MIDLANDS TECHNICAL COLLEGE BELTLINE CAMPUS - COLUMBIA, SC AUTOMOTIVE HVAC UNIT REPLACEMENT

H59-N127-FW

A/E Project Number: 21060.01

3/4/2022
ISSUED FOR
CONSTRUCTION



ROSEWOOD DR

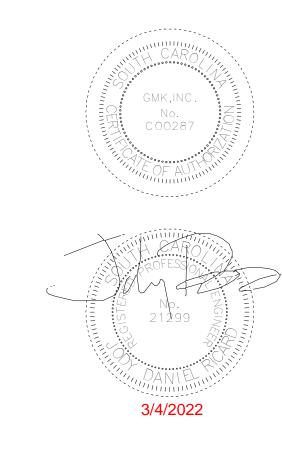
AUTOMOTIVE BUILDING AND PARKING GARAGE

E. CHAPEL DRIVE

Prepared by:



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DRAWING INDEX

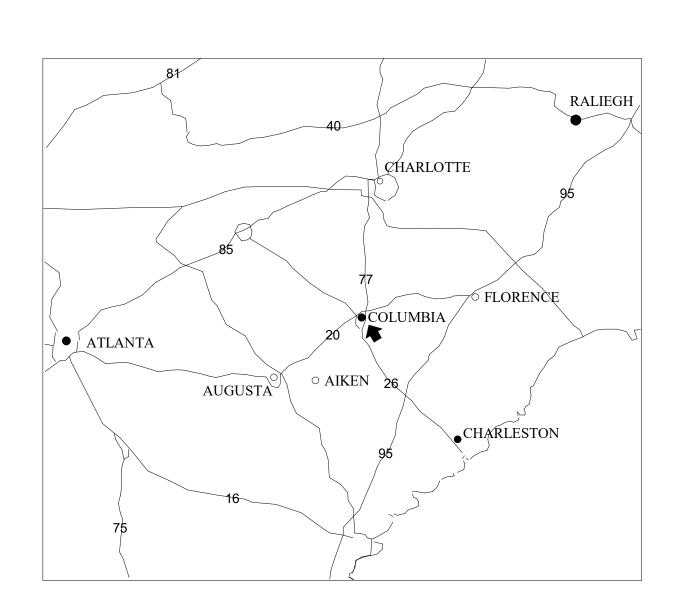
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KEY PLAN







AUTOMOTIVE BUILDING AND PARKING GARAGE

VC	Air Conditioning	MIN	Minimum
AAV	Automatic Air Vent	MOD	Motor Operated Damper
BV	Above	MPT	Male Pipe Thread
CC-#	Air Cooled Condening Unit - No.	N/A	Not Applicable
AD	Access Door	NC	Normally Closed
ADP	Apparatus Dew Point	NIC	Not in Contract
AFF	Above Finished Floor	NO	Normally Open
AHU-#	Air Handler Unit - No.	NPSH	Net Positive Suction Head
BFP	Backflow Preventer	NPT	National Pipe Thread
BHP	Brake Horsepower	NTS	Not To Scale
BMS	Building Management System	PD	Pressure Drop
BOP	Bottom of Pipe	PI	Pressure Indicator
CO	Clean Out	POC	Point of Connection
COL	Column Line	PRV	Pressure Reducing Valve
DB	Dry Bulb Temperature	PS	Pressure Switch
DP	Dew Point	PSI	Pounds Per Square Inch
EAT	Entering Air Temperature	REG	Register
EDB	Entering Air Dry Bulb	RH	Relative Humidity
ELEC	Electric or Electrical	SEER	Seasonal Energy Efficiency Ratio
ELEV	Elevation	SHT	Sheet
EWB	Entering Air Wet Bulb	SP	Static Pressure
FL	Floor	SPEC	Specifications
FOB	Flat On Bottom	SPL	Supply
FOT	Flat On Top	SS	Stainless Steel
FPT	Female Pipe Thread	STD	Standard
FT	Feet	T	Thermostat
FT HD	Feet of Head	TDH	Total Dynamic Head
FZ	Freezestat (low limit thermostat)	TEMP	Temperature
HP	Horsepower	TOC	Top of Concrete
HVAC	"Heating, Ventilating & Air Conditioning"	TOD	Top of Duct
ID	Inside Diameter	TOP	Top of Pipe
ΙΕ	Invert Elevation	TOS	Top of Steel
LAT	Leaving Air Temperature	TSTAT	Thermostat
LWB	Leaving Air Wet Bulb	TYP	Typical
LWT	Leaving Water Temperature	VB	Vacuum Breaker
MAV	Manual Air Vent	VENT	"Ventilate, Ventilator"
MAX	Maximum	VFD	Variable Frequency Drive
MBH	Thousand BTU/Hr (thousands)	WB	Wet Bulb Temperature
		XFMR	Transformer

