERTS THROUGH A MANUFACTURER PROVIDED, CLOUD BASED, CELLULAR REMOTE MONITORING SYSTEM.

2.6 HEATING SYSTEM
A. THE GAS BURNER SHALL BE AN INDIRECT-FIRED, PUSH-THROUGH TYPE, USING (NATURAL) (LP) GAS AT AN INLET-SUPPLY PRESSURE TO THE UNIT OF 7"W.C. MINIMUM NAT. GAS, (11"W.C. MINIMUM LP GAS). BURNER SHALL BE A TUBULAR IN-SHOT FIRED DESIGN CAPABLE OF USING NATURAL OR LP TYPE GAS. EACH BURNER IGNITION SHALL BE OF THE DIRECT-SPARK DESIGN WITH REMOTE FLAME SENSING AT INLET OF THE LAST FIRING TUBE OF THE GAS MANIFOLD.
B. DIRECT-SPARKING SEQUENCE SHALL LAST THROUGH THE COMPLETE DURATION OF THE TRIAL FOR IGNITION PERIOD FOR GUARANTEED LIGHT-OFF. BURNER SHALL ALWAYS BE LIT AT MAXIMUM GAS FLOW AND COMBUSTION AIRFLOW FOR GUARANTEED LIGHT-OFF. EACH BURNER IGNITION MODULE SHALL HAVE LED INDICATORS FOR TROUBLESHOOTING AND A SET OF EXPOSED PRONGS FOR TESTING FLAME INDICATION SIGNAL.
C. ALL FURNACES SHALL BE CONTROLLED BY AN ELECTRONIC VERNIER-TYPE FULLY MODULATING CONTROL SYSTEM CAPABLE OF ACHIEVING 80% COMBUSTION EFFICIENCY OVER THE ENTIRE GAS FIRING RANGE OF THE UNIT.
D. EACH FURNACE SHALL HAVE:
1. A MINIMUM TURNDOWN RATIO OF 6:1 FOR NATURAL GAS AND 5:1 FOR LP GAS WHILE MAINTAINING A CONSTANT 80% EFFICIENCY (90% FOR HIGH EFFICIENCY FURNACE OPTION). NO COLD AIR BYPASS OF THE HEAT EXCHANGER.
2. EACH FURNACE HEAT EXCHANGER SHALL BE A BENT-TUBE STYLE DESIGN MADE ENTIRELY OF TYPE 409 STAINLESS STEEL.
3. STAINLESS STEEL QUICK SEAL CONNECTION FOR GAS CONNECTION.
4. MANIFOLD AND INPUT GAS PRESSURE GAUGES.
5. FACTORY PIPED CONDENSATE DRAIN TO EXTERIOR OF CABINET.
6. A COMBUSTION FLUE TO BE INSTALLED ON ADJACENT SIDE AS COMBUSTION INTAKE WITH INTEGRATED HIGH VELOCITY WIND CAP.
7. A BLOCKED VENT SAFETY AIRFLOW SWITCH WITH HIGH TEMPERATURE SILICONE TUBING OPERATING OFF OF ABSOLUTE PRESSURE MEASURED INSIDE OF THE POWER-VENT BLOWER HOUSING.
8. A HIGH TEMPERATURE AUTO-RECYCLING LIMIT WITH A MAXIMUM NON-ADJUSTABLE SET POINT.
9. A MANUAL RESET HIGH TEMPERATURE FLAME ROLL OUT SWITCH WITH A NON-ADJUSTABLE SET POINT.
10. EACH FURNACE COMPARTMENT SHALL HAVE A REMOVABLE POST AND PANEL THAT ALLOWS THE FURNACE TO BE EASILY REMOVED FOR SERVICE AND MAINTAINABILITY.
11. A POWER-VENT ASSEMBLY FOR EXHAUSTING FLUE GASES WITH A PSC OR ECM TYPE MOTOR THAT IS SECURELY MOUNTED AND EASILY ACCESSIBLE/REMOVABLE FOR SERVICE.
12. A 0-10"W.C. GAS PRESSURE GAUGE INSTALLED ON THE GAS MANIFOLD.

2.7 FILTERS
A. PROVIDE FILTERS AS PART OF UNIT. ALL FILTERS SHALL BE FURNISHED AND INSTALLED TO MEET THE PERFORMANCE REQUIREMENTS SET FORTH IN THE SCHEDULE AND AS SPECIFIED UNDER ANOTHER SECTION OF THIS WORK.
B. ALL FILTERS SHALL BE INSTALLED ON TRACKS FOR EASY REMOVAL FROM THE UNIT.
C. UP TO 3 LAYERS OF OUTDOOR AIR FILTRATION INSTALLED. UNIT SHALL SHIP WITH A 2" WASHABLE METAL MESH OUTDOOR AIR FILTER. MIXED AIR SHALL HAVE OPTIONAL 2" MERV-8 AND MERV-13 FILTERS , 4" MERV-15 OR 4" MERV-17 HEPA FILTER BANKS FACTORY INSTALLED.
D. UNIT SHALL HAVE AN OPTIONAL ADJUSTABLE PRESSURE DIFFERENTIAL SENSOR FOR THE FILTER BANK TO ALERT IN THE EVENT OF A CLOGGED FILTER.

2.8 ELECTRICAL
A. ALL CONTROLS SHALL BE PRE-WIRED AND HOUSED IN AN INSULATED ELECTRICAL CABINET WITHIN THE UNIT TO PROTECT AGAINST RISK OF CONDENSATION.
B. ALL DIRECT FIRED AND COOLING ONLY UNITS SHALL BE PROVIDED WITH SINGLE POINT ELECTRICAL CONNECTION.
C. UNIT SHALL BE PROVIDED WITH A DOOR SAFETY SWITCH THAT DE-ENERGIZES THE SUPPLY FAN WHEN THE DOOR IS OPENED.
D. UNIT SHALL BE PROVIDED WITH A FACTORY MOUNTED AVERAGING SUPPLY AIR TEMPERATURE SENSOR TO ALLOW FOR ACCURATE DISCHARGE TEMPERATURE READINGS WITHIN UNIT WHEN A DOWNSTREAM SENSOR IS NOT INSTALLED. FIELD MOUNTED AND WIRED DISCHARGE AIR SENSORS WILL NOT BE ACCEPTED.
E. UNIT SHALL BE PROVIDED WITH A FACTORY MOUNTED AVERAGING INTAKE AIR TEMPERATURE SENSOR TO ALLOW FOR ACCURATE INTAKE TEMPERATURE READING REGARDLESS OF HOW THE OA/RA DAMPERS ARE POSITIONED.
F. THE ELECTRICAL CABINET SHALL BE OUTFITTED WITH THE FOLLOWING:
1. LED ELECTRICAL CABINET SERVICE LIGHT WITH AUTOMATIC ACTIVATION UPON DOOR SWITCH.
2. COLOR WIRING SCHEMATICS, LAMINATED TO THE INTERIOR WALL OF THE CABINET DOORS.
3. FACTORY MOUNTED DISCONNECT WITH UNIT BOTTOM KNOCKOUTS.
4. A LED BACKLIT, LCD HUMAN-MACHINE INTERFACE (HMI) SHALL BE MOUNTED WITHIN THE UNIT'S CONTROL CABINET TO ALLOW FOR ALL SET POINTS CONFIGURATION AND REFRIGERATION SYSTEM MONITORING AT THE UNIT.
5. UP TO 4 ADDITIONAL SPACE MOUNTED HMIS AVAILABLE. ADDITIONAL HMIS SHALL ALLOW FOR FULL PROGRAMMING CAPABILITIES AND ARE OUTFITTED WITH INTEGRAL TEMPERATURE AND HUMIDITY SENSORS. ADDITIONAL HMIS SHALL BE CAPABLE OF BEING INDIVIDUALLY AVERAGED FOR SPACETEMPERATURE/HUMIDITY READINGS. ALL HMIS SHALL BE WIRED USING STANDARD CAT5/6 CABLES.
6. OPTIONAL 120V, 15A UNIT POWERED OR UNPOWERED CONVENIENCE OUTLET.

G, ALL SENSORS SHALL BE WIRED BACK TO THE MAIN CONTROL BOARD THAT CONTINUOUSLY MONITORS ALL CRITICAL COMPONENTS AND MAKES DECISIONS BASED ON PRE-DETERMINED LOGIC TO ACCURATELY CONTROL THE FOLLOWING:
1. PID LOGIC TO CONTROL HEATER MODULATION ENSURING PRECISE DISCHARGE/SPACE TEMPERATURE CONTROL.
2. PID LOGIC TO CONTROL COMPRESSOR SPEED TO PROVIDE PRECISE CONTROL OVER EVAPORATIVE COIL TEMPERATURES, LEAVING DEW POINT, AND DISCHARGE/SPACE TEMPERATURES.
3. PID LOGIC FOR OUTDOOR FAN MODULATION TO MAINTAIN AN OPTIMAL OUTDOOR COIL TEMPERATURE.
4. PID LOGIC FOR ELECTRONIC EXPANSION VALVE (EEV) POSITION TO MAINTAIN A PRECISE SUPERHEAT TEMPERATURE
5. PID LOGIC FOR MODULATING REHEAT VALVE TO LIMIT SUPPLY AIR TEMPERATURE AND RELATIVE HUMIDITY BASED OFF OF SPACE OR DISCHARGE CONDITIONS.

2.9 CONTROLS
A. UNIT SHALL BE OUTFITTED WITH A CONTROL BOARD TO ALLOW FOR FULL CONTROL OF THE ENTIRE UNIT.
B. PROVIDE AIR FLOW SWITCH ON THE SUPPLY FAN SYSTEM TO SENSE AIR FLOW WITH AVAILABLE SET OF CONTACTS FOR CONNECTION TO BMS FOR AIRFLOW ALERTS.
C. ALL UNIT CONTROLS SHALL BE COMPATIBLE WITH BACNET AND LONWORKS BASED BUILDING MANAGEMENT SYSTEMS.
D. ALL UNITS SHALL BE OUTFITTED WITH CASLINK CLOUD BASED MONITORING, WHICH MONITORS EVERY POINT OF OPERATION. PROVIDES CONFIGURABLE AUTOMATED FAULT ALERT E-MAILS, AND REMOTE CONTROL CAPABILITIES.
E. INTEGRATED CELLULAR MODULE TO PROVIDE REMOTE CONNECTION TO MONITORING SERVICES TO VIEW BOTH REAL TIME AND HISTORICAL UNIT OPERATION. DATA SHALL BE STORED A MINIMUM OF 3 YEARS ON THE CLOUD. DATA SAMPLE RATE SHALL BE A MAXIMUM OF 60 SECONDS.
F. TEMPERATURE CONTROL SYSTEM
1. LOW-AMBIENT COOLING: UNIT IS FACTORY OUTFITTED WITH LOGIC ALLOWING FOR LOW-AMBIENT OPERATION OF THE DX SYSTEM DOWN TO 15F OUTDOOR TEMPERATURES PURELY THROUGH SOFTWARE UTILIZING THE STANDARD FACTORY MODULATING COMPONENTS.
2. DISCHARGE TEMP CONTROL (HEATING) UNIT MODULATES THE BURNER FLAME (CURRENT SUPPLY IN THE CASE OF ELECTRIC HEATING) TO ACCURATELY MAINTAIN THE DESIRED DISCHARGE TEMPERATURE SET POINT AND COMPENSATE FOR FLUCTUATIONS IN ENTERING AIR TEMPERATURE, AIR VOLUME AND % OF OA USING HEATING PID CONTROLS DESIGNED SPECIFICALLY FOR THE DOAS.
3. DISCHARGE TEMP CONTROL (COOLING) UNIT MODULATES THE COMPRESSOR FREQUENCY TO ACCURATELY MAINTAIN THE DESIRED DISCHARGE TEMPERATURE SET POINT AND COMPENSATE FOR FLUCTUATIONS IN ENTERING AIR TEMPERATURE, AIR VOLUME AND % OF OA USING PROPRIETARY COOLING PID CONTROLS DESIGNED SPECIFICALLY FOR THE DOAS.
4. DISCHARGE HUMIDITY CONTROL (DEHUMIDIFICATION) UNIT MODULATES THE COMPRESSOR FREQUENCY TO ACCURATELY MAINTAIN A DESIRED EVAPORATIVE COIL DEW POINT MEASURED VIA A COIL MOUNTED TEMPERATURE SENSOR BETWEEN THE EVAPORATIVE AND HOT GAS REHEAT COILS. A FULLY MODULATING HOT GAS REHEAT VALVE SHALL UTILIZE EXCESS WASTE HEAT FROM THE CONDENSING SECTION FEED THE HOT GAS REHEAT COIL WITH THE PRECISE AMOUNT OF HEAT NEEDED TO ACCURATELY REHEAT THE AIRSTREAM IN ORDER TO MAINTAIN A DESIRED DISCHARGE TEMPERATURE COMPENSATING FOR FLUCTUATIONS IN ENTERING AIR TEMPERATURE, AIR VOLUME AND % OF OA USING PROPRIETARY DEHUMIDIFICATION PID CONTROLS DESIGNED SPECIFICALLY FOR THE DOAS.
5. SPACE TEMP CONTROL (HEATING) UNIT MODULATES THE BURNER FLAME (CURRENT SUPPLY IN THE CASE OF ELECTRIC HEATING) TO ACCURATELY MAINTAIN THE DESIRED SPACE TEMPERATURE SET POINT AND COMPENSATE FOR FLUCTUATIONS IN ENTERING AIR TEMPERATURE, AIR VOLUME AND % OF OA USING HEATING PID CONTROLS DESIGNED SPECIFICALLY FOR THE DOAS. MINIMUM AND MAXIMUM DISCHARGE SET POINTS CAN BE SET TO LIMIT THE TEMPERATURE ENTERING THE SPACE. AN OPTIONAL ADDITIONAL HMI OR ROOM THERMOSTAT CAN BE USED TO DETERMINE THE SPACE TEMPERATURE. IN THE CASE THAT NO TEMPERATURE SENSOR IS AVAILABLE IN THE SPACE, THE UNIT WILL USE AN INTERNAL RETURN TEMPERATURE SENSOR.
6. SPACE TEMP CONTROL (COOLING) UNIT MODULATES THE COMPRESSOR FREQUENCY TO ACCURATELY MAINTAIN THE DESIRED SPACE TEMPERATURE SET POINT AND COMPENSATE FOR FLUCTUATIONS IN ENTERING AIR TEMPERATURE, AIR VOLUME AND % OF OA USING COOLING (HEATING WHEN IN HEAT PUMP MODE) PID CONTROLS DESIGNED SPECIFICALLY FOR THE DOAS. MINIMUM AND MAXIMUM DISCHARGE SET POINTS CAN BE SET TO LIMIT THE TEMPERATURE ENTERING THE SPACE. AN OPTIONAL ADDITIONAL HMI OR ROOM THERMOSTAT CAN BE USED TO DETERMINE THE SPACE TEMPERATURE. IN THE CASE THAT NO TEMPERATURE SENSOR IS AVAILABLE IN THE SPACE, THE UNIT WILL USE AN INTERNAL RETURN TEMPERATURE SENSOR.
7. SPACE HUMIDITY CONTROL (DEHUMIDIFICATION) UNIT MODULATES THE COMPRESSOR FREQUENCY TO ACCURATELY MAINTAIN A DESIRED EVAPORATIVE COIL DEW POINT MEASURED VIA A COIL MOUNTED TEMPERATURE SENSOR BETWEEN THE EVAPORATIVE AND HOT GAS REHEAT COILS. A FULLY MODULATING HOT GAS REHEAT VALVE SHALL UTILIZE EXCESS WASTE HEAT FROM THE CONDENSING SECTION FEED THE HOT GAS REHEAT COIL WITH THE PRECISE AMOUNT OF HEAT NEEDED TO ACCURATELY REHEAT THE AIRSTREAM IN ORDER TO MAINTAIN A DESIRED SPACE TEMPERATURE COMPENSATING FOR FLUCTUATIONS IN ENTERING AIR TEMPERATURE, AIR VOLUME AND % OF OA USING PROPRIETARY DEHUMIDIFICATION PID CONTROLS DESIGNED SPECIFICALLY FOR THE DOAS.
8. ADVANCED TOTAL UNIT ECONOMIZER: THE CONTROL SYSTEM IS OUTFITTED STANDARD, WITHOUT NEED FOR ANY ADDITIONAL HARDWARE, WITH AN ADVANCED TOTAL UNIT ECONOMIZER WHICH WILL TAKE MAXIMUM ADVANTAGE OF AS MUCH ENERGY AVAILABLE IN THE OUTDOOR AIR CONDITIONS IN ORDER TO RUN THE COMPRESSOR THE MINIMUM AMOUNT REQUIRED AT ANY GIVEN INCOMING AIR CONDITIONS. IF THE OUTDOOR ENTHALPY (TEMPERATURE AND RELATIVE HUMIDITY) PERMITS, THE UNIT WILL BE CAPABLE OF COMPLETELY MODULATING AND SHUTTING OFF COMPRESSOR TO PROVIDE "FREE" COOLING AND DEHUMIDIFICATION AS THE OUTDOOR AIR CONDITIONS ALLOW.

