HVAC GENERAL NOTES

ARCHITECTURAL

1. DO NOT SCALE DRAWINGS. REFER TO ARCHITECTURAL DRAWINGS AND REFLECTED CEILING PLANS FOR EXACT LOCATION OF DOORS, WINDOWS, CEILING DIFFUSERS, ETC.
2. LIGHT FIXTURE LOCATIONS TAKE PRECEDENCE OVER DIFFUSER AND GRILLE LOCATIONS. LOCATE DIFFUSERS AND GRILLES TO ACCOMMODATE LIGHTING LAYOUT.
3. REFER TO ARCHITECTURAL FLOOR PLANS FOR LOCATION AND RATING OF ALL FIRE RATED WALLS AND CEILINGS.

GENERAL

1. THE HVAC CONTRACTOR SHALL VISIT THE JOB SITE AND BE FAMILIAR WITH ALL PROJECT CONDITIONS PRIOR TO FABRICATING DUCTWORK, EQUIPMENT, ETC. NO ALLOWANCES WILL BE MADE FOR CONTRACTOR'S UNFAMILIARITY WITH PROJECT CONDITIONS.
2. PIPING AND DUCTWORK ROUTING SHOWN IS SCHEMATIC. HVAC CONTRACTOR SHALL PROVIDE ANY ADDITIONAL OFFSETS AND FITTINGS, INCLUDING DIVIDED DUCTS, REQUIRED FOR PROPER INSTALLATION AND TO MAINTAIN CLEARANCES AS ENCOUNTERED IN THE FIELD.
3. FURNISH ALL LABOR, MATERIAL AND EQUIPMENT REQUIRED FOR THE COMPLETE INSTALLATION AND OPERATION OF ALL SYSTEMS IN THIS SECTION OF WORK IN ACCORDANCE WITH ALL APPLICABLE CODES, ASHRAE, SMACNA, NFPA, EPA, ETC.
4. PRIOR TO INSTALLATION OF ASSOCIATED WORK; INSTALLER SHALL MEET AT PROJECT SITE WITH GENERAL CONTRACTOR, INSTALLER OF EACH COMPONENT OF ASSOCIATED WORK, INSPECTION AND TESTING AGENCY REPRESENTATIVES (IF ANY), INSTALLERS OF OTHER WORK REQUIRING COORDINATION WITH WORK OF THIS SECTION AND ARCHITECT / OWNER FOR PURPOSE OF COORDINATING LOCATIONS OF PROPOSED SYSTEMS, REVIEWING MATERIAL SELECTIONS, AND PROCEDURES TO BE FOLLOWED IN PERFORMING THE WORK IN COMPLIANCE WITH REQUIREMENTS SPECIFIED.
   A. THE HVAC CONTRACTOR SHALL VERIFY THE ENTIRE SCOPE OF THE DEMOLITION (BY OTHERS) AND NEW WORK PRIOR TO BID. ADDITIONAL DEMOLITION AND / OR RELOCATION OF EXISTING SYSTEMS THAT MAY NOT BE REPRESENTED ON DRAWINGS PROVIDED BY OTHERS SHALL HAVE ADDITIONAL FUNDS ALLOCATED FOR A 100% COMPLETE AND OPERATIONAL SYSTEM AND WILL REPRESENT THE CONTRACTOR'S KNOWLEDGE OF THE PROJECT / SITE AND ON-SITE INSPECTION PRIOR TO BID.
5. COORDINATE INSTALLATION AND LOCATIONS OF DUCTWORK AND PIPING WITH BUILDING STRUCTURE, PLUMBING PIPING, ELECTRICAL CONDUIT, LIGHTING, ETC. PRIOR TO PURCHASING OR INSTALLING EQUIPMENT AND MATERIALS.
6. RELOCATE EXISTING DUCTWORK, PIPNG AND / OR EQUIPMENT IN EXISTING CEILING SPACES TO ACCOMMODATE ALL RENOVATIONS AND ADDITIONS.
   A. COORDINATE THE DEMOLITION (BY OTHERS) AND / OR RELOCATION OF EXISTING SYSTEMS WITH THE OWNER AND / OR OWNERS REPRESENTATIVE PRIOR TO PROCEEDING WITH ANY WORK.
7. ALL PIPING, DUCTS, VENTS, ETC. EXTENDING THROUGH WALLS AND ROOF SHALL BE FLASHED AND COUNTERFLASHED IN A WATERPROOF MANNER.
8. MAINTAIN MINIMUM OF TEN (10) FEET BETWEEN OUTDOOR AIR INTAKES AND EXHAUST FAN DISCHARGE, PLUMBING VENTS, ETC.
9. MAINTAIN A MINIMUM OF TEN (10) FEET BETWEEN EDGE OF HVAC EQUIPMENT / ROOF CURBS AND EDGE OF ROOF / PARAPET.
10. REFER TO PLUMBING DRAWINGS FOR LOCATION AND ROUTING OF ALL CONDENSATE DRAIN LINE CONNECTION POINTS, GAS PIPING AND WATER HEATER COMBUSTION / EXHAUST AIR DUCTWORK.
11. DIVISION 23 SHALL BE LICENSED TO PERFORM MECHANICAL WORK IN THE MUNICIPALITY IN WHICH THE PROJECT IS LOCATED.
12. DIVISION 23 SHALL GUARANTEE ALL WORK PERFORMED AND MATERIALS FURNISHED UNDER THIS CONTRACT AGAINST DEFECTS IN MATERIALS AND WORKMANSHIP FOR A PERIOD OF ONE (1) YEAR FROM THE DATE OF THE OWNER'S FINAL ACCEPTANCE OF THE WORK. ANY DEFECTS SHALL BE RECTIFIED BY DIVISION 23 WITHOUT ANY ADDITIONAL COST TO THE OWNER.
13. WORK SHALL COMPLY WITH THE LATEST REVISIONS OF INTERNATIONAL BUILDING CODE, INTERNATIONAL MECHANICAL CODE, INTERNATIONAL FIRE CODE, INTERNATIONAL ENERGY CONSERVATION CODE, AND ANY STATE AND LOCAL CODES OR REGULATIONS THAT APPLY.
   A. IN CASE OF CONFLICTS BETWEEN DRAWINGS, SPECIFICATIONS, AND INTERPRETATION OF CODES BY LOCAL AUTHORITY, LATER SHALL GOVERN.

EQUIPMENT

1. ALL HVAC EQUIPMENT SHALL BE INSTALLED PER MANUFACTURER'S REQUIREMENTS AS SHOWN. UTILIZE FACTORY FILTERS DURING CONSTRUCTION AND REPLACE (IN KIND) JUST PRIOR TO TESTING AND BALANCING. ALL FILTERS SHALL BE 2-INCHES THICK. PROVIDE ONE (1) SET OF EXTRA FILTERS FOR EACH UNIT INSTALLED.
2. ALL EQUIPMENT SHALL HAVE A ONE (1) YEAR WARRANTY; COMPRESSORS SHALL HAVE AN ADDITIONAL FIVE (5) YEAR EXTENDED WARRANTY, ROOFTOP UNIT HEAT EXCHANGERS SHALL HAVE AN ADDITIONAL TEN (10) YEAR EXTENDED WARRANTY; PROVIDE WRITTEN GUARANTEE.
3. GENERAL CONTRACTOR SHALL STORE ALL HVAC EQUIPMENT (ROOFTOP UNITS, DUCTWORK, ETC.) THAT ARRIVES AT THE PROJECT SITE. STORE ALL EQUIPMENT IN A DRY PLACE, PROTECTING ALL EQUIPMENT FROM THE WEATHER, CONSTRUCTION TRAFFIC AND THEFT.
4. ROOF CURBS SHALL HAVE A BASE THAT FITS SLOPE OF ROOF AS REQUIRED. TOP OF ROOF CURB SHALL BE LEVEL.
5. FLEXIBLE CONNECTORS SHALL BE INSTALLED ON SUPPLY, RETURN, AND EXHAUST AIR DUCTS AT ALL EQUIPMENT CONNECTIONS.
6. THE BIDDER MUST SUBMIT IN WRITING TO THE ARCHITECT / OWNER, WHO WILL FORWARD TO THE ENGINEER, ANY REQUEST FOR A PROPOSED DEVIATION, MODIFICATION, OR SUBSTITUTION TO THESE DRAWINGS AND SPECIFICATIONS FOR EVALUATION NO LATER THAN TEN (10) DAYS PRIOR TO THE BID DATE, AND SHALL BE ACCOMPANIED BY TECHNICAL DATA, DRAWINGS, AND COMPLETE DATA SUBSTANTIATING COMPLIANCE OF PROPOSED SUBSTITUTION WITH THESE DRAWINGS AND SPECIFICATIONS.

DUCTWORK

1. RUN ALL DUCTWORK AND PIPING AS TIGHT TO BOTTOM OF ROOF DECK AND JOISTS / BEAMS AS POSSIBLE OR RUN THRU / WITHIN OPEN JOIST WEBBING.
2. DUCTWORK SHALL NOT BE SUPPORTED FROM BRIDGING, CONDUIT, PIPING, ETC. OF ANY KIND. DO NOT USE FASTENERS THAT PENETRATE ROOF DECKS.
3. ASPECT RATIO SHALL NOT EXCEED 3:1.
4. ALL DUCTWORK INSTALLATION SHALL RUN CONTINUOUSLY THROUGH PARTITIONS.
5. LOCATE ALL DUCT BALANCING DAMPERS, CONTROL DAMPERS, AND FIRE DAMPERS ABOVE ACCESSIBLE CEILINGS OR PROVIDE CEILING AND / OR WALL ACCESS DOORS.
6. PROVIDE VOLUME CONTROL DAMPERS WITH QUADRANT AND LOCK AND STANDOFF COLLAR AT ALL BRANCH DUCTS TO DIFFUSERS. INSTALL AT A MINIMUM OF TWO DUCT WIDTHS FROM BRANCH TAKEOFF.
7. DUCTWORK SIZES INDICATED ON DRAWINGS ARE INSIDE, FREE AND CLEAR DIMENSIONS. INCREASE DUCT OUTSIDE DIMENSION SIZE BY TWO (2) TIMES THE THICKNESS OF THE INSULATION.
8. ALL DUCTWORK SHALL BE CONSTRUCTED AND INSTALLED IN ACCORDANCE WITH SMACNA STANDARDS.
9. ALL DUCTWORK SHALL BE GALVANIZED SHEET METAL IN AREAS WITH FINISHED CEILINGS.
   A. ALL CONCEALED DUCTWORK AND FITTINGS SHALL BE CONSTRUCTED OF MINIMUM 26-GAUGE STEEL (GALVANIZED) AND 24-GAUGE (ALUMINUM).
   B. LAUNDRY: ALL DRYER DUCTWORK AND FITTINGS SHALL BE CONSTRUCTED OF MINIMUM 26-GAUGE GALVANIZED STEEL OR MINIMUM 24-GAUGE ALUMINUM.
10. WHERE RECTANGULAR DUCTWORK IS INDICATED, AND AT INSTALLERS OPTION, SPIRAL AND ROUND DUCTWORK MAY BE SUBSTITUTED FOR RECTANGULAR DUCTWORK PROVIDED THEY ARE EQUIVALENT TO THE RECTANGULAR DIMENSIONS INDICATED ON THE DRAWINGS (i.e.: 8x4 = 8"ø, 10x6 = 10"ø).
11. PROVIDE INTERNALLY LINED SUPPLY AIR DUCTWORK FROM ROOFTOP UNITS TO A MINIMUM OF 20-FEET AWAY FROM THE UNIT. REMAINING CONCENALED SUPPLY AIR DUCTWORK SHALL BE EXTERNALLY INSULATED WITH MINIMUM 1-1/2" THICK, 0.75 LB DENSITY, FOIL-BACK INSULATION WITH VAPOR BARRIER AND A MINIMUM R-VALUE OF R-6, FLAME SPREAD RATING OF 25 OR LESS, AND SMOKE-DEVELOPED RATING OF 50 OR LESS.
12. ALL EXPOSED SUPPLY AIR DUCTWORK AND FITTINGS LOCATED ON THE ROOF SHALL BE INTERNALLY LINED (MINIMUM 1-1/2" THICK) AND EXTERNALLY INSULATED WITH MINIMUM 3" THICK, 0.75 LB DENSITY, FOIL-BACK INSULATION WITH VAPOR BARRIER AND ALL SERVICE JACKET, MINIMUM R-VALUE OF R-12, FLAME SPREAD RATING OF 75 OR LESS, AND SMOKE-DEVELOPED RATING OF 150 OR LESS. PROVIDE AN ALUMINUM OR STAINLESS STEEL JACKET OVER EXTERNAL INSULATION AND SEAL ALL SEAMS AIR AND WATERTIGHT TO PREVENT THE ENTRANCE OF MOISTURE, ETC.
   A. OWNERS OPTION: PROVIDE PRE-INSULATED RIGID THERMOSET PHENOLIC DUCTWORK PANELS AS MANUFACTURED BY QDUCT (AQC INDUSTRIES). PANELS SHALL HAVE A MINIMUM R-VALUE OF R-12 AND SHALL CONFORM TO THE REQUIREMENTS OF UL 181. EXTERIOR CLADDING SHALL BE CONSTRUCTED OF ALUMINUM (MINIMUM OF 19.7 MILS THICK) WITH FACTORY INSTALLED DUCTWORK SUPPORT MOUNTING RAILS. PROVIDE ALUMINUM SLOPED ROOF INSULATION PANEL WITH MINIMUM R-VALUE OF R-8.6.
13. ALL RETURN AIR DUCTWORK AND FITINGS LOCATED ON THE ROOF SPACE SHALL BE INTERNALLY LINED (MINIMUM 1-1/2" THICK) AND EXTERNALLY INSULATED WITH MINIMUM 3" THICK, 0.75 LB DENSITY, FOIL-BACK INSULATION WITH VAPOR BARRIER AND ALL SERVICE JACKET, MINIMUM R-VALUE OF R-12, FLAME SPREAD RATING OF 75 OR LESS, AND SMOKE-DEVELOPED RATING OF 150 OR LESS. PROVIDE AN ALUMINUM OR STAINLESS STEEL JACKET OVER EXTERNAL INSULATION AND SEAL ALL SEAMS AIR AND WATERTIGHT TO PREVENT THE ENTRANCE OF MOISTURE, ETC.
   A. OWNERS OPTION: PROVIDE PRE-INSULATED RIGID THERMOSET PHENOLIC DUCTWORK PANELS AS MANUFACTURED BY QDUCT (AQC INDUSTRIES). PANELS SHALL HAVE A MINIMUM R-VALUE OF R-12 AND SHALL CONFORM TO THE REQUIREMENTS OF UL 181. EXTERIOR CLADDING SHALL BE CONSTRUCTED OF ALUMINUM (MINIMUM OF 19.7 MILS THICK) WITH FACTORY INSTALLED DUCTWORK SUPPORT MOUNTING RAILS. PROVIDE ALUMINUM SLOPED ROOF INSULATION PANEL WITH MINIMUM R-VALUE OF R-8.6.
14. ALL RETURN AIR DUCTWORK AND FITTINGS SHALL BE INTERNALLY LINED.
15. ALL DUCT LINERS SHALL BE MINIMUM 1-1/2" THICK, COATED TO PREVENT ELEMENTS FROM ENTERING THE AIRSTREAM (COATING SHALL MEET ASHRAE 62 - LATEST EDITION), AND ENVIRONMENTALLY FRIENDLY WITH A MINIMUM R-VALUE OF R-6. LINER SHALL BE BLACK IN COLOR SO IT IS NOT NOTICEABLE FROM THE INSIDE OF REGISTERS AND GRILLES.
16. ALL SQUARE ELBOWS SHALL HAVE AIRFOIL TYPE TURNING VANES.
17. MAXIMUM FLEXIBLE DUCT LENGTH SHALL BE 5'-0". ALL FLEXIBLE DUCT SHALL CONFORM TO THE REQUIREMENTS OF U.L. 181 FOR CLASS 1 FLEXIBLE AIR DUCTS, WITH A MINIMUM R-VALUE OF R-6. SUPPORT FLEXIBLE DUCT TO ELIMINATE KINKING AND SAGGING. (FLEXIBLE DUCT IS NOT PERMITTED IN EXPOSED AREAS, RETURN AIR GRILLE AND EXHAUST AIR GRILLE CONNECTIONS).

PIPING

1. ALL PIPING LINES, INCLUDING CONDENSATE DRAINS, SHALL BE FULLY INSULATED WITH MINIMUM 1-1/2" THICK, 0.75 LB DENSITY, INSULATION WITH ALL SERVICE JACKET AND VAPOR BARRIER, FLAME SPREAD RATING OF 25 OR LESS, AND SMOKE-DEVELOPED RATING OF 50 OR LESS.
2. CONDENSATE DRAIN PIPING FROM AIR CONDITIONING EQUIPMENT SHALL BE PITCHED A MINIMUM OF 1/4" PER FOOT, IN THE DIRECTION OF FLOW.
3. CONDENSATE DRAIN PIPES SHALL HAVE CLEANOUTS AT EVERY CHANGE IN DIRECTION, DISTANCES GREATER THAN 3 FEET, AND AT THE BEGINNING OF LONG STRAIGHT RUNS.
4. HVAC CONTRACTOR SHALL BE RESPONSIBLE FOR THE SIZING OF REFRIGERANT LINES (LONG LINE APPLICATION) GREATER THAN 50'-0". HVAC EQUIPMENT SUPPLIER SHALL VERIFY REFRIGERANT PIPE LINE SIZES AND CONFIGURATIONS BASED ON CONTRACTOR'S PROPOSED PIPE ROUTING.

CONTROLS

1. ALL CONTROL WIRING AND CONDUIT SHALL COMPLY WITH THE NATIONAL ELECTRIC CODE (NEC) AND NFPA 70.
2. ALL CONTROL WIRING AND POWER CONDUCTOR INSULATION SHALL BE PLENUM RATED.
3. ALL EXPOSED CONTROL WIRING SHALL BE INSTALLED IN 3/4" EMT CONDUIT.
4. PROVIDE ALL RELAYS, CONTACTORS, ETC. REQUIRED TO ACHIEVE INTERLOCK OPERATION OF EQUIPMENT.

BALANCING

1. MECHANICAL CONTRACTOR, WHO IS CERTIFIED BY EITHER THE ASSOCIATED AIR BALANCE COUNCIL (AABC) OR NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB); UPON COMPLETION OF THE PROJECT, SHALL PERFORM A COMPLETE TESTING AND BALANCING OF ALL EQUIPMENT. BALANCE SYSTEM TO WITHIN ±5% OF AIR QUANTITIES INDICATED ON PLANS AND SCHEDULES AND PROVIDE THE OWNER WITH A COMPLETE, SIGNED AND SEALED BALANCE REPORT.

DUCTWORK PRESSURE (TIGHTNESS) TESTING

1. ALL DUCTWORK AND PLENUM SYSTEMS SHALL BE SEALED AND PRESSURE TESTED USING INSTRUMENTS AND PROCEDURES SPECIFIED IN ANSI / ASHRAE 152 AND ASTM E1554 TEST METHOD "A", AND INTERNATIONAL ENERGY CONSERVATION CODE SECTION 403.
   A. EXCEPTION: DUCT TIGHTNESS TEST IS NOT REQUIRED IF THE AIR HANDLER AND ALL DUCTS ARE LOCATED WITHIN THE CONDITIONED SPACE.

HVAC ABBREVIATIONS

AFUE	ANNUAL FUEL UTILIZATION EFFICIENCY	KW	KILOWATT
		LAT	LEAVING AIR TEMPERATURE
BHP	BRAKE HORSEPOWER	LBS	POUNDS
BTU	BRITISH THERMAL UNITS		
CFM	CUBIC FEET PER MINUTE	MBH	1,000 BRITISH THERMAL UNITS
CO_2	CARBON DIOXIDE	MCA	MINIMUM CIRCUIT AMPACITY
COP	COEFFICIENT OF PERFORMANCE	MOCP	MAXIMUM OVERCURRENT PROTECTION
CU	CONDENSING UNIT		
DB	DRY BULB		
EAT	ENTERING AIR TEMPERATURE	NIC	NOT IN CONTRACT
EER	ENERGY EFFICIENCY RATIO	RPM	REVOLUTIONS PER MINUTE
E/F	EXHAUST FAN	RTU	ROOFTOP UNIT
F	FAHRENHEIT	SEER	SEASONAL ENERGY EFFICIENCY RATIO
FCU	FAN COIL UNIT	SP	STATIC PRESSURE
FD	FIRE DAMPER	TU	TERMINAL UNIT
HP	HORSEPOWER	VAV	VARIABLE AIR VOLUME
HSPF	HEATING SEASONAL PERFORMANCE FACTOR	WB	WET BULB
HVAC	HEATING, VENTILATING, AIR CONDITIONING		
IN	INCHES		
INT	INTERNAL		

HVAC DUCTWORK SYMBOLS

SYMBOL	DESCRIPTION
	SUPPLY DUCT RISER
	RETURN DUCT RISER
	EXHAUST DUCT RISER
	DUCT RISE OR DROP
	AIRFOIL TURNING VANES
	FLEXIBLE DUCT
	INTERNALLY LINED DUCTWORK
	MANUAL VOLUME DAMPERS
	DIRECTION OF SLOPE (DOWN IN DIRECTION OF ARROW)
ø	ROUND
200-1 8"ø	SUPPLY AIR DEVICE - FIRST NO. CFM, SECOND NO. TYPE THIRD NO. NECK SIZE (REFER TO SCHEDULE FOR SIZE)
200-2 8"ø	RETURN / EXHAUST AIR DEVICE - FIRST NO. CFM, SECOND NO. TYPE THIRD NO. NECK SIZE (IF REQUIRED) (REFER TO SCHEDULE FOR SIZE)

HVAC CONTROL SYMBOLS

SYMBOL	DESCRIPTION
T	MANUAL, PROGRAMMABLE, 7-DAY, 24-HOUR DIGITAL THERMOSTAT WITH BACKLIT DISPLAY AND BATTERY BACKUP
S	COMBINATION SPACE TEMPERATURE SENSOR AND HUMIDISTAT WITH OVERRIDE
—·—·—	CONTROL WIRING (PLENUM RATED)

HVAC DRAWING LIST

M-1	HVAC SCHEDULES, LEGENDS AND ABBREVIATIONS
M-2	HVAC SCHEDULES
M-3	HVAC SCHEDULES
M-4	HVAC OUTSIDE AIR CALCULATIONS
M-5	HVAC SPECIFICATIONS
M-6	HVAC SPECIFICATIONS
M-7	HVAC CONTROLS SPECIFICATIONS
M-8	HVAC SEQUENCE OF OPERATIONS
M-9	SECOND FLOOR PLAN - HVAC DUCTWORK AND PIPING
M-10	ROOF PLAN - HVAC DUCTWORK AND PIPING
M-11	HVAC DETAILS
M-12	HVAC DETAILS AND CONTROL DIAGRAMS
M-13	HVAC VARIABLE AIR VOLUME (VAV) WIRING DIAGRAMS

AIR DISTRIBUTION DEVICE SCHEDULE

SYMBOL	STYLE & DEVICE SIZE	MOUNTING	DESCRIPTION	MANUFACTURER	MODEL NO.	MAXIMUM NC
			SUPPLY			
TYPE 1	SUPPLY 24x24	LAY-IN	ARCHITECTURAL PLAQUE FACE, STEEL CONSTRUCTION, 3 SLOTS (SLOT WIDTH IS 1-1/2"), OPPOSED BLADE VOLUME DAMPER, 4-WAY THROW, WHITE FINISH	TITUS	DAT	15
			RETURN			
TYPE 2	RETURN 24x24	LAY-IN	PERFORATED FACE, STEEL CONSTRUCTION, OPPOSED BLADE VOLUME DAMPERS, PROVIDE 22"x22" BACKPAN FOR FULL PANEL LAY-IN APPLICATION, WHITE FINISH	TITUS	PAR	14
			EXHAUST			
TYPE 3	EXHAUST 12x12	SURFACE	PERFORATED FACE, STEEL CONSTRUCTION, OPPOSED BLADE VOLUME DAMPERS, PROVIDE 10"x10" BACKPAN FOR FULL PANEL APPLICATION, WHITE FINISH	TITUS	PAR	---
TYPE 4	EXHAUST 24x24	LAY-IN	PERFORATED FACE, STEEL CONSTRUCTION, OPPOSED BLADE VOLUME DAMPERS, PROVIDE 22"x22" BACKPAN FOR FULL PANEL LAY-IN APPLICATION, WHITE FINISH	TITUS	PAR	15

AIR DISTRIBUTION DEVICE NOTES:

1. ALL DEVICES SHALL BE FROM A SINGLE MANUFACTURER.
2. ALL DEVICES SHALL HAVE MATCHING MATTE, WHITE FINISH (UNLESS OTHERWISE NOTED IN DESCRIPTION ABOVE).
3. MAXIMUM NC OF 20.
4. ACCESSORIES:
   A. PLASTER RING: FOR INSTALLATION IN GYPBOARD CEILING.
   B. OPERATING KEYS: TOOLS DESIGNED TO FIT THROUGH DIFFUSER FACE AND OPERATE VOLUME CONTROL DEVICE AND / OR PATTERN ADJUSTMENT
5. ACCEPTABLE MANUFACTURER'S - TITUS, PRICE.

NOTE: SUBMITTALS SHALL INCLUDE DIFFUSER AND GRILLE SCHEDULE INDICATING ROOM LOCATION. NOISE CRITERIA (NC) AND PERFORMANCE DATA FOR EACH TYPE OF DIFFUSER AND GRILLES INDICATED.

DRYER BOOSTER FAN SCHEDULE

MARK	AREA SERVED	CFM	STATIC PRESS. IN. WG EXT.	MANUFACTURER	MODEL NO.	FAN				MOTOR		OPERATING WEIGHT (LBS.)
						FAN TYPE	DRIVE TYPE	RPM	SONES	WATTS	VOLTS / PH	
BF-1	LAUNDRY / STORAGE 234	150	---	FANTECH	DEDPV-705	CENTRIFUGAL	---	2800	---	83	120/1/60	25

DRYER BOOSTER FAN NOTES:

1. DEDPV-705
2. MINIMUM 18-GAUGE CORROSION RESISTANT GALVANIZED STEEL PARTICULATE HANDLING IMPELLER.
3. BACKWARD INCLINED FAN WHEEL.
4. MOTORS WITH BUILT-IN THERMAL OVERLOAD PROTECTION.
5. PSC, PERMANENTLY LUBRICATED MOTOR MOUNTED OUT OF THE AIRSTREAM.
6. INLET AND OUTLET DUCT FLANGES.
7. FACTORY INSTALLED AND WIRED POWER CORD (MINIMUM 6'-0" LONG) FOR CONNECTION TO A STANDARD ELECTRICAL OUTLET.
   A. AUTOMATICALLY ACTIVATED BY PRESSURE SENSING CONTROL.
8. CONTROLS - PRESSURE SENSING WITH SELF-CLEANING TUBE DESIGN.
   A. AUTOMATICALLY ACTIVATES FAN BASED ON OPERATION OF DRYER.
9. WALL MOUNTED INDICATOR PANEL WITH LED DISPLAY AND MINIMUM 50-FOOT CABLE.
10. TEMPERATURE LIMIT DEVICE (SHUTS DOWN THE FAN IN CASE OF A DRYER FIRE).
11. MOUNT DRYER BOOSTER FANS IN VERTICAL PORTION (EXPOSED) OF THE DRYER EXHAUST DUCTWORK LOCATED WITHIN THE LAUNDRY ROOM. IF MOUNTED IN THE HORIZONTAL POSITION (CONCEALED ABOVE CEILING), PROVIDE CEILING ACCESS DOORS.
12. PROVIDE ALL NECESSARY WALL AND / OR CEILING BRACKETS AS REQUIRED FOR A COMPLETE INSTALLATION.
13. ACCEPTABLE MANUFACTURER'S - FANTECH, TJERNLUND.