MECHANICAL SYSTEMS SEISMIC AND WIND REQUIREMENTS

PER IBC-2018/ASCE 7-16

- A. PER THE 2018 INTERNATIONAL BUILDING CODE, MECHANICAL, PLUMBING AND ELECTRICAL EQUIPMENT AND COMPONENTS, INCLUDING THEIR SUPPORTS AND ATTACHMENTS, SHALL BE DESIGNED FOR SEISMIC FORCES IN ACCORDANCE WITH CHAPTER 13 OF ASCE 7-16.
- B. EXTERIOR EQUIPMENT (INCLUDING ROOF CURBS, RAILS, SUPPORTS) EXPOSED TO WIND SHALL BE DESIGNED AND INSTALLED TO RESIST THE WIND PRESSURES DETERMINED IN ACCORDANCE WITH CHAPTER 26 TO 29 OF ASCE 7-16.
- C. WHERE DESIGN FOR SEISMIC AND WIND LOADS IS REQUIRED, THE MORE DEMANDING FORCE MUST BE USED.
- D. REFERENCE THE STRUCTURAL DRAWINGS FOR SITE SPECIFIC INFORMATION ON SEISMIC DESIGN CATEGORY, WIND SPEEDS, ETC.
- E. USE THE TABLE BELOW TO DETERMINE SEISMIC RESTRAINT REQUIREMENTS FOR EACH COMPONENT.

- F. FOR ALL COMPONENTS REQUIRING SEISMIC RESTRAINT. THE COMPONENT SUPPORTS AND ATTACHMENTS SHALL BE DESIGNED BY A REGISTERED DESIGN PROFESSIONAL REGISTERED IN THE STATE THE JOB IS LOCATED. SUBMITTALS MUST INCLUDE STAMPED AND SIGNED DRAWINGS AND
- . WHERE SEISMIC RESTRAINT IS REQUIRED, HOUSEKEEPING PADS NEEDED FOR THE INSTALLATION OF EQUIPMENT UNDER THIS CONTRACT MUST BE DESIGNED BY THE SEISMIC ENGINEER. DO NOT POUR ANY HOUSEKEEPING PADS PRIOR TO THE RECEIPT OF THE APPROVED SEISMIC SUBMITTAL.
- H. SEISMIC RESTRAINTS FOR DUCTWORK, PIPING, CONDUIT, CABLE TRAYS AND BUS DUCT MUST BE SHOWN ON LAYOUT DRAWINGS SHOWING SPECIFIC RESTRAINT LOCATIONS ALONG WITH ACCOMPANYING DETAILS AND CALCULATIONS.