G. ACTIVATION CONTROLS:
1. ACTIVATE BASED ON SPACE (HEATING) UNIT WILL ACTIVATE HEATING WHEN THE SPACE TEMPERATURE DROPS BELOW THE DESIRED SET POINT.
2. ACTIVATE BASED ON SPACE (COOLING) UNIT WILL ACTIVATE COOLING WHEN THE SPACE TEMPERATURE RISES ABOVE THE DESIRED SET POINT.
3. ACTIVATE BASED ON BOTH (HEATING) UNIT WILL ACTIVATE HEATING WHEN THE SPACE AND INTAKE TEMPERATURE DROP BELOW THE DESIRED SET POINT.
4. ACTIVATE BASED ON BOTH (COOLING) UNIT WILL ACTIVATE COOLING WHEN THE SPACE AND INTAKE TEMPERATURE RISE ABOVE THE DESIRED SET POINT.
5. ACTIVATE BASED ON EITHER (HEATING) UNIT WILL ACTIVATE HEATING WHEN THE SPACE OR INTAKE TEMPERATURE DROPS BELOW THE DESIRED SET POINT.
6. ACTIVATE BASED ON EITHER (COOLING) UNIT WILL ACTIVATE COOLING WHEN THE SPACE OR INTAKE TEMPERATURE RISES ABOVE THE DESIRED SET POINT.

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	10/14/2022	ISSUED FOR BID AND PERMIT
1	11/18/2022	ADDENDUM 1
3	02/03/2023	ADDENDUM 3
4	03/10/2023	ADDENDUM 4
5	03/31/2023	ADDENDUM 5

SEAL 053111
YVETTE RICHARDSON

Seal / Signature

Project Name
VILLAGE DISTRICT

Project Number
69.6575.000

Description
MECHANICAL SPECIFICATIONS IV

Scale
NONE

M-594

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7. ACTIVATE BASED ON EITHER (DEHUMIDIFICATION) UNIT WILL ACTIVATE DEHUMIDIFICATION WHEN THE SPACE OR INTAKE SET POINT RISES ABOVE THE DESIRED SPACE OR INTAKE SET POINT, WITH ACTIVATION SET POINTS CONFIGURED TO A DEW POINT, RELATIVE HUMIDITY OR A COMBINATION OF DEW POINT/RELATIVE HUMIDITY.
8. ACTIVATE BASED ON STAT (HEATING) UNIT WILL ACTIVATE HEATING WHEN THE SPACE THERMOSTAT SENDS A 24V SIGNAL TO W AND G ON THE MAIN CONTROL BOARD. UNIT WILL MODULATE TO MAINTAIN A CONSTANT DISCHARGE HEAT SET POINT.
9. ACTIVATE BASED ON STAT (COOLING) UNIT WILL ACTIVATE COOLING WHEN THE SPACE THERMOSTAT SENDS A 24V SIGNAL TO Y AND G ON THE MAIN CONTROL BOARD. UNIT WILL MODULATE TO MAINTAIN A CONSTANT DISCHARGE COOL SET POINT.

2.10 ROOF CURB
A. UNIT SHALL BE FACTORY ASSEMBLED, AND CONSTRUCTED OF 18GA GALVANIZED STEEL, WITH OPTIONAL 16GA AVAILABLE.
B. CURB SHALL BE FULLY INSULATED WITH 1" ACOUSTICAL AND THERMAL INSULATION.
C. CURB SHALL BE FACTORY OUTFITTED WITH DUCT SUPPORT HANGERS.

2.11 VARIABLE FREQUENCY DRIVES
A. PROVIDE VARIABLE FREQUENCY DRIVE FOR THE COMPRESSOR AS PART OF THE AC UNIT. VFD SHALL BE FURNISHED AND INSTALLED TO MEET THE PERFORMANCE SET FORTH IN THE SCHEDULE AND AS SPECIFIED UNDER ANOTHER SECTION OF THIS WORK.
1. ACCESSORIES TO BE FURNISHED AND MOUNTED BY THE DRIVE MANUFACTURER AND CONTAINED IN A SINGLE ENCLOSURE. (THE USE OF MORE THAN ONE ENCLOSURE IS NOT ACCEPTABLE).
B. PROVIDE VARIABLE FREQUENCY DRIVE FOR SPEED CONTROL ON ALL NON-ECM DIRECT DRIVE SUPPLY FANS.
C. ALL VFDS SHALL PROVIDE THE FOLLOWING INHERENT PROTECTIONS:
1. PHASE PROTECTION
2. BROWNOUT PROTECTION
3. OVERLOAD/OVERHEAT PROTECTION
4. SOFT STARTS TO PROTECT BEARINGS/HARDWARE.
5. LOW & HIGH VOLTAGE & OVER-TORQUE PROTECTIONS.

PART 3 - EXECUTION
3.1 EXAMINATION
A. EXAMINE AREAS AND CONDITIONS UNDER WHICH PACKAGED UNITS ARE TO BE INSTALLED. DO NOT PROCEED WITH WORK UNTIL UNSATISFACTORY CONDITIONS HAVE BEEN CORRECTED IN MANNER ACCEPTABLE TO INSTALLER.
3.2 INSTALLATION
A. INSTALL IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS, DRAWINGS, WRITTEN SPECIFICATIONS, MANUFACTURER'S INSTALLATION MANUAL AND ALL APPLICABLE BUILDING CODES.
3.3 CONNECTIONS
A. PIPING INSTALLATION REQUIREMENTS ARE SPECIFIED IN OTHER DIVISION 23 SECTIONS. DRAWINGS INDICATE THE GENERAL ARRANGEMENT OF PIPING, FITTINGS, AND SPECIALTIES. INSTALL PIPING TO ALLOW SERVICE AND MAINTENANCE.
B. DUCT INSTALLATION REQUIREMENTS ARE SPECIFIED IN OTHER DIVISION 23 SECTIONS. DRAWINGS INDICATE THE GENERAL ARRANGEMENT OF DUCTS.
C. ELECTRICAL: CONFORM TO APPLICABLE REQUIREMENTS IN DIVISION 26 SECTIONS.
3.4 SYSTEM START-UP
A. SYSTEM START UP IS PERFORMED BY A FACTORY TRAINED SERVICE TECHNICIAN

SECTION 237513 - PACKAGED ROOFTOP UNITS

PART 1 - GENERAL
1.1 DESCRIPTION OF WORK
A. OUTDOOR, ROOF CURB MOUNTED, ELECTRONICALLY CONTROLLED, HEATING AND COOLING UNIT UTILIZING HERMETIC SCROLL COMPRESSOR(S) FOR COOLING DUTY AND GAS COMBUSTION FOR HEATING DUTY. UNITS SHALL DISCHARGE SUPPLY AIR VERTICALLY OR HORIZONTALLY AS SHOWN ON CONTRACT DRAWINGS.
B. OUTDOOR, ROOF CURB MOUNTED, AIR-TO-AIR HEAT PUMP UNIT UTILIZING A HERMETIC SCROLL COMPRESSOR FOR COOLING DUTY AND GAS COMBUSTION FOR HEATING DUTY. UNITS SHALL DISCHARGE SUPPLY AIR VERTICALLY OR HORIZONTALLY AS SHOWN ON CONTRACT DRAWINGS.
1.2 RELATED SECTIONS
A. SECTION 233113 - SHEET METAL WORK.
B. DIVISION 26.
1.3 SUBMITTALS
A. SHOP DRAWINGS: SUBMIT DRAWINGS FOR EACH SIZE OF FACTORY FABRICATED ROOF CURB
B. PRODUCT DATA: MANUFACTURER'S CATALOG SHEETS, BROCHURES, PERFORMANCE CHARTS, STANDARD SCHEMATIC DRAWINGS, SPECIFICATIONS AND INSTALLATION INSTRUCTIONS FOR EACH SIZE UNIT.
C. CONTRACT CLOSEOUT SUBMITTALS - OPERATION AND MAINTENANCE DATA: DELIVER 2 COPIES, COVERING THE INSTALLED PRODUCTS, TO THE DIRECTOR'S REPRESENTATIVE.
1.4 QUALITY ASSURANCE
A. REGULATORY REQUIREMENTS:
1. UNIT SHALL BE FACTORY TESTED AND THE DESIGN, CONSTRUCTION AND INSTALLATION SHALL BE IN ACCORDANCE WITH THE FOLLOWING: AHRI STANDARDS 210/240 AND 340/360, NFPA, UL, ASHRAE 15, SAFETY CODE FOR MECHANICAL REFRIGERATION, AND ALL STATE AND LOCAL CODES OR REGULATIONS HAVING JURISDICTION.
2. UNIT SHALL BE LISTED BY ETL AS A TOTAL PACKAGE.
3. RATE COOLING CAPACITIES IN ACCORDANCE WITH ARI STANDARD 210.
4. ELECTRICAL COMPONENTS SHALL BE UL LISTED.
5. GAS HEAT EQUIPPED UNITS SHALL BE DESIGNED TO CONFORM WITH ANSI STANDARD Z21.47, GAS-FIRED CENTRAL FURNACES.
6. ROOF CURB SHALL BE DESIGNED TO NRCA CRITERIA PER BULLETIN B-1986.
7. INSULATION AND ADHESIVE SHALL MEET NFPA 90A REQUIREMENTS FOR FLAME SPREAD AND SMOKE GENERATION.
8. UNIT SHALL MEET ASHRAE 90.1 MINIMUM EFFICIENCY REQUIREMENTS.
9. 3 PHASE UNITS SHALL BE ENERGY STAR CERTIFIED.
1.5 PRODUCT DELIVERY
A. UNIT SHALL BE STORED AND HANDLED PER MANUFACTURER'S RECOMMENDATIONS.
B. UNIT SHALL ONLY BE STORED OR POSITIONED IN THE UPRIGHT POSITION.
C. DELIVER EACH UNIT AS AN INTEGRAL FACTORY PACKAGED ASSEMBLY.
1.6 MAINTENANCE
A. MAINTENANCE SERVICE: A FULLY EQUIPPED AUTHORIZED SERVICE ORGANIZATION CAPABLE OF GUARANTEEING RESPONSE WITHIN 8 HOURS TO SERVICE CALLS SHALL BE AVAILABLE 24 HOURS A DAY, 7 DAYS A WEEK TOSERVICE THE COMPLETED WORK.
B. EXTRA MATERIALS: PROVIDE WITH EACH UNIT, ONE SPARE SET OF AIR FILTERS. SUITABLE BOX AND LABEL SPARE FILTERS AS TO THEIR USAGE.