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TITLE:
HVAC SCHEDULES, LEGENDS AND ABBREVIATIONS

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DATE: 4-6-2020

DRAWING #: M-1

VARIABLE AIR VOLUME TERMINAL UNIT SCHEDULE

MARK	AREA SERVED	ASSOCIATED ROOFTOP UNIT	MANUFACTURER	MODEL NO.	INLET DUCT SIZE (DIA.)	AIR QUANTITY			ELECTRIC REHEAT SECTION								RADIATED NOISE CRITERIA (NC)	DISCHARGE NOISE CRITERIA (NC)	OPERATING WEIGHT (LBS)
						TOTAL CFM	MINIMUM OUTSIDE AIR CFM	MINIMUM CFM	KW	MBH	STEPS	EAT °F	LAT °F	MCA	MOCP	VOLTS / PH			
TU-01	CLASSROOM 260	RTU-1	TITUS	DESV-09	9"ø	650	175	175	3.5	11.9	SCR	90	105	15.8	20	277/1/60		18	23	25
TU-02	CLASSROOM 258	RTU-1	TITUS	DESV-09	9"ø	700	175	175	3.5	11.9	SCR	90	105	15.8	20	277/1/60		18	24	25
TU-03	CLASSROOM 257	RTU-1	TITUS	DESV-07	7"ø	550	150	150	3.0	10.2	SCR	90	105	13.5	15	277/1/60		24	25	25
TU-04	CLASSROOM 256	RTU-1	TITUS	DESV-07	7"ø	500	125	125	2.5	8.5	SCR	90	105	11.3	15	277/1/60		21	25	25
TU-05	FACULTY 254	RTU-1	TITUS	DESV-09	9"ø	900	200	200	4.5	15.4	SCR	90	105	20.3	25	277/1/60		20	25	25
TU-06	DIRECTOR 253	RTU-1	TITUS	DESV-07	7"ø	400	100	100	2.0	6.8	SCR	90	105	9.0	15	277/1/60		19	24	25
TU-07	LEARNING 252	RTU-1	TITUS	DESV-05	5"ø	125	50	50	1.0	3.4	SCR	90	105	4.5	15	277/1/60		---	23	25
TU-08	LAB 241	RTU-1	TITUS	DESV-09	9"ø	700	200	200	4.0	13.6	SCR	90	105	18.1	20	277/1/60		19	23	25
TU-09	LAB 243	RTU-2	TITUS	DESV-12	12"ø	1,100	300	300	---	---	---	---	---	---	---	---		20	25	25
TU-10	LIBRARY 245	RTU-2	TITUS	DESV-14	14"ø	2,375	575	575	---	---	---	---	---	---	---	---		22	20	25
TU-11	CLASSROOM 266	RTU-2	TITUS	DESV-07	7"ø	400	100	100	---	---	---	---	---	---	---	---		19	25	25
TU-12	LOUNGE 263	RTU-2	TITUS	DESV-05	5"ø	125	50	50	---	---	---	---	---	---	---	---		---	23	25
TU-13	LECTURE 265	RTU-2	TITUS	DESV-07	7"ø	400	100	100	---	---	---	---	---	---	---	---		19	25	25
TU-14	CORRIDOR 242	RTU-2	TITUS	DESV-14	14"ø	1,200	300	300	---	---	---	---	---	---	---	---		16	19	25
TU-15	CORRIDOR	RTU-3	TITUS	DESV-09	9"ø	700	150	150	---	---	---	---	---	---	---	---		18	24	25
TU-16	CLASSROOM 268	RTU-3	TITUS	DESV-09	9"ø	700	150	150	---	---	---	---	---	---	---	---		18	24	25
TU-17	ESPORTS 262	RTU-3	TITUS	DESV-07	7"ø	550	125	125	---	---	---	---	---	---	---	---		24	25	25
TU-18	CLASSROOM 264	RTU-3	TITUS	DESV-06	6"ø	350	75	100	---	---	---	---	---	---	---	---		19	23	25
TU-19	CLASSROOM 267	RTU-3	TITUS	DESV-09	9"ø	700	150	175	---	---	---	---	---	---	---	---		18	24	25
TU-20	CLASSROOM 269	RTU-3	TITUS	DESV-12	12"ø	950	225	275	---	---	---	---	---	---	---	---		19	23	25
TU-21	OFFICE 270	RTU-3	TITUS	DESV-07	7"ø	475	125	125	---	---	---	---	---	---	---	---		20	25	25
TU-22	CORRIDOR 272	RTU-3	TITUS	DESV-09	9"ø	625	125	125	---	---	---	---	---	---	---	---		17	24	25
TU-23	OFFICE 261	RTU-3	TITUS	DESV-05	5"ø	150	50	50	---	---	---	---	---	---	---	---		10	25	25
TU-24	CORRIDOR 207	RTU-4	TITUS	DESV-14	14"ø	1,650	475	475	---	---	---	---	---	---	---	---		20	22	25
TU-25	CONF 208	RTU-4	TITUS	DESV-07	7"ø	400	100	100	---	---	---	---	---	---	---	---		19	25	25
TU-26	DIRECTOR 221	RTU-5	TITUS	DESV-07	7"ø	400	100	100	2.0	6.8	SCR	90	105	9.0	15	277/1/60		19	24	25
TU-27	CD 220	RTU-5	TITUS	DESV-06	6"ø	250	75	75	1.5	5.1	SCR	90	105	6.8	15	277/1/60		15	19	25
TU-28	ADMISSIONS 218	RTU-5	TITUS	DESV-14	14"ø	1,925	400	400	9.5	32.4	SCR	90	105	42.9	45	277/1/60		20	23	25
TU-29	DEAN 225	RTU-5	TITUS	DESV-07	7"ø	475	00	100	2.5	8.5	SCR	90	105	9.5	15	277/1/60		20	24	25
TU-30	ADVISOR 227	RTU-5	TITUS	DESV-14	14"ø	1,150	250	250	5.5	18.8	SCR	90	105	24.8	25	277/1/60		15	18	25
TU-31	FINANCIAL 209	RTU-6	TITUS	DESV-14	14"ø	1,500	375	375	---	---	---	---	---	---	---	---		18	22	25
TU-32	CAREER 229	RTU-6	TITUS	DESV-07	7"ø	400	100	100	---	---	---	---	---	---	---	---		19	25	25
TU-33	RECEPTION 203	RTU-6	TITUS	DESV-14	14"ø	1,250	300	300	---	---	---	---	---	---	---	---		16	20	25
TU-34	MANAGER 213	RTU-7	TITUS	DESV-09	9"ø	675	200	200	3.5	11.9	SCR	90	105	15.8	20	277/1/60		18	24	25
TU-35	LOUNGE 204	RTU-7	TITUS	DESV-14	14"ø	1,725	525	525	8.5	29.0	SCR	90	105	38.4	40	277/1/60		22	20	25

VARIABLE AIR VOLUME TERMINAL UNIT NOTES:

1. DOUBLE WALL CONSTRUCTION, MINIMUM 22-GAUGE GALVANIZED STEEL HOUSING.
2. MINIMUM 1" THICK MATTE FACE INSULATION (ULTRALOC) ENLOSED BETWEEN THE UNIT CASING AND NON-PERFORATED INTERNAL 22-GAUGE SHEET METAL COVER.
3. LOW LEAKAGE CONTROL DAMPER WITH EDGE SEALS.
4. FACTORY INSTALLED CONTROL BOX AND TRANSFORMER.
5. SINGLE POINT POWER CONNECTION (FACTORY WIRED TRANSFORMER AND ELECTRIC REHEAT COIL).
6. ELECTRIC REHEAT COILS SHALL BE TYPE SCR.
7. MAXIMUM AIR PRESSURE DROP OF 0.40 INCHES WG.
8. ACCESSORIES:
   A. DISCHARGE AIR SENSOR.
   B. SOUND ATTENUATOR (UNITS WITH ELECTRIC REHEAT ONLY).
   C. FACTORY INSTALLED ACCESS DOOR.
9. MAXIMUM RADIATED NC OF 24 AND DISCHARGE NC OF 25.
10. ACCEPTABLE MANUFACTURERS: CARRIER, TITUS, PRICE.

NOTE: SUBMITTALS SHALL INCLUDE MINIMUM OUTSIDE AIR, MINIMUM CFM, RADIATED NOISE CRITERIA (NC) AND DISCHARGE NOISE CRITERIA (NC) FOR EACH TYPE OF VARIABLE AIR VOLUME BOX INDICATED.

ROOF EXHAUST FAN SCHEDULE

MARK	AREA SERVED	CFM	STATIC PRESS. IN. WG EXT.	MANUFACTURER	MODEL NO.	FAN				MOTOR		ROOF CURB SIZE	OPERATING WEIGHT (LBS.)
						FAN TYPE	DRIVE TYPE	RPM	SONES	HP	VOLTS / PH		
E/F-1	WOMENS 274, MENS 275	525	0.25	GREENHECK	LD-95-VG	CENTRIFUGAL	DIRECT	1234	5.4	1/6	120/1/60	GPI-19/10-A12	100
E/F-2	WOMENS 235, JANITOR 236, MENS 237	575	0.25	GREENHECK	LD-95VG	CENTRIFUGAL	DIRECT	1282	6.0	1/6	120/1/60	GPI-19/10-A12	100

ROOF EXHAUST FAN NOTES:

1. HOUSING - "LOW PROFILE" ANODIZED ALUMINUM WITH HINGED HOOD AND ALUMINUM BIRDSCREEN.
2. FAN - BACKWARD INCLINED ANODIZED ALUMINUM.
3. BUILT-IN POWER DISCONNECT.
4. MOTORS SHALL HAVE BUILT-IN THERMAL OVERLOAD PROTECTION.
5. ROOF CURBS:
   A. EACH EXHAUST FAN SHALL BE EQUIPPED WITH AN INSULATED, ANODIZED ALUMINUM ROOF CURB (0.080" MINIMUM THICKNESS), ALL WELDED JOINT CONSTRUCTION.
      1). ROOF CURBS SHALL HAVE A BASE THAT FITS SLOPE OF ROOF AS REQUIRED. TOP OF ROOF CURB SHALL BE LEVEL.
   B. ALL CURBS SHALL BE MINIMUM 1'-0" HIGH.
6. ACCESSORIES:
   A. MOTORIZED, OPPOSED BLADE, LOW LEAKAGE ALUMINUM CONTROL DAMPERS (120V ACTUATOR).
   B. 1" THICK FAN HOUSING INSULATION.
   C. VARI-GREEN EC MOTOR WITH UNIT MOUNTED POTENTIOMETER DIAL.
7. INTERLOCK EXHAUST FAN (E/F-1) WITH ASSOCIATED ROOFTOP UNIT (RTU-3) OPERATION.
8. INTERLOCK EXHAUST FAN (E/F-2) WITH ASSOCIATED ROOFTOP UNIT (RTU-4) OPERATION.
9. MAXIMUM SONES TO BE 5.4 (E/F-1) AND 6.0 (E/F-2) OR LESS, UNLESS OTHERWISE INDICATED.
10. ACCEPTABLE MANUFACTURER'S - GREENHECK, COOK, ACME.

NOTES:

1. UNITS SHALL BE INSTALLED TO RESIST THE WIND PRESSURES DETERMINED IN ACCORDANCE WITH THE INTERNATIONAL BUILDING CODE.

CONDENSING UNIT SCHEDULE

MARK	AREA SERVED	MANUFACTURER	MODEL NO.	DX COOLING		DX HEATING		REFRIGERANT CONNECTIONS		MOTOR			MCA	MOCP	SEER	OPERATING WEIGHT (LBS.)
				RATED MBH	MBH RANGE (MINIMUM TO MAXIMUM)	RATED MBH	MBH RANGE (MINIMUM TO MAXIMUM)	SUCTION	LIQUID	RPM	HP	VOLTS / PH				
CU-1	FCU-1	CARRIER	38MAQB-24	24.0	8.5 - 26.5	24.0	13.2 - 32.0	5/8"	3/8"	1150	1/6	208/1/60	20.0	30.0	20.0	125

CONDENSING UNIT NOTES:

1. UNIT CABINET SHALL BE CONSTRUCTED OF HEAVY-GAUGE, CORROSION RESISTANT STEEL, WITH FACTORY POWDER COAT PAINT.
2. UNIT ENCLOSURE SHALL CONTAIN FACTORY WIRING, PIPING, CONTROLS, COMPRESSOR, REFRIGERANT CHARGE, AND SPECIAL FEATURES.
3. CONDENSER COIL SHALL BE CONSTRUCTED OF ALUMINUM FINS MECHANICALLY BONDED TO COPPER TUBES.
4. CONDENSER FAN SHALL BE DIRECT DRIVE DIRECT DRIVE, PROPELLER TYPE, MULTIPLE SPEED OPERATION.
5. COMPRESSORS SHALL BE VARIABLE SPEED (INVERTER) TYPE.
6. MOTORS SHALL HAVE BUILT-IN THERMAL OVERLOAD PROTECTION.
7. UNIT SHALL HAVE:
   A. R410A REFRIGERANT.
   B. LINE SET.
   C. FILTER DRIER.
   D. THERMOSTATIC EXPANSION VALVES.
   E. LOW PRESSURE SWITCH.
   F. HIGH PRESSURE SWITCH.
8. ACCESSORIES:
   A. LOW AMBIENT CONTROLS, HEATING AND COOLING (OPERATION DOWN TO MINUS 13-DEGREES F, MINIMUM).
   B. WINTER START CONTROL.
   C. CRANKCASE HEATER.
   D. PE MOUNTING BASE (PIPE RISER CURB).
   E. ALUMINUM EQUIPMENT RAIL (MINIMUM 2'-0" HIGH).
   F. FIELD INSTALLED WIND BAFFLE TO PROTECT THE UNIT FROM SNOW ACCUMULATION AND / OR BLOCKED AIR INTAKE, AS REQUIRED BY THE UNIT MANUFACTURER (COORDINATE EXACT UNIT LOCATIONS AND REQUIREMENTS WITH UNIT MANUFACTURER PRIOR TO INSTALLING WIND BAFFLE).
9. ACCEPTABLE MANUFACTURER'S - CARRIER, LG, DAIKIN.

NOTES:

1. UNITS SHALL BE INSTALLED TO RESIST THE WIND PRESSURES DETERMINED IN ACCORDANCE WITH THE INTERNATIONAL BUILDING CODE.
2. SUBMITTALS SHALL INCLUDE HEATING / COOLING RATED MBH CAPACITY, AND HEATING / COOLING MINIMUM-MAXIMUM MBH RANGE FOR EACH TYPE OF CONDENSING UNIT INDICATED.

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DRAWING #: M-2

FAN COIL UNIT SCHEDULE

MARK	AREA SERVED	TONS	SUPPLY AIR CFM	RETURN AIR CFM	STATIC PRESS. IN. WG EXT.	MANUFACTURER	MODEL NO.	DX COOLING					DX HEATING				SUPPLY FAN				MCA	SEER	HSPF	COP	OPERATING WEIGHT (LBS.)
								RATED MBH	MBH RANGE (MINIMUM TO MAXIMUM)	EAT °F (OUTSIDE DB)	EAT °F (OUTSIDE WB)	MIN. ROWS	RATED MBH	MBH RANGE (MINIMUM TO MAXIMUM)	EAT °F	LAT °F	RPM	BHP	HP	VOLTS / PH					
FCU-1	SERVER 232	2.0	750	750	---	CARRIER	40MBCQ-24 (CEILING CASSETTE)	24.0	8.5 – 26.5	95	70	2	24.0	13.2 – 32.0	72	95	790	---	1/16	208/1/60	0.30	20.0	11.5	3.46	50

FAN COIL UNIT NOTES:

1. HEAT PUMP UNIT.
2. UNIT SHALL HAVE:
   - A. R410A REFRIGERANT.
   - B. MINIMUM 20-GAUGE, FACTORY FINISHED, BONDERIZED STEEL CABINET.
   - C. 3-SPEED CENTRIFUGAL MOTOR.
   - D. FAN MOTOR THERMAL OVERLOAD PROTECTOR.
   - E. CONTROL CIRCUIT BOARD.
   - F. MICROPROCESSOR CONTROLS.
   - G. SELF-DIAGNOSTICS.
   - H. AUTO-RESTART FUNCTION.
   - I. CONDENSATE DRAIN PAN WITH CONDENSATE PUMP.
   - J. INTERNAL TRANSFORMER FOR WALL MOUNTED 24V THERMOSTAT CONTROL.
   - K. FREEZESTAT.
   - L. FILTER TRACK WITH CLEANABLE FILTERS.
   - M. ALL NECESSARY CEILING BRACKETS AS REQUIRED FOR A COMPLETE INSTALLATION.
3. ACCESSORIES:
   - A. LOW AMBIENT CONTROLS, HEATING AND COOLING (OPERATION DOWN TO MINUS 13-DEGREES F, MINIMUM)
   - B. AUXILIARY DRAIN PAN OR SECONDARY CONDENSATE DRAIN CONNECTION FOR OVERFLOW PROTECTION.
     1). WATER LEVEL DETECTION DEVICE CONFORMING TO UL 508 SHALL BE PROVIDED THAT WILL SHUT OFF THE EQUIPMENT SERVED IN THE EVENT THAT THE PRIMARY DRAIN IS BLOCKED.
   - C. SERVICE VALVES WITH SCHRADER PORTS.
   - D. FACTORY WIRED CONTROLS FOR REMOTE WALL MOUNTED THERMOSTAT.
   - E. WALL MOUNTED THERMOSTAT, 7-DAY CONVENTIONAL (7-DAY PROGRAMMABLE THERMOSTAT WITH MANUAL CHANGEOVER, SINGLE STAGE HEATING / COOLING, BACKLIT DISPLAY, BATTERY BACKUP, 24V AC).
   - F. VIBRATION ISOLATION HANGERS.
4. ACCEPTABLE MANUFACTURER'S – CARRIER, LG, DAIKIN.

*NOTE: FAN COIL UNITS ARE POWERED BY IT'S ASSOCIATED CONDENSING UNIT POWER.

ROOFTOP UNIT SCHEDULE

MARK	AREA SERVED	TONS	SUPPLY AIR CFM	RETURN AIR CFM	OUTSIDE AIR CFM	STATIC PRESS. IN. WG EXT.	MANUFACTURER	MODEL NO.	DX COOLING COIL				GAS HEATING SECTION					SUPPLY AIR FAN				SEER / EER	MCA	MOCP (HACR BREAKER)	OPERATING WEIGHT (LBS.)
																			MOTOR						
									MBH	EAT °F (OUTSIDE DB)	EAT °F (OUTSIDE WB)	MIN. ROWS	MBH INPUT	MBH OUTPUT	AFUE %	EAT °F	LAT °F	RPM	BHP	HP	VOLTS / PH				
RTU-1	CORRIDOR 239, LAB 241, LEARNING CENTER OFFICE 252, PROGRAM DIRECTOR 253, FACULTY 254, CLASSROOM 256, CLASSROOM 257, CLASSROOM 258, CLASSROOM 260	12.5	4,575	3,400	1,175	1.20	CARRIER	48LCF-14	146.0	95	70	4	248.0 (1ST STAGE) 310.0 (2ND STAGE)	200.0 (1ST STAGE) 251.0 (2ND STAGE)	81%	54	90	866	2.14	3	460/3/60	--- / 12.4	45.6	50.0	3,400
RTU-2	CORRIDOR 242, LAB 243, LAB STORAGE 244, LIBRARY 245, TESTING 247, TESTING 248, TESTING 249, TESTING 250, LEARNING CENTER OFFICE 241, VETERANS LOUNGE 263, LECTURE 265, CLASSROOM 266	10.0	4,675	3,500	1,175	1.10	CARRIER	48LCF-12	116.0	95	70	4	252.0 (1ST STAGE) 315.0 (2ND STAGE)	202.0 (1ST STAGE) 252.0 (2ND STAGE)	80%	54	95	849	3.35	5	460/3/60	--- / 13.0	33.0	40.0	2,800
RTU-3	ATHLETIC OFFICE 261, ESPORTS 262, MICRO CLASS 264, CLASSROOM 267, CLASSROOM 268, CLASSROOM 269, CORRIDOR, ATHLETIC OFFICE 270, ATHLETIC MEETING AREA 271, CORRIDOR 272, WOMENS 274, MENS 275	12.5	5,200	4,025	1,175	1.20	CARRIER	48LCF-14	146.0	95	70	4	248.0 (1ST STAGE) 310.0 (2ND STAGE)	200.0 (1ST STAGE) 251.0 (2ND STAGE)	81%	56	95	892	2.57	3	460/3/60	--- / 12.4	45.6	50.0	3,400
RTU-4	CORRIDOR 207, CONFERENCE 208, CORRIDOR 233, LAUNDRY 234, WOMENS 235, JANITOR 236, MENS 237, ELECTRICAL ROOM	5.0	2,050	1,475	575	1.00	CARRIER	48LCF-06	58.5	95	70	4	120.0 (1ST STAGE) 150.0 (2ND STAGE)	96.0 (1ST STAGE) 117.0 (2ND STAGE)	80%	52	95	1441	1.75	2	460/3/60	17.2 / 12.7	18.0	25.0	1,100
RTU-5	ADMISSIONS AREA 218, FIREPROOF STORAGE 219, CD 220, ADMISSIONS DIRECTOR 221, BREAK ROOM 222, REGISTRAR 223, ASSOC DEAN 224, DEAN OF INSTRUCTION 225, STORAGE 226, ADVISOR AREA 227, SHARED WAITING 228, WELLNESS 231	10.0	4,200	3,275	925	1.10	CARRIER	48LCE-12	116.0	95	70	4	192.0 (1ST STAGE) 240.0 (2ND STAGE)	156.0 (1ST STAGE) 195.0 (2ND STAGE)	81%	56	90	828	2.98	5	460/3/60	--- / 13.0	31.0	35.0	2,300
RTU-6	RECEPTION 203, INTERVIEW ROOM 205, INTERVIEW ROOM 206, FINANCIAL ADVISOR AREA 209, IT CORD 216, BOOK DIST 217, CAREER SERVICES 229, CS OFFICE 230	7.5	3,150	2,375	775	1.10	CARRIER	48LCE-08	89.0	95	70	4	144.0 (1ST STAGE) 180.0 (2ND STAGE)	118.0 (1ST STAGE) 146.0 (2ND STAGE)	81%	54	95	785	2.26	3	460/3/60	--- / 13.0	29.0	30.0	2,300
RTU-7	STUDENT LOUNGE 204, FA MANAGER 210, BUSINESS OFFICE DIRECTOR 211, ANALYSIS 212, OFFICE MANAGER 213, STORAGE 214	6.0	2,400	1,675	725	1.10	CARRIER	48LCF-07	70.0	95	70	4	120.0 (1ST STAGE) 180.0 (2ND STAGE)	98.0 (1ST STAGE) 148.0 (2ND STAGE)	82%	50	90	8.62	1.36	2	460/3/60	--- / 13.0	24.0	25.0	1,600

ROOFTOP UNIT NOTES:

1. UNITS SHALL BE LISTED AND LABELED WITH THE ENERGY STAR LOGO.
2. FACTORY ASSEMBLED, PACKAGED UNIT WITH ROOF CURB AND ALL STANDARD ACCESSORIES.
3. UNIT SHALL BE SINGLE-WALL CONSTRUCTION AND MINIMUM 1/2" THICK (1-1/2 LB.) DENSITY INSULATION.
4. UNIT SHALL BE U.L. OR AGA APPROVED.
5. UNIT SHALL BE OF DOWNFLOW DESIGN AND SHALL HAVE 100% ECONOMIZER FUNCTION.
   - A. UNIT SHALL HAVE 100% ECONOMIZER FUNCTION WITH DIFFERENTIAL ENTHALPY CONTROL AND MINIMUM OUTSIDE AIR SETTING, AND BAROMETRIC RELIEF.
6. COMPRESSORS SHALL BE HIGH EFFICIENCY DESIGN.
7. UNIT SHALL HAVE:
   - A. R410A REFRIGERANT.
   - B. ALL SECTIONS SHALL HAVE HINGED ACCESS DOORS.
   - C. MOTORS SHALL HAVE BUILT-IN OVERLOAD PROTECTION.
   - D. UNITS SHALL HAVE ADJUSTABLE PITCH MOTOR SHEAVES AND MOTOR PULLEYS.
   - E. 2-STAGE GAS HEATING AND 2-STAGE COOLING (RTU-4).
   - F. 2-STAGE GAS HEATING AND 3-STAGE COOLING (RTU-1, RTU-2, RTU-3, RTU-5, RTU-6, RTU-7).
   - G. 30% PLEATED FILTERS.
   - H. ALUMINIZED STEEL HEAT EXCHANGER.
   - J. FACTORY INSTALLED REMOTE SHUTDOWN TERMINALS.
   - K. DOUBLE-SLOPE DRAIN PAN WITH P-TRAP ASSEMBLY.
8. ACCESSORIES:
   - A. RTU-1 THRU RTU-3: 4'-0" HIGH, SOLID BOTTOM THERMAL / ACCOUSTICAL VIBRATION ISOLATION ROOF CURB WITH INTEGRAL, 14-GAUGE (MINIMUM) SERVICE PLATFORM (SERVICE PLATFORM SHALL BE SIZED TO ALLOW FOR THE MANUFACTURERS MINIMUM SERVICE CLEARANCE REQUIREMENTS).
     1). FACTORY APPLIED, BLACK BAKED ENAMEL FINISH (COORDINATE EXACT COLOR, INCLUDING CUSTOM COLOR, WITH ARCHITECT PRIOR TO PURCHASING AND INSTALLING ROOF CURB AND SERVICE PLATFORM).
   - B. RTU-4 THRU RTU-7: 2'-0" HIGH, SOLID BOTTOM THERMAL / ACCOUSTICAL VIBRATION ISOLATION ROOF CURB.
   - C. OUTSIDE AIR INTAKE HOOD AND RELIEF / EXHAUST HOOD.
   - D. MODULATING, LOW-LEAKAGE, OPPOSED BLADE OUTSIDE AIR DAMPERS.
   - E. POWER EXHAUST.
   - F. CARBON DIOXIDE (CO_2) SENSOR FOR OUTSIDE AIR CONTROL OVERRIDE (MOUNT IN RETURN AIR DUCTWORK).
   - G. DISCHARGE AIR SENSOR MOUNTED IN SUPPLY AIR DUCTWORK.
   - H. STATIC PRESSURE SENSOR MOUNTED IN SUPPLY AIR DUCTWORK.
   - I. HUMIDI-MIZER DEHUMIDIFICATION CONTROL.
   - J. FACTORY INSTALLED AND WIRED VARIABLE FREQUENCY DRIVE WITH INVERTER DUTY, PREMIUM EFFICIENT MOTOR – SUPPLY AND EXHAUST.
   - K. STAINLESS STEEL, DOUBLE-SLOPE DRAIN PAN WITH P-TRAP ASSEMBLY.
   - L. FACTORY INSTALLED AND WIRED NON-FUSED DISCONNECT SWITCH.
   - M. FACTORY INSTALLED AND WIRED 120 VOLT GFI DUPLEX RECEPTACLE.
   - N. CONTROLS: SYSTEM CONTROLLER WITH VISUAL SCROLLING MARQUEE DISPLAY (COLOR DISPLAY CONTROLLER). LOCATE IN SERVER 232 (COORDINATE EXACT LOCATION IN FIELD WITH THE OWNER PRIOR TO INSTALLATION).
     1). I-VU CONTROL SYSTEM (COORDINATE EXACT LOCATION IN THE FIELD WITH THE OWNER PRIOR TO INSTALLATION.
     2). COMBINATION SPACE TEMPERATURE SENSORS WITH OVERRIDE AND HUMIDITY SENSOR.
     3). PRIMARY AIR SENSORS.
     4). ACTUATOR WITH 4-20mA OUTPUT.
     5). INTERLOCKS FOR OTHER EQUIPMENT.
   - O. FACTORY-AUTHORIZED SERVICE REPRESENTATIVE TO PERFORM STARTUP SERVICE.
9. INSTALLATION:
   - A. UNITS SHALL BE ON MANUFACTURER PROVIDED, FULL PERIMETER, INSULATED ROOF CURB SUITABLE FOR THE ROOF DECK, INSULATION AND MEMBRANE (REFER TO ARCHITECTURAL DRAWINGS FOR ROOF CONSTRUCTION).
     1). ROOF CURBS SHALL HAVE A BASE THAT FITS SLOPE OF ROOF AS REQUIRED. TOP OF ROOF CURB SHALL BE LEVEL.
   - B. ALL SERVICES TO THE UNIT SHALL ENTER WITHIN THE ROOF CURB. NO SEPARATE ROOF PENETRATIONS ARE ALLOWED.
10. ACCEPTABLE MANUFACTURER'S – CARRIER, AAON, MCQUAY.