PART 2 - PRODUCTS
2.1 GENERAL
A. OUTDOOR, ROOFTOP MOUNTED, ELECTRICALLY CONTROLLED, HEATING AND COOLING UNIT UTILIZING A FULLY HERMETIC SCROLL COMPRESSOR(S) FOR COOLING DUTY AND GAS COMBUSTION FOR HEATING DUTY.
B. FACTORY ASSEMBLED, SINGLE-PIECE HEATING AND COOLING ROOFTOP UNIT. CONTAINED WITHIN THE UNIT ENCLOSURE SHALL BE ALL FACTORY WIRING, PIPING, CONTROLS, AND SPECIAL FEATURES REQUIRED PRIOR TO FIELD START-UP.
C. UNIT SHALL USE ENVIRONMENTALLY SOUND, PURONR REFRIGERANT.
D. UNIT SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.
E. UNIT MUST BE SELECTED AND INSTALLED IN COMPLIANCE WITH LOCAL, STATE, AND FEDERAL CODES.
2.2 QUALITY ASSURANCE
A. UNIT MEETS ASHRAE 90.1 MINIMUM EFFICIENCY REQUIREMENTS.
B. 3-PHASE UNITS ARE ENERGY STAR CERTIFIED.
C. UNIT SHALL BE RATED IN ACCORDANCE WITH AHRI STANDARDS 340/360.
D. UNIT SHALL BE DESIGNED TO CONFORM TO ASHRAE 15, 2001.
E. UNIT SHALL BE UL-TESTED AND CERTIFIED IN ACCORDANCE WITH ANSI Z21.47 STANDARDS AND UL-LISTED AND CERTIFIED UNDER CANADIAN STANDARDS AS A TOTAL PACKAGE FOR SAFETY REQUIREMENTS.
F. INSULATION AND ADHESIVE SHALL MEET NFPA 90A REQUIREMENTS FOR FLAME SPREAD AND SMOKE GENERATION.
G. UNIT CASING SHALL BE CAPABLE OF WITHSTANDING 500-HOUR SALT SPRAY EXPOSURE PER ASTM B117 (SCRIBED SPECIMEN).
H. UNIT CASING SHALL BE CAPABLE OF WITHSTANDING FEDERAL TEST METHOD STANDARD NO. 141 (METHOD 6061) 5000-HOUR SALT SPRAY.
I. UNIT SHALL BE DESIGNED IN ACCORDANCE WITH ISO 9001, AND SHALL BE MANUFACTURED IN A FACILITY REGISTERED BY ISO 9001.
J. ROOF CURB SHALL BE DESIGNED TO CONFORM TO NRCA STANDARDS.
K. UNIT SHALL BE SUBJECTED TO A COMPLETELY AUTOMATED RUN TEST ON THE ASSEMBLY LINE. THE DATA FOR EACH UNIT WILL BE STORED AT THE FACTORY, AND MUST BE AVAILABLE UPON REQUEST.
L. UNIT SHALL BE DESIGNED IN ACCORDANCE WITH UL STANDARD 1995, INCLUDING TESTED TO WITHSTAND RAIN.
M. UNIT SHALL BE CONSTRUCTED TO PREVENT INTRUSION OF SNOW AND TESTED TO PREVENT SNOW INTRUSION INTO THE CONTROL BOX UP TO 40 MPH.
N. UNIT SHAKE TESTED TO ASSURANCE LEVEL 1, ASTM D4169 TO ENSURE SHIPPING RELIABILITY.
O. HIGH EFFICIENT MOTORS LISTED SHALL MEET SECTION 313 OF THE ENERGY INDEPENDENCE AND SECURITY ACT OF 2007 (EISA 2007).
2.3 DELIVERY, STORAGE, AND HANDLING
A. UNIT SHALL BE STORED AND HANDLED PER MANUFACTURER'S RECOMMENDATIONS.
B. LIFTED BY CRANE REQUIRES EITHER SHIPPING TOP PANEL OR SPREADER BARS.
C. UNIT SHALL ONLY BE STORED OR POSITIONED IN THE UPRIGHT POSITION.
2.4 PROJECT CONDITIONS
A. AS SPECIFIED IN THE CONTRACT.
2.5 OPERATING CHARACTERISTICS
A. UNIT SHALL BE CAPABLE OF STARTING AND RUNNING AT 125° F (52° C) AMBIENT OUTDOOR TEMPERATURE, MEETING MAXIMUM LOAD CRITERIA OF AHRI STANDARD 210/240 OR 340/360 AT ± 10% VOLTAGE.
B. COMPRESSOR WITH STANDARD CONTROLS SHALL BE CAPABLE OF OPERATION DOWN TO 35° F (2° C), AMBIENT OUTDOOR TEMPERATURES. ACCESSORY LOW AMBIENT KITS SHALL BE AVAILABLE IF OPERATION BELOW 35° F (2° C), IS REQUIRED. SEE BELOW FOR HEAD PRESSURE CONTROL PACKAGE OR WINTER START KIT.
C. UNIT SHALL DISCHARGE SUPPLY AIR VERTICALLY OR HORIZONTALLY AS SHOWN ON CONTRACT DRAWINGS.
D. UNIT SHALL BE FACTORY CONFIGURED FOR VERTICAL SUPPLY & RETURN CONFIGURATIONS.
E. UNIT SHALL BE FIELD CONVERTIBLE FROM VERTICAL SUPPLY TO HORIZONTAL SUPPLY AIRFLOW ON ALL MODELS. NO SPECIAL KIT REQUIRED.
F. UNIT SHALL BE CAPABLE OF MIXED OPERATION: HORIZONTAL SUPPLY WITH VERTICAL RETURN.
2.6 ELECTRICAL REQUIREMENTS
A. MAIN POWER SUPPLY VOLTAGE, PHASE, AND FREQUENCY MUST MATCH THOSE REQUIRED BY THE MANUFACTURER.
2.7 CABINET
A. UNIT CABINET SHALL BE CONSTRUCTED OF GALVANIZED STEEL, AND SHALL BE BONDERIZED AND COATED WITH A PRE-PAINTED BAKED ENAMEL FINISH ON ALL EXTERNALLY EXPOSED SURFACES.
B. UNIT CABINET EXTERIOR PAINT SHALL BE: FILM THICKNESS, (DRY) 0.003 INCHES MINIMUM, GLOSS (PER ASTM D523, 60° F / 16° C): 60, HARDNESS: H-2H PENCIL HARDNESS.
B. EVAPORATOR FAN COMPARTMENT INTERIOR CABINET INSULATION SHALL CONFORM TO AHRI STANDARDS 340/360 MINIMUM EXTERIOR SWEAT CRITERIA. INTERIOR SURFACES SHALL BE INSULATED WITH A MINIMUM 1/2-IN. THICK, 1 LB DENSITY, FLEXIBLE FIBERGLASS INSULATION, NEOPRENE COATED ON THE AIR SIDE. ALUMINUM FOIL-FACED FIBERGLASS INSULATION SHALL BE USED IN THE GAS HEAT COMPARTMENT.
C. BASE OF UNIT SHALL HAVE A MINIMUM OF FOUR LOCATIONS FOR THRU-THE-BASE GAS AND ELECTRICAL CONNECTIONS (FACTORY INSTALLED OR FIELD INSTALLED), STANDARD.
D. BASE RAIL
1. UNIT SHALL HAVE BASE RAILS ON A MINIMUM OF 4 SIDES.
2. HOLES SHALL BE PROVIDED IN THE BASE RAILS FOR RIGGING SHACKLES TO FACILITATE MANEUVERING AND OVERHEAD RIGGING.
3. HOLES SHALL BE PROVIDED IN THE BASE RAIL FOR MOVING THE ROOFTOP BY FORK TRUCK.
4. BASE RAIL SHALL BE A MINIMUM OF 16 GAUGE THICKNESS.
F. CONDENSATE PAN AND CONNECTIONS:
1. SHALL BE AN INTERNALLY SLOPED CONDENSATE DRAIN PAN MADE OF A NON-CORROSIVE MATERIAL.
2. SHALL COMPLY WITH ASHRAE STANDARD 62.
3. SHALL USE A 3/4-IN. -14 NPT DRAIN CONNECTION, POSSIBLE EITHER THROUGH THE BOTTOM OR SIDE OF THE DRAIN PAN. CONNECTION SHALL BE MADE PER MANUFACTURER'S RECOMMENDATIONS.
G. TOP PANEL:
H. GAS CONNECTIONS:
1. ALL GAS PIPING CONNECTING TO UNIT GAS VALVE SHALL ENTER THE UNIT CABINET AT A SINGLE LOCATION ON SIDE OF UNIT (HORIZONTAL PLANE).
2. THRU-THE-BASE CAPABILITY
a. STANDARD UNIT SHALL HAVE A THRU-THE-BASE GAS-LINE LOCATION USING A RAISED, EMBOSSED PORTION OF THE UNIT BASEPAN.
b. OPTIONAL, FACTORY-APPROVED, WATER-TIGHT CONNECTION METHOD MUST BE USED FOR THRU-THE-BASE GAS CONNECTIONS.
c. NO BASEPAN PENETRATION, OTHER THAN THOSE AUTHORIZED BY THE MANUFACTURER, IS PERMITTED.
I. ELECTRICAL CONNECTIONS
1. ALL UNIT POWER WIRING SHALL ENTER UNIT CABINET AT A SINGLE, FACTORY-PREPARED, KNOCKOUT LOCATION.
2. THRU-THE-BASE CAPABILITY.
a. STANDARD UNIT SHALL HAVE A THRU-THE-BASE ELECTRICAL LOCATION (S) USING A RAISED, EMBOSSED PORTION OF THE UNIT BASEPAN.
b. OPTIONAL, FACTORY-APPROVED, WATER-TIGHT CONNECTION METHOD MUST BE USED FOR THRU-THE-BASE ELECTRICAL CONNECTIONS.
c. NO BASEPAN PENETRATION, OTHER THAN THOSE AUTHORIZED BY THE MANUFACTURER, IS PERMITTED.
J. COMPONENT ACCESS PANELS (STANDARD)
1. CABINET PANELS SHALL BE EASILY REMOVABLE FOR SERVICING.
2. UNIT SHALL HAVE ONE FACTORY INSTALLED, TOOL-LESS, REMOVABLE, FILTER ACCESS PANEL.
3. PANELS COVERING CONTROL BOX, INDOOR FAN, INDOOR FAN MOTOR, GAS COMPONENTS (WHERE APPLICABLE), AND COMPRESSORS SHALL HAVE A MOLDED COMPOSITE HANDLES.
4. HANDLES SHALL BE UV MODIFIED, COMPOSITE. THEY SHALL BE PERMANENTLY ATTACHED, AND RECESSED INTO THE PANEL.
5. SCREWS ON THE VERTICAL PORTION OF ALL REMOVABLE ACCESS PANEL SHALL ENGAGE INTO HEAT RESISTANT, MOLDED COMPOSITE COLLARS.
6. COLLARS SHALL BE REMOVABLE AND EASILY REPLACEABLE USING MANUFACTURER RECOMMENDED PARTS.
2.8 GAS HEAT
A. GENERAL
1. HEAT EXCHANGER SHALL BE AN INDUCED DRAFT DESIGN. POSITIVE PRESSURE HEAT EXCHANGER DESIGNS SHALL NOT BE ALLOWED.
2. SHALL INCORPORATE A DIRECT-SPARK IGNITION SYSTEM AND REDUNDANT MAIN GAS VALVE.
3. GAS SUPPLY PRESSURE AT THE INLET TO THE ROOFTOP UNIT GAS VALVE MUST MATCH THAT REQUIRED BY THE MANUFACTURER.
B. THE HEAT EXCHANGER SHALL BE CONTROLLED BY AN INTEGRATED GAS CONTROLLER (IGC) MICROPROCESSOR.
1. IGC BOARD SHALL NOTIFY USERS OF FAULT USING AN LED (LIGHT-EMITTING DIODE).
2. THE LED SHALL BE VISIBLE WITHOUT REMOVING THE CONTROL BOX ACCESS PANEL.
3. IGC BOARD SHALL CONTAIN ALGORITHMS THAT MODIFY EVAPORATOR-FAN OPERATION TO PREVENT FUTURE CYCLING ON HIGH TEMPERATURE LIMIT SWITCH.
UNIT SHALL BE EQUIPPED WITH ANTI-CYCLE PROTECTION WITH ONE SHORT CYCLE ON UNIT FLAMEROLLOUT SWITCH OR 4 CONTINUOUS SHORT CYCLES ON THE HIGH TEMPERATURE LIMIT SWITCH. FAULT INDICATION SHALL BE MADE USING AN LED.
C. STANDARD HEAT EXCHANGER CONSTRUCTION
1. HEAT EXCHANGER SHALL BE OF THE TUBULAR-SECTION TYPE CONSTRUCTED OF A MINIMUM OF 20-GAUGE STEEL COATED WITH A NOMINAL 1.2 MIL ALUMINUM-SILICONE ALLOY FOR CORROSION RESISTANCE.
2. BURNERS SHALL BE OF THE IN-SHOT TYPE CONSTRUCTED OF ALUMINUM-COATED STEEL.
3. BURNERS SHALL INCORPORATE ORIFICES FOR RATED HEAT OUTPUT UP TO 2000 FT (610M) ELEVATION. ADDITIONAL ACCESSORY KITS MAY BE REQUIRED FOR APPLICATIONS ABOVE 2000 FT (610M) ELEVATION, DEPENDING ON LOCAL GAS SUPPLY CONDITIONS.
4. EACH HEAT EXCHANGER TUBE SHALL CONTAIN MULTIPLE DIMPLES FOR INCREASED HEATING EFFECTIVENESS.
D. INDUCED DRAFT COMBUSTION MOTOR AND BLOWER
1. SHALL BE A DIRECT-DRIVE, SINGLE INLET, FORWARD-CURVED CENTRIFUGAL TYPE.
2. SHALL BE MADE FROM STEEL WITH A CORROSION-RESISTANT FINISH.
3. SHALL HAVE PERMANENTLY LUBRICATED SEALED BEARINGS.
4. SHALL HAVE INHERENT THERMAL OVERLOAD PROTECTION.
5. SHALL HAVE AN AUTOMATIC RESET FEATURE.
2.9 COILS
A. STANDARD ALUMINUM FIN/COPPER TUBE COILS:
1. STANDARD EVAPORATOR AND CONDENSER COILS SHALL HAVE ALUMINUM LANCED PLATE FINS MECHANICALLY BONDED TO SEAMLESS INTERNALLY GROOVED COPPER TUBES WITH ALL JOINTS BRAZED.
2. EVAPORATOR COILS SHALL BE LEAK TESTED TO 150 PSIG, PRESSURE TESTED TO 450 PSIG, AND QUALIFIED TO UL 1995 BURST TEST AT 1775 PSIG.
3. CONDENSER COILS SHALL BE LEAK TESTED TO 150 PSIG, PRESSURE TESTED TO 650 PSIG, AND QUALIFIED TO UL 1995 BURST TEST AT 1980 PSIG.
2.10 REFRIGERANT COMPONENTS
A. REFRIGERANT CIRCUIT SHALL INCLUDE THE FOLLOWING CONTROL, SAFETY, AND MAINTENANCE FEATURES:
1. THERMOSTATIC EXPANSION VALVE (TXV) SHALL HELP PROVIDE OPTIMUM PERFORMANCE ACROSS THE ENTIRE OPERATING RANGE. SHALL CONTAIN REMOVABLE POWER ELEMENT TO ALLOW CHANGE OUT OF POWER ELEMENT AND BULB WITHOUT REMOVING THE VALVE BODY.
2. REFRIGERANT FILTER DRIER - SOLID CORE DESIGN.
3. SERVICE GAUGE CONNECTIONS ON SUCTION AND DISCHARGE LINES.
4. PRESSURE GAUGE ACCESS THROUGH A SPECIALLY DESIGNED ACCESS PORT IN THE TOP PANEL OF THE UNIT.
B. COMPRESSORS
1. UNIT SHALL USE FULLY HERMETIC, SCROLL COMPRESSOR FOR EACH INDEPENDENT REFRIGERATION CIRCUIT.
2. MODELS SHALL BE AVAILABLE WITH TWO COMPRESSOR/TWO STAGE COOLING DESIGN.
3. COMPRESSOR MOTORS SHALL BE COOLED BY REFRIGERANT GAS PASSING THROUGH MOTOR WINDINGS.
4. COMPRESSORS SHALL BE INTERNALLY PROTECTED FROM HIGH DISCHARGE TEMPERATURE CONDITIONS.
5. COMPRESSORS SHALL BE PROTECTED FROM AN OVER-TEMPERATURE AND OVER-AMPERAGE CONDITIONS BY AN INTERNAL, MOTOR OVERLOAD DEVICE.
6. COMPRESSOR SHALL BE FACTORY MOUNTED ON RUBBER GROMMETS.
7. COMPRESSOR MOTORS SHALL HAVE INTERNAL LINE BREAK THERMAL, CURRENT OVERLOAD AND HIGH PRESSURE DIFFERENTIAL PROTECTION.
8. CRANKCASE HEATERS SHALL NOT BE REQUIRED FOR NORMAL OPERATING RANGE, UNLESS PROVIDED BY THE FACTORY.
2.11 FILTER SECTION
A. FILTERS ACCESS IS SPECIFIED IN THE UNIT CABINET SECTION OF THIS SPECIFICATION.
B. FILTERS SHALL BE HELD IN PLACE BY A PIVOTING FILTER TRAY, FACILITATING EASY REMOVAL AND INSTALLATION.
C. SHALL CONSIST OF FACTORY-INSTALLED, LOW VELOCITY, THROW-AWAY 2-IN. THICK FIBERGLASS FILTERS.
D. FILTERS SHALL BE STANDARD, COMMERCIALLY AVAILABLE SIZES.
E. ONLY ONE SIZE FILTER PER UNIT IS ALLOWED.
2.12 EVAPORATOR FAN AND MOTOR
A. EVAPORATOR FAN MOTOR:
1. SHALL HAVE PERMANENTLY LUBRICATED BEARINGS.
2. SHALL HAVE INHERENT AUTOMATIC-RESET THERMAL OVERLOAD PROTECTION OR CIRCUIT BREAKER.
3. SHALL HAVE A MAXIMUM CONTINUOUS BHP RATING FOR CONTINUOUS DUTY OPERATION; NO SAFETY FACTORS ABOVE THAT RATING SHALL BE REQUIRED.
B. BELT-DRIVEN EVAPORATOR FAN:
1. BELT DRIVE SHALL INCLUDE AN ADJUSTABLE-PITCH MOTOR PULLEY.
2. SHALL USE SEALED, PERMANENTLY LUBRICATED BALL-BEARING TYPE.
3. BLOWER FAN SHALL BE DOUBLE-INLET TYPE WITH FORWARD-CURVED BLADES.
4. SHALL BE CONSTRUCTED FROM STEEL WITH A CORROSION RESISTANT FINISH AND DYNAMICALLY BALANCED.
5. STANDARD ON ALL 07-14 SIZE MODELS. OPTIONAL ON ALL 04-06 3-PHASE MODELS.
2.13 CONDENSER FANS AND MOTORS
A. CONDENSER FAN MOTORS:
1. SHALL BE A TOTALLY ENCLOSED MOTOR.
2. SHALL USE PERMANENTLY LUBRICATED BEARINGS.
3. SHALL HAVE INHERENT THERMAL OVERLOAD PROTECTION WITH AN AUTOMATIC RESET FEATURE.
4. SHALL USE A SHAFT-UP DESIGN WITH RAIN SHIELD.
B. CONDENSER FANS:
1. SHALL BE A DIRECT-DRIVEN PROPELLER TYPE FAN.
2. SHALL HAVE ALUMINUM BLADES RIVETED TO CORROSION-RESISTANT STEEL SPIDERS AND SHALL BE DYNAMICALLY BALANCED.
2.14 SPECIAL FEATURES OPTIONS AND ACCESSORIES
A. ENERGYX AND ECONOMIZER
1. SYSTEM DESCRIPTION
a. ONE-PIECE ENERGYX (ENERGY RECOVERY VENTILATION) UNIT IS AN ELECTRICALLY CONTROLLED VENTILATION AIR PRE-CONDITIONER UTILIZING AN ARI 1060 CERTIFIED ENERGY RECOVERY CASSETTE TO REDUCE THE COOLING AND HEATING LOADS PLACED ON THE PRIMARY HVAC UNIT BY UNTREATED OUTDOOR AIR. BUILDING EXHAUST AIR SHALL BE INTRODUCED TO THE ENERGYX UNIT THROUGH DUCTWORK. UNIT SHALL BE DESIGNED AS A FACTORY-INSTALLED OPTION TO BE USED WITH WEATHERMASTER 48HC UNITS FOR USE IN VERTICAL RETURN APPLICATIONS ONLY.
2. QUALITY ASSURANCE
a. UNIT SHALL BE DESIGNED IN ACCORDANCE WITH UL STANDARD 1995
b. ENERGY RECOVERY UNIT SHALL BE ETL TESTED AND CERTIFIED.
c. ROOFTOP UNIT AND ENERGY RECOVERY UNIT SHALL BE ETL CERTIFIED AS ONE SINGLE SYSTEM.
d. ROOF CURB OR CURB EXTENSION SHALL BE DESIGNED TO CONFORM TO NRCA STANDARDS.
e, INSULATION AND ADHESIVE SHALL MEET NFPA 90A REQUIREMENTS FOR FLAME SPREAD AND SMOKE GENERATION.
f. UNIT CASING SHALL BE CAPABLE OF WITHSTANDING ASTM NO. 141 (METHOD 6061) 500-HOUR SALT SPRAY TEST.
g. UNIT SHALL CONTAIN ARI 1060 CERTIFIED ENERGY RECOVERY CASSETTE.
h. UNIT SHALL LEAKAGE RATES SHALL BE CAPABLE OF MEETING ASHRAE STANDARD 62.1 REQUIREMENTS FOR USE OF CLASS-2 EXHAUST WITH CLASS-1 VENTILATION AIR.
B. PRODUCTS
1. EQUIPMENT (STANDARD)
a. GENERAL
I) THE ENERGYX UNIT SHALL BE A FACTORY ASSEMBLED, SINGLE PIECE UNIT. CONTAINED WITHIN THE UNIT ENCLOSURE SHALL BE ALL FACTORY WIRING WITH A SINGLE, PRE-DETERMINED POINT OF POWER INPUT AND A SINGLE POINT OF 24-VOLT CONTROL WIRING.
2. UNIT CABINET
a. UNIT CABINET SHALL BE CONSTRUCTED OF GALVANIZED STEEL COATED WITH A PRE-PAINTED BAKED ENAMEL FINISH.
b. ALL MODELS SHALL HAVE HOODS INSTALLED OVER OUTSIDE AIR INTAKE AND EXHAUST OPENINGS. OUTSIDE AIR HOOD SHALL HAVE ALUMINUM WATER ENTRAINMENT FILTERS.
c. ALL MODELS HAVE 1-IN., 2 POUND DENSITY FIBERGLASS INSULATION.
d. HINGED ACCESS DOORS WITH COMPRESSION LATCHES SHALL BE PROVIDED ON ALL UNITS FOR ACCESS TO FANS AND FILTERS. HINGED DOORS SHALL BE PROVIDED WITH AT LEAST ONE HANDLE CAPABLE OF BEING LOCKED.
e. EXHAUST AIR STREAM SHALL HAVE BACK-DRAFT DAMPERS TO PREVENT AIR PENETRATION DURING OFF CYCLES.
f. HOLES SHALL BE PROVIDED IN THE BASE RAILS FOR RIGGING SHACKLES TO FACILITATE OVERHEAD RIGGING.
3. BLOWERS
a. BLOWERS SHALL BE DIRECT DRIVE WITH VARIABLE SPEED MOTORS.
b. BLOWER WHEEL SHALL BE MADE OF STEEL WITH A CORROSION RESISTANT FINISH. IT SHALL BE DYNAMICALLY BALANCED, DOUBLE-INLET TYPE WITH BACKWARD-CURVED BLADES.
c. BLOWER SHALL BE MOUNTED ON NEOPRENE VIBRATION ISOLATION PADS.
d. MOTOR SHALL BE HIGH EFFICIENCY AND HAVE THERMAL OVERLOAD PROTECTION.
4. FILTER SECTION
a. STANDARD FILTER SECTION SHALL ACCEPT COMMERCIALLY AVAILABLE, 2-IN. PLEATED FILTER(S).
5. CONTROLS AND SAFETIES
a. THE ENERGYX UNIT SHALL OPERATE IN CONJUNCTION WITH ROOFTOP UNIT FAN.
6. ELECTRICAL REQUIREMENTS
a. ALL UNIT POWER WIRING SHALL ENTER UNIT CABINET AT A SINGLE LOCATION.
7. ENERGY RECOVERY CASSETTE
a. THE ENERGY RECOVERY MEDIA SHALL HAVE A MINIMUM OF 70% EFFECTIVENESS AT NOMINAL UNIT AIRFLOW.
b. ENERGY WHEEL PERFORMANCE SHALL BE ARI STANDARD 1060 CERTIFIED AND BEAR THE ARI CERTIFIED PRODUCT SEAL.
c. THE ENERGY RECOVERY CASSETTE SHALL BE AN UL RECOGNIZED COMPONENT FOR ELECTRICAL AND FIRE SAFETY.
d. THE WHEEL SHALL BE COATED WITH SILICA GEL DESICCANT, PERMANENTLY BONDED WITHOUT THE USE OF BINDERS OR ADHESIVES.
e. COATED WHEELS SHALL BE WASHABLE WITH DETERGENT OR ALKALINE COIL CLEANER AND WATER.
f. THE SILICA GEL SHALL NOT DISSOLVE OR DELIQUESCE IN THE PRESENCE OF WATER OR HIGH HUMIDITY.
g. THE SUBSTRATE SHALL BE MADE OF A LIGHTWEIGHT POLYMER AND SHALL NOT DEGRADE OR REQUIRE ADDITIONAL COATINGS FOR APPLICATION IN COASTAL ENVIRONMENTS.
h. THE WHEEL POLYMER LAYERS SHALL BE WOUND CONTINUOUSLY WITH ONE FLAT AND ONE STRUCTURED LAYER IN AN IDEAL PARALLEL PLATE GEOMETRY PROVIDING LAMINAR FLOW AND MINIMUM PRESSURE DROP.
i. THE POLYMER LAYERS SHALL BE CAPTURED IN A STAINLESS STEEL WHEEL FRAME OR ALUMINUM AND STAINLESS STEEL SEGMENT FRAMES THAT PROVIDE A RIGID AND SELF-SUPPORTING MATRIX.
j. ENERGY RECOVERY WHEELS GREATER THAN 19 INCHES IN DIAMETER SHALL BE PROVIDED WITH REMOVABLE WHEEL SEGMENTS.
k. WHEEL FRAME SHALL BE A WELDED HUB, SPOKE AND RIM ASSEMBLY OF STAINLESS, PLATED, AND OR COATED STEEL AND SHALL BE SELF SUPPORTING WITHOUT THE WHEEL SEGMENTS IN PLACE.
l. WHEEL SEGMENTS SHALL BE REMOVABLE WITHOUT THE USE OF TOOLS TO FACILITATE MAINTENANCE AND CLEANING.
WHEEL RIM SHALL BE CONTINUOUS ROLLED STAINLESS STEEL AND THE WHEEL SHALL BE CONNECTED TO THE SHAFT BY MEANS OF TAPER LOCKS.
n. WHEEL BEARINGS SHALL PROVIDE AN L-10 LIFE OF 400,000 HOURS.
o. DRIVE BELTS OF STRETCH URETHANE SHALL BE PROVIDED FOR WHEEL RIM DRIVE WITHOUT THE NEED FOR EXTERNAL TENSIONERS OR ADJUSTMENT.
C. SPECIAL FEATURES (OPTIONS AND ACCESSORIES)
1. SUPPLY AND EXHAUST AIR FROST CONTROL OPTION
a. FACTORY-INSTALLED FROST PROTECTION MODULE SHALL SENSE PRESSURE DIFFERENTIAL ACROSS THE ENERGY RECOVERY CASSETTE.
b. SUPPLY BLOWER SHALL BE SHUT-OFF IF THE PRESSURE DIFFERENTIAL ACROSS THE ENERGY RECOVERY CASSETTE EXCEEDS AN ADJUSTABLE SET POINT. BLOWER SHALL REMAIN OFF FOR AN ADJUSTABLE TIME PERIOD.
c. EXHAUST BLOWER AND WHEEL SHALL REMAIN IN OPERATION IN ORDER TO REMOVE ANY FROST BUILD-UP ON THE WHEEL.
2. ENERGYX FREE COOLING WITH ENTHALPY AND STOP/JOG CONTROL
a. AN ENTHALPY SENSOR SHALL PREVENT THE WHEEL FROM ROTATING IF THE OUTSIDE AIR CONDITIONS ARE ACCEPTABLE FOR FREE COOLING. BOTH EXHAUST AND SUPPLY BLOWERS WILL REMAIN ON.
b. STOP-JOG-CONTROL SHALL ENERGIZE THE WHEEL PERIODICALLY DURING THE FREE COOLING OPERATION OF THE ENERGYX TO PREVENT DIRT BUILD-UP ON THE WHEEL.
3. ECONOMIZER OPTION
a. THE ECONOMIZER SHALL BE INTEGRATED IN THE ENERGY RECOVERY MODULE AND SHALL ALLOW AIR TO BYPASS THE ENERGY RECOVERY WHEEL FOR FREE COOLING AND FAIL SAFE OPERATION. TILTING WHEEL MECHANISMS SHALL NOT BE ALLOWED.
b. THE ECONOMIZER DAMPER SHALL BE MOTORIZED WITH FACTORY INSTALLED, 24-VOLT BELIMO ACTUATOR.
c. THE ENERGYX SHALL BE CAPABLE OF USING THE ECONOMIZER IN A FREE COOLING OPERATION.
d. THE ECONOMIZER SHALL UTILIZE ENTHALPY SENSOR CONTROLS WHEN IN THE ECONOMIZER MODE.
4. ROOF CURB EXTENSION (HC04-14 SIZES WITH ENERGYX) ACCESSORY FOR USE WITH ENERGYX UNITS
a. THE ENERGY RECOVERY MODULE SHALL US THE STANDARD ROOFTOP UNIT ROOFTOP CURB.
b. ROOFTOP EXTENSIONS, SUPPORT RAILS OR OTHER DEVICES THAT COME IN CONTACT WITH THE ROOF SURFACE TO SUPPORT THE ENERGY RECOVERY MODULE SHALL NOT BE ALLOWED.
c. A HORIZONTAL ADAPTER CURB SHALL BE USED TO CONVERT VERTICAL RETURN AIR APPLICATIONS INTO HORIZONTAL RETURN AIR APPLICATIONS. THE SUPPLY AIRFLOW SHALL BE CONVERTIBLE VIA THE BASE ROOFTOP UNIT OPERATION AND RESTRICTIONS.
D. STAGED AIR VOLUME SYSTEM (SAV) FOR 2-STAGE COOLING MODELS ONLY:
1. EVAPORATOR FAN MOTOR:
a. SHALL HAVE PERMANENTLY LUBRICATED BEARINGS.
b. SHALL HAVE A MAXIMUM CONTINUOUS BHP RATING FOR CONTINUOUS DUTY OPERATION; NO SAFETY FACTORS ABOVE THAT RATING.
c. SHALL BE VARIABLE FREQUENCY DUTY AND 2-SPEED CONTROL.
d. SHALL CONTAIN MOTOR SHAFT GROUNDING RING TO PREVENT ELECTRICAL BEARING FLUTING DAMAGE BY SAFELY DIVERTING HARMFUL SHAFT VOLTAGES AND BEARING CURRENTS TO GROUND.
E. VARIABLE FREQUENCY DRIVE (VFD). ONLY AVAILABLE ON 2-SPEED INDOOR FAN MOTOR OPTION (SAV):
1. SHALL BE INSTALLED INSIDE THE UNIT CABINET, MOUNTED, WIRED AND TESTED.
2. SHALL CONTAIN ELECTROMAGNETIC INTERFERENCE (EMI) FREQUENCY PROTECTION.
3. INSULATED GATE BI-POLAR TRANSISTORS (IGBT) USED TO PRODUCE THE OUTPUT PULSE WIDTH MODULATED (PWM) WAVEFORM, ALLOWING FOR QUIET MOTOR OPERATION.
4. SELF DIAGNOSTICS WITH FAULT AND POWER CODE LED INDICATOR. FIELD ACCESSORY DISPLAY KIT AVAILABLE FOR FURTHER DIAGNOSTICS AND SPECIAL SETUP APPLICATIONS.
5. RS485 CAPABILITY STANDARD.
6. ELECTRONIC THERMAL OVERLOAD PROTECTION.
7. 5% SWINGING CHOKES FOR HARMONIC REDUCTION AND IMPROVED POWER FACTOR.
8. ALL PRINTED CIRCUIT BOARDS SHALL BE CONFORMAL COATED.
F. HEAD PRESSURE CONTROL PACKAGE
1. CONTROLLER SHALL CONTROL COIL HEAD PRESSURE BY CONDENSER-FAN SPEED MODULATION OR CONDENSER-FAN CYCLING AND WIND BAFFLES.
2. SHALL CONSIST OF SOLID-STATE CONTROL AND CONDENSER-COIL TEMPERATURE SENSOR TO MAINTAIN CONDENSING TEMPERATURE BETWEEN 90° F (32° C) AND 110° F (43° C)AT OUTDOOR AMBIENT TEMPERATURES DOWN TO -20° F (-29° C).
G. CONDENSER COIL HAIL GUARD ASSEMBLY :
1. SHALL PROTECT AGAINST DAMAGE FROM HAIL.
2. SHALL BE OF LOUVERED STYLE.
H. UNIT-MOUNTED, NON-FUSED DISCONNECT SWITCH:
1. SWITCH SHALL BE FACTORY-INSTALLED, INTERNALLY MOUNTED.
2. NATIONAL ELECTRIC CODE (NEC) AND UL APPROVED NON-FUSED SWITCH SHALL PROVIDE UNIT POWER SHUTOFF.
3. SHALL BE ACCESSIBLE FROM OUTSIDE THE UNIT.
4. SHALL PROVIDE LOCAL SHUTDOWN AND LOCKOUT CAPABILITY.
I. CONVENIENCE OUTLET:
1. POWERED CONVENIENCE OUTLET (3-PHASE MODELS ONLY).
a. OUTLET SHALL BE POWERED FROM MAIN LINE POWER TO THE ROOFTOP UNIT.
b. OUTLET SHALL BE POWERED FROM LINE SIDE OR LOAD SIDE OF DISCONNECT BY INSTALLING CONTRACTOR, AS REQUIRED BY CODE. IF OUTLET IS POWERED FROM LOAD SIDE OF DISCONNECT, UNIT ELECTRICAL RATINGS SHALL BE UL CERTIFIED AND RATED FOR ADDITIONAL OUTLET AMPERAGE.
c. OUTLET SHALL BE FACTORY-INSTALLED AND INTERNALLY MOUNTED WITH EASILY ACCESSIBLE 115-V FEMALE RECEPTACLE.
d. OUTLET SHALL INCLUDE 15 AMP GFI RECEPTACLES WITH INDEPENDENT FUSE PROTECTION.
e. VOLTAGE REQUIRED TO OPERATE CONVENIENCE OUTLET SHALL BE PROVIDED BY A FACTORY-INSTALLED STEP-DOWN TRANSFORMER.
f. OUTLET SHALL BE ACCESSIBLE FROM OUTSIDE THE UNIT.
g. OUTLET SHALL INCLUDE A FIELD-INSTALLED “WET IN USE” COVER.
J. ROOF CURBS (VERTICAL):
1. FULL PERIMETER ROOF CURB WITH EXHAUST CAPABILITY PROVIDING SEPARATE AIR STREAMS FOR ENERGY RECOVERY FROM THE EXHAUST AIR WITHOUT SUPPLY AIR CONTAMINATION.
2. FORMED GALVANIZED STEEL WITH WOOD NAILER STRIP AND SHALL BE CAPABLE OF SUPPORTING ENTIRE UNIT WEIGHT.
3. PERMITS INSTALLATION AND SECURING OF DUCTWORK TO CURB PRIOR TO MOUNTING UNIT ON THE CURB.