NOTES:

1. UNITS SHALL BE INSTALLED TO RESIST THE WIND PRESSURES DETERMINED IN ACCORDANCE WITH THE INTERNATIONAL BUILDING CODE.

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SA JOB #: 19099.02

DATE: 4-6-2020

DRAWING #: M-3

OUTSIDE AIR SCHEDULE

RTU-1

OCCUPANCY OR USE	ROOM NAME	ROOM SQUARE FOOTAGE	OCCUPANT LOAD (PEOPLE / SQFT)	OUTSIDE AIR VENTILATION (CFM / SQFT)	MINIMUM OUTSIDE AIR REQUIRED
CORRIDORS	CORRIDOR 239	181	---	0.06 CFM / SQFT	181 x 0.06 11 CFM
EDUCATION	LAB 241	432	35 / 1000 35 x (432 / 1000) 15 PEOPLE	0.12 CFM / SQFT	10 CFM / PERSON (15 x 10) + (0.12 x 432) 202 CFM
OFFICE SPACES	LEARNING 252	185	5 / 1000 5 x (103 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 103) 11 CFM
OFFICE SPACES	DIRECTOR 253	328	5 / 1000 5 x (328 / 1000) 2 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (2 x 5) + (0.06 x 328) 30 CFM
OFFICE SPACES	FACULTY 254	679	5 / 1000 5 x (679 / 1000) 3 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (3 x 5) + (0.06 x 679) 56 CFM
EDUCATION	CLASSROOM 256	401	35 / 1000 35 x (401 / 1000) 14 PEOPLE	0.12 CFM / SQFT	10 CFM / PERSON (14 x 10) + (0.12 x 401) 188 CFM
EDUCATION	CLASSROOM 257	413	35 / 1000 35 x (413 / 1000) 14 PEOPLE	0.12 CFM / SQFT	10 CFM / PERSON (14 x 10) + (0.12 x 413) 190 CFM
EDUCATION	CLASSROOM 258	304	35 / 1000 35 x (304 / 1000) 11 PEOPLE	0.12 CFM / SQFT	10 CFM / PERSON (11 x 10) + (0.12 x 304) 146 CFM
EDUCATION	CLASSROOM 259	240	35 / 1000 35 x (240 / 1000) 8 PEOPLE	0.12 CFM / SQFT	10 CFM / PERSON (8 x 10) + (0.12 x 240) 109 CFM
EDUCATION	CLASSROOM 260	482	35 / 1000 35 x (482 / 1000) 17 PEOPLE	0.12 CFM / SQFT	10 CFM / PERSON (17 x 10) + (0.12 x 482) 228 CFM
				TOTAL MINIMUM OUTSIDE AIR REQUIRED	1171 CFM

RTU-1
4575 SUPPLY CFM x 25% OUTSIDE AIR
1144 CFM

RTU-1 TOTAL OUTSIDE AIR PROVIDED = 1175 CFM

OUTSIDE AIR NOTES:

1. MINIMUM OUTSIDE AIR VENTILATION RATES ARE BASED ON INTERNATIONAL MECHANICAL CODE, TABLE 403.3.1.1.

OUTSIDE AIR SCHEDULE

RTU-2

OCCUPANCY OR USE	ROOM NAME	ROOM SQUARE FOOTAGE	OCCUPANT LOAD (PEOPLE / SQFT)	OUTSIDE AIR VENTILATION (CFM / SQFT)	MINIMUM OUTSIDE AIR REQUIRED
EDUCATION	LAB 243	818	35 / 1000 35 x (818 / 1000) 29 PEOPLE	0.12 CFM / SQFT	10 CFM / PERSON (29 x 10) + (0.12 x 818) 388 CFM
LIBRARIES	LIBRARY 245	575	35 / 1000 10 x (572 / 1000) 6 PEOPLE	0.12 CFM / SQFT	5 CFM / PERSON (6 x 10) + (0.12 x 575) 129 CFM
OFFICE SPACES	TESTING 247	73	5 / 1000 5 x (73 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 73) 9 CFM
OFFICE SPACES	TESTING 248	73	5 / 1000 5 x (73 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 73) 9 CFM
OFFICE SPACES	TESTING 249	73	5 / 1000 5 x (73 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 73) 9 CFM
OFFICE SPACES	TESTING 250	73	5 / 1000 5 x (73 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 73) 9 CFM
CORRIDORS	CORRIDOR	106	---	0.06 CFM / SQFT	106 x 0.06 6 CFM
OFFICE SPACES	LEARNING 251	145	5 / 1000 5 x (145 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 145) 14 CFM
EDUCATION	LECTURE 265	326	35 / 1000 35 x (326 / 1000) 11 PEOPLE	0.12 CFM / SQFT	10 CFM / PERSON (11 x 10) + (0.12 x 326) 149 CFM
EDUCATION	CLASSROOM 266	324	35 / 1000 35 x (324 / 1000) 11 PEOPLE	0.12 CFM / SQFT	10 CFM / PERSON (11 x 10) + (0.12 x 324) 149 CFM
OFFICE SPACES	PATHWAY 263	95	5 / 1000 5 x (95 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 95) 11 CFM
				TOTAL MINIMUM OUTSIDE AIR REQUIRED	882 CFM

RTU-2
4675 SUPPLY CFM x 25% OUTSIDE AIR
1169 CFM

RTU-2 TOTAL OUTSIDE AIR PROVIDED = 1175 CFM

OUTSIDE AIR NOTES:

1. MINIMUM OUTSIDE AIR VENTILATION RATES ARE BASED ON INTERNATIONAL MECHANICAL CODE, TABLE 403.3.1.1.

OUTSIDE AIR SCHEDULE

RTU-3

OCCUPANCY OR USE	ROOM NAME	ROOM SQUARE FOOTAGE	OCCUPANT LOAD (PEOPLE / SQFT)	OUTSIDE AIR VENTILATION (CFM / SQFT)	MINIMUM OUTSIDE AIR REQUIRED
CORRIDORS	CORRIDOR	659	---	0.06 CFM / SQFT	659 x 0.06 40 CFM
EDUCATION	CLASSROOM 264	221	35 / 1000 35 x (221 / 1000) 8 PEOPLE	0.12 CFM / SQFT	10 CFM / PERSON (8 x 10) + (0.12 x 221) 107 CFM
EDUCATION	ESPORTS 262	424	35 / 1000 35 x (424 / 1000) 15 PEOPLE	0.12 CFM / SQFT	10 CFM / PERSON (15 x 10) + (0.12 x 424) 201 CFM
EDUCATION	CLASSROOM 267	494	35 / 1000 35 x (494 / 1000) 17 PEOPLE	0.12 CFM / SQFT	10 CFM / PERSON (17 x 10) + (0.12 x 494) 229 CFM
EDUCATION	CLASSROOM 268	481	35 / 1000 35 x (481 / 1000) 17 PEOPLE	0.12 CFM / SQFT	10 CFM / PERSON (17 x 10) + (0.12 x 481) 228 CFM
EDUCATION	CLASSROOM 269	696	35 / 1000 35 x (696 / 1000) 24 PEOPLE	0.12 CFM / SQFT	10 CFM / PERSON (24 x 10) + (0.12 x 696) 324 CFM
OFFICE SPACES	OFFICE 270	109	5 / 1000 5 x (109 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 109) 12 CFM
OFFICE SPACES	OFFICE 271	284	5 / 1000 5 x (284 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 284) 22 CFM
OFFICE SPACES	OFFICE 261	112	5 / 1000 5 x (112 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 112) 12 CFM
				TOTAL MINIMUM OUTSIDE AIR REQUIRED	1175 CFM

RTU-3
5200 SUPPLY CFM x 22% OUTSIDE AIR
1144 CFM

RTU-3 TOTAL OUTSIDE AIR PROVIDED = 1175 CFM

OUTSIDE AIR NOTES:

1. MINIMUM OUTSIDE AIR VENTILATION RATES ARE BASED ON INTERNATIONAL MECHANICAL CODE, TABLE 403.3.1.1.

OUTSIDE AIR SCHEDULE

RTU-4

OCCUPANCY OR USE	ROOM NAME	ROOM SQUARE FOOTAGE	OCCUPANT LOAD (PEOPLE / SQFT)	OUTSIDE AIR VENTILATION (CFM / SQFT)	MINIMUM OUTSIDE AIR REQUIRED
CORRIDORS	CORRIDOR 233	195	---	0.06 CFM / SQFT	195 x 0.06 12 CFM
LAUNDRY	LAUNDRY 234	122	35 / 1000 10 x (122 / 1000) 2 PEOPLE	---	25 CFM / PERSON (25 x 2) 50 CFM
CORRIDORS	CORRIDOR 207	628	---	0.06 CFM / SQFT	628 x 0.06 38 CFM
CONFERENCE ROOMS	CONFERENCE 208	293	50 / 1000 50 x (293 / 1000) 15 PEOPLE	0.06 CFM / SQFT	20 CFM / PERSON (15 x 20) + (0.12 x 293) 335 CFM
				TOTAL MINIMUM OUTSIDE AIR REQUIRED	435 CFM

RTU-4
2050 SUPPLY CFM x 27% OUTSIDE AIR
553 CFM

RTU-4 TOTAL OUTSIDE AIR PROVIDED = 575 CFM

OUTSIDE AIR NOTES:

1. MINIMUM OUTSIDE AIR VENTILATION RATES ARE BASED ON INTERNATIONAL MECHANICAL CODE, TABLE 403.3.1.1.

OUTSIDE AIR SCHEDULE

RTU-5

OCCUPANCY OR USE	ROOM NAME	ROOM SQUARE FOOTAGE	OCCUPANT LOAD (PEOPLE / SQFT)	OUTSIDE AIR VENTILATION (CFM / SQFT)	MINIMUM OUTSIDE AIR REQUIRED
OFFICE SPACES	CD 220	199	5 / 1000 5 x (199 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 199) 17 CFM
OFFICE SPACES	ADMISSIONS 218	1331	5 / 1000 5 x (1331 / 1000) 7 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (7 x 5) + (0.06 x 1331) 115 CFM
UTILITIES	FIRE STORAGE 219	258	---	0.06 CFM / SQFT	258 x 0.06 15 CFM
OFFICE SPACES	WELLNESS 231	42	5 / 1000 5 x (42 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 42) 8 CFM
OFFICE SPACES	DIRECTOR 221	149	5 / 1000 5 x (149 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 149) 14 CFM
OFFICE SPACES	BREAK ROOM 222	180	50 / 1000 50 x (180 / 1000) 9 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (9 x 5) + (0.06 x 180) 56 CFM
OFFICE SPACES	REGISTRAR 223	78	5 / 1000 5 x (78 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 78) 10 CFM
OFFICE SPACES	ASSOC. DEAN 224	74	5 / 1000 5 x (74 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 74) 9 CFM
OFFICE SPACES	DEAN 225	122	5 / 1000 5 x (122 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 122) 12 CFM
UTILITIES	STORAGE 226	40	---	0.06 CFM / SQFT	40 x 0.06 2 CFM
OFFICE SPACES	ADVISOR 227	537	5 / 1000 5 x (537 / 1000) 3 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (3 x 5) + (0.06 x 537) 47 CFM
LOBBIES	WAITING	320	30 / 1000 30 x (128 / 1000) 10 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (10 x 5) + (0.06 x 320) 69 CFM
				TOTAL MINIMUM OUTSIDE AIR REQUIRED	374 CFM

RTU-5
4200 SUPPLY CFM x 22% OUTSIDE AIR
924 CFM

RTU-5 TOTAL OUTSIDE AIR PROVIDED = 925 CFM

OUTSIDE AIR NOTES:

1. MINIMUM OUTSIDE AIR VENTILATION RATES ARE BASED ON INTERNATIONAL MECHANICAL CODE, TABLE 403.3.1.1.

OUTSIDE AIR SCHEDULE

RTU-6

OCCUPANCY OR USE	ROOM NAME	ROOM SQUARE FOOTAGE	OCCUPANT LOAD (PEOPLE / SQFT)	OUTSIDE AIR VENTILATION (CFM / SQFT)	MINIMUM OUTSIDE AIR REQUIRED
OFFICE SPACES	FINANCIAL 209	921	5 / 1000 5 x (921 / 1000) 5 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (5 x 5) + (0.06 x 921) 80 CFM
RECEPTION AREAS	RECEPTION 203	853	60 / 1000 30 x (853 / 1000) 26 PEOPLE	0.06 CFM / SQFT	15 CFM / PERSON (6 x 5) + (0.06 x 853) 201 CFM
OFFICE SPACES	CAREER 229	229	5 / 1000 5 x (229 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 229) 19 CFM
OFFICE SPACES	CS OFFICE 230	88	5 / 1000 5 x (88 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 88) 10 CFM
OFFICE SPACES	BOOK 211	90	5 / 1000 5 x (90 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 90) 10 CFM
OFFICE SPACES	IT 216	92	5 / 1000 5 x (92 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 92) 11 CFM
OFFICE SPACES	INTERVIEW 206	96	5 / 1000 5 x (96 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 96) 11 CFM
OFFICE SPACES	LOUNGE 205	101	5 / 1000 5 x (101 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 101) 11 CFM
CORRIDORS	CORRIDOR	165	---	0.06 CFM / SQFT	165 x 0.06 10 CFM
				TOTAL MINIMUM OUTSIDE AIR REQUIRED	363 CFM

RTU-6
3150 SUPPLY CFM x 24% OUTSIDE AIR
756 CFM

RTU-6 TOTAL OUTSIDE AIR PROVIDED = 775 CFM

OUTSIDE AIR NOTES:

1. MINIMUM OUTSIDE AIR VENTILATION RATES ARE BASED ON INTERNATIONAL MECHANICAL CODE, TABLE 403.3.1.1.

OUTSIDE AIR SCHEDULE

RTU-7

OCCUPANCY OR USE	ROOM NAME	ROOM SQUARE FOOTAGE	OCCUPANT LOAD (PEOPLE / SQFT)	OUTSIDE AIR VENTILATION (CFM / SQFT)	MINIMUM OUTSIDE AIR REQUIRED
OFFICE SPACES	MANAGER 210	108	5 / 1000 5 x (108 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 108) 11 CFM
OFFICE SPACES	DIRECTOR 211	104	5 / 1000 5 x (104 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 104) 11 CFM
OFFICE SPACES	ANALYSIS 212	81	5 / 1000 5 x (81 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 81) 10 CFM
OFFICE SPACES	MANAGER 213	106	5 / 1000 5 x (106 / 1000) 1 PEOPLE	0.06 CFM / SQFT	5 CFM / PERSON (1 x 5) + (0.06 x 106) 11 CFM
UTILITIES	STORAGE 214	80	---	0.06 CFM / SQFT	80 x 0.06 5 CFM
ASSEMBLY	LOUNGE 204	1200	100 / 1000 100 x (1200 / 1000) 120 PEOPLE	0.06 CFM / SQFT	7.5 CFM / PERSON (120 x 5) + (0.06 x 1200) 672 CFM
				TOTAL MINIMUM OUTSIDE AIR REQUIRED	720 CFM

RTU-7
2400 SUPPLY CFM x 30% OUTSIDE AIR
1754 CFM

RTU-7 TOTAL OUTSIDE AIR PROVIDED = 725 CFM

OUTSIDE AIR NOTES:

1. MINIMUM OUTSIDE AIR VENTILATION RATES ARE BASED ON INTERNATIONAL MECHANICAL CODE, TABLE 403.3.1.1.

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SA JOB #: 19099.02

DATE: 4-6-2020

DRAWING #: M-4

HVAC SPECIFICATIONS

PART 1 – GENERAL

1.1 QUALITY ASSURANCE

A. MATERIALS AND EQUIPMENT SHALL BE PROVIDED BY ONE OF THE MANUFACTURERS LISTED IN PART 2 – PRODUCTS.

1. DIVISION 23 BIDS SHALL BE BASED ON THE MATERIAL MENTIONED OR SPECIFIED, AND ANY PROPOSALS FOR A SUBSTITUTION SHALL BE MADE IN WRITING TO THE ARCHITECT / ENGINEER ALLOWING ADEQUATE TIME FOR APPROPRIATE ACTION.

a. REFER TO DIVISION 1 REQUIREMENTS FOR SUBSTITUTION PROCEDURES.

2. MATERIALS AND EQUIPMENT FROM OTHER MANUFACTURERS MAY BE ACCEPTED IF PROVEN EQUAL TO THOSE SPECIFIED.

a. EQUIPMENT SELECTION OF HIGHER ELECTRICAL CHARACTERISTICS, PHYSICAL DIMENSIONS, CAPACITIES, AND RATINGS MAY BE FURNISHED PROVIDED SUCH PROPOSED EQUIPMENT IS APPROVED IN WRITING AND CONNECTING MECHANICAL AND ELECTRICAL SERVICES, CIRCUIT BREAKERS, CONDUIT, MOTOR, BASES, AND EQUIPMENT SPACES ARE INCREASED.

1). DIVISION 23 ALSO IS LIABLE FOR ALL COSTS AND CHANGES IN THE WORK REQUIRED BY SUBSTITUTE EQUIPMENT.

a). NO ADDITIONAL COSTS WILL BE APPROVED FOR THESE INCREASES, IF LARGER EQUIPMENT IS APPROVED.

2). IF MINIMUM ENERGY RATINGS OR EFFICIENCIES OF EQUIPMENT ARE SPECIFIED, EQUIPMENT MUST MEET DESIGN AND COMMISSIONING REQUIREMENTS.

3. DIVISION 23 IS LIABLE FOR AND SHALL PAY FOR, ALL ARCHITECTURAL AND ENGINEERING REVIEWS AND REDESIGN COSTS FOR SUBSTITUTE MATERIALS AND EQUIPMENT.
4. THE BIDDER MUST SUBMIT IN WRITING TO THE ARCHITECT / OWNER, WHO WILL FORWARD TO THE ENGINEER, ANY REQUEST FOR A PROPOSED DEVIATION, MODIFICATION, OR SUBSTITUTION TO THESE DRAWINGS AND SPECIFICATIONS FOR EVALUATION NO LATER THAN TEN (10) DAYS PRIOR TO THE BID DATE.

a. A REQUEST FOR ANY SUBSTITUTION SHALL BE ACCOMPANIED BY TECHNICAL DATA, DRAWINGS, PRODUCT SAMPLES, AND COMPLETE DATA SUBSTANTIATING COMPLIANCE OF PROPOSED SUBSTITUTION WITH THESE SPECIFICATIONS AND DRAWINGS.

1). REQUESTS FOR SUBSTITUTION SHALL BE MADE ONLY BY THE BIDDER; REQUESTS FOR SUBSTITUTION FROM SALES REPRESENTATIVES, VENDORS, OR SUPPLIERS ARE NOT ACCEPTABLE.

b. NO MATERIALS SHALL BE DEEMED ACCEPTABLE IF NOT IN STRICT AND FULL COMPLIANCE WITH THESE DRAWINGS AND SPECIFICATIONS.

c. ALL BIDDERS MUST BID SOLELY ON THE SPECIFIED MATERIALS UNLESS ACCEPTANCE BY THE ENGINEER OF A DEVIATION, OMISSION, MODIFICATION, OR SUBSTITUTION IS GRANTED IN WRITING THROUGH THE ARCHITECT / OWNER TO ALL BIDDERS PRIOR TO THE BID DATE.

1). FAILURE TO SUBMIT PROPOSED SUBSTITUTED EQUIPMENT / MATERIALS PRIOR TO THE BID EVALUATION DATE, AND IS INCLUDED IN THE BIDDERS PRICE / SUBMITTAL REVIEW DRAWINGS (AFTER THE PROJECT IS AWARDED); WILL RESULT IN A "REJECTED" SUBMITTAL PACKAGE.

B. THE LENGTH OF TIME THE MANUFACTURER HAS BEEN IN BUSINESS, THE LOCATION AND CAPABILITY OF COMPLETE REPAIR FACILITIES, AVAILABILITY OF REPAIR PARTS AND ANNUAL MAINTENANCE CONTRACTS ALL WILL BE CONSIDERED IN DETERMINING EQUALITY.

1.2 LAWS, PERMITS, INSPECTIONS

A. WORK SHALL COMPLY WITH THE LATEST REVISIONS OF INTERNATIONAL BUILDING CODE, INTERNATIONAL MECHANICAL CODE, INTERNATIONAL FIRE CODE, INTERNATIONAL ENERGY CONSERVATION CODE, AND ANY STATE AND LOCAL CODES OR REGULATIONS THAT APPLY.

B. COMPLY WITH NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) CODES AS APPLICABLE.

C. COMPLY TO REQUIREMENTS OF DRAWINGS AND SPECIFICATIONS THAT ARE IN EXCESS OF GOVERNING CODES.

D. DO NOT INSTALL WORK AS SPECIFIED OR SHOWN IF IN CONFLICT WITH GOVERNING CODES.

1. NOTIFY ENGINEER IN WRITING AND REQUEST DIRECTION.

E. PAY ALL INSPECTION AND PERMIT FEES.

F. PROVIDE CERTIFICATE OF INSPECTION FROM ALL GOVERNING AUTHORITIES.

1.3 INSTALLERS QUALIFICATIONS

A. SKILLED MECHANICS WHO HAVE SUCCESSFULLY COMPLETED AN APPRENTICESHIP PROGRAM OR ANOTHER CRAFT TRAINING PROGRAM CERTIFIED BY THE U.S. DEPARTMENT OF LABOR, BUREAU OF APPRENTICESHIP AND TRAINING.

B. THE MECHANICAL CONTRACTOR SHALL BE LICENSED TO PERFORM MECHANICAL WORK IN THE MUNICIPALITY IN WHICH THE PROJECT IS LOCATED.

1.4 OMISSIONS.

A. OMISSIONS, DISCREPANCIES OR POINTS OF QUESTION FOUND BY A BIDDER IN THE PLANS OR SPECIFICATIONS SHALL BE REFERRED TO THE ARCHITECT, WHO WILL FORWARD TO THE ENGINEER TO MAKE ANY CLARIFICATIONS IN WRITING.

1.5 REQUEST FOR INFORMATION (RFI).

A. PRIOR TO, AND DURING THE CONSTRUCTION OF THE PROJECT, QUESTIONS FROM THE HVAC CONTRACTOR REGARDING OMISSIONS, DISCREPANCIES, COORDINATION ITEMS, AND ANY OTHER CONDITIONS THAT RESULT IN CHANGES TO THE HVAC LAYOUT SHALL BE REFERRED TO THE ARCHITECT, WHO WILL MAKE ANY CLARIFICATIONS IN WRITING.

1. THE HVAC CONTRACTOR SHALL PROVIDE A DETAILED DESCRIPTION OF THE INFORMATION BEING REQUESTED ALONG WITH A DRAWING SHOWING THE AREA AND ITEMS WHERE THE CONFLICTS OCCUR AS WELL AS A PROPOSED SOLUTION TO RESOLVE THE CONFLICTS.
2. FAILURE TO PROVIDE A DETAILED DESCRIPTION AND PROPOSED SOLUTION TO THE INFORMATION BEING REQUESTED WILL RESULT IN THE ARCHITECT / ENGINEER RETURNING THE REQUEST AND REQUIRING THAT THIS BE PROVIDED BEFORE REVIEWING, ACCEPTING OR MODIFYING THE PROPOSED REQUEST.

B. THE ENGINEER SHALL HAVE 5 (FIVE) WORKING BUSINESS DAYS (NOT INCLUDING HOLIDAYS AND VACATIONS) FROM THE DATE THAT THE ENGINEER HAS RECEIVED THEM TO REVIEW AND ISSUE A RESPONSE THE CONTRACTOR.

1.6 SHOP DRAWINGS

A. DIVISION 23 SUBMITTALS SHALL BE SUBMITTED ELECTRONICALLY VIA EMAIL IN PDF FORMAT TO THE ARCHITECT WHO WILL THEN FORWARD THEM TO THE ENGINEER.

1. DIVISION 23 SHALL CHECK, SIGN, STAMP AND DATE ALL SUBMITTALS BEFORE SENDING THEM TO THE ENGINEER FOR REVIEW.
2. EACH PIECE OF EQUIPMENT SHALL BE SUBMITTED IN A SEPARATE PDF FILE, COMBINING THE EQUIPMENT INTO ONE (1) PDF FILE WILL NOT BE ACCEPTED.
3. THE ENGINEER SHALL HAVE 10–WORKING BUSINESS DAYS (NOT INCLUDING HOLIDAYS AND VACATIONS) AFTER THE DATE THAT THE ENGINEER HAS RECEIVED THEM TO REVIEW, SIGN AND STAMP THE SUBMITTALS BEFORE RETURNING THEM TO THE ARCHITECT.

B. PREPARE COORDINATION DRAWINGS ACCORDING TO 1/4–INCH EQUALS 1'–0" SCALE OR LARGER.

1. DETAIL MAJOR ELEMENTS, COMPONENTS AND SYSTEMS OF MECHANICAL EQUIPMENT AND MATERIALS IN RELATIONSHIP WITH OTHER SYSTEMS, INSTALLATIONS, AND BUILDING COMPONENTS.
2. INCLUDE THE FOLLOWING:

a. PROPOSED LOCATIONS AND SIZES OF PIPING, DUCTWORK, EQUIPMENT, PIPING SPECIALTIES, DUCTWORK ACCESSORIES AND MATERIALS.
b. CLEARANCES FOR SERVICING AND MAINTAINING EQUIPMENT, INCLUDING SPACE FOR EQUIPMENT DISASSEMBLY REQUIRED FOR PERIODIC MAINTENANCE.
c. EQUIPMENT SERVICE CONNECTIONS AND SUPPORT DETAILS.
d. FIRE–RATED WALL AND CEILING PENETRATIONS.
e. FLOOR PLANS, ELEVATIONS AND DETAILS TO INDICATE PENETRATIONS IN FLOORS, WALLS AND CEILINGS AND THEIR RELATIONSHIP TO OTHER PENETRATIONS AND INSTALLATIONS.
f. REFLECTED CEILING PLANS TO COORDINATE AND INTEGRATE INSTALLATIONS, AIR OUTLETS AND INLETS, LIGHT FIXTURES, AND OTHER CEILING MOUNTED ITEMS.

1.7 RECORD (AS–BUILT) DRAWINGS

A. DURING THE PROGRESS OF CONSTRUCTION, THE RECORD DRAWINGS SHALL BE CORRECTED BY DIVISION 23 TO INDICATE ACTUAL INSTALLATIONS.

B. UPON COMPLETION OF THE PROJECT, 3–SETS OF FINAL RECORD DRAWINGS SHALL PRODUCED, WITH 1–SET EACH BEING DELIVERED TO THE OWNER, ARCHITECT AND ENGINEER.

1.8 PROTECTION

A. DELIVER PIPES AND TUBES WITH FACTORY APPLIED END–CAPS.

1. MAINTAIN END–CAPS THROUGH SHIPPING, STORAGE AND HANDLING TO PREVENT PIPE–END DAMAGE AND PREVENT ENTRANCE OF DIRT, DEBRIS AND MOISTURE.

B. CLOSE AND WATERPROOF BETWEEN OPENINGS AND VOIDS IN WALLS AND FLOORS TO PREVENT ENTRANCE OF WATER OR MOISTURE.

C. PROTECT STORED PIPES AND TUBES FROM MOISTURE AND DIRT.

1. ELEVATE ABOVE GRADE.

D. SEAL ALL DUCTWORK AND PIPING, INCLUDING OPEN–ENDED DUCTWORK, AT THE END OF EACH DAY TO PREVENT DUST, DEBRIS, ETC. FROM ENTERING THE DUCTWORK AND PIPING.

1.9 OPERATION DURING CONSTRUCTION

A. DIVISION 23 IS RESPONSIBLE FOR THE INSTALLATION AND OPERATION, SERVICE AND MAINTENANCE OF ALL NEW EQUIPMENT DURING CONSTRUCTION AND PRIOR TO ACCEPTANCE BY THE OWNER OF THE COMPLETED PROJECT. WARRANTY PERIODS SHALL NOT COMMENCE UNTIL FINAL ACCEPTANCE BY THE OWNER.

1.10 PROJECT COMPLETION.

A. AT THE COMPLETION OF THE PROJECT, DIVISION 23 SHALL PROVIDE, TO THE OWNER, THREE (3) HARD BOUND VOLUMES OF MANUALS CONTAINING OPERATING SERVICE AND LUBRICATION INSTRUCTIONS, AND PARTS LISTS FOR ALL MAJOR EQUIPMENT AND MANUFACTURERS GUARANTIES OR WARRANTIES.

1.11 HVAC SCOPE OF WORK.

A. THE WORK INCLUDED UNDER THIS CONTRACT CONSISTS OF THE PROVIDING OF ALL LABOR, MATERIALS, TOOLS, TRANSPORTATION, SERVICES, ETC., NECESSARY TO COMPLETE THE INSTALLATION THE HEATING, VENTILATING, AND AIR CONDITIONING SYSTEMS, AND OTHER ITEMS HEREIN LISTED, AND AS DESCRIBED IN THESE SPECIFICATIONS, AS ILLUSTRATED IN THE ACCOMPANYING DRAWINGS, OR AS DIRECTED BY THE OWNERS AUTHORIZED REPRESENTATIVE. HVAC WORK IS COMPRISED OF, BUT NOT LIMITED TO THE FOLLOWING PRINCIPAL ITEMS:

1. SUPPLY AND RETURN SYSTEMS INCLUDING DUCTS, GRILLES AND OUTLETS.
2. PIPING SYSTEMS INCLUDING VALVES AND PIPING SPECIALTIES,
3. EXHAUST SYSTEMS INCLUDING FANS, DUCTS, ETC.
4. INSULATION FOR PIPING, DUCTS, ETC.
5. MISCELLANEOUS EQUIPMENT REQUIRED FOR SYSTEMS.
6. TEMPERATURE CONTROLS.