SECTION 238129 - VARIABLE REFRIGERANT FLOW HVAC SYSTEM

PART 1 -GENERAL
1.01 SYSTEM DESCRIPTION
INDOOR, IN-CEILING MOUNTED, DIRECT-EXPANSION FAN COILS ARE MATCHED WITH A HEAT PUMP OUTDOOR UNIT.
1.02 AGENCY LISTINGS
UNIT SHALL BE RATED PER AHRI STANDARDS 210/240 AND LISTED IN THE AHRI DIRECTORY AS A MATCHED SYSTEM.
1.03 DELIVERY, STORAGE, AND HANDLING
UNITS SHALL BE STORED AND HANDLED PER UNIT MANUFACTURER'S RECOMMENDATIONS.
1.04 WARRANTY (FOR INCLUSION BY SPECIFYING ENGINEER)
PART 2 -PRODUCTS
2.01 EQUIPMENT
A. GENERAL:
INDOOR, DIRECT-EXPANSION, IN-CEILING CASSETTE FAN COIL. UNIT SHALL BE COMPLETE WITH COOLING/HEATING COIL, FAN, FAN MOTOR, PIPING CONNECTORS, ELECTRICAL CONTROLS, MICROPROCESSOR CONTROL SYSTEM, AND INTEGRAL TEMPERATURE SENSING.
B. UNIT CABINET:
CABINET SHALL BE CONSTRUCTED OF ZINC--COATED STEEL. FULLY INSULATED DISCHARGE AND INLET GRILLES SHALL BE ATTRACTIVELY STYLED, HIGH-IMPACT POLYSTYRENE. GRILLE SHALL HAVE HINGES AND CAN BE OPENED TO OBTAIN ACCESS TO THE CLEANABLE FILTERS, INDOOR FAN MOTOR AND CONTROL BOX.
C. FANS:
1. FAN SHALL BE CENTRIFUGAL DIRECT--DRIVE BLOWER TYPE WITH AIR INTAKE IN THE CENTER OF THE UNIT AND DISCHARGE AT THE PERIMETER. AUTOMATIC, MOTOR--DRIVEN VERTICAL AIR SWEEP SHALL BE PROVIDED STANDARD. AUTOMATIC MOTOR--DRIVEN LOUVERS SHALL BE PROVIDED STANDARD AND SHALL BE ADJUSTABLE FOR 2, 3 OR 4-WAY DISCHARGE.
2. AIR SWEEP OPERATION SHALL BE USER SELECTABLE.
D. COIL:
COIL SHALL BE COPPER TUBE WITH ALUMINUM FINS AND GALVANIZED STEEL TUBE SHEETS. FINS SHALL BE BONDED TO THE TUBES BY MECHANICAL EXPANSION AND ESPECIALLY GOLDEN HYDROPHILIC PRE−COATED FOR ENHANCED WET-ABILITY. A DRIP PAN UNDER THE COIL SHALL HAVE A FACTORY INSTALLED CONDENSATE PUMP AND DRAIN CONNECTION FOR HOSE ATTACHMENT TO REMOVE CONDENSATE.
E. MOTORS:
MOTORS SHALL BE OPEN DRIP-PROOF, PERMANENTLY LUBRICATED BALL BEARING WITH INHERENT OVERLOAD PROTECTION. FAN MOTORS SHALL BE 3-SPEED.
F. CONTROLS:
CONTROLS SHALL CONSIST OF A MICROPROCESSOR-BASED CONTROL SYSTEM WHICH SHALL CONTROL SPACE TEMPERATURE, DETERMINE OPTIMUM FAN SPEED, AND RUN SELF-DIAGNOSTICS. THE TEMPERATURE CONTROL RANGE SHALL BE FROM 62°F TO 86°F (17°C TO 30°C) IN INCREMENTS OF 1°F OR 1°C, AND HAVE 46°F HEATING MODE (HEATING SETBACK). THE WIRELESS REMOTE CONTROLLER SHALL HAVE THE ABILITY TO ACT AS THE TEMPERATURE SENSING LOCATION FOR ROOM COMFORT.