1.12 GUARANTEES.

A. DIVISION 23 SHALL GUARANTEE ALL WORK PERFORMED AND MATERIALS FURNISHED UNDER THIS CONTRACT AGAINST DEFECTS IN MATERIALS AND WORKMANSHIP FOR A PERIOD OF ONE (1) YEAR FROM THE DATE OF THE OWNER'S FINAL ACCEPTANCE OF THE WORK. ANY DEFECTS SHALL BE RECTIFIED BY DIVISION 23 WITHOUT ANY ADDITIONAL COST TO THE OWNER.

1.13 PUNCH LIST.

A. DIVISION 23 SHALL SCHEDULE, THROUGH THE ARCHITECT WITH A MINIMUM OF 7–DAYS NOTICE, THE ENGINEER TO PERFORM THE FOLLOWING:

1. PRE–PUNCH LIST: VERIFICATION OF MECHANICAL ITEMS SUCH AS, BUT NOT LIMITED TO, DUCTWORK SIZES, LOCATIONS, METHODS OF ASSEMBLY / INSTALLATION, BEFORE ITEMS ARE ENCLOSED BY CEILINGS, WALLS, ETC.

a. DIVISION 23 SHALL DELIVER TO BOTH THE ARCHITECT AND ENGINEER, A LETTER STATING THAT ALL ITEMS IN THE PRE–PUNCH LIST HAVE BEEN CORRECTED OR ADJUSTED ACCORDING TO THE GENERAL CONDITIONS OF THE CONTRACT BEFORE ANY CEILINGS, WALLS, ETC. CAN BE INSTALLED TO ENCLOSE MECHANICAL ITEMS.

2. FINAL PUNCH LIST: VERIFICATION OF MECHANICAL ITEMS SUCH AS, BUT NOT LIMITED TO, UNIT OPERATION, SENSOR LOCATIONS, COLORS SELECTED BY ARCHITECT.

a. BEFORE PROCEEDING WITH THE FINAL PUNCH LIST, DIVISION 23 SHALL PROVIDE THE ENGINEER WITH A COMPLETE SIGNED AND SEALED BALANCE REPORT.

1). THE ENGINEER SHALL NOT PERFORM A FINAL PUNCH LIST UNTIL A COMPLETED BALANCE REPORT IS RECEIVED.

b. DIVISION 23 SHALL, AT THE REQUEST OF THE ENGINEER, PROVIDE A LADDER AND ONE EMPLOYEE TO REMOVE AND REPLACE CEILING TILES, OPEN ACCESS DOORS, ETC. FOR INSPECTION OF MECHANICAL ITEMS.

1). THE EMPLOYEE SHALL BE MADE IMMEDIATELY AVAILABLE TO REMOVE ITEMS THAT ARE REQUESTED BY THE ENGINEER.
2). ANY CEILING TILE THAT IS DAMAGED SHALL BE REPLACED WITH NEW (TO MATCH EXISTING) AT DIVISION 15's EXPENSE.

c. DIVISION 23 SHALL DELIVER TO BOTH THE ARCHITECT AND ENGINEER, A LETTER STATING THAT ALL ITEMS IN THE FINAL PUNCH LIST HAVE BEEN CORRECTED OR ADJUSTED ACCORDING TO THE GENERAL CONDITIONS OF THE CONTRACT.

PART 2 – PRODUCTS

2.1 FIRESTOPPING

A. PROVIDE UL LISTED AND TESTED FIRESTOPPING MATERIAL, SILICONE ELASTOMER SPECIFICALLY FORMULATED FOR USE IN HORIZONTAL AND VERTICAL APPLICATIONS.

1. THE MATERIAL SHALL POSSESS INTUMESCENT CHARACTERISTICS, AND UPON EXPOSURE TO HEAT ABOVE 250° F, SHALL EXPAND TO NOT LESS THAN FIVE TIMES ITS ORIGINAL VOLUME TO FORM A FIREPROOF ENVELOPE UL RATED FOR 2 AND 3–HOURS PROTECTION, WHEN APPLIED IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATIONS.

B. UNUSED SLOTS AND OTHER PENETRATIONS IN WALLS OR OTHER GENERAL CONSTRUCTION SHALL BE CLOSED AND SEALED WITH AN APPROVED FIRESTOPPING MATERIAL.

1. DUCT OPENINGS IN WALLS SHALL BE CLOSED WITH 16–GAUGE GALVANIZED STEEL SHEET SECURELY ATTACHED AT THE MIDPOINT OF THE WALL THICKNESS AND FIRESTOPPED ON BOTH SIDES OF THE STEEL SHEET WITH NOT LESS THAN 1/8–INCH THICK LAYER OF NON–SAGGING SILICONE ELASTOMER TO FULLY COVER THE OPENING.
2. SINGLE OR MULTIPLE PIPES PASSING THROUGH WALLS SHALL HAVE THE ANNULAR SPACE BETWEEN PIPES AND STRUCTURE FILLED WITH SILICONE ELASTOMER TO PROVIDE A MINIMUM 2–HOUR RATED FIRESTOP FOR WALLS.

C. PIPES AND DUCTS: THE ANNULUS BETWEEN PIPING AND DUCTWORK AND WALLS IN FINISHED SPACES SHALL BE FILLED, SEALED, AND PAINTED TO MATCH ADJACENT SURFACES.

1. WHERE DUCTWORK PASSES THROUGH A FIRE–RATED WALL ASSEMBLY, AND THERE ARE NO FIRE DAMPERS SHOWN ON THE PLANS (DUCTWORK SIZE IS LESS THAN 100 SQUARE INCHES), PROVIDE THE FOLLOWING, MINIMUM:

a. A MINIMUM OF 12–INCH LONG BY 0.060–INCH THICK STEEL SLEEVE SHALL BE CENTERED IN EACH DUCT OPENING.
b. THE SLEEVE SHALL BE SECURED TO BOTH SIDES OF THE WALL / CEILING AND ALL FOUR SIDES OF THE SLEEVE WITH A MINIMUM OF 1–1/2" x 1–1/2" x 0.060" STEEL RETAINING ANGLES.
c. THE RETAINING ANGLES SHALL BE SECURED TO THE SLEEVES AND THE WALL / CEILING WITH NO. 10 (M5) SCREWS.
d. THE ANNULAR SPACE BETWEEN THE STEEL SLEEVE AND WALL / CEILING SHALL BE FILLED WITH SILICONE ELASTOMER TO PROVIDE A MINIMUM 2–HOUR RATED FIRESTOP.

2.2 MECHANICAL IDENTIFICATION

A. DUCT IDENTIFICATION DEVICES.

1. PLASTIC DUCT MARKERS; MANUFACTURERS STANDARD LAMINATED PLASTIC, COLOR CODED, CONTACT–TYPE, PERMANENT ADHESIVE.

a. LETTER SIZE: MINIMUM 1/4" FOR NAME OF UNITS IF VIEWING DISTANCE IS LESS THAN 2'–0", 1/2" FOR VIEWING DISTANCES UP TO 6'–0", AND PROPORTIONALLY LARGER LETTERING FOR GREATER VIEWING DISTANCES.
b. CONFORM TO THE FOLLOWING COLOR CODE:

1). GREEN: RETURN AIR.
2). YELLOW: SUPPLY AIR.
3). BLUE: EXHAUST AIR.
4). NOMENCLATURE: INCLUDE THE FOLLOWING, AS A MINIMUM:

a). DIRECTION OF AIRFLOW.
b). DUCT SERVICE (SUPPLY, RETURN, EXHAUST, ETC.).

2. LOCATE DUCT MARKERS NEAT POINTS WHERE DUCTS ENTER INTO CONCEALED SPACES AND AT MAXIMUM INTERVALS OF 25'–0" IN EACH SPACE WHERE DUCTS ARE EXPOSED OR CONCEALED BY REMOVABLE CEILING SYSTEMS.

B. PIPING IDENTIFICATION DEVICES.

1. MANUFACTURED PIPE MARKERS: PRE–PRINTED, COLOR CODED WITH LETTERING INDICATING SERVICE, AND SHOWING DIRECTION OF FLOW.

a. COLORS: COMPLY WITH ASME A–13.1 UNLESS OTHERWISE INDICATED.
b. PIPES WITH OD, INCLUDING INSULATION, LESS THAN 6": FULL–BAND PIPE MARKERS EXTENDING 360–DEGREES AROUND PIPE AT EACH LOCATION.
c. ARROWS: INTEGRAL WITH PIPING SYSTEM SERVICE LETTERING TO ACCOMMODATE BOTH DIRECTIONS, OR AS SEPARATE UNIT ON EACH PIPE MARKER TO INDICATE DIRECTION OF FLOW.

2. LOCATE PIPE MARKERS AS FOLLOWS:

a. NEAR PENETRATIONS THROUGH WALLS; ONE PER SIDE OF PENETRATION.
b. SPACED AT MAXIMUM INTERVALS OF 25'–0" ALONG EACH RUN.

C. EQUIPMENT IDENTIFICATION DEVICES.

1. EQUIPMENT NAMEPLATES: METAL NAMEPLATE WITH OPERATIONAL DATA ENGRAVED OR STAMPED, PERMANENTLY ATTACHED TO EQUIPMENT.

a. DATA: MANUFACTURER, PRODUCT NAME, MODEL NUMBER, SERIAL NUMBER, CAPACITY, OPERATING AND POWER CHARACTERISTICS, LABELS OF TESTED COMPLIANCES, AND SIMILAR ESSENTIAL DATA.

1). ENGRAVING: MANUFACTURER'S STANDARD LETTER STYLE, OF SIZES AND WITH TERMS TO MATCH EQUIPMENT IDENTIFICATION.
2). THICKNESS: 1/16 INCH FOR UNITS UP TO 20 SQUARE INCHES OR 8–INCHES IN LENGTH, AND 1/8 INCH FOR LARGER UNITS.

b. LOCATION: AN ACCESSIBLE AND VISIBLE LOCATION.
c. FASTENERS: AS REQUIRED TO MOUNT ON EQUIPMENT.

2. DUCT ACCESS DOOR MARKERS: 1/16–INCH THICK, ENGRAVED LAMINATED PLASTIC, WITH ABBREVIATED TERMS AND NUMBERS CORRESPONDING TO IDENTIFICATION.

a. PROVIDE 1/8–INCH CENTER HOLE FOR ATTACHMENT.
b. FASTENERS: SELF–TAPPING, STAINLESS–STEEL SCREWS OR CONTACT–TYPE, PERMANENT ADHESIVE.

2.3 PIPING MATERIALS

A. REFRIGERANT PIPING.: ALL SIZES, TYPE L ANNEALED–TEMPER COPPER, ASTM B–280, TYPE ACR.

1. FITTINGS: WROUGHT COPPER COMPLYING WITH ASME B16.22.

B. CONDENSATE PIPING: TYPE L DRAWN–TEMPER COPPER, ASTM B–88. WITH CRIMPED SOLDERED JOINTS.

1. FITTINGS: WROUGHT COPPER COMPLYING WITH ASME B16.22.

2.4 PIPING INSULATION

A. FIRE–TEST RESPONSE CHARACTERISTICS: FLAME–SPREAD RATING OF 25 OR LESS, AND SMOKE–DEVELOPED RATING OF 50 OR LESS; COMPLYING WITH ASTM E–84.

B. INSULATION MATERIALS.

1. MINERAL–FIBER INSULATION: PREFORMED PIPE INSULATION WITH GLASS FIBERS BONDED WITH A THERMOSETTING RESIN; WITH FACTORY–APPLIED, ALL PURPOSE, VAPOR–RETARDER PVC JACKET.
2. CLOSED–CELL PHENOLIC FOAM INSULATION: PREFORMED PIPE INSULATION OF RIGID, EXPANDED, CLOSED CELL STRUCTURE, WITH VAPOR BARRIER AND ALL SERVICE JACKET; COMPLYING WITH ASTM C–1126, TYPE III, GRADE 1.

C. SCHEDULE OF PIPING INSULATION THICKNESSES.

MINIMUM PIPE INSULATION

SYSTEM TYPE	TEMPERATURE RANGE (° F)	PIPE DIAMETER	INSULATION THICKNESS
REFRIGERANT SUCTION, REFRIGERANT LIQUID,	105–140	≤ 1–1/2"	1–1/2"
CONDENSATE	ALL	≤ 1" TO ≤8"	1–1/2"

2.5 PIPING ROOF SUPPORT SPACING.

A. HORIZONTAL PIPING.

DRAWN–TEMPER COPPER PIPE SIZE AND SPACING (REFRIGERANT PIPING)

PIPE SIZE	MAXIMUM SPACING
1/2" – 5/8"	5'–0"
3/4" – 1"	6'–0"
1–1/4" – 2"	8'–0"

B. SUPPORT HORIZONTAL PIPING WITHIN 2'–0" (MAXIMUM) OF EACH ELBOW.

2.6 DUCTWORK ROOF SUPPORT SPACING.

A. SUPPORT HORIZONTAL DUCTWORK WITH A MINIMUM OF 6'–0" OF SPA.CING BETWEEN EACH SUPPORT.

B. SUPPORT HORIZONTAL DUCTWORK WITHIN 2'–0" (MAXIMUM) OF EACH ELBOW.

2.7 SHEET METAL MATERIALS

A. COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS–METAL AND FLEXIBLE" FOR ACCEPTABLE MATERIALS, MATERIAL THICKNESSES, AND DUCT CONSTRUCTION METHODS, UNLESS OTHERWISE INDICATED.

1. SHEET METAL MATERIALS SHALL BE FREE FROM VISUAL IMPERFECTIONS INCLUDING PITTING, SEAM MARKS, ROLLER MARKS, OIL CANNING, STAINS, DISCOLORATIONS, AND OTHER IMPERFECTIONS, INCLUDING THOSE WHICH WOULD IMPAIR PAINTING.

B. GALVANIZED SHEET STEEL.

1. LOCK–FORMING QUALITY; COMPLYING WITH ASTM A653/A653M AND HAVING G90 ZINC COATING DESIGNATION; DUCTS SHALL HAVE MILL–PHOSPHATIZED FINISH FOR SURFACES EXPOSED TO VIEW.

C. ALUMINUM SHEETS.

1. ASTM B 209, ALLOY 3003, TEMPER H14; WITH MILL FINISH FOR CONCEALED DUCTS AND STANDARD, 1–SIDE BRIGHT FINISH FOR EXPOSED DUCTS.

2.8 SHEET METAL SEALANT MATERIALS

A. MASTIC: NON–HARDENING, NON–MIGRATING MASTIC ELASTIC SEALANT SPECIFICALLY FOR SEALING JOINTS AND SEAMS IN DUCTWORK.

B. WATER–BASED JOINT AND SEAM SEALANT: FLEXIBLE, ADHESIVE SEALANT, RESISTANT TO UV LIGHT WHEN CURED, UL 723 LISTED, AND COMPLYING WITH NFPA REQUIREMENTS FOR CLASS 1 DUCTS.

C. SOLVENT–BASED JOINT AND SEAM SEALANT: ONE–PART, NONSAG, SOLVENT–RELEASE–CURING, POLYMERIZED BUTYL SEALANT FORMULATED WITH A MINIMUM OF 75 PERCENT SOLIDS.

2.9 DUCTWORK INSULATION

A. FIRE–TEST RESPONSE CHARACTERISTICS.

1. INDOOR APPLICATIONS: FLAME–SPREAD RATING OF 25 OR LESS, AND SMOKE–DEVELOPED RATING OF 50 OR LESS; COMPLYING WITH ASTM E–84.

B. INSULATION MATERIALS.

1. MINERAL–FIBER BLANKET THERMAL INSULATION: GLASS FIBERS BONDED WITH A THERMOSETTING RESIN, WITHOUT FACING AND WITH ALL SERVICE JACKET MANUFACTURED FROM KRAFT PAPER, REINFORCING SCRIM, ALUMINUM FOIL, AND VINYL FILM.

2.10 DUCTWORK ACCESSORIES

A. VOLUME DAMPERS.

1. LOW LEAKAGE VOLUME DAMPERS: MULTIPLE OR SINGLE–BLADE, OPPOSED BLADE DESIGN, LOW LEAKAGE RATING, LINKAGE OUTSIDE OF AIRSTREAM, AND SUITABLE FOR HORIZONTAL OR VERTICAL APPLICATIONS.

a. STEEL FRAMES: HAT–SHAPED, GALVANIZED SHEET STEEL CHANNELS, MINIMUM OF 0.064" THICK, WITH MITERED AND WELDED CORNERS; FRAMES WITH FLANGES FOR ATTACHING TO WALLS, FLANGELESS FRAMES FOR INSTALLATION IN DUCTS.
b. ROLL–FORMED STEEL BLADES: 0.064" THICK, GALVANIZED SHEET STEEL.
c. BLADE AXLES: 1/2", GALVANIZED STEEL.
d. BEARINGS: TWO–PIECE MOLDED SYNTHETIC THRUST OR BALL.
e. BLADE SEALS: FELT OR NEOPRENE.
f. JAMB SEALS: CAMBERED STAINLESS STEEL.
g. TIE BARS AND BRACKETS: GALVANIZED STEEL.
h. FINISH: MILL.

2. JACKSHAFT: 1" DIAMETER, GALVANIZED STEEL PIPE ROTATING WITHIN PIPE–BEARING ASSEMBLY MOUNTED ON SUPPORTS AT EACH MULLION AND AT EACH END OF MULTIPLE DAMPER ASSEMBLIES.
3. DAMPER HARDWARE: ZINC–PLATED, DIE–CAST CORE WITH DIAL AND HANDLE MADE OF 3/32" THICK ZINC–PLATED STEEL, AND A 3/4" HEXAGON LOCKING NUT.

a. INCLUDE CENTER HOLE TO SUIT DAMPER OPERATING–ROD SIZE.
b. INCLUDE ELEVATED PLATFORM FOR INSULATED DUCT MOUNTING.

4. DUCT ACCESSORY HARDWARE.

a. QUADRANT LOCKS: PROVIDE FOR EACH VOLUME DAMPER, QUADRANT LOCK DEVICE ON ONE END OF SHAFT; AND END BEARING PLATE ON OTHER END FOR DAMPER LENGTHS OVER 12".

1). PROVIDE EXTENDED QUADRANT LOCKS FOR EXTERNALLY INSULATED DUCTWORK.
2). MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE QUADRANT LOCKS OF ONE OF THE FOLLOWING:

a). VENT FABRICS, INC.
b). YOUNG REGULATOR COMPANY.

5. MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE VOLUME DAMPERS OF ONE OF THE FOLLOWING:

a. AIR BALANCE, INC.
b. GREENHECK.
c. McGILL AIRFLOW CORPORATION.
d. RUSKIN COMPANY.

B. DUCT–MOUNTING ACCESS DOORS.

1. DESCRIPTION: FABRICATE DOORS AIRTIGHT AND SUITABLE FOR DUCT PRESSURE CLASS.

a. PROVIDE ACCESS DOORS IN DUCTS FOR READY ACCESS TO OPERATING PARTS INCLUDING FIRE DAMPERS, ETC.

2. ACCESS DOORS IN DUCTS – PROVIDE AND SIZE DOOR AS FOLLOWS:

a. INSTALL THE FOLLOWING MINIMUM SIZES FOR DUCT–MOUNTING, RECTANGULAR ACCESS DOORS:

1). HEAD AND HAND ACCESS: 18 BY 10 INCHES.

b. INSTALL THE FOLLOWING MINIMUM SIZES FOR DUCT–MOUNTING, ROUND ACCESS DOORS:

1). HEAD AND HAND ACCESS: 12 INCHES IN DIAMETER.

c. WHEN FIELD CONDITIONS REQUIRE AN ACCESS OPENING SMALLER THAN 18–INCH BY 10–INCH OR 12–INCHES IN DIAMETER, PROVIDE A 24–INCH LONG REMOVABLE SECTION OF CASING OR DUCT, SECURED WITH QUICK ACTING LOCKING DEVICES, 6 INCHES ON CENTERS, TO PERMIT READY ACCESS WITHOUT DISMANTLING OTHER EQUIPMENT.
d. LABEL FIRE DAMPERS ACCESS DOORS IN ACCORDANCE WITH NFPA AND DRAWINGS.

3. RECTANGULAR DOORS: MINIMUM 22–GAUGE, DOUBLE–WALL, DUCT MOUNTING, FABRICATED OF GALVANIZED SHEET METAL (OR MATERIAL MATCHING ADJOINING DUCTWORK).

1). INCLUDE CONTINUOUS PIANO HINGE AND CAM LATCHES.
2). FRAME: MINIMUM 22–GAUGE GALVANIZED SHEET STEEL, WITH BEND–OVER TABS AND FOAM GASKETS.
3). LOCKS: MINIMUM 16–GAUGE GALVANIZED STEEL CAM AND 20–GAUGE GALVANIZED STEEL LATCH.
4). ARRANGE DOORS SO THAT SYSTEM AIR PRESSURE WILL ASSIST CLOSURE AND PREVENT OPENING WHEN THE SYSTEM IS IN OPERATION.
5). MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE RECTANGULAR ACCESS DOORS OF ONE OF THE FOLLOWING:

a). DUCTMATE INDUSTRIES, INC.
b). McGILL AIRFLOW CORPORATION.
c). RUSKIN COMPANY.

4. ROUND DOORS: MINIMUM 22–GAUGE, DOUBLE WALL, DUCT MOUNTING; FABRICATED OF GALVANIZED SHEET METAL (OR MATERIAL MATCHING ADJOINING DUCTWORK).

1). INCLUDE CAM LATCHES.
2). FRAME: MINIMUM 22–GAUGE GALVANIZED SHEET STEEL, WITH SPIN–IN NOTCHED FRAME.
3). ARRANGE DOORS SO THAT SYSTEM AIR PRESSURE WILL ASSIST CLOSURE AND PREVENT OPENING WHEN THE SYSTEM IS IN OPERATION.
4). MANUFACTURER: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE ROUND ACCESS DOORS BY ONE OF THE FOLLOWING:

a). DUCTMATE INDUSTRIES, INC.
b). FLEXMASTER U.S.A., INC.

5. SEAL AROUND FRAME ATTACHMENT TO DUCT AND DOOR TO FRAME WITH NEOPRENE OR FOAM RUBBER GASKET.
6. INSULATION: 1–INCH THICK, FIBROUS–GLASS OR POLYSTYRENE–FOAM BOARD.

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HVAC SPECIFICATIONS (cont'd)

C. CEILING AND WALL ACCESS DOORS.

1. WHERE CEILINGS AND WALLS MUST BE PENETRATED FOR ACCESS TO MECHANICAL WORK, PROVIDE TYPES OF ACCESS DOORS INDICATED.
   a. FURNISH SIZES INDICATED OR, WHERE NOT OTHERWISE INDICATED, FURNISH ADEQUATE SIZE FOR INTENDED AND NECESSARY ACCESS.
      1). HEAD AND HAND ACCESS MINIMUM SIZES FOR RECTANGULAR ACCESS DOORS: 20 INCHES BY 12 INCHES.
   b. FURNISH MANUFACTURER'S COMPLETE UNITS, OF TYPE RECOMMENDED FOR APPLICATION IN INDICATED SUBSTRATE CONSTRUCTION, IN EACH CASE, COMPLETE WITH ANCHORAGES AND HARDWARE.
2. CONSTRUCTION: EXCEPT AS OTHERWISE INDICATED, FABRICATE CEILING AND WALL DOOR UNITS OF WELDED STEEL CONSTRUCTION WITH WELDS GROUND SMOOTH, 16-GAUGE FRAMES AND 14-GAUGE FLUSH PANEL DOORS, 175 DEGREE SWING WITH CONCEALED SPRING HINGES, FLUSH SCREWDRIVER OPERATED CAM LOCKS, FACTORY APPLIED RUST-INHIBITIVE PRIME COAT PAINT FINISH (FINISH COLOR AS SELECTED BY ARCHITECT).
3. MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE CEILING AND WALL ACCESS DOORS OF ONE OF THE FOLLOWING:
   a. MILCOR DIV., INRYCO INC.
   b. SMITH (JAY R.) MFG. CO.
   c. ZURN INDUSTRIES, INC.

D. FIRE DAMPERS.

1. DESCRIPTION: LABELED ACCORDING TO UL 555, AND UL 555C (FIRE RATED CEILINGS WITH WOOD JOIST / TRUSS CONSTRUCTION), HORIZONTAL OR VERTICAL MOUNTING, MILL FINISH.
   a. FIRE RATING: 1-1/2 HOURS AND 2 HOURS.
   b. FRAME: CURTAIN TYPE WITH BLADES OUTSIDE AIRSTREAM; FABRICATED WITH ROLL-FORMED, MINIMUM 20-GAUGE GALVANIZED STEEL; WITH MITERED AND INTERLOCKING CORNERS.
   c. MOUNTING SLEEVE: FACTORY FURNISHED, FIELD INSTALLED, MINIMUM 20-GAUGE GALVANIZED SHEET STEEL AND RETAINING ANGLES.
      1). MINIMUM THICKNESS: 0.138" THICK AND OF LENGTH TO SUIT APPLICATION.
      2). EXCEPTIONS: OMIT SLEEVE WHERE DAMPER FRAME WIDTH PERMITS DIRECT ATTACHMENT OF PERIMETER MOUNTING ANGLES ON EACH SIDE OF WALL OR FLOOR, AND THICKNESS OF DAMPER FRAME COMPLIES WITH SLEEVE REQUIREMENTS.
   d. BLADES: ROLL-FORMED, INTERLOCKING, MINIMUM 24-GAUGE GALVANIZED SHEET STEEL.
      1). IN PLACE OF INTERLOCKING BLADES, USE FULL LENGTH, 0.034" THICK, GALVANIZED STEEL BLADE CONNECTORS.
   e. HORIZONTAL MOUNTING: INCLUDE BLADE LOCK AND 301 STAINLESS STEEL CONSTANT FORCE TYPE CLOSURE SPRING.
   f. FUSIBLE LINK: REPLACEABLE, 165° F, VIBRATION PROOF AND SECURED WITH CLINCHED "S" HOOKS OR STAINLESS STEEL BOLTS AND LOCK NUTS.
2. MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE FIRE DAMPERS OF ONE OF THE FOLLOWING:
   a. AIR BALANCE, INC.
   b. GREENHECK.
   c. RUSKIN COMPANY.

E. FLEXIBLE CONNECTORS.

1. DESCRIPTION: FLAME RETARDANT OR NON-COMBUSTIBLE FABRICS, COATINGS, AND ADHESIVES COMPLYING WITH UL 181, CLASS 1.
   a. FABRIC: GLASS FABRIC DOUBLE COATED WITH NEOPRENE.
   b. METAL EDGE CONNECTORS: FACTORY FABRICATED WITH A FABRIC STRIP 3-1/2" WIDE ATTACHED TO TWO STRIPS OF 2-3/4" WIDE, 0.028" THICK GALVANIZED SHEET STEEL OR 0.032" THICK ALUMINUM SHEETS.
      1). SELECT METAL COMPATIBLE WITH DUCTS.
2. ATTACHMENTS: ATTACH TO EQUIPMENT CONNECTIONS AS SPECIFIED BY MANUFACTURER AND AS SHOWN ON THE DRAWINGS.
   a. LENGTH: LIMIT FLEXIBLE CONNECTIONS TO 4" ACTIVE LENGTH IN DIRECTION OF AIRFLOW.
3. MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE FLEXIBLE CONNECTORS OF ONE OF THE FOLLOWING:
   a. DUCTMATE INDUSTRIES, INC.
   b. DURO DYNE CORPORATION.
   c. VENTFABRICS, INC.

F. FLEXIBLE DUCTS.

1. INSULATED FLEXIBLE DUCTS: UL 181, CLASS 1; BLACK POLYMER FILM SUPPORTED BY HELICALLY WOUND, SPRING-STEEL WIRE; 1" THICK FIBROUS-GLASS INSULATION; ALUMINUM VAPOR BARRIER FILM; MAXIMUM 5'-0" IN LENGTH.
2. FLEXIBLE DUCT CLAMPS: STAINLESS STEEL BAND WITH CADMIUM-PLATED HEX SCREW TO TIGHTEN BAND WITH A WORM-GEAR ACTION, IN SIZES TO SUIT DUCT SIZE.
3. FLEXIBLE DUCT FITTINGS: FACTORY FABRICATED GALVANIZED STEEL FITTINGS.
   a. USE 45-DEGREE LATERALS, BALL MOUTH TEES, SPIN COLLARS, OR CONICAL TEES FOR DUCT TAPS.
   b. 90-DEGREE TEES ARE NOT ALLOWED.
4. MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE FLEXIBLE DUCTS OF ONE OF THE FOLLOWING:
   a. FLEXMASTER U.S.A., INC.
   b. McGILL AIRFLOW CORPORATION.

G. MOTORIZED CONTROL DAMPERS.

1. DESCRIPTION: OPPOSED-BLADE DESIGN WITH INFLATABLE SEAL BLADE EDGING, OR REPLACEABLE RUBBER SEALS, AMCA RATED AND TESTED TO AMCA 500D.
   a. FRAME: 5"x1"x16-GAUGE GALVANIZED STEEL HAT CHANNEL REINFORCED WITH CORNER BRACES EQUAL TO 13-GAUGE CHANNEL FRAMES (3-1/2"x3/8"x16-GAUGE TOP AND BOTTOM ON 12" HIGH OR LESS) AND HOLES FOR DUCT MOUNTING.
   b. BLADES: 6" WIDE, 14-GAUGE GALVANIZED STEEL AIRFOIL SHAPE, DOUBLE-SKIN CONSTRUCTION.
      1). SECURE BLADES TO 1/2" REMOVABLE DIAMETER, ZINC-PLATED AXLES USING ZINC-PLATED HARDWARE, WITH NYLON BLADE BEARINGS, BLADE-LINKAGE HARDWARE OF ZINC-PLATED STEEL AND BRASS (CONCEALED IN FRAME), ENDS SEALED AGAINST SPRING-STAINLESS STEEL BLADE BEARINGS, AND THRUST BEARINGS AT EACH END OF EVERY BLADE.
   c. LEAKAGE RATE: NOT GREATER THAN 4 CFM / FT2 OF DAMPER SURFACE AREA AT 1.0 INCH WATER GAUGE.
2. MANUFACTURER: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE MOTORIZED CONTROL DAMPERS OF ONE OF THE FOLLOWING:
   a. AIR BALANCE, INC.
   b. GREENHECK.
   c. RUSKIN COMPANY.

2.11 DIFFUSERS, REGISTERS AND GRILLES

A. CEILING COMPATIBILITY: PROVIDE DIFFUSERS AND GRILLES WITH BORDER STYLES THAT ARE COMPATIBLE WITH ADJACENT CEILING SYSTEMS, AND THAT ARE SPECIFICALLY MANUFACTURED TO FIT INTO CEILING MODULE AND WITH ACCURATE FIT AND ADEQUATE SUPPORT.

B. PERFORMANCE: PROVIDE CEILING DIFFUSERS THAT HAVE, AS MINIMUM, TEMPERATURE AND VELOCITY TRAVERSES, THROW AND DROP, AND NOISE CRITERIA RATINGS FOR EACH SIZE DEVICE AS LISTED IN MANUFACTURERS CURRENT DATA.
   1. NOISE LEVELS OF NC 20 OR LESS.

C. SQUARE CEILING SUPPLY DIFFUSERS.

1. ARCHITECTURAL SQUARE CEILING DIFFUSERS.
   a. MATERIAL: STEEL.
   b. FINISH: BAKED ENAMEL, WHITE.
   c. FACE SIZE: 24"x24".
   d. FACE STYLE.
      1). ARCHITECTURAL PLAQUE FACE: 18-GAUGE STEEL PLAQUE FACE PANEL AND 22-GAUGE STEEL LOUVERED BLADES AND BACKPAN (WELDED-IN INLETS AND CORNER JOINTS ARE NOT ACCEPTABLE), EASILY REMOVABLE ONE-PIECE CORE ASSEMBLY.
         a). DIFFUSER SHALL CONSIST OF THREE CONTINUOS PERIMETER SLOTS, 1-1/2" WIDE, SURROUNDING A FIXED CENTERED PLAQUE FACE, ROUND DUCT CONNECTION.
   e. MOUNTING: T-BAR (LAY-IN), SURFACE.
   f. PATTERN (THROW): FIXED.
   g. DAMPERS: ADJUSTABLE, OPPOSED-BLADE, KEY OPERATED FROM FACE OF DIFFUSER.
   h. ACCESSORIES.
      1). SQUARE TO ROUND NECK ADAPTOR.
      2). PLASTER RING.

D. CEILING RETURN AND EXHAUST GRILLES.

1. MATERIAL: STEEL, ALUMINUM
2. FINISH: BAKED ENAMEL, WHITE.
3. FACE STYLE: FLUSH, HOUSING COVERED WITH REMOVABLE PERFORATED PANEL (PERFORATED SCREEN WITH 3/16" DIAMETER HOLES ON 1/4" STAGGERED CENTERS) IN FRAME, MINIMUM 51% FREE AREA.
4. FACE SIZE.
   a. 24"x24" SQUARE: MINIMUM 22-GAUGE STEEL, PROVIDE 22"x22" BACKPAN (NECK SIZE AS SHOWN ON DRAWINGS, STANDARD NECK SIZE WHERE NOT INDICATED).
      1). MINIMUM 22-GAUGE STEEL BACKPAN (WELDED-IN INLETS AND CORNER JOINTS ARE NOT ACCEPTABLE).
5. MOUNTING: LAY-IN (T-BAR), SURFACE.
6. DAMPERS: ADJUSTABLE, OPPOSED-BLADE, KEY OPERATED FROM FACE OF DIFFUSER.
7. ACCESSORIES.
   a. SQUARE TO ROUND NECK ADAPTOR.
   b. PLASTER RING.

E. MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE DIFFUSERS, REGISTERS AND GRILLES OF ONE OF THE FOLLOWING:

1. PRICE INDUSTRIES.
2. TITUS.

2.12 AIR DUCTWORK CLEANING

A. SCOPE OF WORK.

1. SUPPLY, RETURN AND EXHAUST AIR DUCTWORK SYSTEMS.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE REMOVAL OF VISIBLE SURFACE CONTAMINANTS AND DEPOSITS FROM WITHIN THE HVAC SYSTEM IN STRICT ACCORDANCE WITH THESE SPECIFICATIONS.
3. THE HVAC SYSTEM INCLUDES ANY INTERIOR SURFACE OF THE FACILITY'S AIR DISTRIBUTION SYSTEM FOR CONDITIONED SPACES AND / OR OCCUPIED ZONES.
   a. THIS INCLUDES THE ENTIRE HEATING, AIR CONDITIONING AND VENTILATION SYSTEMS FROM THE POINTS WHERE THE AIR ENTERS THE SYSTEM TO THE POINTS WHERE THE AIR IS DISCHARGED FROM THE SYSTEM.

B. CLEANING REQUIREMENTS.

1. ENGAGE A QUALIFIED AIR SYSTEM CLEANING SPECIALIST (ASCS) TO CLEAN THE SYSTEMS.
2. COMPONENT CLEANING: CLEANING METHODS SHALL BE EMPLOYED SUCH THAT ALL HVAC YSTEM COMPONENTS MUST BE VISIBLY CLEAN AS DEFINED IN APPLICABLE STANDARDS; SEE NATIONAL AIR DUCT CLEANERS ASSOCIATION (NADCA) STANDARDS.
3. AIR VOLUME CONTROL DEVICES: DAMPERS AND ANY AIR DIRECTIONAL MECHANICAL DEVICES INSIDE THE HVAC SYSTEM MUST HAVE THEIR POSITION MARKED PRIOR TO CLEANING AND, UPON COMPLETION, MUST BE RESTORED TO THEIR MARKED POSITION.
4. SERVICE OPENINGS: THE CONTRACTOR SHALL UTILIZE SERVICE OPENINGS, AS REQUIRED FOR PROPER CLEANING, AT VARIOUS POINTS OF THE HVAC SYSTEM FOR PHYSICAL AND MECHANICAL ENTRY AND INSPECTION.
   a. OTHER OPENINGS SHALL BE CREATED WHERE NEEDED AND THEY MUST BE CREATED SO THEY CAN BE SEALED IN ACCORDANCE WITH INDUSTRY CODES AND STANDARDS.
   b. CLOSURES MUST NOT SIGNIFICANTLY HINDER, RESTRICT, OR ALTER THE AIRFLOW WITHIN THE SYSTEM AND MUST BE PROPERLY INSULATED TO PREVENT HEAT LOSS / GAIN OR CONDENSATION ON SURFACES WITHIN THE SYSTEM.
5. CUTTING SERVICE OPENINGS INTO FLEXIBLE DUCTS AND FLEXIBLE CONNECTORS IS NOT PERMITTED.
6. CEILING SECTIONS (TILE): THE CONTRACTOR MAY REMOVE AND REINSTALL CEILING SECTIONS TO GAIN ACCESS TO HVAC SYSTEMS DURING THE CLEANING PROCESS; ANY CEILING TILE THAT IS DAMAGED SHALL BE REPLACED WITH NEW (TO MATCH EXISTING) AT THE CONTRACTOR'S EXPENSE.
7. CLEAN THE FOLLOWING METAL DUCT SYSTEM COMPONENTS BY REMOVING VISIBLE SURFACE CONTAMINANTS AND DEPOSITS.
   a. AIR DISTRIBUTION DEVICES (REGISTERS, GRILLES AND DIFFUSERS).
   b. SUPPLY, RETURN AND EXHAUST AIR DUCTS, DAMPERS, ACTUATORS, AND TURNING VANES.

C. MECHANICAL CLEANING METHODOLOGY.

1. THE HVAC SYSTEM SHALL BE CLEANED USING SOURCE REMOVAL MECHANICAL CLEANING METHODS DESIGNED TO EXTRACT CONTAMINANTS FROM WITHIN THE HVAC SYSTEM AND SAFELY REMOVE CONTAMINANTS FROM THE FACILITY.
   a. IT IS THE CONTRACTOR'S RESPONSIBILITY TO SELECT SOURCE REMOVAL METHODS WHICH WILL RENDER THE HVAC SYSTEM VISIBLY CLEAN AND CAPABLE OF PASSING CLEANING VERIFICATION METHODS (SEE APPLICABLE NADCA STANDARDS).
      1). NO CLEANING METHOD, OR COMBINATION OF METHODS, SHALL BE USED WHICH COULD POTENTIALLY DAMAGE COMPONENTS OF THE HVAC SYSTEM OR NEGATIVELY ALTER THE INTEGRITY OF THE SYSTEM.
   b. ALL METHODS USED SHALL INCORPORATE THE USE OF VACUUM COLLECTION DEVICES THAT ARE OPERATED CONTINUOUSLY DURING CLEANING.
   c. ALL VACUUM DEVICES EXHAUSTING AIR INSIDE THE BUILDING SHALL BE EQUIPPED WITH HEPA FILTERS (MINIMUM 99.97 PERCENT COLLECTION EFFICIENCY FOR 0.3-MICRON SIZE OR GREATER PARTICLES), INCLUDING HAND-HELD VACUUMS AND WET VACUUMS.
   d. ALL VACUUM DEVICES EXHAUSTING AIR OUTSIDE THE FACILITY SHALL BE EQUIPPED WITH PARTICULATE COLLECTION INCLUDING ADEQUATE FILTRATION TO CONTAIN DEBRIS REMOVED FROM THE HVAC SYSTEM AND SHALL BE LOCATED DOWN WIND AND AWAY FROM AIR INTAKES AND OTHER POINTS OF ENTRY INTO BUILDING.
      1). RELEASE OF DEBRIS OUTDOORS MUST NOT VIOLATE ANY OUTDOOR ENVIRONMENTAL STANDARDS, CODES OR REGULATIONS.
   e. ALL METHODS REQUIRE MECHANICAL AGITATION DEVICES TO DISLODGE DEBRIS ADHERED TO INTERIOR HVAC SYSTEM SURFACES, SUCH THAT DEBRIS MAY BE SAFELY CONVEYED TO VACUUM COLLECTION DEVICES.
      1). ACCEPTABLE METHODS WILL INCLUDE THOSE WHICH WILL NOT POTENTIALLY DAMAGE THE INTEGRITY OF THE DUCTWORK, NOR DAMAGE POROUS SURFACE MATERIALS SUCH AS LINERS INSIDE THE DUCTWORK OR SYSTEM COMPONENTS.
2. METHODS OF CLEANING FIBROUS GLASS INSULATED COMPONENTS.
   a. FIBROUS GLASS THERMAL OR ACOUSTICAL INSULATION ELEMENTS PRESENT IN ANY EQUIPMENT OR DUCTWORK SHALL BE THOROUGHLY CLEANED WITH HEPA VACUUMING EQUIPMENT, WHILE THE HVAC SYSTEM IS UNDER CONSTANT NEGATIVE PRESSURE, AND NOT PERMITTED TO GET WET IN ACCORDANCE WITH APPLICABLE NADCA AND NAIMA STANDARDS AND RECOMMENDATIONS.
   b. CLEANING METHODS USED SHALL NOT CAUSE DAMAGE TO FIBROUS GLASS COMPONENTS AND WILL RENDER THE SYSTEM CAPABLE OF PASSING CLEANING VERIFICATION TESTS (SEE NADCA STANDARDS).
      1). IN THE EVENT FIBER GLASS MATERIALS MUST BE REPLACED, ALL MATERIALS SHALL CONFORM TO APPLICABLE INDUSTRY CODES AND STANDARDS, INCLUDING THOSE OF UL AND SMACNA.
3. CLEANING OF COILS.
   a. ANY CLEANING METHOD MAY BE USED WHICH WILL RENDER THE COIL VISIBLY CLEAN AND CAPABLE OF PASSING COIL CLEANING VERIFICATION (SEE APPLICABLE NADCA STANDARDS).
   b. COIL DRAIN PANS SHALL BE SUBJECT TO NON-POROUS SURFACES CLEANING VERIFICATION (THE DRAIN FOR THE CONDENSATE DRAIN PAN SHALL BE OPERATIONAL).
   c. CLEANING METHODS SHALL NOT CAUSE ANY APPRECIABLE DAMAGE TO, DISPLACEMENT OF, INHIBIT HEAT TRANSFER, OR EROSION OF THE COIL SURFACE OR FINS, AND SHALL CONFORM TO COIL MANUFACTURER RECOMMENDATIONS.
   d. COILS SHALL BE THOROUGHLY RINSED WITH CLEAN WATER TO REMOVE ANY LATENT RESIDUES AND CLEANING MATERIALS; COMB AND STRAIGHTEN FINS.
   e. PROVIDE OPERATIVE DRAINAGE SYSTEM FOR WASHDOWN PROCEDURES.

D. CLEANLINESS VERIFICATION.

1. VERIFICATION OF HVAC SYSTEM CLEANLINESS WILL BE DETERMINED AFTER MECHANICAL CLEANING AND BEFORE THE APPLICATION OF ANY TREATMENT OR INTRODUCTION OF ANY TREATMENT-RELATED SUBSTANCE TO THE HVAC SYSTEM, INCLUDING BIOCIDAL AGENTS AND COATINGS.
2. VISUAL INSPECTION: THE HVAC SYSTEM SHALL BE INSPECTED VISUALLY TO ENSURE THAT NO VISIBLE CONTAMINANTS ARE PRESENT.
   a. IF NO CONTAMINANTS ARE EVIDENT THROUGH VISUAL INSPECTION, THE HVAC SYSTEM SHALL BE CONSIDERED CLEAN; HOWEVER, THE OWNER RESERVES THE RIGHT TO FURTHER VERIFY SYSTEM CLEANLINESS THROUGH GRAVIMETRIC OR WIPE TESTING ANALYSIS TESTING AS SPECIFIED HEREIN.
   b. IF VISIBLE CONTAMINANTS ARE EVIDENT THROUGH VISUAL INSPECTION, THOSE PORTIONS OF THE SYSTEM WHERE CONTAMINANTS ARE VISIBLE SHALL BE RE-CLEANED AND SUBJECTED TO RE-INSPECTION FOR CLEANLINESS.
3. GRAVIMETRIC ANALYSIS: AT THE DISCRETION AND EXPENSE OF THE OWNER, SECTIONS OF THE HVAC SYSTEM MAY BE TESTED FOR CLEANLINESS USING THE NADCA VACUUM TEST (GRAVIMETRIC ANALYSIS) AS SPECIFIED IN APPLICABLE NADCA STANDARDS (LEVELS OF DEBRIS COLLECTED SHALL BE EQUAL TO OR LESS THAN ACCEPTABLE LEVELS DEFINED IN APPLICABLE NADCA STANDARDS).
   a. GRAVIMETRIC ANALYSIS SHALL BE PERFORMED BY A QUALIFIED THIRD-PARTY EXPERIENCED IN TESTING OF THIS NATURE.
      1). IF GRAVIMETRIC ANALYSIS DETERMINES THAT LEVELS OF DEBRIS EXCEED THOSE SPECIFIED IN APPLICABLE NADCA STANDARDS, THE SYSTEM SHALL NOT BE CONSIDERED CLEAN AND THOSE SECTIONS OF THE SYSTEM WHICH FAILED CLEANLINESS VERIFICATION SHALL BE RE-CLEANED AT THE EXPENSE OF THE ORIGINAL HVAC SYSTEM CLEANING CONTRACTOR.

PART 3 - TESTING, ADJUSTING AND BALANCING

3.1 TESTING, ADJUSTING AND BALANCING

A. GENERAL: MULTIPLE MOBILIZATIONS ARE REQUIRED PER EACH COMPLETED WORK AREA / PHASE (i.e. PRIOR TO OWNER'S OCCUPANCY SPACE).
   1. HVAC PRIME CONTRACTOR SHALL REVIEW THE PHASING PLANS AND INCLUDE IN BASE BID, SEPARATE BALANCE REPORTS FOR EACH COMPLETED AREA OF WORK.

B. AIR BALANCING CONTRACTOR SHALL INCLUDE, IN THEIR PRICING, ONE SHEAVE CHANGE FOR EACH ROOFTOP UNIT TO BE INSTALLED AT COMPLETION OF PROJECT, IF NECESSARY.
   1. SHEAVES AND BELT ADJUSTMENTS SHALL BE SET IN ACCORDANCE WITH THE UNIT MANUFACTURER RECOMMENDATIONS AND WITH FACTORY-AUTHORIZED SERVICE REPRESENTATIVE PRESENT, IN ORDER TO MAINTAIN MAXIMUM BELT LIFE.

C. TAB FIRM QUALIFICATIONS: ENGAGE A TAB FIRM CERTIFIED BY EITHER ASSOCIATED AIR BALANCE COUNCIL (AABC) OR NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB).
   1. A SPECIALIST WITH AT LEAST 5-YEARS OF EXPERIENCE IN THOSE TESTING, ADJUSTING AND BALANCING REQUIREMENTS SIMILAR TO THOSE REQUIRED FOR THIS PROJECT.
      a. SUBMIT BIOGRAPHICAL DATA ON TAB SUPERVISOR WHO IS DIRECTLY SUPERVISING TESTING, ADJUSTING AND BALANCING WORK.
      b. SUBMIT THE INDIVIDUAL QUALIFICATIONS OF ALL PERSONS RESPONSIBLE FOR SUPERVISING AND PERFORMING THE ACTUAL WORK.

D. TAB FORM REPORTS: USE STANDARD FORMS FROM AABC'S "NATIONAL STANDARDS FOR TESTING AND BALANCING HEATING, VENTILATING,, AND AIR CONDITIONING SYSTEMS" OR NEBB'S "PROCEDURAL STANDARDS FOR TESTING, ADJUSTING AND BALANCING OF ENVIRONMENTAL SYSTEMS".

E. PROJECT CONDITIONS.

1. GENERAL: DO NOT PROCEED WITH TESTING, ADJUSTING AND BALANCING WORK UNTIL THE FOLLOWING CONDITIONS HAVE BEEN MET.
   a. WORK HAS BEEN COMPLETED AND IS OPERABLE.
   b. WORK SCHEDULED FOR TESTING, ADJUSTING AND BALANCING IS CLEAN AND FREE FROM DEBRIS, DIRT AND DISCARDED BUILDING MATERIALS.
   c. ALL ARCHITECTURAL OPENINGS (DOORS, WINDOWS, AND OTHER OPENINGS) WHICH MAY AFFECT THE OPERATION OF THE SYSTEM TO BE TESTED, ADJUSTED AND BALANCED SHALL BE AT THEIR NORMAL STATES.
   d. ALL RELATED MECHANICAL SYSTEMS, WHICH MAY AFFECT THE OPERATION OF THE SYSTEM TO BE TESTED, ADJUSTED AND BALANCED SHALL BE AT THEIR NORMAL OPERATING CONDITIONS; COORDINATE WITH CONTROLS CONTRACTOR.
   e. UNIT FILTERS ARE NOT "LOADED"; MECHANICAL CONTRACTOR SHALL REPLACE, IF REQUIRED, PRIOR TO BALANCING.

F. GENERAL PROCEDURES FOR TESTING AND BALANCING.

1. PERFORM TESTING AND BALANCING PROCEDURES ON EACH SYSTEM ACCORDING TO THE PROCEDURES CONTAINED IN AABC'S "NATIONAL STANDARDS FOR TESTING AND BALANCING HEATING, VENTILATING, AND AIR CONDITIONING SYSTEMS" OR NEBB'S "PROCEDURAL STANDARDS FOR TESTING, ADJUSTING, AND BALANCING OF ENVIRONMENTAL SYSTEMS".
2. TEST, ADJUST AND BALANCE SYSTEMS DURING NEAR-PEAK SUMMER SEASON FOR AIR CONDITIONING SYSTEMS AND DURING NEAR-PEAK WINTER SEASON FOR HEATING SYSTEMS, INCLUDING AT LEAST A PERIOD OF OPERATION AT OUTSIDE CONDITIONS WITHIN 5 DEGREE F (3 DEGREE C) WET BULB TEMPERATURE OF MAXIMUM SUMMER DESIGN CONDITION, AND WITHIN 10 DEGREE F (6 DEGREE C) DRY BULB TEMPERATURE OF MINIMUM WINTER DESIGN CONDITION. WHEN SEASONAL OPERATION DOES NOT PERMIT MEASURING FINAL TEMPERATURES, THEN TAKE FINAL TEMPERATURE READINGS WHEN SEASONAL OPERATION DOES PERMIT.
   a. TEST DURATION: OPERATING TESTS OF EQUIPMENT SHALL BE OF NOT LESS THAN FOUR (4) HOURS DURATION AFTER STABILIZED OPERATING CONDITIONS HAVE BEEN ESTABLISHED.
3. MARK EQUIPMENT AND BALANCING DEVICE SETTINGS WITH PAINT OR OTHER SUITABLE, PERMANENT IDENTIFICATION MATERIAL, INCLUDING DAMPER-CONTROL POSITIONS, FAN-SPEED CONTROL LEVERS, AND SIMILAR CONTROL DEVICES, TO SHOW FINAL SETTINGS.

G. TOLERANCES.

1. SUPPLY AND EXHAUST FANS: 0% TO PLUS 5%.
2. AIR OUTLETS AND INLETS: 0% TO PLUS 5%.

H. FINAL REPORT.

1. GENERAL: PROVIDE TYPEWRITTEN OR COMPUTER PRINTOUT IN LETTER-QUALITY FONT, ON STANDARD BOND PAPER, IN THREE-RING BINDER, TABULATED AND DIVIDED INTO SECTIONS BY TESTED AND BALANCED SYSTEM.
   a. INCLUDE A CERTIFICATION SHEET IN FRONT OF BINDER, SEALED AND SIGNED BY THE TESTING AND BALANCING ENGINEER.
   b. INCLUDE A LIST OF INSTRUMENTS USED FOR PROCEDURES, ALONG WITH PROOF OF CALIBRATION.
2. GENERAL REPORT DATA: IN ADDITION TO FORM TITLES AND ENTRIES, INCLUDE THE FOLLOWING DATA IN THE FINAL REPORT, AS APPLICABLE.
   a. TITLE PAGE.
   b. NAME AND ADDRESS OF TAB FIRM.
   c. PROJECT NAME AND LOCATION.
   d. ARCHITECTS NAME AND ADDRESS.
   e. ENGINEERS NAME AND ADDRESS.
   f. MECHANICAL CONTRACTORS NAME AND ADDRESS.
   g. REPORT DATE.
   h. TABLE OF CONTENTS WITH THE TOTAL NUMBER OF PAGES (NUMBER EACH PAGE IN REPORT) DEFINED FOR EACH SECTION OF THE REPORT.
   i. SUMMARY OF CONTENTS INCLUDING THE FOLLOWING:
      1). INDICATED VERSUS FINAL PERFORMANCE.
      2). NOTABLE CHARACTERISTICS OF SYSTEMS.
      3). DESCRIPTION OF SYSTEM OPERATION SEQUENCE IF IT VARIES FROM THE CONTRACT DOCUMENTS.

I. INSPECTIONS.

1. INITIAL INSPECTION.
   a. AFTER TESTING AND BALANCING ARE COMPLETE, OPERATE EACH SYSTEM AND RANDOMLY CHECK MEASUREMENTS TO VERIFY THAT THE SYSTEM IS OPERATING ACCORDING TO THE FINAL TEST AND BALANCE READINGS DOCUMENTED IN THE FINAL REPORT.
      1). RANDOMLY CHECK THE FOLLOWING FOR EACH SYSTEM:
         a). MEASURE AIRFLOW OF AT LEAST 10% OF AIR OUTLETS.
         b). MEASURE ROOM TEMPERATURE AT EACH THERMOSTAT.
         c). MEASURE SPACE PRESSURE OF AT LEAST 10% OF LOCATIONS.
         d). BALANCING DEVICES ARE MARKED WITH FINAL BALANCE POSITION.
2. FINAL INSPECTION.
   a. AFTER INITIAL INSPECTION IS COMPLETE AND EVIDENCE BY RANDOM CHECKS VERIFIES THAT TESTING AND BALANCING ARE COMPLETE AND ACCURATELY DOCUMENTED IN THE FINAL REPORT, REQUEST THAT A FINAL INSPECTION BE MADE BY THE ARCHITECT AND OWNER.
      1). TAB FIRM TEST AND BALANCE ENGINEER SHALL CONDUCT THE INSPECTION IN THE PRESENCE OF THE ARCHITECT AND OWNER.
   b. ARCHITECT AND OWNER SHALL RANDOMLY SELECT MEASUREMENTS DOCUMENTED IN THE FINAL REPORT TO BE RECHECKED.
      1). THE RECHECKING SHALL BE LIMITED TO EITHER 10% OF THE TOTAL MEASUREMENTS RECORDED, OR THE EXTENT OF THE MEASUREMENTS THAT CAN BE ACCOMPLISHED IN A NORMAL 8-HOUR BUSINESS DAY.
   c. IF THE RECHECKS YIELD MEASUREMENTS THAT DIFFER FROM THE MEASUREMENTS DOCUMENTED IN THE FINAL REPORT BY MORE THAN THE TOLERANCES ALLOWED, THE MEASUREMENTS SHALL BE NOTED AS "FAILED".
      1). IF THE NUMBER OF "FAILED" MEASUREMENTS IS GREATER THAN 10% OF THE TOTAL MEASUREMENTS CHECKED DURING THE FINAL INSPECTION, OR A SOUND LEVEL OF 2 db OR MORE GREATER THAN THAT RECORDED IN THE REPORT LISTINGS, THE TESTING AND BALANCING SHALL BE CONSIDERED INCOMPLETE AND SHALL BE REJECTED.
         a). IN THE EVENT THE REPORT IS REJECTED, ALL SYSTEMS SHALL BE READJUSTED AND TESTED, NEW DATA RECORDED, NEW CERTIFIED REPORTS SUBMITTED, AND NEW INSPECTIONS TEST MADE, ALL AT NO ADDITIONAL COST.
   d. TAB FIRM SHALL RECHECK ALL MEASUREMENTS AND MAKE READJUSTMENTS.
      1). REVISE THE FINAL REPORT AND BALANCE DEVICE SETTINGS TO INCLUDE ALL CHANGES AND RESUBMIT THE FINAL REPORT.
   e. REQUEST A SECOND FINAL INSPECTION.
      1). IF THE SECOND FINAL INSPECTION ALSO FAILS, THE OWNER SHALL CONTRACT THE SERVICES OF ANOTHER QUALIFIED TAB FIRM TO COMPLETE THE TESTING AND BALANCING IN ACCORDANCE WITH THE CONTRACT DOCUMENTS AND DEDUCT THE COST OF THE SERVICES FROM THE FINAL PAYMENT OF THE ORIGINAL TAB FIRM.