THE UNIT SHALL HAVE THE FOLLOWING FUNCTIONS AS A MINIMUM:
1. AN AUTOMATIC RESTART AFTER POWER FAILURE AT THE SAME OPERATING CONDITIONS AS AT FAILURE.
2. A TIMER FUNCTION TO PROVIDE A MINIMUM 24-HOUR TIMER CYCLE FOR SYSTEM AUTO START/STOP.
3. TEMPERATURE-SENSING CONTROLS SHALL SENSE RETURN AIR TEMPERATURE.
4. INDOOR COIL FREEZE PROTECTION.
5. A WIRED REMOTE OR WIRELESS INFRARED REMOTE CONTROL OR A WIRED CONTROL TO ENTER SET POINTS AND OPERATING CONDITIONS.
6. AUTOMATIC AIR SWEEP CONTROL TO PROVIDE ON OR OFF ACTIVATION OF AIR SWEEP LOUVERS.
7. DEHUMIDIFICATION MODE SHALL PROVIDE INCREASED LATENT REMOVAL CAPABILITY BY MODULATING SYSTEM OPERATION AND SET POINT TEMPERATURE.
8. FAN-ONLY OPERATION TO PROVIDE ROOM AIR CIRCULATION WHEN NO COOLING IS REQUIRED.
9. DIAGNOSTICS SHALL PROVIDE CONTINUOUS CHECKS OF UNIT OPERATION AND WARN OF POSSIBLE MALFUNCTIONS. ERROR MESSAGES SHALL BE DISPLAYED AT THE UNIT.
10. FAN SPEED CONTROL SHALL BE USER-SELECTABLE: HIGH, MEDIUM, LOW, OR MICROPROCESSOR CONTROLLED AUTOMATIC OPERATION DURING ALL OPERATING MODES.
11. AUTOMATIC HEATING-TO-COOLING CHANGEOVER IN HEAT PUMP MODE. CONTROL SHALL INCLUDE DEADBAND TO PREVENT RAPID MODE CYCLING BETWEEN HEATING AND COOLING.
12. INDOOR COIL HIGH TEMPERATURE PROTECTION SHALL BE PROVIDED TO DETECT EXCESSIVE INDOOR DISCHARGE TEMPERATURE WHEN UNIT IS IN HEAT PUMP MODE.
G. FILTERS:
UNIT SHALL HAVE FILTER TRACK WITH FACTORY-SUPPLIED CLEANABLE FILTERS.
H. ELECTRICAL REQUIREMENTS:
INDOOR UNITS ARE 208/230-1-60 AND ARE POWERED FROM THE OUTDOOR UNIT.
I. OPERATING CHARACTERISTICS:
THE 40MBCQ SYSTEM SHALL HAVE A MINIMUM SEER (SEASONAL ENERGY EFFICIENCY RATIO) AND HSPF AT AHRI CONDITIONS, AS LISTED ON THE SPECIFICATIONS TABLE.
J. REFRIGERANT LINES:
ALL UNITS SHOULD HAVE REFRIGERANT LINES THAT CAN BE ORIENTED TO CONNECT FROM THE SIDE OF UNIT. BOTH REFRIGERANT LINES NEED TO BE INSULATED.

PART 1 -GENERAL
1.01 SYSTEM DESCRIPTION
A. OUTDOOR AIR-COOLED SPLIT SYSTEM COMPRESSOR SECTIONS SUITABLE FOR ON-THE-GROUND, ROOFTOP, WALL HUNG OR BALCONY MOUNTING. UNITS SHALL CONSIST OF A ROTARY COMPRESSOR, AN AIR-COOLED COIL, PROPELLER-TYPE DRAW-THROUGH OUTDOOR FAN, REVERSING VALVE (HP), ACCUMULATOR (HP UNITS), METERING DEVICE(S), AND CONTROL BOX. UNITS SHALL DISCHARGE AIR HORIZONTALLY AS SHOWN ON THE CONTRACT DRAWINGS. UNITS SHALL FUNCTION AS THE OUTDOOR COMPONENT OF AN AIR-TO-AIR HEAT PUMP SYSTEM.
B. UNITS SHALL BE USED IN A REFRIGERATION CIRCUIT MATCHED TO DUCTLESS HEAT PUMP FAN COIL UNITS.
1.02 AGENCY LISTINGS
A. UNIT CONSTRUCTION SHALL COMPLY WITH ANSI/ASHRAE 15, LATEST REVISION, AND WITH THE NEC.
B. UNITS SHALL BE EVALUATED IN ACCORDANCE WITH UL STANDARD 1995.
C. UNITS SHALL BE LISTED IN THE CEC DIRECTORY.
D. UNIT CABINET SHALL BE CAPABLE OF WITHSTANDING 500-HOUR SALT SPRAY TEST PER FEDERAL TEST STANDARD NO. 141 (METHOD 6061).
E. AIR-COOLED CONDENSER COILS SHALL BE LEAK TESTED AT 550 PSIG.
1.03 DELIVERY, STORAGE, AND HANDLING
UNITS SHALL BE SHIPPED IN ONE PIECE AND SHALL BE STORED AND HANDLED PER UNIT MANUFACTURER'S RECOMMENDATIONS.
1.04 WARRANTY (FOR INCLUSION BY SPECIFYING ENGINEER)

PART 3 -PRODUCTS
3.01 EQUIPMENT
A. GENERAL:
FACTORY ASSEMBLED, SINGLE PIECE, AIR-COOLED OUTDOOR UNIT. CONTAINED WITHIN THE UNIT ENCLOSURE SHALL BE ALL FACTORY WIRING, PIPING, CONTROLS, AND THE COMPRESSOR.
B. UNIT CABINET:
1. UNIT CABINET SHALL BE CONSTRUCTED OF GALVANIZED STEEL, BONDERIZED AND COATED WITH A BAKED-ENAMEL FINISH ON INSIDE AND OUTSIDE.
2. UNIT ACCESS PANELS SHALL BE REMOVABLE WITH MINIMAL SCREWS AND SHALL PROVIDE FULL ACCESS TO THE COMPRESSOR, FAN, AND CONTROL COMPONENTS.
3. OUTDOOR COMPARTMENT SHALL BE ISOLATED AND HAVE AN ACOUSTIC LINING TO ASSURE QUIET OPERATION.
C. FANS:
1. OUTDOOR FANS SHALL BE DIRECT-DRIVE PROPELLER TYPE, AND SHALL DISCHARGE AIR HORIZONTALLY. FANS SHALL DRAW AIR THROUGH THE OUTDOOR COIL.
2. OUTDOOR FAN MOTORS SHALL BE TOTALLY-ENCLOSED, SINGLE PHASE MOTORS WITH CLASS E INSULATION AND PERMANENTLY-LUBRICATED BALL BEARINGS. MOTOR SHALL BE PROTECTED BY INTERNAL THERMAL OVERLOAD PROTECTION.
3. SHAFT SHALL HAVE INHERENT CORROSION RESISTANCE.
4. FAN BLADES SHALL BE NON-METALLIC AND SHALL BE STATICALLY AND DYNAMICALLY BALANCED.
5. OUTDOOR FAN OPENINGS SHALL BE EQUIPPED WITH PVC METAL/MESH COATED PROTECTION GRILLE OVER FAN.
D. COMPRESSOR:
1. COMPRESSOR SHALL BE FULLY HERMETIC ROTARY TYPE.
2. COMPRESSOR SHALL BE EQUIPPED WITH OIL SYSTEM, OPERATING OIL CHARGE, AND MOTOR. INTERNAL OVERLOADS SHALL PROTECT THE COMPRESSOR FROM OVER-TEMPERATURE AND OVER-CURRENT.
3. MOTOR SHALL BE NEMA RATED CLASS E, SUITABLE FOR OPERATION IN A REFRIGERANT ATMOSPHERE.
4. COMPRESSOR ASSEMBLY SHALL BE INSTALLED ON RUBBER VIBRATION ISOLATORS.
5. COMPRESSORS SHALL BE SINGLE PHASE.
E. OUTDOOR COIL:
COIL SHALL BE CONSTRUCTED OF ALUMINUM GOLDEN HYDROPHILIC PRE-COATED FINS MECHANICALLY BONDED TO SEAMLESS COPPER TUBES, WHICH ARE CLEANED, DEHYDRATED, AND SEALED.
F. REFRIGERATION COMPONENTS:
REFRIGERANT CIRCUIT COMPONENTS SHALL INCLUDE BRASS EXTERNAL LIQUID LINE SERVICE VALVE WITH SERVICE GAGE PORT CONNECTIONS, SUCTION LINE SERVICE VALVE WITH SERVICE GAGE CONNECTION PORT, SERVICE GAGE PORT CONNECTIONS ON COMPRESSOR SUCTION AND DISCHARGE LINES WITH SCHRADER TYPE FITTINGS WITH BRASS CAPS, ACCUMULATOR, REVERSING VALVE.
G. CONTROLS AND SAFETIES:
OPERATING CONTROLS AND SAFETIES SHALL BE FACTORY SELECTED, ASSEMBLED, AND TESTED. THE MINIMUM CONTROL FUNCTIONS SHALL INCLUDE THE FOLLOWING:
1. CONTROLS:
a. A TIME DELAY CONTROL SEQUENCE IS PROVIDED STANDARD THROUGH THE FAN COIL BOARD.
b. AUTOMATIC OUTDOOR-FAN MOTOR PROTECTION.
2. SAFETIES:
a. SYSTEM DIAGNOSTICS.
b. COMPRESSOR MOTOR CURRENT AND TEMPERATURE OVERLOAD PROTECTION.
c. OUTDOOR FAN FAILURE PROTECTION.
H. ELECTRICAL REQUIREMENTS:
1. UNIT SHALL OPERATE ON SINGLE-PHASE, 60 HZ POWER AT 115V FOR UNIT SIZE 12 AND 208-230V FOR UNIT SIZES 09, 12, 18, 24, 30 AND 36, AS SPECIFIED.
2. UNIT ELECTRICAL POWER SHALL BE A SINGLE POINT CONNECTION.
3. UNIT CONTROL VOLTAGE TO THE INDOOR FAN COIL SHALL BE 0-15V DC.
4. ALL POWER AND CONTROL WIRING MUST BE INSTALLED PER NEC AND ALL LOCAL ELECTRICAL CODES.
5. UNIT SHALL HAVE HIGH-AND LOW-VOLTAGE TERMINAL BLOCK CONNECTIONS.

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△	Date	Description
	10/14/2022	ISSUED FOR BID AND PERMIT
1	11/18/2022	ADDENDUM 1
3	02/03/2023	ADDENDUM 3
4	03/10/2023	ADDENDUM 4
5	03/31/2023	ADDENDUM 5

NORTH CAROLINA PROFESSIONAL ENGINEER
SEAL 053111
YVETTE RICHARDSON

Seal / Signature

Project Name
VILLAGE DISTRICT

Project Number
69.6575.000

Description
MECHANICAL SPECIFICATIONS IV

Scale
NONE

M-595

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PACKAGED ROOFTOP GAS FIRED AC UNITS

EQUIPMENT NO.	LOCATION	AREA SERVED	NOMINAL TON	SUPPLY FAN							COOLING COIL				CONDENSER SECTION				COMPRESSOR			HEATING SECTION				ELECTRICAL DATA			FILTER		NOMINAL OPERATION WEIGHT (LBS.)	IEER	MANUFACTURER OR APPROVED EQUAL	MODEL	NOTES
				OA MIN	(CFM)	EXT. S.P. (IN W.G)	BHP	HP	RPM	TYPE	TOTAL COOLING CAPACITY (MBH)	TOTAL SENSIBLE CAPACITY (MBH)	EAT. DB/WB (DEG. F)	LVG DB/WB (DEG F)	EDB °F	CFM	FLA (EA)	FAN QUANTITY	TYPE	QUANTITY	RLA/LRA (EA)	TYPE	TEM RISE (°F)	INPUT (MBH)	OUTPUT (MBH)	VOLT/PH/HZ	MCA (A)	MFS (A)	TYPE	N0. SIZE					
RTU-1	ROOF	KITCHEN AREA	20	2630	2630	1.0	1.95	3.0	-	DIRECT DRIVE	186.9	101.0	95/78	56.7/54.1	95	-	-	2	SCROLL	-	-	GAS	78	296.30	240.0	208-3-60	63.4	70	MERV 13	1-16x25x2	2700	18.8	CAPTIVE AIRE	CASRTU3-I.300-18-15T -DOAS	SEE CAPTIVE AIRE DWG M704
RTU-2	ROOF	DINING AREA	10	1200	4,000	1.0	-	5.0	-	DIRECT DRIVE	112.20	96.50	78.8/66.1	53.4/53.4	92	-	-	2	SCROLL	-	-	GAS	38	222.0	180.0	208-3-60	67.8	80	MERV 13	1-16x25x2	2200	18.6	CAPTIVE AIRE	CASRTU2-I.300-18-10T -DOAS	SEE CAPTIVE AIRE DWG M704

EQUIPMENT FURNISHED AND INSTALLED PER THE RESPONSIBILITY SCHEDULE. EQUIPMENT SHALL BE OBTAINED THROUGH SHAKE SHACK NATIONAL ACCOUNT. REFER TO T.12/ VENDOR LIST FOR MORE INFORMATION.

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

NOTES:

1. REFER TO CONTROL MATRIX FOR CONTROL FEATURES MODULES AND ACCESSORIES THAT SHALL BE PROVIDED WITH THE EQUIPMENT
2. 2-SPEED INDOOR FAN MOTOR CONTROLLED BY VFD FOR RTU-2
3. NON-FUSED DISCONNECT SWITCH
4. AIR ECONOMIZER
5. 14" TALL ROOF CURB
6. PROVIDE BMS INTERFACE CARD FUTURE CONNECTION
7. MODULATING REHEAT
8. 120V FIELD-POWERED CONVENIENCE OUTLET
9. DIRTY FILTER SWITCH
10. COMPRESSOR SOUND JACKETS
11. BOTTOM DISCHARGE/RETURN FOR RTU-2, SIDE DISCHARGE/RETURN FOR RTU-1
12. 5 YEAR EXTENDED COMPRESSOR WARRANTY
13. PROVIDE BOTH UNITS WITH UV LIGHT INTERLOCK WITH RESPECTIVE RTU UNIT . SEE SCHEDULE BELOW

SPLIT HEAT PUMP AIRCOOLED AC UNIT SECTION

UNIT No.	SERVICE	TYPE	TONS	SUPPLY FAN DATA			COOLING PERFORMANCE				HEATING PERFORMANCE		REFRIGERATION PIPE		ELECTRICAL DATA			MFR	MODEL	SOUND PRESSURE DBA	WEIGHT (LBS)	UNIT DIMENSIONS (W"XL"XHZ")	COMMENTS
				CFM	EXT.SP. (IN. WG)	TYPE	CAPACITY (MBH)		EAT	EAT	TOTAL CAP MBH	EAT °F DB	LIQUID (INCH)	SUCTION (INCH)	MCA (AMP)	MFS (AMP)	V/PH/HZ						
							TOTAL	SENSIBLE	°F DB	°F WB													
AC-1	OFFICE /IT	CASSETTE DIFFUSER	1.0	240/340/400	-	DIRECT DRIVE	11,352	8,072	80	67	11,373	70	1/4	1/2	0.2	-	-	TOSHIBA CARRIER	40MBCQ12-3	52	45	25.47x25.47x12.44	

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

NOTES:

1. FOR ALL UNITS PROVIDE DISCONNECT SWITCH, CONDENSATE PUMPS, (PROVIDE CONDENSATE PUMP BUILT IN FOR WALL MTD AC UNIT)
2. PROVIDE AC-1 WITH WALL MTD THERMOSTAT
3. PROVIDE EACH AC UNIT WITH INTERNET INTERFACE

SPLIT HEAT PUMP AIR COOLED CONDENSING UNIT SECTION

UNIT No.	LOCATION	NOM. TONS	NOM. COOLING CAP. (BTU/H)	NOM. HEATING CAP. (BTU/H)	COOLING OUTDOOR TEMP °F DB	HEATING OUTDOOR TEMP °F DB	REFRIGERATION PIPE LIQUID / SUCTION (INCH)	COMPRESSOR		CONDENSER	ELECTRICAL DATA			SEER	MFR	MODEL	WEIGHT (LBS)	UNIT DIMENSIONS (W"xL"xH")	COMMENTS
								TYPE	RLA	FAN (CFM)	MCA	MFS	V/PH/HZ						
ACCU-1	ROOF	1	12,000	12,000	95	47	1/4" / 1/2"	ROTARY INVERTER	5.7	1,200	25	40	230-1-60	19.5	TOSHIBA CARRIER	38MAQB12R-3	91.5	32.09x13.11x21.81	

NOTES:

1. 12"H STEEL DUNNAGE
2. SEE ASSOCIATED INDOOR UNIT FOR CONTROL OPTION INTERLOCKS.
3. INTERNAL UNIT CONTROLS.
4. AUTO CHARGE FUNCTION.
5. INTERNET INTERFACE.
6. ADVANCED CONTINUOUS HEATING DURING DEFROST CYCLE.
7. LOW AMBIENT CONTROLS DOWN TO -4°F. PROVIDE WITH BAFFLE

FAN SCHEDULE

UNIT No.	LOCATION	SERVICE	PERFORMANCE DATA					FAN MOTOR DATA									WEIGHT (LBS)	MODEL No.	MANUFACTURER	REMARKS
			CFM	ESP IN. W.G	RPM	dBA	SONE	BHP	MHP	STARTER TYPE	ELECTRICAL DATA				ENC	RPM				
											VOLTS	PH	HZ	FLA						
TX-1	ROOF	TOILETS	350	0.30	1180	48	4.9	0.15	1/10	HOA	120	1	60	1.38	ODP	1725	30	G-090-VG	GREENHECK	①⑦⑨⑩⑪
KEF-1	ROOF	HOOD 1 & 2	2727	1.50	1134	-	21.0	1.17	3.0	HOA	208	3	60	6.6	ODP-PREMIUM	1725	475	USBI20DD-RM	CAPTIVE AIRE	SEE DWG M-707

NOTES:

① PROVIDE WITH MOTORIZED DAMPER & ACTUATOR
② INTERLOCK WITH LIGHT SWITCH
③ ISOLATION KIT
④ SOLID STATE CONTROLLER (UNIT MOUNTED)
⑤ WALL MTD COOLING ONLY THERMOSTAT
⑥ WALL SWITCH WITH PILOT LIGHT
⑦ TIME CLOCK
⑧ INTERLOCK WITH ASS0CIATED UNITS
⑨ 14" ROOF CURB
⑩ ROOF CURB EXTENSION WITH SOUND ATTENUATOR
⑪ DISCONNECT SWITCH

OUTSIDE AIR REQUIREMENTS, IMC-2015 (IP)

SYSTEM DESIGNATION	SYSTEM TAB NAME OR LIST "SINGLE"	SINGLE-ZONE SYSTEMS ONLY		MULTI-ZONE SYSTEMS ONLY	FLOOR AREA SERVED BY SYSTEM [As] (SF)	SYSTEM AVERAGED AREA-BASED OUTDOOR AIR RATE (CFM/SF)	SYSTEM POPULATION [Ps] (PEOPLE)	SYSTEM AVERAGED PEOPLE-BASED OUTDOOR AIR RATE (CFM/P)	REQUIRED OA INTAKE FLOW [Vot] (CFM)	REQUIRED DCV OA INTAKE FLOW [Vot] (CFM)	DESIGN OA INTAKE FLOW [Vot] (CFM)
		SINGLE-ZONE SYSTEM ASSOCIATED VENTILATION ZONE	SINGLE-ZONE WORST CASE ZONE AIR DISTRIBUTION EFFECTIVENESS [Ez]	SYSTEM VENTILATION EFFICIENCY [Ev]							
RTU-1	MULTIZONE	-	-	1.00	1200	0.000	8	0.00	0	N/A	2630
RTU-2	MULTIZONE	-	-	0.68	1825	0.18	100	7.50	1,100	N/A	1200
AC-1	SINGLE ZONE	OFFICE	0.80	-	75	0.060	2	5.00	15	N/A	40
								TOTALS	1,115	0	3870

GENERAL NOTES:

1. VENTILATION CALCULATIONS BASED ON IMC-2015.
2. SYSTEM POPULATIONS BASED ON MAX SEATING AND/OR CODE MAXIMUM VALUES.
3. SINGLE-ZONE SYSTEMS (Vot = Voz): SYSTEM VENTILATION EFFICIENCY CALCULATION IS NOT REQUIRED FOR SINGLE ZONE SYSTEMS. WORST CASE AIR DISTRIBUTION EFFECTIVENESS BETWEEN HEATING AND COOLING MODES OF OPERATION IS SHOWN IN TABLE.
4. 100% OA SYSTEMS ($Vot = \Sigma_{all\ zones}Voz$): WHEN ONE AIR HANDLER SUPPLIES ONLY OUTDOOR AIR TO ONE OR MORE ZONES. EACH ZONE IS INDIVIDUALLY CALCULATED WITH ITS WORSE CASE ZONE AIR DISTRIBUTION EFFECTIVENESS (HEATING/COOLING).
5. MULTI-ZONE RECIRCULATING SYSTEMS: CALCULATOR USED TO DETERMINE VENTILATION AIRFLOW IN COMPLIANCE WITH IMC-2015 VRP AND ASHRAE 62.1-2013 APPENDIX A. VENTILATION RATE SHOWN IS ACTUAL CALCULATED WITH CORRECTION FACTORS INCLUDED. EACH ZONE IS CALCULATED WITH ITS WORST CASE ZONE AIR DISTRIBUTION EFFECTIVENESS (HEATING/COOLING) AS PART OF CALCULATIONS TO FIND Ev.

PRODUCT DESIGN CONDITIONS

CLIMATE CONDITIONS

WEATHER STATION		OCEANSIDE, NEW YORK, USA			
CLIMATE ZONE		4A			
HEATING (DB):	99.6%	11.69	°F		
COOLING (DB/MCWB):	0.4%	92.8	°F/	74.2	°F

BUILDING OPERATING HOURS

MONDAY-FRIDAY	TBD BY OWNER
SATURDAY	TBD BY OWNER
SUNDAY	TBD BY OWNER
HOLIDAY	TBD BY OWNER

SPACE/UNIT DESCRIPTION	SET POINTS											SPACE OPERATING HOURS OCCUPIED / UNOCCUPIED			NOTES
	COOLING/DE-HUMIDIFICATION				HEATING		HUMIDIFICATION		ZONE VENTILATION RESET						
	OCC °F	UNOCC °F	MAX RH %	MIN RH %	OCC °F	UNOCC °F	MIN RH %	MAX RH %	CONTROL METHOD	BASE PPM	MAXIMUM PPM	M-F	SAT	SUN	
DINING AREAS	75	80	50	NA	70	60	NA	NA	NA	NA	NA	TBD	TBD	TBD	A,B,C
OFFICES	75	80	NA	NA	70	60	NA	NA	NA	NA	NA	TBD	TBD	TBD	A,B,C
STOCKROOM/STORAGE	75	80	NA	NA	70	60	NA	NA	NA	NA	NA	TBD	TBD	TBD	A,B,C
FOOD PREP AREAS	75	80	NA	NA	70	60	NA	NA	NA	NA	NA	TBD	TBD	TBD	A,B,C

NOTES:
A. ZONE LEVEL SET POINT CONDITIONS SHALL BE AS SCHEDULED UNLESS OTHERWISE SCHEDULED OR NOTED ON THE DRAWINGS FOR ROOM SPECIFIC SPACE CONDITIONS.
B. ZONE LEVEL OCCUPANCY HOUR SCHEDULE SHALL BE PER BUILDING OEPRATING HOURS UNLESS OTHERWISE SCHEDULED.
C. ZONE LEVEL CONTROLS SHALL BE CAPABLE OF OPERATING WITH INDEPENDENT OCCUPANCY SCHEDULES.

CONTROL MATRIX FOR ROOFTOP UNIT

CONTROL FEATURE SETPOINT OR Y/N	UNITS	RTU-1 KITCHEN SETPOINT OR Y/N	RTU-2 DINING SETPOINT OR Y/N	NOTES
SETPOINTS				
COOLING - OCCUPIED SETPOINT	°F	75	75	
COOLING UNOCCUPIED SETPOINT	°F	80	80	
HEATING - OCCUPIED SETPOINT	°F	70	70	
HEATING - UNOCCUPIED SETPOINT	°F	60	60	
DEHUMIDIFICATION SETPOINT - HUMIDITY SENSOR FEEDBACK	%RH	N	60%	B
PROGRAMMED CONTROL FEATURES				
HVAC SYSTEM OCCUPIED/UNOCCUPIED MODE - PROGRAMMABLE THERMOSTAT		Y	Y	B
REMOTE TEMPERATURE SENSOR		Y	Y	B
EQUIPMENT ACCESSORIES AND CONTROL MODULES				
OUTSIDE AIR DAMPER - MOTOR OPERATED (MODULATING)		Y	Y	K
INTEGRATED ECONOMIZER - DIFFERENTIAL ENTHALPY ENABLE (OA ENTHALPY < RA ENTHALPY)	BTU/LB	Y	Y	E
ECONOMIZER FAULT DETECTION AND DIAGNOSTICS (FDD) SYSTEM		Y	Y	F, G
RELIEF - BAROMETRIC DAMPER		N	Y	
RELIEF - CONSTANT VOLUME POWERED EXHAUST FAN (EXISTING)		Y	N	H
COOLING COIL (DX - STAGED)		Y	Y	M
DEHUMIDIFICATION-HOT GAS REHEAT		N	Y	O
HEATING COIL (NATURAL GAS)		Y	Y	M
SUPPLY FAN CONTROL METHODS				
ON DURING OCCUPIED HOURS		Y	Y	
OPTIMUM START SEQUENCE		Y	Y	
VARIABLE VOLUME - MODULATE FAN SPEED IN RESPONSE TO ZONE TEMPERATURE		Y	Y	M, R
SAFETIES, INTERLOCKS, AND ALARMS				
GAS VALVE SAFETY		Y	Y	F
RETURN AIR SMOKE DETECTOR - SAFETY SHUTDOWN		Y	Y	U
LOW LIMIT FREEZESTAT - FREEZE PROTECTION SAFETY SHUTDOWN		Y	Y	F
FIRE ALARM CONTROL PANEL - SAFETY SHUTDOWN INTERLOCK		Y	Y	
KITCHEN EXHAUST SYSTEM INTERLOCK		Y	Y	S

DIV. 23 CONTRACTOR SHALL PROVIDE CONTROL PANEL(S), WIRING, THERMOSTAT(S), TEMPERATURE SENSOR(S), HUMIDISTAT(S), AND/OR CO2 SENSOR(S) WHERE SHOWN ON THE DRAWINGS AND AS REQUIRED TO FACILITATE THE SCHEDULED CONTROL MODULES AND SEQUENCES OF OPERATION. EACH UNIT SHALL CONTROL BASED ON ITS OWN INTERNAL SAFETIES, TIME DELAYS, AND SEQUENCES UNLESS NOTED OTHERWISE. COORDINATE WITH OWNER FINAL BUILDING AND EQUIPMENT SCHEDULES DURING STARTUP. REFERENCE DIVISION SPECIFICATIONS FOR INDIVIDUAL DEVICE REQUIREMENTS.