3.2 EQUIPMENT REPORT TEST DATA.

A. TEST DATA REQUIREMENTS: PROVIDE THE FOLLOWING, AS A MINIMUM, INDICATED AND ACTUAL VALUES PER EACH PIECE OF SYSTEM TESTED.
   1. EXHAUST FANS.
      a. TOTAL AIRFLOW RATE IN CFM.
      b. TOTAL SYSTEM STATIC PRESSURE IN INCHES WG.
      c. FAN RPM.
      d. DISCHARGE AND SUCTION STATIC PRESSURE IN INCHES WG.
   2. ROOFTOP UNITS.
      a. TOTAL AIRFLOW RATE IN CFM.
      b. TOTAL SUPPLY AND RETURN AIRFLOW RATE IN CFM.
      c. TOTAL SUPPLY FAN STATIC PRESSURE IN INCHES WG.
      d. DISCHARGE STATIC PRESSURE IN INCHES WG.
      e. FILTER STATIC PRESSURE DIFFERENTIAL IN INCHES WG.
      f. OUTSIDE AIRFLOW RATE IN CFM.
      g. OUTSIDE AIR DAMPER POSITION.
      h. OUTSIDE AIR ENTERING AND LEAVING AIR TEMPERATURE IN DEGREES F.
      i. MOTOR VOLTAGE AT EACH CONNECTION.
      j. MOTOR AMPERAGE FOR EACH PHASE.
   3. AIR TERMINAL DEVICES.
      a. AIRFLOW RATE IN CFM.
      b. AIR VELOCITY IN FPM.
      c. PRELIMINARY AIRFLOW RATE AS NEEDED IN CFM.
      d. PRELIMINARY VELOCITY AS NEEDED IN FPM.
      e. FINAL AIRFLOW RATE IN CFM.
      f. FINAL VELOCITY IN FPM.
      g. SPACE TEMPERATURE IN DEGREES F.
   4. RECTANGULAR AND ROUND DUCTWORK.
      a. SYSTEM AND FURNACE UNIT NUMBER.
      b. DUCT STATIC PRESSURE IN INCHES WG.
      c. DUCT SIZE IN INCHES.
      d. ACTUAL AIRFLOW RATE IN CFM.
      e. ACTUAL VELOCITY IN FPM.

3.3 DUCTWORK PRESSURE (TIGHTNESS) TESTING

1. ALL DUCTWORK AND PLENUM SYSTEMS SHALL BE SEALED AND PRESSURE TESTED USING INSTRUMENTS AND PROCEDURES SPECIFIED IN ANSI / ASHRAE 152 AND ASTM E1554 TEST METHOD "A", AND INTERNATIONAL ENERGY CONSERVATION CODE SECTION 403.
   A. EXCEPTION: DUCT TIGHTNESS TEST IS NOT REQUIRED IF THE AIR HANDLER AND ALL DUCTS ARE LOCATED WITHIN THE CONDITIONED SPACE.

EBS ENGINEERING, PC
ENGINEERED BUILDING SYST

HVAC CONTROL SPECIFICATIONS

PART 1 – CONTROLS

1.1 SOFTWARE

A. OPERATOR INTERFACE (CARRIER I–VU STANDARD).

1. DESCRIPTION.

a. THE CONTROL SYSTEM SHALL BE AS SHOWN AND CONSIST OF A HIGH–SPEED, PEER–TO–PEER NETWORK OF DDC CONTROLLERS AND A STANDALONE WEB SERVER OPERATOR INTERFACE.
b. DEPICT EACH MECHANICAL SYSTEM AND BUILDING FLOOR PLAN BY A POINT–AND–CLICK GRAPHIC.
c. A WEB SERVER SHALL GATHER DATA FROM THIS SYSTEM AND GENERATE WEB PAGES ACCESSIBLE THROUGH A CONVENTIONAL WEB BROWSER ON EACH PC CONNECTED TO THE NETWORK.
d. OPERATORS SHALL BE ABLE TO PERFORM ALL NORMAL OPERATOR FUNCTIONS THROUGH THE WEB BROWSER INTERFACE.
e. OPERATORS WITH SUFFICIENT ACCESS LEVEL SHALL HAVE AN ABILITY TO MAKE CHANGES TO ALL SYSTEM AND EQUIPMENT GRAPHICS IN THE WEB SERVER IN ADDITION TO HAVING FULL DDC SYSTEM ACCESS TO MAKE CONFIGURATION CHANGES TO THE CONTROL SYSTEM.
f. ANY TOOLS REQUIRED FOR MAKING GRAPHIC CHANGES SHALL BE PROVIDED WITH WEB SERVER.

2. OPERATOR INTERFACE.

a. FURNISH ONE WEB SERVER INTERFACE.
b. OPERATORS SHALL BE ABLE TO ACCESS ALL NECESSARY OPERATIONAL INFORMATION IN THE DDC SYSTEM VIA CLIENT COMPUTER UTILIZING WEB BROWSER.
c. WEB SERVER SHALL CONNECT VIA THE LAN AND BE ABLE TO SIMULTANEOUSLY SERVE UP CONTROLLER INFORMATION TO MULTIPLE OPERATORS CONNECTED VIA LAN WITH WEB BROWSERS.

1). EACH CLIENT WEB BROWSER CONNECTED TO SERVER SHALL BE ABLE TO ACCESS ALL SYSTEM INFORMATION.

d. WITH THE USE OF A REMOTE SMTP EMAIL SERVER THE OPERATORS INTERFACE WEB SERVER SHALL BE ABLE TO NOTIFY PERSONNEL OF AN ALARM OR RECORD INFORMATION ABOUT AN ALARM IN THE DDC SYSTEM.
e. SECONDARY INTERFACE, IN ADDITION TO THE PRIMARY OPERATOR INTERFACE, THE SYSTEM SHALL INCLUDE A SECONDARY INTERFACE COMPATIBLE WITH A LOCALLY AVAILABLE COMMERCIAL WIRELESS NETWORK AND VIEWABLE ON A COMMERCIALLY AVAILABLE WIRELESS DEVICE SUCH AS A WIRELESS ACCESS PROTOCOL (WAP) ENABLE CELLULAR TELEPHONE AND TABLET DEVICES.

1). AS A MINIMUM, THE FOLLOWING CAPABILITIES SHALL BE PROVIDED THROUGH THIS INTERFACE.

a). SECONDARY INTERFACE WITH SCREEN RESOLUTION 1024x768 AND ABOVE SHALL BE ABLE TO PROVIDE A FULL GRAPHICAL ENVIRONMENT AS THE PRIMARY INTERFACE.
b). SECONDARY INTERFACE WITH SCREEN RESOLUTION LOWER THAN 1024x768 MAY BE TEXT–BASED AND SHALL PROVIDE A SUMMARY OF THE MOST IMPORTANT DATA.

1)). AS A MINIMUM, THE FOLLOWING CAPABILITIES SHALL BE PROVIDED THROUGH THIS INTERFACE:

a)). AN OPERATOR AUTHENTICATION SYSTEM THAT REQUIRES AN OPERATOR TO LOG IN BEFORE VIEWING OR EDITING ANY DATA, AND WHICH CAN BE CONFIGURED TO LIMIT THE PRIVILEGES OF AN INDIVIDUAL OPERATOR.
b)). THE ABILITY TO VIEW AND ACKNOWLEDGE ANY ALARM IN THE SYSTEM. ALARMS OR LINKS TO ALARMS SHALL BE PROVIDED ON A CONTIGUOUS LIST SO THE OPERATOR CAN QUICKLY VIEW ALL ALARMS.
c)). A SUMMARY PAGE OR PAGES FOR EACH PIECE OF EQUIPMENT IN THE SYSTEM.

1))). THIS PAGE SHALL INCLUDE THE CURRENT VALUES OF ALL CRITICAL I/O POINTS AND SHALL ALLOW THE OPERATOR TO LOCK BINARY POINTS ON OR OFF AND TO LOCK ANALOG POINTS TO ANY VALUE WITHIN THEIR RANGE.

d)). NAVIGATION LINKS THAT ALLOW THE OPERATOR TO QUICKLY NAVIGATE FROM THE HOME SCREEN TO ANY PIECE OF EQUIPMENT IN THE SYSTEM, AND THEN RETURN TO THE HOME SCREEN.

1))). THESE LINKS MAY BE ARRANGED IN A HIERARCHICAL FASHION, SUCH AS NAVIGATING FROM THE HOME SCREEN TO A PARTICULAR BUILDING, THEN TO A SPECIFIC FLOOR IN THE BUILDING, AND THEN TO A SPECIFIC ROOM OR PIECE OF EQUIPMENT.

3. WEB SERVER HARDWARE.

a. FURNISH ONE WEB SERVER WITH ETHERNET PORT FOR LAN OR DIRECT OPERATOR CLIENT COMPUTER ACCESS.

1). THE WEB SERVER SHALL BE CAPABLE OF COMMUNICATING TO THE PEER TO PEER DDC CONTROLLER NETWORK.
2). ANY REQUIRED INSTALLATION OR COMMISSIONING SOFTWARE SHALL BE PRE–INSTALLED ON THE WEB SERVER.
3). INSTALLATION OR COMMISSIONING OF THE WEB SERVER SHALL BE DONE THROUGH A CLIENT COMPUTER WITH A STANDARD WEB BROWSER.

4. COMMUNICATION.

a. WEB SERVER OR WORKSTATION AND CONTROLLERS SHALL COMMUNICATE USING BACNET PROTOCOL.
b. WEB SERVER OR WORKSTATION AND CONTROL NETWORK BACKBONE SHALL COMMUNICATE USING ISO 8802–3 (ETHERNET) DATA LINK / PHYSICAL LAYER PROTOCOL AND BACNET / IP ADDRESSING AS SPECIFIED IN ANSI/ASHRAE 135, BACNET ANNEX J.

5. OPERATOR FUNCTIONS.

a. OPERATOR INTERFACE SHALL ALLOW EACH AUTHORIZED OPERATOR TO EXECUTE THE FOLLOWING FUNCTIONS AS A MINIMUM:

1). LOG IN AND LOG OUT: SYSTEM SHALL REQUIRE USER NAME AND PASSWORD TO LOG IN TO OPERATOR INTERFACE.
2). POINT–AND–CLICK NAVIGATION: OPERATOR INTERFACE SHALL BE GRAPHICALLY BASED AND SHALL ALLOW OPERATORS TO ACCESS GRAPHICS FOR EQUIPMENT AND GEOGRAPHIC AREAS USING POINT–AND CLICK NAVIGATION.
3). VIEW AND ADJUST EQUIPMENT PROPERTIES: OPERATORS SHALL BE ABLE TO VIEW CONTROLLED EQUIPMENT STATUS AND TO ADJUST OPERATING PARAMETERS SUCH AS SET POINTS, PID GAINS, ON AND OFF CONTROLS, AND SENSOR CALIBRATION.
4). VIEW AND ADJUST OPERATING SCHEDULES: OPERATORS SHALL BE ABLE TO VIEW SCHEDULED OPERATING HOURS OF EACH SCHEDULABLE PIECE OF EQUIPMENT ON A WEEKLY OR MONTHLY CALENDAR–BASED GRAPHICAL SCHEDULE DISPLAY, TO SELECT AND ADJUST EACH SCHEDULE AND TIME PERIOD, AND TO SIMULTANEOUSLY SCHEDULE RELATED EQUIPMENT.

a). SYSTEM SHALL CLEARLY SHOW EXCEPTION SCHEDULES AND HOLIDAYS ON THE SCHEDULE DISPLAY.

5). VIEW AND RESPOND TO ALARMS: OPERATORS SHALL BE ABLE TO VIEW A LIST OF CURRENTLY ACTIVE SYSTEM ALARMS, TO ACKNOWLEDGE EACH ALARM, AND TO CLEAR (DELETE) UNNEEDED ALARMS.

a). REMOTE USERS SHALL BE ABLE TO RECEIVE ALARMS VIA EMAILS OR CELL PHONE TEXT MESSAGES.

6). VIEW AND CONFIGURE TRENDS: OPERATORS SHALL BE ABLE TO VIEW A TREND GRAPH OF EACH TRENDED POINT AND TO EDIT GRAPH CONFIGURATION TO DISPLAY A SPECIFIC TIME PERIOD OR DATA RANGE.

a). OPERATOR SHALL BE ABLE TO CREATE CUSTOM TREND GRAPHS TO DISPLAY ON THE SAME PAGE DATA FROM MULTIPLE TRENDED POINTS.

7). VIEW AND CONFIGURE REPORTS: OPERATORS SHALL BE ABLE TO RUN PRECONFIGURED REPORTS, TO VIEW REPORT RESULTS, AND TO CUSTOMIZE REPORT CONFIGURATION TO SHOW DATA OF INTEREST.

8). MANAGE CONTROL SYSTEM HARDWARE: OPERATORS SHALL BE ABLE TO VIEW CONTROLLER STATUS, TO RESTART (REBOOT) EACH CONTROLLER, AND TO DOWNLOAD NEW CONTROL SOFTWARE TO EACH CONTROLLER.

9). MANAGE OPERATOR ACCESS: TYPICALLY, ONLY A FEW OPERATORS ARE AUTHORIZED TO MANAGE OPERATOR ACCESS.

a). AUTHORIZED OPERATORS SHALL BE ABLE TO VIEW A LIST OF OPERATORS WITH SYSTEM ACCESS AND OF FUNCTIONS THEY CAN PERFORM WHILE LOGGED IN.
b). OPERATORS SHALL BE ABLE TO ADD OPERATORS, TO DELETE OPERATORS, AND TO EDIT OPERATOR FUNCTION AUTHORIZATION.
c). OPERATOR SHALL BE ABLE TO AUTHORIZE EACH OPERATOR FUNCTION SEPARATELY.

6. SYSTEM SOFTWARE.

a. OPERATING SYSTEM AND REQUIRED SOFTWARE: WEB SERVER OPERATOR INTERFACE SHALL BE A SELF–CONTAINED WEB SERVER WITHOUT THE NEED FOR ANY TYPE OF MAINTENANCE.
b. SYSTEM GRAPHICS: OPERATOR INTERFACE SHALL BE GRAPHICAL AND SHALL INCLUDE AT LEAST ONE GRAPHIC PER PIECE OF EQUIPMENT OR OCCUPIED ZONE, GRAPHICS THAT SUMMARIZE CONDITIONS ON EACH FLOOR OF EACH BUILDING INCLUDED IN THIS CONTRACT.

1). INDICATE THERMAL COMFORT ON FLOOR PLAN SUMMARY GRAPHICS USING DYNAMIC COLORS TO REPRESENT ZONE TEMPERATURE RELATIVE TO ZONE SETPOINT.

a). FUNCTIONALITY: GRAPHICS SHALL ALLOW OPERATOR TO MONITOR SYSTEM STATUS, TO VIEW A SUMMARY OF THE MOST IMPORTANT DATA FOR EACH CONTROLLED ZONE OR PIECE OF EQUIPMENT, TO USE POINT–AND–CLICK NAVIGATION BETWEEN ZONES OR EQUIPMENT, AND TO EDIT SETPOINTS AND OTHER SPECIFIED PARAMETERS.
b). ANIMATION: GRAPHICS SHALL BE ABLE TO ANIMATE BY DISPLAYING DIFFERENT IMAGE FILES FOR CHANGED OBJECT STATUS.
c). ALARM INDICATION: INDICATE AREAS OR EQUIPMENT IN AN ALARM CONDITION USING COLOR OR OTHER VISUAL INDICATOR.
d). FORMAT: GRAPHICS SHALL BE SAVED IN AN INDUSTRY–STANDARD FORMAT SUCH AS BMP, JPEG, PNG, OR GIF. WEB–BASED SYSTEM GRAPHICS SHALL BE VIEWABLE ON BROWSERS COMPATIBLE WITH WORLD WIDE WEB CONSORTIUM BROWSER STANDARDS.

1)). WEB GRAPHIC FORMAT SHALL REQUIRE NO PLUG–IN (SUCH AS HTML AND JAVASCRIPT) OR SHALL ONLY REQUIRE WIDELY AVAILABLE NO–COST PLUG–INS.

7. SYSTEM TOOLS.

a. SYSTEM SHALL PROVIDE THE FOLLOWING FUNCTIONALITY TO AUTHORIZED OPERATORS AS AN INTEGRAL PART OF THE OPERATOR INTERFACE OR AS STAND–ALONE SOFTWARE PROGRAMS.

1). IF FURNISHED AS PART OF THE INTERFACE, THE TOOL SHALL BE AVAILABLE FROM EACH WORKSTATION OR WEB BROWSER INTERFACE.
2). IF FURNISHED AS A STAND–ALONE PROGRAM, SOFTWARE SHALL BE INSTALLABLE ON STANDARD WINDOWS COMPATIBLE PCS WITH NO LIMIT ON THE NUMBER OF COPIES THAT CAN BE INSTALLED UNDER THE SYSTEM LICENSE.

b. AUTOMATIC SYSTEM DATABASE CONFIGURATION: EACH WEB SERVER SHALL STORE INTERNALLY STORE A COPY OF THE CURRENT SYSTEM DATABASE, INCLUDING CONTROLLER FIRMWARE AND SOFTWARE.

1). STORED DATABASE SHALL BE AUTOMATICALLY UPDATED WITH EACH SYSTEM CONFIGURATION OR CONTROLLER FIRMWARE OR SOFTWARE CHANGE.

c. CONTROLLER MEMORY DOWNLOAD: OPERATORS SHALL BE ABLE TO DOWNLOAD MEMORY FROM THE SYSTEM DATABASE TO EACH CONTROLLER.
d. SYSTEM CONFIGURATION: OPERATORS SHALL BE ABLE TO CONFIGURE THE SYSTEM.
e. ONLINE HELP: CONTEXT–SENSITIVE ONLINE HELP FOR EACH TOOL SHALL ASSIST OPERATORS IN OPERATING AND EDITING THE SYSTEM.
f. SECURITY: SYSTEM SHALL REQUIRE A USER NAME AND PASSWORD TO VIEW, EDIT, ADD, OR DELETE DATA.

1). OPERATOR ACCESS: EACH USER NAME AND PASSWORD COMBINATION SHALL DEFINE ACCESSIBLE VIEWING, EDITING, ADDING, AND DELETING FUNCTIONS IN EACH SYSTEM APPLICATION, EDITOR, AND OBJECT.
2). AUTOMATIC LOG OUT: AUTOMATICALLY LOG OUT EACH OPERATOR IF NO KEYBOARD OR MOUSE ACTIVITY IS DETECTED. OPERATORS SHALL BE ABLE TO ADJUST AUTOMATIC LOG

a). OPERATORS SHALL BE ABLE TO ADJUST AUTOMATIC LOG OUT DELAY.

3). ENCRYPTED SECURITY DATA: STORE SYSTEM SECURITY DATA INCLUDING OPERATOR PASSWORDS IN AN ENCRYPTED FORMAT.

a). SYSTEM SHALL NOT DISPLAY OPERATOR PASSWORDS.

g. SYSTEM DIAGNOSTICS: SYSTEM SHALL AUTOMATICALLY MONITOR CONTROLLER AND I/O POINT OPERATION.

1). SYSTEM SHALL ANNUNCIATE CONTROLLER FAILURE AND I/O POINT LOCKING (MANUAL OVERRIDING TO A FIXED VALUE).

h. ALARM PROCESSING: SYSTEM INPUT AND STATUS OBJECTS SHALL BE CONFIGURABLE TO ALARM ON DEPARTING FROM AND ON RETURNING TO NORMAL STATE.

1). OPERATOR SHALL BE ABLE TO ENABLE OR DISABLE EACH ALARM AND TO CONFIGURE ALARM LIMITS, ALARM LIMIT DIFFERENTIALS, ALARM STATES, AND ALARM REACTIONS FOR EACH SYSTEM OBJECT.

a). CONFIGURE AND ENABLE ALARM POINTS AS SPECIFIED IN POINTS LIST.
b). ALARMS SHALL BE BACNET ALARM OBJECTS AND SHALL USE BACNET ALARM SERVICES.

i. ALARM MESSAGES: ALARM MESSAGES SHALL USE AN ENGLISH LANGUAGE DESCRIPTOR WITHOUT ACRONYMS OR MNEMONICS TO DESCRIBE ALARM SOURCE, LOCATION, AND NATURE.
j. ALARM REACTIONS: OPERATOR SHALL BE ABLE TO CONFIGURE (BY OBJECT) ACTIONS WORKSTATION OR WEB SERVER SHALL INITIATE ON RECEIPT OF EACH ALARM.

1). AS A MINIMUM, WORKSTATION OR WEB SERVER SHALL BE ABLE TO LOG, PRINT, START PROGRAMS, DISPLAY MESSAGES, SEND E–MAIL, SEND PAGE, AND AUDIBLY ANNUNCIATE.

k. ALARM MAINTENANCE: OPERATORS SHALL BE ABLE TO VIEW SYSTEM ALARMS AND CHANGES OF STATE CHRONOLOGICALLY, TO ACKNOWLEDGE AND DELETE ALARMS, AND TO ARCHIVE ARCHIVE CLOSED ALARMS TO THE WORKSTATION OR WEB SERVER FROM EACH WORKSTATION OR WEB BROWSER INTERFACE.
l. TREND CONFIGURATION: OPERATOR SHALL BE ABLE TO CONFIGURE TREND SAMPLE OR CHANGE OF VALUE (COV) INTERVAL, START TIME, AND STOP TIME FOR EACH SYSTEM DATA OBJECT AND SHALL BE ABLE TO RETRIEVE DATA FOR USE IN SPREADSHEETS AND STANDARD DATABASE PROGRAMS.

1). CONTROLLER SHALL SAMPLE AND STORE TREND DATA AND SHALL BE ABLE TO ARCHIVE DATA TO THE HARD DISK. CONFIGURE TRENDS AS SPECIFIED IN POINTS LIST.
2). TRENDS SHALL BE BACNET TREND OBJECTS.

m. OBJECT AND PROPERTY STATUS AND CONTROL: OPERATOR SHALL BE ABLE TO VIEW, AND TO EDIT IF APPLICABLE, THE STATUS OF EACH SYSTEM OBJECT AND PROPERTY BY MENU, ON GRAPHICS.
n. REPORTS AND LOGS: OPERATOR SHALL BE ABLE TO SELECT, TO MODIFY, TO CREATE, AND TO PRINT REPORTS AND LOGS.

1). OPERATOR SHALL BE ABLE TO STORE REPORT DATA IN A FORMAT ACCESSIBLE BY STANDARD SPREADSHEET AND WORD PROCESSING PROGRAMS.

a). STANDARD REPORTS: FURNISH THE FOLLOWING STANDARD SYSTEM REPORTS.

1)). REPORTS SHALL BE FILTERED BASED UPON THE SELECTED EQUIPMENT.
2)). ALARM REPORTS.

a)). ALARM SUMMARY – CURRENT ALARMS.
b)). ALARM SOURCES – LIST OF EQUIPMENT AND ASSOCIATED ALARM CONDITIONS.
c)). ALARM ACTIONS – CONFIGURED ALARM ACTIONS SUCH AS E–MAIL AND ALARM POP–UP.

3)). SCHEDULE REPORTS.

a)). EFFECTIVE SCHEDULES – DISPLAYS EFFECTIVE SCHEDULES FOR EACH EQUIPMENT.
b)). SCHEDULE INSTANCES – DISPLAYS ALL SCHEDULES ENTERED.

4)). SECURITY REPORTS: MAINTAINS AUDIT OF ALL ACTIONS TAKEN THROUGH USER INTERFACE.
5)). COMMISSIONING REPORTS: PROVIDE EQUIPMENT CHECKOUT STATUS AND NOTES
6)). EQUIPMENT REPORTS: PROVIDE REPORTS SHOWING TRENDED POINTS AND AVAILABLE NETWORK POINTS.

b). CUSTOM REPORTS: OPERATOR SHALL BE ABLE TO CREATE CUSTOM REPORTS THAT RETRIEVE DATA, INCLUDING ARCHIVED TREND DATA, FROM THE SYSTEM, THAT ANALYZE DATA USING COMMON ALGEBRAIC CALCULATIONS, AND THAT PRESENT RESULTS IN TABULAR OR GRAPHICAL FORMAT.

1)). REPORTS SHALL BE LAUNCHED FROM THE OPERATOR INTERFACE.

o. GRAPHICS GENERATION: GRAPHICALLY BASED TOOLS AND DOCUMENTATION SHALL ALLOW OPERATOR TO EDIT SYSTEM GRAPHICS, TO CREATE GRAPHICS, AND TO INTEGRATE GRAPHICS INTO THE SYSTEM.

1). OPERATOR SHALL BE ABLE TO ADD ANALOG AND BINARY VALUES, DYNAMIC TEXT, STATIC TEXT, AND ANIMATION FILES TO A BACKGROUND GRAPHIC USING A MOUSE.

p. GRAPHICS LIBRARY: COMPLETE LIBRARY OF STANDARD HVAC EQUIPMENT GRAPHICS SHALL INCLUDE EQUIPMENT SUCH AS ROOFTOP UNITS, TERMINALS, AND FAN COIL UNITS.

1). LIBRARY SHALL INCLUDE STANDARD SYMBOLS FOR OTHER EQUIPMENT INCLUDING FANS, PUMPS, COILS, VALVES, PIPING, DAMPERS, AND DUCTWORK.
2). LIBRARY GRAPHIC FILE FORMAT SHALL BE COMPATIBLE WITH GRAPHICS GENERATION TOOLS.

8. PORTABLE OPERATOR'S TERMINAL.

a. PROVIDE ALL NECESSARY SOFTWARE TO CONFIGURE AN IBM–COMPATIBLE LAPTOP COMPUTER FOR USE AS A PORTABLE OPERATOR'S TERMINAL.

1). OPERATOR SHALL BE ABLE TO CONNECT CONFIGURED TERMINAL TO THE SYSTEM NETWORK OR DIRECTLY TO EACH CONTROLLER FOR PROGRAMMING, SETTING UP, AND TROUBLESHOOTING.

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HVAC SEQUENCE OF OPERATIONS

1.1 SEQUENCE OF OPERATIONS – HVAC DUCTWORK

A. EXHAUST FANS (E/F-1 AND E/F-2).

1. GENERAL.

a. CONFIGURATION: CONSTANT-VOLUME MIXED-AIR SINGLE PATH.
b. ASSOCIATED ROOFTOP UNIT: RTU-3 (E/F-1).
c. ASSOCIATED ROOFTOP UNIT: RTU-4 (E/F-2).

2. SYSTEM RUN.

a. OCCUPIED MODE.

1). EXHAUST FAN SHALL BE INTERLOCKED TO RUN DURING THE OCCUPIED MODE OF ITS ASSOCIATED ROOFTOP UNIT.

b. UNOCCUPIED MODE.

1). EXHAUST FAN SHALL BE OFF DURING THE UNOCCUPIED MODE OF ITS ASSOCIATED ROOFTOP UNIT.

3. SYSTEM OFF.

a. THE EXHAUST FAN SHALL BE OFF.
b. THE EXHAUST DAMPERS SHALL BE CLOSED.

4. FAILURE MODES.

a. FAN FAILURE: IF THE EXHAUST FAN FAILS TO OPERATE, THE EXHAUST FAN SHALL SHUT DOWN AND ALARM SHALL BE ANNUNCIATED.

1). DAMPERS SHALL BE INDEXED TO THEIR "SYSTEM OFF" CONDITIONS.

b. POWER FAILURE.

1). FANS: UPON RESTORATION OF POWER, THE EXHAUST FAN SHALL START AFTER AN ADJUSTABLE DELAY TO PROVIDE A STAGGERED START OF ALL BUILDING
2). DAMPERS: DAMPERS SHALL BE PROVIDED WITH SPRING RETURN ACTUATORS TO FAIL TO THEIR "SYSTEM OFF" POSITIONS.

B. VARIABLE AIR VOLUME TERMINAL UNITS (TU-01 THRU TU-36).

1. GENERAL.

a. ASSOCIATED ROOFTOP UNIT: RTU-1 (TU-01 THRU TU-08).
b. ASSOCIATED ROOFTOP UNIT: RTU-2 (TU-09 THRU TU-14).
c. ASSOCIATED ROOFTOP UNIT: RTU-3 (TU-15 THRU TU-23).
d. ASSOCIATED ROOFTOP UNIT: RTU-4 (TU-24 AND TU-25).
e. ASSOCIATED ROOFTOP UNIT: RTU-5 (TU-26 THRU TU-30).
f. ASSOCIATED ROOFTOP UNIT: RTU-6 (TU-31 THRU TU-33).
g. ASSOCIATED ROOFTOP UNIT: RTU-7 (TU-34 AND TU-35).
h. VAV MODULAR CONTROL ASSEMBLIES (CONTROLLER, ACTUATOR, AND DIFFERENTIAL PRESSURE TRANSMITTER) SHALL BE FURNISHED BY THE CONTROLS CONTRACTOR.
j. INTERLOCK WITH ROOM / SPACE TEMPERATURE SENSOR.