NOTES:
B. DIVISION 23 CONTRACTOR SHALL PROVIDE DEVICE.
E. IF SETPOINT VALUE IS LISTED, IT INDICATES ECONOMIZER HIGH-LIMIT SHUT-OFF. UNIT SHALL BE IN ECONOMIZER IF CONDITIONS ARE LESS THAN SETPOINT. THE FOLLOWING SENSORS SHALL DETERMINE ECONOMIZER ON POINT.
OUTSIDE AIR TEMPERATURE; DIVISION 23 PROVIDED AS PART OF ECONOMIZER CONTROL MODULE.
RETURN AIR TEMPERATURE; DIVISION 23 PROVIDED AS PART OF ECONOMIZER CONTROL MODULE.
F. DEVICE SHALL BE FACTORY MOUNTED AND PRE-WIRED FOR OPERATION SUBJECT TO THE ONBOARD CONTROLLER.
G. PROVIDE UNIT WITH AN FDD SYSTEM CONSISTING OF PERMANENTLY INSTALLED OUTSIDE AIR, SUPPLY AIR, AND RETURN AIR TEMPERATURE SENSORS. THE UNIT CONTROLLER SHALL AT A MINIMUM CAPABLE OF PROVIDING SYSTEM STATUS OF ECONOMIZER, COMPRESSOR, HEATING, MIXED AIR LOW LIMIT ALARM, AND SENSOR VALUES. EACH OPERATING MODE SHALL BE CAPABLE OF INDEPENDENTLY OPERATING FOR TESTING. THE SYSTEM SHALL REPORT FAULTS TO AN APPLICATION ACCESSIBLE BY SERVICE PERSONNEL. THE FOLLOWING FAULTS SHALL BE DETECTED: AIR TEMPERATURE SENSOR FAILURE, ECONOMIZER ENABLED/DISABLED WHEN ECONOMIZER SHOULD BE OFF/ON, RESPECTIVELY, DAMPER NOT MODULATING, AND EXCESS OUTSIDE AIR.
H. POWERED EXHAUST FAN SHALL STAGE ON AND OFF ACCORDING TO DAMPER POSITION.
K. DTERMINE MINIMUM DAMPER POSITION IN FIELD DURING BALANCING TO PROVIDE SCHEDULED OURDOOR AIRFLOW DURING OCCUPIED HOURS. DAMPER SHALL BE CLOSED DURING UNOCCUPIED HOURS.
L. EQUIPMENT MANUFACTURER SHALL PROVIDE MODULATING DAMPER AND CONTROLS CAPABLE OF ADJUSTING THE DAMPER POSITION TO MAINTAIN THE SCHEDULED OUTSIDE AIR ON THE DRAWINGS ACROSS ALL FAN SPEEDS. DIV. 23 CONTRACTOR SHALL PROGRAM MULTIPLE DAMPER POSITION SETPOINTS IN THE FIELD DURING TESTING AND BALANCING TO MAINTAIN MINIMUM VENTILATION WHEN NOT IN ECONOMIZER. DAMPER SHALL BE CLOSED DURING UNOCCUPIED HOURS.
M. UNITARY CONTROLLER SHALL MODULATE AND/OR CYCLE SUPPLY FAN SPEED SETTING AND COIL CAPACITY STAGES SUBJECT TO THE INTERNAL SAFETIES AND SEQUENCES TO MAINTAIN SCHEDULED SETPOINTS.
O. PROGRAM DEHUMIFICATION SEQUENCE BASED ON ZONE AIR HUMIDITY.
R. PROVIDE MODULATING FAN CONTROL WITH MINIMUM SPEED LESS THAN 50% OF FULL SPEED. AT MINIMUM SPEED THE FAN SHALL DRAW NO MORE THAN 30% OF FULL SPEED POWER.
S. INTERLOCK RTU WITH KITCHEN EXHAUST HOOD SYSTEM(S) TO SHUT DOWN UPON SIGNAL FROM HOOD FIRE EXTINGUISHING SYSTEM. INTERLOCK RTU WITH KITCHEN EXHAUST FAN TO ENERGIZE WHEN HOOD SYSTEM IS ENERGIZED FOR PRESSURIZATION.
U. DIVISION 28 CONTRACTOR SHALL PROVIDE DEVICE.

AIR CURTAIN SCHEDULE

UNIT NO.	SERVICE	AIR DATA		ELECTRICAL DATA				SOUND PRESSURE DBA	DIMENSION	WEIGHT (LBS)	MFG	MODEL	REMARKS
		CFM	VELOCITY (FPM)	HEATING (KW)	MOTOR (HP)	AMPS	V/Ø/HZ						
EAC-1	VESTIBULE 101	2434	1623	12.0	2-1/2	63	208/1/60	68	72"X26"X17"H	120	MARS	PH1072-2EEN	

REMARKS

1. DISCONNECT SWITCH
2. COLOR BY ARCHITECT
3. PROVIDE EACH WITH WALL MTD THERMOSTAT.
4. TIME DELAY AND DOOR LIMIT SWITCH
5. PROVIDE WITH MOUNTING BRACKET AS REQUIRED
6. HEAT ON DEMAND

5. FILTER (THROWAWAY)

UV LIGHT SCHEDULE

UNIT NO.	SERVICE	TON	AIR DATA	ELECTRICAL DATA			DIMENSION W x L x D	WEIGHT (LBS)	MFG	MODEL
				WATTS	AMPS	V/Ø/HZ				
UV-1	RTU-1	20.0	2630	11W	0.70	115/1/60	2.25"x18.5x1.75	2.0	RGF ENVIROMENTAL	PHI-PKG14-24V
UV-2	RTU-2	10.0	4000	11W	0.70	115/1/60	2.25"x18.5x1.75	2.0	RGF ENVIROMENTAL	PHI-PKG14-24V

REMARKS

1. DISCONNECT SWITCH
2. PROVIDE WITH 24V STEP-DOWN TRANSFORMER
3. 2 YEARS WARRANTY
4. INTERLOCK WITH RTU

DIFFUSER, GRILLE AND REGISTER SCHEDULE

TAG NO.	SERVICE	CONSTRUCTION MATERIAL	FACE TYPE	FRAME TYPE	FACE SIZE (IN)	MAX NC	MODEL
CSD1	SUPPLY DIFFUSER	STEEL	SQUARE CONE	SURFACE	12X12	30	SCD
CSD2	SUPPLY DIFFUSER	STEEL	SQUARE CONE	LAY-IN OR SURFACE	24X24	30	SCD
CSD3	SUPPLY DIFFUSER	STEEL	PERFORATED	SURFACE	24X24	30	PDF
WSR	SUPPLY DIFFUSER W/ OBD	STEEL	LOUVERED	WALL OR DUCT	SEE PLAN	30	520D
CRG	RETURN GRILLE	STEEL	EGGCRATE	LAY-IN	24X24	30	80
CEG	EXHAUST GRILLE W/ OBD	STEEL	EGGCRATE	SURFACE	12X12	30	80D
WRG	EXHAUST GRILLE W/ OBD	STEEL	LOUVERED	WALL OR DUCT	SEE PLAN	30	530D

NOTES: (E.H. PRICE AS STANDARD MANUFACTURER)

1. ALL BRANCH CONNECTIONS TO DIFFUSERS SHALL BE AS SHOWN ON THE FLOOR PLANS OR AS INDICATED IN THE LOW PRESSURE DUCT SIZING SHOWN TABLE IN THIS SAME DRAWING.
2. SEE PLAN FOR CFM.
3. SEE APPLICABLE GENERAL NOTES AND SPECIFICATIONS.
4. FURNISH ALL DIFFUSERS WITH EQUALIZING GRIDS AND OPPOSED BLADE DAMPER.
5. PROVIDE DIFFUSER AND REGISTER DESIGN AS INDICATED IN THE DRAWINGS AND IN THIS SCHEDULE.
6. THE CONTRACTOR MUST COORDINATE THE FRAME TYPE TO MOUNT THE DIFFUSERS, REGISTERS, SLOT DIFFUSERS, ETC., WITH THE ARCHITECTURAL DRAWINGS AND/OR THE ARCHITECT PRIOR TO RELEASING THE DIFFUSERS FOR FABRICATION. FRAME TYPE SHALL BE SUITABLE FOR MOUNTING IN LAY-IN TYPE CEILING, SPLINE, SHEETROCK CEILING, ETC. AS REQUIRED AND AS INDICATED IN THE DRAWINGS.
7. FINISH FOR DIFFUSERS, REGISTERS, GRILLES SHALL MATCH COLOR SAMPLE AS APPROVED BY THE ARCHITECT.
8. PROVIDE CABLE OPERATED DAMPERS AT ALL VOLUME DAMPERS INSTALLED ABOVE NON ACCESSIBLE CEILINGS. (SIMILAR TO 800AW).
9. RETURN / EXHAUST GRILLE SHALL BE ALUMINUM WHEN USED IN BATHROOMS AND HIGH HUMIDITY AREAS WHERE INDICATED IN THE PLANS.
10. PROVIDE BLANK OFF PLATE(S) WHERE SHOWN IN THE DRAWINGS TO ALLOW FOR 2 OR 3 WAY DISCHARGE PATTERN.
11. DIFFUSERS (CEILING, LINEAR, ETC.) LOCATED IN SHEETROCK AND CONCEALED SPLINE CEILING TYPES SHALL BE PROVIDED WITH A FRAME TYPE TO ALLOW FOR SURFACE MOUNTING.
12. PROVIDE A VOLUME DAMPER FOR ALL BRANCHES CONNECTING TO ANY DIFFUSER.
13. PROVIDE LIGHT SHIELDS ON ALL PLENUM RETURN REGISTERS/LINEARS TO CONCEAL CEILING PLENUM.
14. ALL CEILING/RETURN/EXHAUST GRILLES TO BE 3/4" SPACING WITH 45 DEG. DEFLECTION, U.O.N.
15. ALL SUPPLY GRILLES SHALL BE SELECTED FOR A 22.5° THROW SPREAD.

BUILDING AIR BALANCE SUMMARY NORMAL OPERATION

UNIT NO.	SUPPLY (CFM)	OUTDOOR (CFM)	EXHAUST (CFM)	PERCENT OA/SA
RTU-1	2,630	2,630	-	100%
RTU-2	4,000	1200	-	30%
AC-1	400	40	-	10%
KEF-1	-	-	1356	-
KEF-2	-	-	1370	-
TX-1	-	-	350	-
TOTAL	7200	3,870	2726	-
			DESIGN BUILDING PRESSURIZATION AIRFLOW (CFM)	1144
			PRESSURIZATION CHECK	29%

BUILDING AIR BALANCE SUMMARY ECONOMIZER MODE

UNIT NO.	SUPPLY (CFM)	OUTDOOR (CFM)	EXHAUST (CFM)	PERCENT OA/SA
RTU-1	2,630	2,630	-	100%
RTU-2	4,000	4,000	-	100%
AC-1	4O0	40	-	10%
KEF-1	-	-	1357	-
KEF-2		-	1370	-
	-	-		-
TX-1	-	-	350	
POWER EF RTU-2	-	-	2630	-
TOTAL	7200	6670	5707	-
			DESIGN BUILDING PRESSURIZATION AIRFLOW (CFM)	963
			PRESSURIZATION CHECK	14%

SHAKE SHACK®

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△	Date	Description
	10/14/2022	ISSUED FOR BID AND PERMIT
1	11/18/2022	ADDENDUM 1
3	02/03/2023	ADDENDUM 3
4	03/10/2023	ADDENDUM 4
5	03/31/2023	ADDENDUM 5

SEAL 053141
YVETTE RICHARDSON

Seal / Signature

Project Name
VILLAGE DISTRICT

Project Number
69.6575.000

Description
MECHANICAL SCHEDULES

Scale
NONE

M-601

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