2. SYSTEM RUN.

a. OCCUPIED MODE.

1). THE TERMINAL UNIT SHALL OPERATE WHEN ITS ASSOCIATED ROOFOTP UNIT IS IN THE OCCUPIED MODE.

a). TERMINAL UNIT DAMPER: MODULATE TO MAINTAIN THE TERMINAL UNIT AIRFLOW (CFM) AT SETPOINT AS RESET BY SPACE TEMPERATURE.

1)). PROVIDE MINIMUM AND MAXIMUM CFM SETPOINTS FOR BOTH HEATING AND COOLING.

b). REHEAT COIL (WHERE SPECIFIED): CYCLE TO MAINTAIN SPACE TEMPERATURE AT SETPOINT.
c). SETPOINTS SHALL BE ADJUSTED REMOTELY FROM SPACE THERMOSTAT (±2° F).

1)). WALL MOUNTED TEMPERATURE SENSORS SHALL MODULATE THE VAV BOX DAMPERS TO MAINTAIN SPACE TEMPERATURE SETPOINT.
2)). AS THE ROOM TEMPERATURE DROPS BELOW 72° F (ADJUSTABLE), THE VAV BOX DAMPER SHALL CLOSE TO A MINIMUM AIR VOLUME SETPOINT.
3)). AS THE ROOM TEMPERATURE INCREASES ABOVE 74° F (ADJUSTABLE), THE VAV BOX DAMPER SHALL MODULATE OPEN TO A MAXIMUM AIR VOLUME SETPOINT SUBJECT TO THE DISCHARGE AIR TEMPERATURE BEING LESS THAN THE SPACE TEMPERATURE.

b. UNOCCUPIED MODE.

1). THE TERMINAL UNIT SHALL OPERATE WHEN ITS ASSOCIATED ROOFTOP UNIT IS INDEXED TO THE UNOCCUPIED MODE.

a). THE TERMINAL UNIT BOX DAMPER SHALL BE CLOSED WHEN THE SUPPLY FAN IS OFF.
b). THE TERMINAL UNIT DAMPER SHALL OPEN TO MAINTAIN THE SPACE TEMPERATURE AT ITS UNOCCUPIED SETPOINTS WHEN THE SUPPLY FAN IS OPERATING.

3. SYSTEM OFF.

a. THE TERMINAL UNIT BOX DAMPER SHALL BE CLOSED.

4. SAFETIES AND ALARMS.

a. DISPLAY SPACE TEMPERATURE ALARM WHENEVER SPACE TEMPERATURE LIMITS ARE EXCEEDED.

5. FAILURE MODES.

a. SENSOR FAILURE: UPON THE FAILURE OF AN ANALOG SENSOR, DAMPERS SHALL REMAIN AT THEIR LAST POSITION AND ALARM SHALL BE DISPLAYED.
b. POWER FAILURE.

1). DAMPER: TERMINAL UNIT DAMPER SHALL FAIL TO ITS LAST POSITION.

C. ROOFTOP UNITS (RTU-1 THRU RTU-7).

1. GENERAL.

a. CONFIGURATION: VARIABLE-VOLUME MIXED-AIR SINGLE PATH.
b. ASSOCIATED EXHAUST FANS: E/F-1 (RTU-3).
c. ASSOCIATED EXHAUST FANS: E/F-2 (RTU-4).
d. ASSOCIATED TERMINAL UNITS: TU-01 THRU TU-08 (RTU-1).
e. ASSOCIATED TERMINAL UNITS: TU-09 THRU TU-14 (RTU-2).
f. ASSOCIATED TERMINAL UNITS: TU-15 THRU TU-23 (RTU-3).
g. ASSOCIATED TERMINAL UNITS: TU-24 AND TU-25 (RTU-4).
h. ASSOCIATED TERMINAL UNITS: TU-26 THRU TU-30 (RTU-5).
i. ASSOCIATED TERMINAL UNITS: TU-31 THRU TU-33 (RTU-6).
j. ASSOCIATED TERMINAL UNITS: TU-34 AND TU-35 (RTU-7).

2. SYSTEM START.

a. WHEN THE ROOFTOP UNIT IS INDEXED TO OPERATE, THE SUPPLY FAN SHALL START.

1). SUPPLY FAN SPEED SHALL RAMP UP AND MODULATE TO MAINTAIN DUCT STATIC PRESSURE 2/3 DOWNSTREAM OF THE SUPPLY FAN AT SETPOINT (1" WC, ADJUSTABLE).

b. UPON PROOF OF SUPPLY FAN OPERATION, MODULATING OUTSIDE AIR DAMPER SHALL OPEN.

1). DAMPER END SWITCH SHALL ALLOW ECONOMIZER DAMPER OPERATION WHEN OUTSIDE AIR DAMPER IS FULLY OPEN.

c. UPON PROOF OF SUPPLY FAN OPERATION, DAMPERS AND CONTROL VALVES SHALL BE INDEXED TO THEIR "SYSTEM RUN" CONDITIONS.
d. WHEN EXHAUST DAMPER POSITION EXCEEDS 20% OPEN (ADJUSTABLE), THE EXHAUST FAN SHALL START.

1). EXHAUST FAN SPEED SHALL RAMP UP AND MODULATE TO MAINTAIN EXHAUST DUCT STATIC PRESSURE AT SETPOINT (-0.1" WC, ADJUSTABLE).

3. SYSTEM RUN.

a. WARM-UP MODE.

1). SUPPLY FAN SHALL START AND RUN CONTINUOUSLY.

a). THE SUPPLY FAN SPEED SHALL MODULATE TO MAINTAIN DUCT STATIC PRESSURE AT SET POINT (ADJUSTABLE).
b). SEE SYSTEM START.

2). ECONOMIZER DAMPERS: OUTSIDE AIR AND EXHAUST DAMPERS ARE FULLY CLOSED RETURN AIR DAMPER IS FULLY OPEN
3). GAS VALVE: CYCLE AS FOLLOWS WHEN THE SUPPLY FAN IS ON:

a). BELOW 50° F (ADJUSTABLE) OUTDOOR AIR TEMPERATURE, FULLY OPEN GAS VALVE TO MAINTAIN SUPPLY AIR TEMPERATURE AT SETPOINT AS RESET FROM COLDEST SPACE TEMPERATURE.
b). ABOVE 50° F (ADJUSTABLE) OUTDOOR AIR TEMPERATURE, CYCLE THE GAS VALVE TO MAINTAIN SUPPLY AIR TEMPERATURE AT SETPOINT AS RESET FROM SPACE TEMPERATURE.

4). DX COOLING: OFF.
5). EXHAUST FAN: OFF.

b. COOL-DOWN MODE.

1). SUPPLY FAN SHALL START AND RUN CONTINUOUSLY.

a). THE SUPPLY FAN SPEED SHALL MODULATE TO MAINTAIN DUCT STATIC PRESSURE AT SET POINT (ADJUSTABLE).
b). SEE SYSTEM START.

2). ECONOMIZER DAMPERS SHALL BE ENABLED TO PROVIDE FREE COOLING WHEN THE OUTSIDE AIR TEMPERATURE IS BELOW THE DRY BULB ECONOMIZER SETPOINT.

a). ECONOMIZER AVAILABLE: OUTSIDE AIR AND EXHAUST AIR DAMPERS ARE FULLY OPEN AND RETURN AIR DAMPER IS FULLY CLOSED WHEN THE SUPPLY FAN IS ON.
b). ECONOMIZER NOT AVAILABLE: OUTSIDE AIR AND EXHAUST DAMPERS ARE FULLY CLOSED AND RETURN AIR DAMPER IS FULLY OPEN.

3). GAS VALVE: CLOSED.
4). DX COOLING: CYCLE WHEN OUTSIDE AIR TEMPERATURE IS ABOVE THE DX COOLING SYSTEM ENABLE SETPOINT TO MAINTAIN SUPPLY AIR TEMPERATURE AT SETPOINT AS RESET FROM SPACE TEMPERATURE.
5). EXHAUST FAN: CYCLE BASED ON EXHAUST DAMPER POSITION.

a). SEE SYSTEM START.

c. OCCUPIED MODE.

1). SUPPLY FAN SHALL RUN CONTINUOUSLY.

a). THE SUPPLY FAN SPEED SHALL MODULATE TO MAINTAIN DUCT STATIC PRESSURE AT SETPOINT (ADJUSTABLE)
b). SEE SYSTEM START.

2). ECONOMIZER (WITH CO2 SENSOR).

a). THE CONTROL SYSTEM SHALL SENSE THE INCREASED OCCUPANTS / CARBON DIOXIDE AND INCREASE THE OUTSIDE AIR QUANTITY ON THE EQUIPMENT SERVING THAT AREA SUCH THAT THE CARBON DIOXIDE SHALL BE CONTROLLED SO AS NOT TO EXCEED 500 PPM (ADJUSTABLE) ABOVE THE OUTSIDE AIR CARBON DIOXIDE CONCENTRATION.
b). MINIMUM OUTSIDE AIR IS SUPPLIED TO ALL AREAS AT ALL TIMES DURING OCCUPIED MODE.
c). CARBON DIOXIDE SENSOR OVERRIDES MINIMUM OUTSIDE AIR SETPOINT TO INCREASE OUTSIDE AIR SHOULD THE CONDITIONS IN THE SPACE DEVIATE FROM DESIGN CONDITIONS.

3). VARIABLE FREQUENCY DRIVE FAN.

a). THE SUPPLY FAN VARIABLE FREQUENCY DRIVE (VFD) SHALL VARY THE SUPPLY QUANTITY BASED UPON MAINTAINING A MINIMUM POSITIVE STATIC PRESSURE OF 1" WC (ADJUSTABLE) AT REMOTELY LOCATED STATIC PRESSURE SENSOR.
b). IF THE STATIC PRESSURE EXCEEDS SETPOINT, THE DDC SYSTEM WILL SLOW DOWN THE VFD UNTIL THE STATIC PRESSURE LIMIT IS MET.

1). IF THE STATIC PRESSURE CONTINUES ABOVE SETPOINT THE DDC SYSTEM WILL SHUT DOWN THE UNIT IN ORDER TO PROTECT THE DUCTWORK.

4). GAS VALVE: CYCLE IN SEQUENCE WITH THE ECONOMIZER DAMPERS TO MAINTAIN THE DISCHARGE AIR TEMPERATURE AT SETPOINT AS RESET FROM SPACE TEMPERATURE.

a). BELOW 50° F (ADJUSTABLE) DISCHARGE AIR TEMPERATURE (FOR A PERIOD OF 5-MINUTES) AS SENSED BY THE DISCHARGE AIR TEMPERATURE SENSOR, THE SYSTEM SHALL BE DISABLED.

1). THE OUTSIDE AIR DAMPER SHALL CLOSE, THE SUPPLY FAN SHALL STOP AND THE GAS VALVE SHALL BE DISABLED.

b). ABOVE 115° F (ADJUSTABLE) DISCHARGE AIR TEMPERATURE (FOR A PERIOD OF 5-MINUTES) AS SENSED BY THE DISCHARGE AIR TEMPERATURE SENSOR, THE GAS VALVE SHALL CLOSE.

1). IF THE DISCHARGE AIR TEMPERATURE DOES NOT DROP BELOW 115° F, THE UNIT SHALL SHUT DOWN.
2). THE OUTSIDE AIR DAMPER SHALL CLOSE AND THE SUPPLY FAN SHALL STOP.

5). DX COOLING: CYCLE WHEN OUTSIDE AIR TEMPERATURE IS ABOVE THE DX COOLING SYSTEM ENABLE SETPOINT TO MAINTAIN SUPPLY AIR TEMPERATURE AT SETPOINT AS RESET FROM DISCHARGE AIR TEMPERATURE.
6). THE EXHAUST FAN SHALL OPERATE BASED ON EXHAUST DAMPER POSITION.

a). FAN SPEED SHALL MODULATE TO MAINTAIN EXHAUST DUCT STATIC PRESSURE AT SETPOINT.
b). SEE SYSTEM START.

d. UNOCCUPIED HEATING MODE.

1). SUPPLY FAN SHALL CYCLE TO MAINTAIN LOWEST ASSOCIATED SPACE TEMPERATURE AT THE UNOCCUPIED HEATING SETPOINT (55° F, ADJUSTABLE).

a). THE SUPPLY FAN SPEED SHALL MODULATE TO MAINTAIN DUCT STATIC PRESSURE AT SETPOINT (ADJUSTABLE).

2). ECONOMIZER DAMPERS: OUTSIDE AIR AND EXHAUST DAMPERS ARE FULLY CLOSED AND RETURN AIR DAMPER IS FULLY OPEN.
3). GAS VALVE: CYCLE AS FOLLOWS WHEN THE SUPPLY FAN IS ON:

a). BELOW 55° F (ADJUSTABLE) SPACE TEMPERATURE, FULLY OPEN GAS VALVE TO MAINTAIN SUPPLY AIR TEMPERATURE AT 95° F (ADJUSTABLE).
b). ABOVE 55° F (ADJUSTABLE) SPACE TEMPERATURE, CYCLE THE GAS VALVE TO MAINTAIN SUPPLY AIR TEMPERATURE AT 95° F (ADJUSTABLE).

4). DX COOLING: OFF.
5). EXHAUST FAN: OFF.

e. UNOCCUPIED COOLING MODE.

1). SUPPLY FAN SHALL CYCLE TO MAINTAIN HIGHEST ASSOCIATED SPACE TEMPERATURE AT THE UNOCCUPIED COOLING SETPOINT (85° F, ADJUSTABLE).

a). THE SUPPLY FAN SPEED SHALL MODULATE TO MAINTAIN DUCT STATIC PRESSURE AT SET POINT (ADJUSTABLE).
b). SEE SYSTEM START.

2). ECONOMIZER DAMPERS: ECONOMIZER DAMPERS SHALL BE ENABLED TO PROVIDE FREE COOLING WHEN THE OUTSIDE AIR TEMPERATURE IS BELOW THE DRY BULB ECONOMIZER SETPOINT.

a). ECONOMIZER AVAILABLE: OUTSIDE AIR AND EXHAUST AIR DAMPERS ARE FULLY OPEN AND RETURN AIR DAMPER IS FULLY CLOSED WHEN THE SUPPLY FAN IS ON.
b). ECONOMIZER NOT AVAILABLE: OUTSIDE AIR AND EXHAUST DAMPERS ARE FULLY CLOSED AND RETURN AIR DAMPER IS FULLY OPEN.

3). GAS VALVE: CLOSED.
4). DX COOLING: CYCLE WHEN OUTSIDE AIR TEMPERATURE IS ABOVE THE DX COOLING SYSTEM ENABLE SETPOINT TO MAINTAIN SUPPLY AIR TEMPERATURE AT 55° F (ADJUSTABLE).
5). EXHAUST FAN: CYCLE BASED ON EXHAUST DAMPER POSITION.

a). SEE SYSTEM START.

5. SYSTEM OFF.

a. THE SUPPLY FAN AND EXHAUST FAN SHALL BE OFF.

1). THE SUPPLY FAN AND EXHAUST FAN VFD?S WILL BE COMMANDED TO 0%.

b. THE OUTSIDE AIR AND EXHAUST DAMPERS SHALL BE CLOSED.
c. THE RETURN AIR DAMPER SHALL BE OPEN.
d. THE GAS VALVE SHALL CYCLE TO MAINTAIN THE MIXED AIR PLENUM TEMPERATURE AT 50° F (ADJUSTABLE).
e. THE DX COOLING SHALL BE OFF.

6. SAFETIES AND ALARMS.

a. DISPLAY OFF-NORMAL ALARM WHENEVER SUPPLY FAN STATUS DOES NOT EQUAL COMMAND.
b. LOW LIMIT: MANUAL RESET LOW LIMIT THERMOSTAT SHALL STOP THE SUPPLY AND EXHAUST FANS AND DISPLAY AN ALARM SHOULD THE COIL DISCHARGE AIR TEMPERATURE FALL BELOW 38° F (ADJUSTABLE).

1). HEATING COIL VALVE SHALL OPEN FULLY, AND DAMPERS AND DX COOLING CONTROL VALVE SHALL BE INDEXED TO THEIR "SYSTEM OFF" CONDITIONS.

c. HIGH LIMIT: MANUAL RESET HIGH LIMIT THERMOSTAT LOCATED IN THE RETURN AIR SHALL STOP THE SUPPLY AND EXHAUST FANS AND DISPLAY AN ALARM SHOULD THE RETURN AIR TEMPERATURE RISE ABOVE 125° F (ADJUSTABLE).

1). DAMPERS AND CONTROL VALVES SHALL BE INDEXED TO THEIR "SYSTEM OFF" CONDITIONS.

d. SMOKE CONTROL.

1). DUCT SMOKE DETECTOR(S) SHALL STOP THE SUPPLY FAN AND DISPLAY ALARM WHEN PRODUCTS OF COMBUSTION ARE DETECTED IN THE AIR STREAM.

a). DAMPERS AND CONTROL VALVE SHALL BE INDEXED TO THEIR "SYSTEM OFF" CONDITIONS.

2). THE SUPPLY FAN SHALL BE INTERLOCKED TO SHUT DOWN UPON A COMMAND FROM THE BUILDING FIRE ALARM SYSTEM.
3). UPON A RETURN TO NORMAL, THE SUPPLY FAN SHALL START AFTER AN ADJUSTABLE DELAY TO PROVIDE A STAGGERED START OF ALL BUILDING LOADS.

e. FILTER CONDITION: MONITOR DIFFERENTIAL PRESSURE ACROSS FILTER AND DISPLAY AN ALARM WHEN DIFFERENTIAL PRESSURE SETPOINT IS EXCEEDED.
f. STATIC HIGH LIMIT: SUPPLY AND EXHAUST FANS WILL BE SHUT DOWN IF THE DISCHARGE AIR STATIC PRESSURE EXCEEDS 3" WC.

7. FAILURE MODES.

a. FAN FAILURE: IF THE SUPPLY OR EXHAUST FAN FAILS TO OPERATE, BOTH SUPPLY AND EXHAUST FANS SHALL SHUT DOWN AND ALARM SHALL BE DISPLAYED.

1). DAMPERS AND CONTROL VALVE SHALL BE INDEXED TO THEIR "SYSTEM OFF" CONDITIONS.

b. SENSOR FAILURE: UPON THE FAILURE OF AN ANALOG SENSOR, ASSOCIATED DAMPERS AND CONTROL VALVES SHALL REMAIN AT THEIR LAST POSITION AND ALARM SHALL BE DISPLAYED.
c. POWER FAILURE.

1). FANS: UPON RESTORATION OF POWER, THE SUPPLY AND EXHAUST FANS SHALL START AFTER AN ADJUSTABLE DELAY TO PROVIDE A STAGGERED START OF ALL BUILDING LOADS.
2). DAMPERS: ECONOMIZER DAMPERS SHALL BE PROVIDED WITH SPRING RETURN ACTUATORS TO FAIL TO THEIR "SYSTEM OFF" POSITIONS.
3). VALVES: GAS VALVE SHALL BE PROVIDED WITH SPRING RETURN ACTUATOR TO FAIL OPEN TO THE COIL.

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JOB CAPT. _____ INTERIORS N.Catuzza

SEAL:

TITLE:
HVAC SEQUENCE OF OPERATIONS

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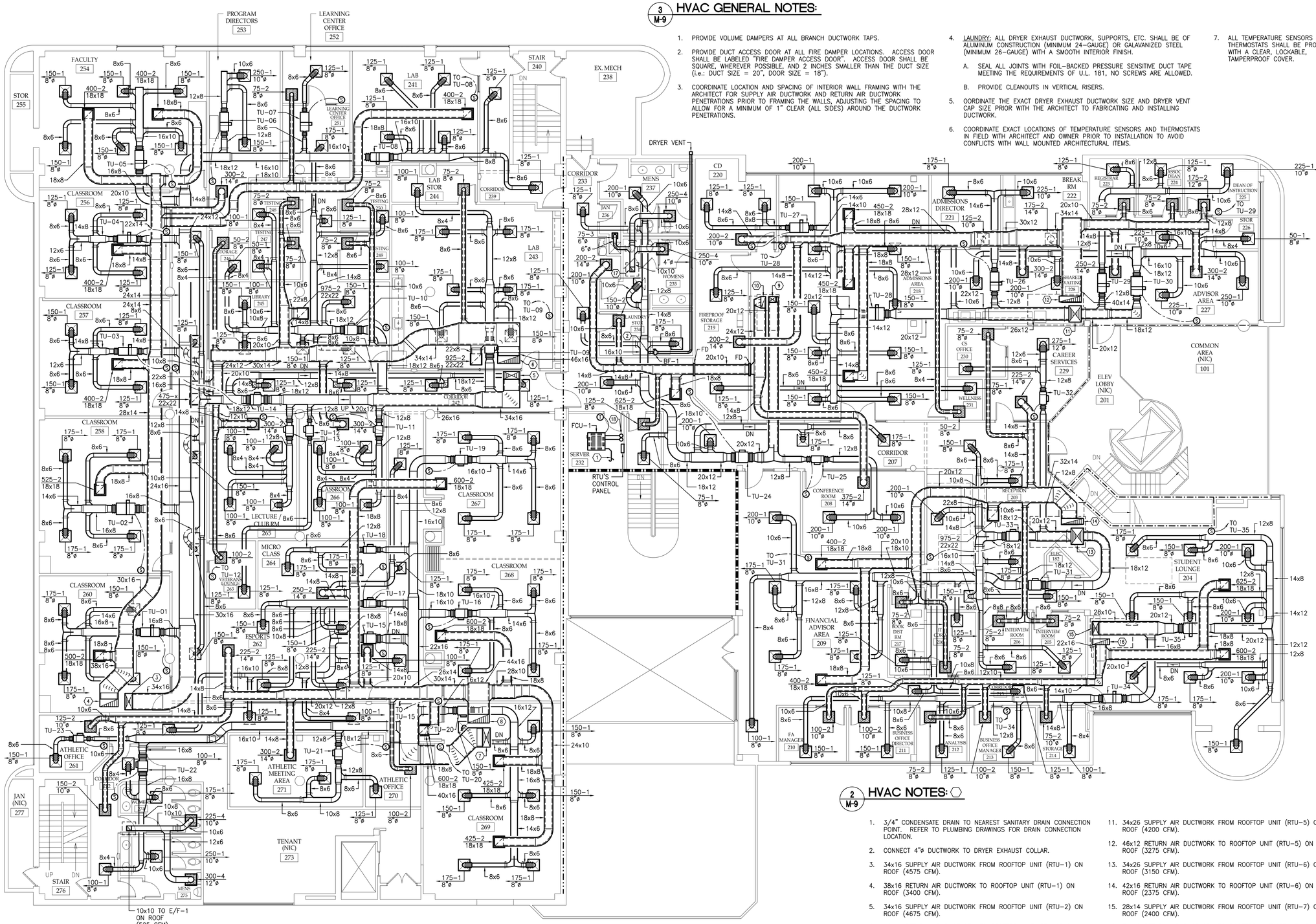
SA JOB #: 19099.02
DATE: 4-6-2020

DRAWING #: M-8



3 M-9 HVAC GENERAL NOTES:

1. PROVIDE VOLUME DAMPERS AT ALL BRANCH DUCTWORK TAPS.
2. PROVIDE DUCT ACCESS DOOR AT ALL FIRE DAMPER LOCATIONS. ACCESS DOOR SHALL BE LABELED "FIRE DAMPER ACCESS DOOR". ACCESS DOOR SHALL BE SQUARE, WHEREVER POSSIBLE, AND 2 INCHES SMALLER THAN THE DUCT SIZE (i.e.: DUCT SIZE = 20", DOOR SIZE = 18").
3. COORDINATE LOCATION AND SPACING OF INTERIOR WALL FRAMING WITH THE ARCHITECT FOR SUPPLY AIR DUCTWORK AND RETURN AIR DUCTWORK PENETRATIONS PRIOR TO FRAMING THE WALLS, ADJUSTING THE SPACING TO ALLOW FOR A MINIMUM OF 1" CLEAR (ALL SIDES) AROUND THE DUCTWORK PENETRATIONS.
4. LAUNDRY: ALL DRYER EXHAUST DUCTWORK, SUPPORTS, ETC. SHALL BE OF ALUMINUM CONSTRUCTION (MINIMUM 24-GAUGE) OR GALVANIZED STEEL (MINIMUM 26-GAUGE) WITH A SMOOTH INTERIOR FINISH.
   A. SEAL ALL JOINTS WITH FOIL-BACKED PRESSURE SENSITIVE DUCT TAPE MEETING THE REQUIREMENTS OF U.L. 181, NO SCREWS ARE ALLOWED.
   B. PROVIDE CLEANOUTS IN VERTICAL RISERS.
5. OORDINATE THE EXACT DRYER EXHAUST DUCTWORK SIZE AND DRYER VENT CAP SIZE PRIOR WITH THE ARCHITECT TO FABRICATING AND INSTALLING DUCTWORK.
6. COORDINATE EXACT LOCATIONS OF TEMPERATURE SENSORS AND THERMOSTATS IN FIELD WITH ARCHITECT AND OWNER PRIOR TO INSTALLATION TO AVOID CONFLICTS WITH WALL MOUNTED ARCHITECTURAL ITEMS.
7. ALL TEMPERATURE SENSORS AND THERMOSTATS SHALL BE PROVIDED WITH A CLEAR, LOCKABLE, TAMPERPROOF COVER.

1 M-9 SECOND FLOOR PLAN - HVAC DUCTWORK AND PIPING

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

2 M-9 HVAC NOTES:

1. 3/4" CONDENSATE DRAIN TO NEAREST SANITARY DRAIN CONNECTION POINT. REFER TO PLUMBING DRAWINGS FOR DRAIN CONNECTION LOCATION.
2. CONNECT 4"ø DUCTWORK TO DRYER EXHAUST COLLAR.
3. 34x16 SUPPLY AIR DUCTWORK FROM ROOFTOP UNIT (RTU-1) ON ROOF (4575 CFM).
4. 38x16 RETURN AIR DUCTWORK TO ROOFTOP UNIT (RTU-1) ON ROOF (3400 CFM).
5. 34x16 SUPPLY AIR DUCTWORK FROM ROOFTOP UNIT (RTU-2) ON ROOF (4675 CFM).
6. 46x16 RETURN AIR DUCTWORK TO ROOFTOP UNIT (RTU-2) ON ROOF (3500 CFM).
7. 40x16 SUPPLY AIR DUCTWORK FROM ROOFTOP UNIT (RTU-3) ON ROOF (5200 CFM).
8. 44x16 RETURN AIR DUCTWORK TO ROOFTOP UNIT (RTU-3) ON ROOF (4025 CFM).
9. 16x12 SUPPLY AIR DUCTWORK FROM ROOFTOP UNIT (RTU-4) ON ROOF (2050 CFM).
10. 24x10 RETURN AIR DUCTWORK TO ROOFTOP UNIT (RTU-4) ON ROOF (1475 CFM).
11. 34x26 SUPPLY AIR DUCTWORK FROM ROOFTOP UNIT (RTU-5) ON ROOF (4200 CFM).
12. 46x12 RETURN AIR DUCTWORK TO ROOFTOP UNIT (RTU-5) ON ROOF (3275 CFM).
13. 34x26 SUPPLY AIR DUCTWORK FROM ROOFTOP UNIT (RTU-6) ON ROOF (3150 CFM).
14. 42x16 RETURN AIR DUCTWORK TO ROOFTOP UNIT (RTU-6) ON ROOF (2375 CFM).
15. 28x14 SUPPLY AIR DUCTWORK FROM ROOFTOP UNIT (RTU-7) ON ROOF (2400 CFM).
16. 36x12 RETURN AIR DUCTWORK TO ROOFTOP UNIT (RTU-7) ON ROOF (1675 CFM).
17. 10x10 EXHAUST AIR DUCTWORK TO EXHAUST FAN (E/F-2) ON ROOF (575 CFM).
18. 3/8" REFRIGERANT LIQUID (RL) FROM CONDENSING UNIT ON ROOF, 5/8" REFRIGERANT SUCTION (RS) TO CONDENSING UNIT ON ROOF.

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TITLE:
SECOND FLOOR PLAN - HVAC DUCTWORK AND PIPING

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DATE: 4-6-2020

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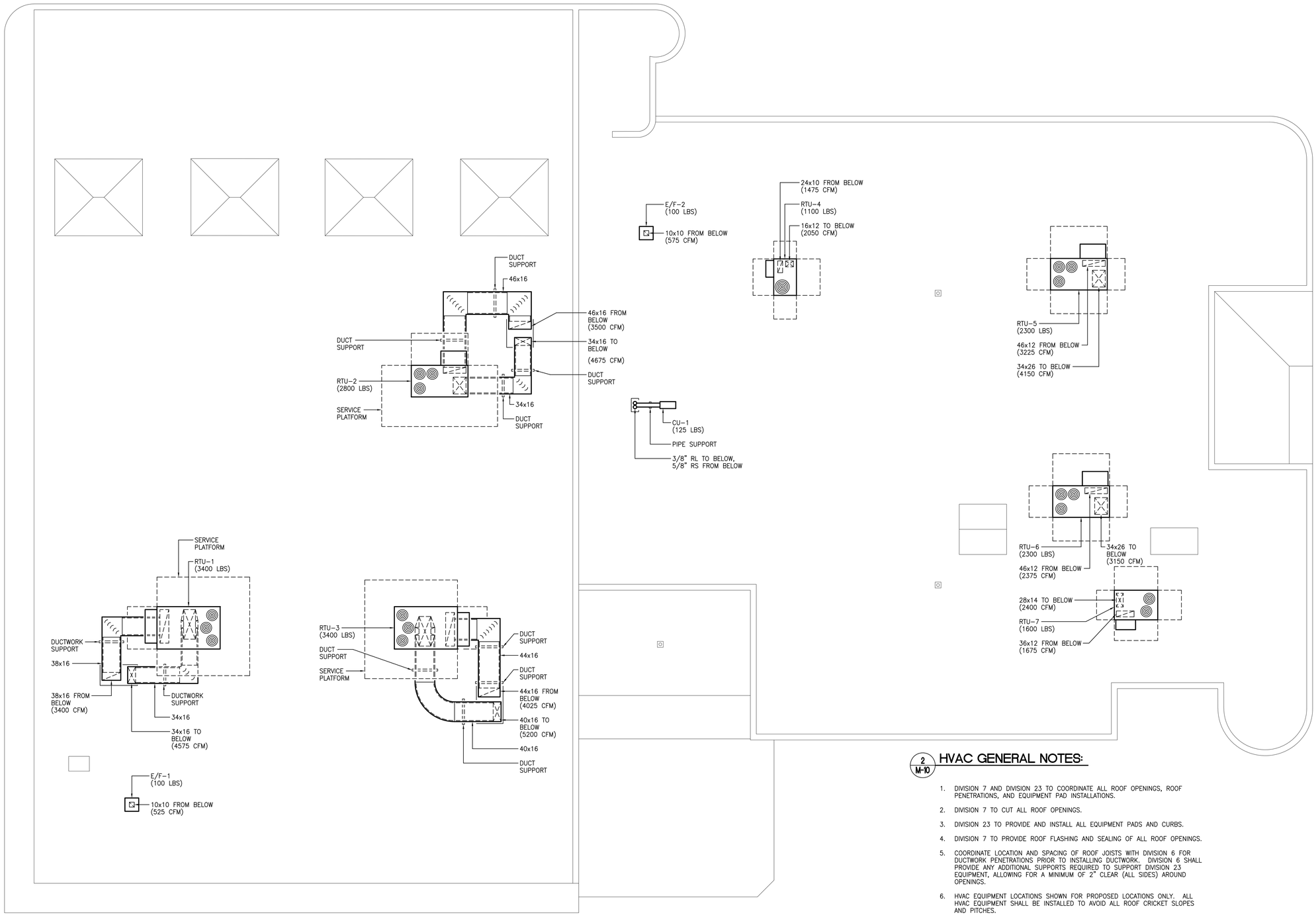

1 M-10 ROOF PLAN - HVAC DUCTWORK AND PIPING

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

2 M-10 HVAC GENERAL NOTES:

1. DIVISION 7 AND DIVISION 23 TO COORDINATE ALL ROOF OPENINGS, ROOF PENETRATIONS, AND EQUIPMENT PAD INSTALLATIONS.
2. DIVISION 7 TO CUT ALL ROOF OPENINGS.
3. DIVISION 23 TO PROVIDE AND INSTALL ALL EQUIPMENT PADS AND CURBS.
4. DIVISION 7 TO PROVIDE ROOF FLASHING AND SEALING OF ALL ROOF OPENINGS.
5. COORDINATE LOCATION AND SPACING OF ROOF JOISTS WITH DIVISION 6 FOR DUCTWORK PENETRATIONS PRIOR TO INSTALLING DUCTWORK. DIVISION 6 SHALL PROVIDE ANY ADDITIONAL SUPPORTS REQUIRED TO SUPPORT DIVISION 23 EQUIPMENT, ALLOWING FOR A MINIMUM OF 2" CLEAR (ALL SIDES) AROUND OPENINGS.
6. HVAC EQUIPMENT LOCATIONS SHOWN FOR PROPOSED LOCATIONS ONLY. ALL HVAC EQUIPMENT SHALL BE INSTALLED TO AVOID ALL ROOF CRICKET SLOPES AND PITCHES.
7. ALL EXPOSED SUPPLY AIR AND RETURN AIR DUCTWORK AND FITTINGS LOCATED ON THE ROOF SHALL BE INTERNALLY LINED (MINIMUM 1-1/2" THICK) AND EXTERNALLY INSULATED WITH MINIMUM 3" THICK, 0.75 LB DENSITY, FOIL-BACK INSULATION WITH VAPOR BARRIER AND ALL SERVICE JACKET, MINIMUM R-VALUE OF R-12, FLAME SPREAD RATING OF 75 OR LESS, AND SMOKE-DEVELOPED RATING OF 150 OR LESS. PROVIDE AN ALUMINUM OR STAINLESS STEEL JACKET OVER EXTERNAL INSULATION AND SEAL ALL SEAMS AIR AND WATERTIGHT TO PREVENT THE ENTRANCE OF MOISTURE, ETC.
   A. OWNERS OPTION: PROVIDE PRE-INSULATED RIGID THERMOSET PHENOLIC DUCTWORK PANELS AS MANUFACTURED BY QDUCT (AQC INDUSTRIES). PANELS SHALL HAVE A MINIMUM R-VALUE OF R-12 AND SHALL CONFORM TO THE REQUIREMENTS OF UL 181. EXTERIOR CLADDING SHALL BE CONSTRUCTED OF ALUMINUM (MINIMUM OF 19.7 MILS THICK) WITH FACTORY INSTALLED DUCTWORK SUPPORT MOUNTING RAILS. PROVIDE ALUMINUM SLOPED ROOF INSULATION PANEL WITH MINIMUM R-VALUE OF R-8.6.

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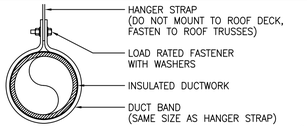
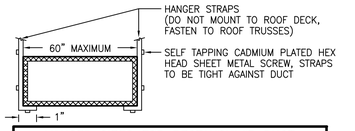


HANGER SIZES FOR ROUND DUCT				
DUCT DIAMETER	ROUND HANGERS	STRAP HANGERS	MAXIMUM SPACING	NUMBER OF HANGERS
UP THRU 18"	1/4" ROD	1" x 16 GAUGE	10'–0"	1
19" THRU 36"	3/8" ROD	1" x 12 GAUGE	10'–0"	1

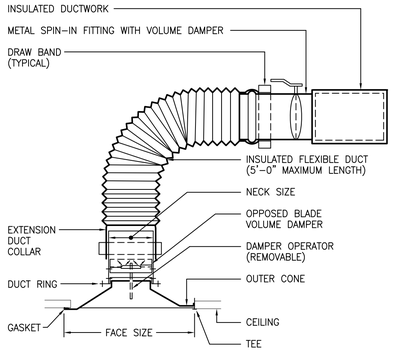


HANGER SIZES FOR RECTANGULAR DUCT			
LONGEST DIMENSION OF DUCT	ROUND HANGERS	STRAP HANGERS	MAXIMUM SPACING
UP THRU 18"	1/4" ROD	1" x 16 GAUGE	10'–0"
19" THRU 42"	1/4" ROD	1" x 16 GAUGE	10'–0"

NOTES:

1. INSULATE ALL DUCTWORK AS PER SPECIFICATIONS.

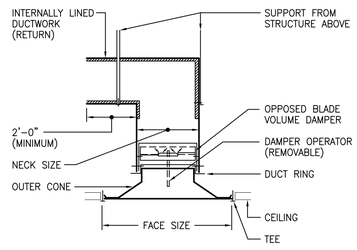
DUCT HANGER DETAIL



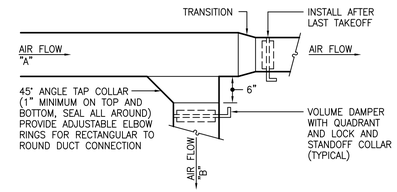
INSTALLATION NOTES:

1. FASTEN DUCT RING TO EXTENSION DUCT COLLAR WITH SHEET METAL SCREWS.
2. "TAP–OUT" EITHER SIDE OR BOTTOM OF DUCT; TOP "TAP–OUT" IS NOT ACCEPTABLE.

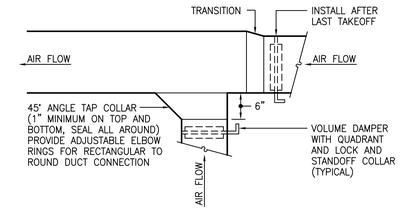
CEILING DIFFUSER CONNECTION DETAIL



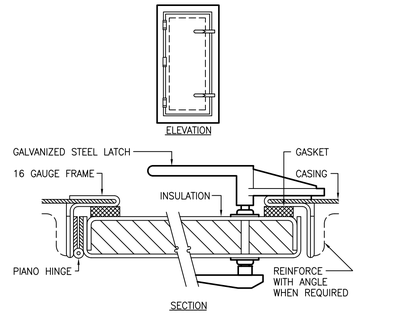
RETURN AND EXHAUST GRILLE CONNECTION DETAIL



SUPPLY BRANCH TAKEOFF FITTING DETAIL



RETURN / EXHAUST BRANCH TAKEOFF FITTING DETAIL



NOTE:

1. ALL DOORS TO OPEN AGAINST PRESSURE.
2. LABEL DOOR "FIRE DAMPER ACCESS".

DUCT ACCESS DOOR DETAIL

NOTES:

1. OPENINGS IN WALL SHALL BE 1/8" PER FOOT LARGER THAN DAMPER DIMENSIONS (3/16" LARGER PER FOOT FOR STAINLESS STEEL). MINIMUM CLEARANCE OF 1/4" REQUIRED FOR ALL INSTALLATIONS.
2. SLEEVE GAUGE SHALL BE AT LEAST EQUAL TO THE GAUGE OF THE DUCT AS DEFINED BY THE APPROPRIATE SMACNA DUCT CONSTRUCTION STANDARDS AND NFPA 90A, WHEN ONE OR MORE OF THE FOLLOWING DUCT SLEEVE CONNECTIONS ARE USED:
   A. PLAIN "S" SLIP.
   B. HEMMED "S" SLIP.
   C. STANDING "S" SLIP.
   D. REINFORCED STANDING "S" SLIP.
   E. INSIDE SLIP JOINT.
   F. DOUBLE "S" SLIP.
3. IF ANY OTHER DUCT SLEEVE CONNECTIONS ARE USED, THE SLEEVE SHALL BE MINIMUM 16–GAUGE FOR DAMPERS UP TO 36"W x 24"H AND 14–GAUGE IF WIDTH EXCEEDS 36" OR HEIGHT EXCEEDS 24".
4. MOUNTING ANGLE SHALL BE MINIMUM OF 2"x1"x14–GAUGE AND BOLTED, TACK WELDED OR SCREWED TO SLEEVE AT MAXIMUM SPACING OF 12" AND WITH MINIMUM OF TWO CONNECTIONS IN EACH SIDE, TOP AND BOTTOM. MOUNTING ANGLES SHALL OVERLAP WALL A MINIMUM OF 1" ON ALL FOUR SIDES.
5. DAMPER SHALL BE BOLTED, TACK WELDED OR SCREWED TO SLEEVE ON SAME SPACING AS ANGLES. SLEEVES SHALL NOT EXTEND MORE THAN 6" OUTSIDE OF WALL.

FIRE DAMPER (OUTSIDE DUCT) DETAIL

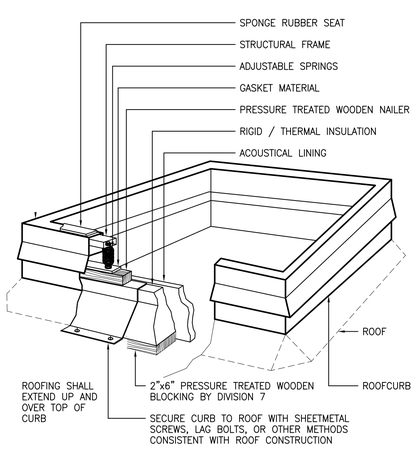
VAV BOX DETAIL

NOTES:

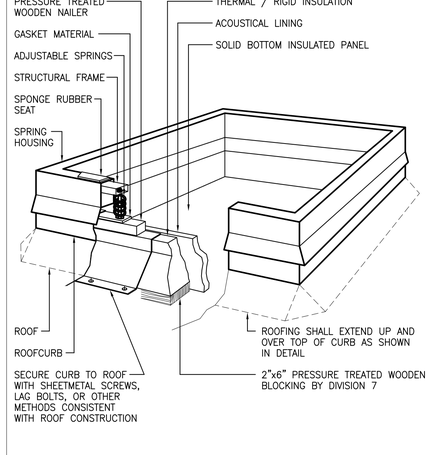
1. MOUNT BOTTOM OF VENT CAP A MINIMUM OF 2'–0" ABOVE FINISHED GRADE.

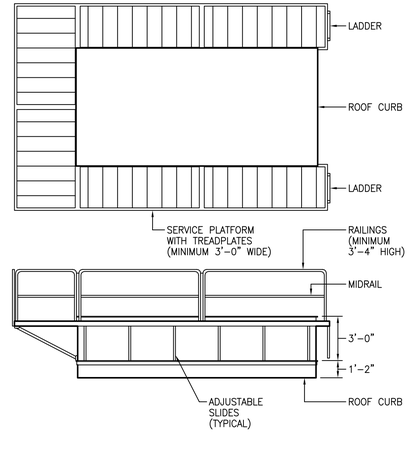
DRYER VENT THRU WALL DETAIL

ROOF MOUNTED EXHAUST FAN DETAIL

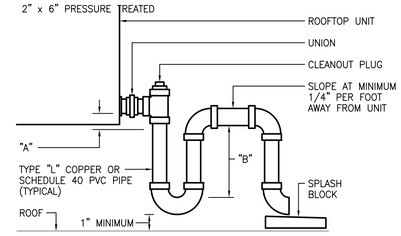


THERMAL ACOUSTICAL AND VIBRATION ISOLATION ROOF CURB DETAIL





THERMAL ACOUSTICAL AND VIBRATION ISOLATION ROOF CURB WITH INTEGRAL SERVICE PLATFORM DETAIL

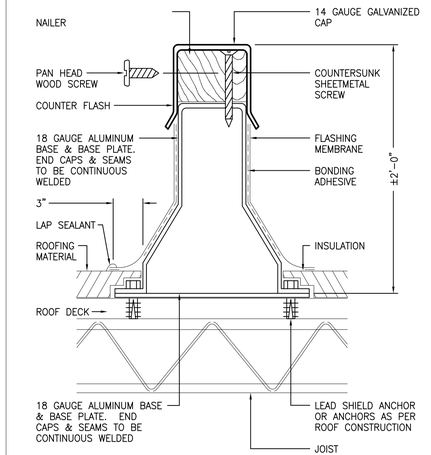


COIL CONFIGURATION	DIMENSION "A"	DIMENSION "B"
BLOW–THRU	1"	FAN DISCHARGE STATIC PRESSURE PLUS 1"
DRAW–THRU	FAN SUCTION STATIC PRESSURE PLUS 1"	2–1/2"

NOTES:

1. MINIMUM "A" OR "B" DIMENSION SHALL NOT BE LESS THAN 1".
2. COPPER CONDENSATE DRAIN LINES SHALL BE INSULATED WITH MINIMUM 1–1/2" THICK ARMAFLEX II SLIP–ON TYPE INSULATION.
3. DISCHARGE CONDENSATE PIPING A MINIMUM OF 3'–0" AWAY FROM UNIT TO RSPLASH BLOCK ON ROOF (UNLESS PROHIBITED BY LOCAL CODE).

ROOFTOP UNIT CONDENSATE TRAP DETAIL



ROOF MOUNTED EQUIPMENT RAIL DETAIL

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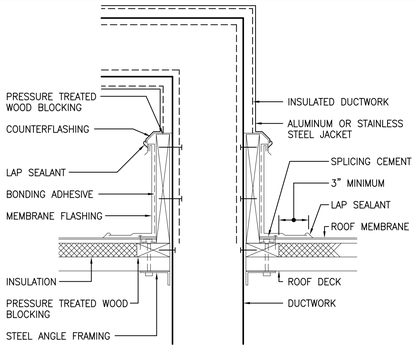
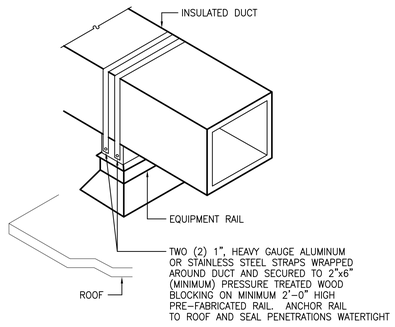


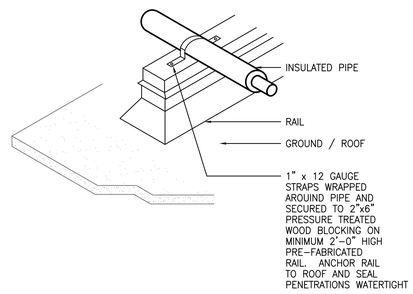
NOTES:

1. FLASHING MINIMUM 6" HIGH WHENEVER POSSIBLE AND MUST BE ABOVE ROOF FLOOD LEVEL.

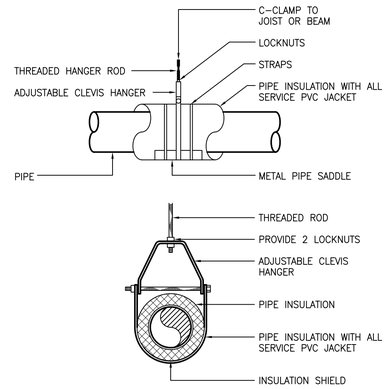
DUCT THRU FLAT ROOF DETAIL



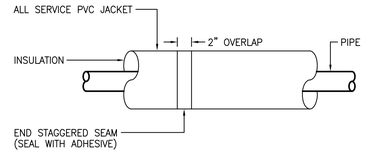
ROOF MOUNTED DUCTWORK SUPPORT DETAIL



ROOF MOUNTED PIPE SUPPORT DETAIL



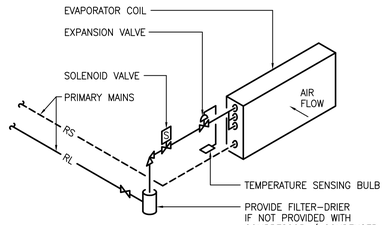
SINGLE PIPE HANGER DETAIL



NOTE:

1. ALL PIPING EXPOSED IN OCCUPIED AREAS SHALL BE JACKETED WITH MATERIALS SUITABLE FOR PAINTING.

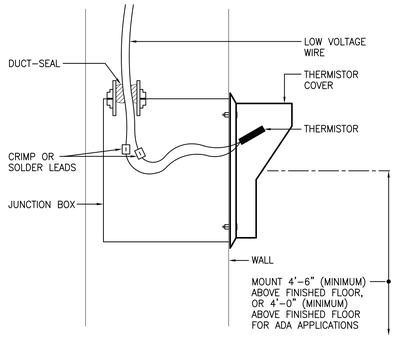
PIPING INSULATION JACKET DETAIL



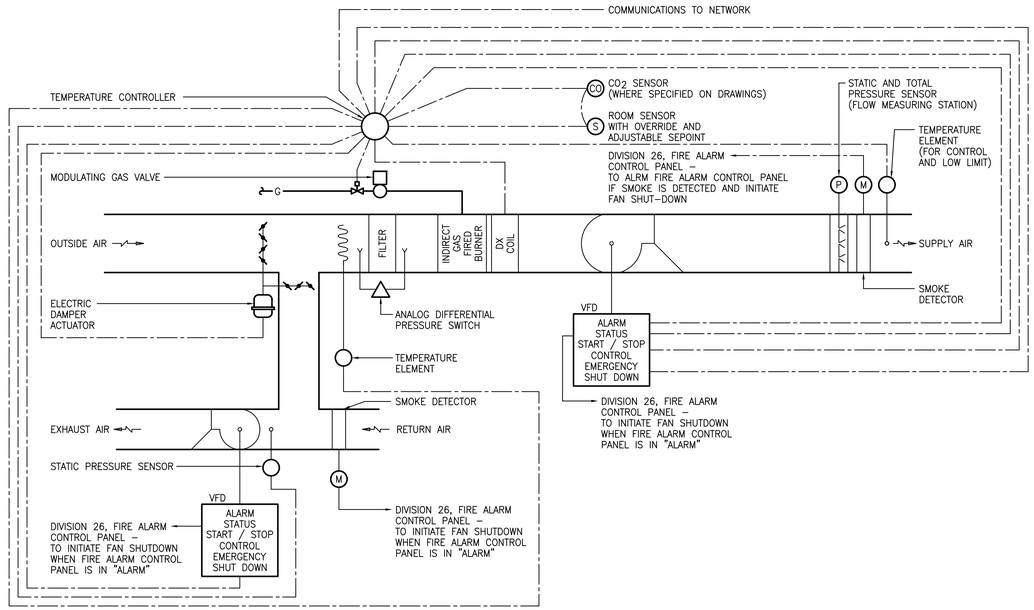
NOTES:

1. PITCH ALL GAS LINES IN DIRECTION OF FLOW, 1/16 INCH/FOOT (MINIMUM).
2. PROVIDE DOUBLE RISER WHERE NECESSARY TO MAINTAIN REQUIRED VELOCITIES FOR OIL FLOW.
3. PROVIDE A TRAP FOR EVERY 25 FEET OF VERTICAL RISE IN GAS LINES.
4. HVAC EQUIPMENT SUPPLIER SHALL SIZE REFRIGERANT LINES TO MEET SYSTEM REQUIREMENTS.

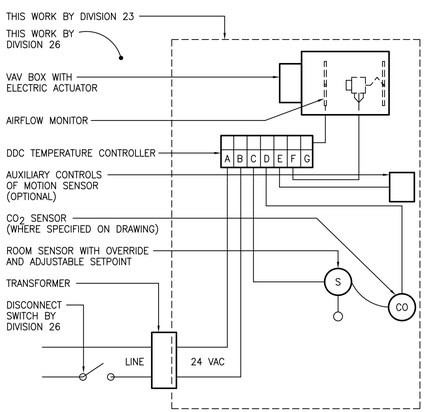
DX COOLING COIL PIPING DETAIL



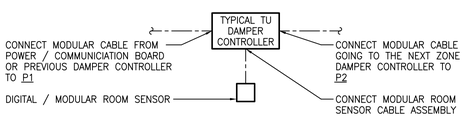
THERMOSTAT / TEMPERATURE SENSOR MOUNTING DETAIL



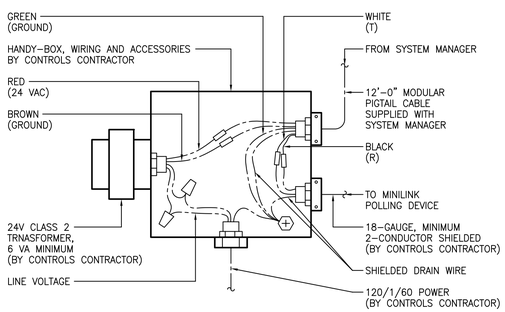
ROOFOTP UNIT- GAS HEATING AND DX COOLING WITH VARIABLE FREQUENCY DRIVE AND POWER EXHAUST CONTROL DIAGRAM



VAV TERMINAL STRIP CONNECTION DETAIL



TYPICAL VARIABLE AIR VOLUME (VAV) DAMPER CONTROLLER CONNECTION DETAIL



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SA JOB #: 19099.02
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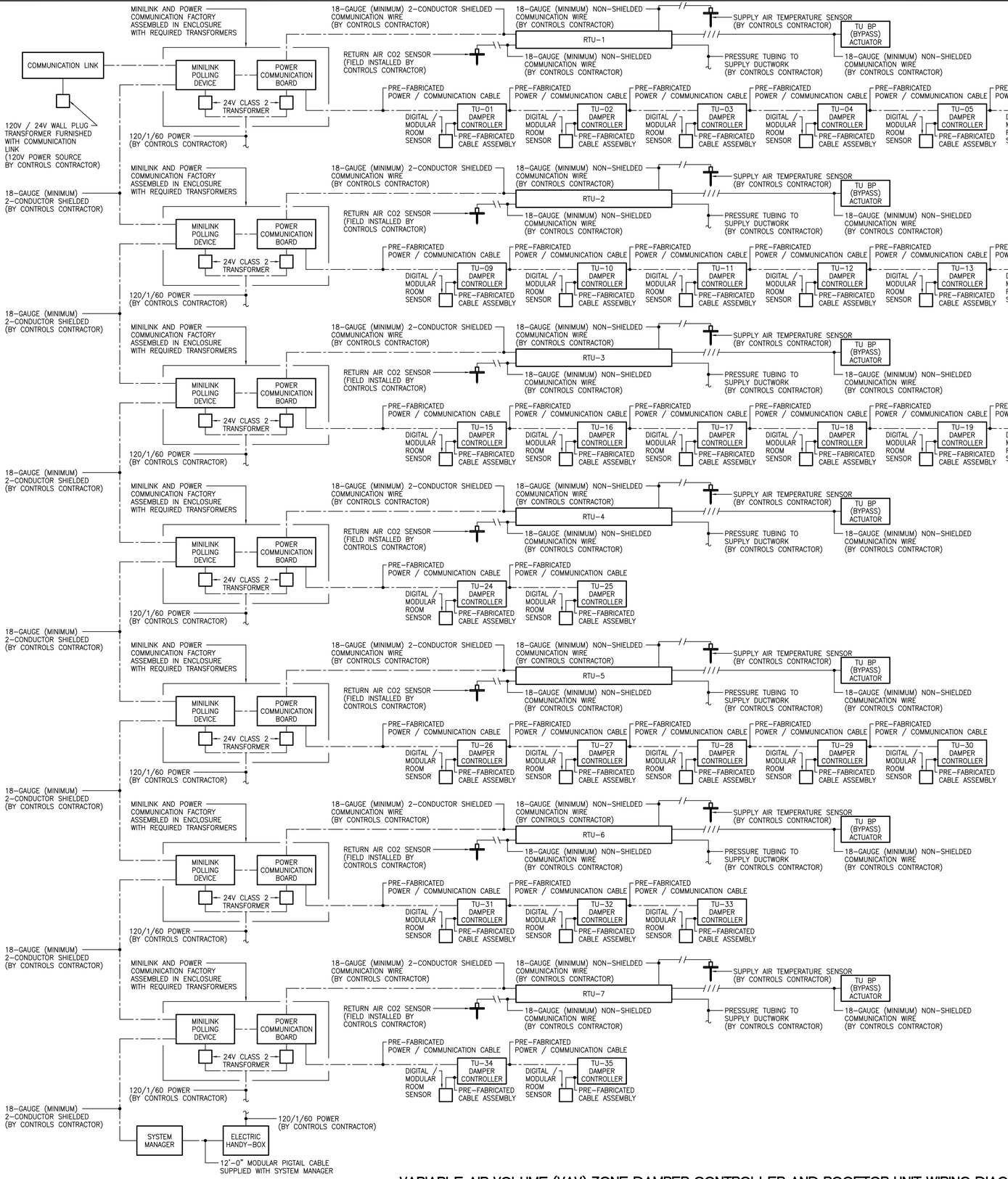

VARIABLE AIR VOLUME (VAV) ZONE DAMPER CONTROLLER AND ROOFTOP UNIT WIRING DIAGRAM

NOTES:

1. ALL WIRING TO BE IN ACCORDANCE WITH NATIONAL ELECTRICAL CODE AND LOCAL CODES.

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JOB CAPT. _____ INTERIORS N.Catuzza

SEAL:

TITLE:

HVAC VARIABLE AIR VOLUME (VAV) WIRING DIAGRAMS

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