MECHANICAL COMPONENT IMPORTANCE FACTOR (Ip) DESIGNATION

	Ip=1.0		lp=1.5						
ALL HVAC CO	MPONENTS								
				SEISMIC D	DESIGN CATEGORIES C				
				COMPONE	ENT IMPORTANCE FACTOR (Ip)				
		Ip=1.0			lp=1.5				
COMPONENT I	DENTIFICATION	SEISMIC RESTRAINT REQUIREMEN	NT	NOTES	SEISMIC RESTRAINT REQUIREMENT	NOTES			
ROOF MOUNTE	:D	NOT REQUIRED		-	RESTRAIN ALL	-			
FLOOR MOUNT	ED	NOT REQUIRED		-	RESTRAIN ALL	-			
WALL MOUNTE	D	NOT REQUIRED		-	RESTRAIN ALL	-			
COMPONENT S	SUPPORTS	NOT REQUIRED		-	RESTRAIN ALL	-			
SUSPENDED	INLINE WITH DUCT	NOT REQUIRED		-	RESTRAIN IF >75 LBS PROVIDE FLEX. CONN.	3			
EQUIPMENT	NOT INLINE WITH DUCT/PIPE	NOT REQUIRED		-	RESTRAIN ALL	-			
SUSPENDED DI ALUMINUM, CO	UCTILE PIPING (STEEL, PPER, ETC.)	NOT REQUIRED		-	>2"	4			
	ON DUCTILE PIPING LASTIC, CERAMIC)	NOT REQUIRED		-	RESTRAIN ALL	4			
SUSPENDED PI	IPE ON TRAPEZE	NOT REQUIRED		-	RESTRAIN IF ANY PIPE ON TRAPEZE > 2" RESTRAIN IF TOTAL WEIGHT OF PIPES ON TRAPEZE > 15 LBS/FT	4			
DUCTWORK		NOT REQUIRED		-	6 SQ.FT. AND LARGER AND > 17 LBS/FT	4,5			
MULTIPLE DUC	TS ON TRAPEZE	NOT REQUIRED		-	RESTRAIN IF TOTAL WEIGHT OF DUCTS ON TRAPEZE > 10 LBS/FT	3,4			
COMPONENT C	CERTIFICATION	NOT REQUIRED		-	REQUIRED	6			

- 1. EQUIPMENT 20 LBS. OR LESS IS EXEMPT IF THE COMPONENT IS POSITIVELY ATTACHED TO THE STRUCTURE AND FLEXIBLE CONNECTIONS ARE PROVIDED BETWEEN THE COMPONENT AND ASSOCIATED DUCTWORK, PIPING, AND CONDUIT.
- RESTRAINTS ARE NOT REQUIRED IF THE COMPONENT WEIGHS 400 LBS. OR LESS, IS MOUNTED WITH THE CENTER OF MASS LOCATED AT 4 FT. OR LESS ABOVE A FLOOR, IS POSITIVELY ATTACHED TO THE STRUCTURE AND HAS FLEXIBLE CONNECTIONS BETWEEN THE COMPONENT AND ASSOCIATED DUCTWORK, PIPING, AND CONDUIT.
- 3. FLEXIBLE CONNECTIONS REQUIRED FOR PIPE CONNECTIONS ONLY.
- . RESTRAINT IS NOT REQUIRED IF THE PIPING / DUCTWORK IS SUPPORTED BY HANGERS AND EACH HANGER IN THE PIPING RUN IS 12 IN. OR LESS IN LENGTH FROM THE TOP OF THE PIPE TO THE SUPPORTING STRUCTURE. WHERE PIPES ARE SUPPORTED ON A TRAPEZE, THE TRAPEZE SHALL BE SUPPORTED BY HANGERS HAVING A LENGTH OF 12 IN. OR LESS. WHERE ROD HANGERS ARE USED, THEY SHALL BE EQUIPPED WITH SWIVELS, EYE NUTS OR OTHER DEVICES TO PREVENT BENDING IN THE ROD.

5. ALL DUCTWORK, REGARDLESS OF SIZE, DESIGNED TO CARRY TOXIC, HIGHLY TOXIC, OR EXPLOSIVE GASES OR USED FOR SMOKE CONTROL MUST BE

6. COMPONENT CERTIFICATION MUST BE SUPPLIED BY THE EQUIPMENT MANUFACTURER AT TIME OF SUBMITTAL FOR REVIEW BY ENGINEER OF RECORD.

MECHANICAL GENERAL NOTES

1. DO NOT SCALE DRAWINGS; SEE ARCHITECTURAL DRAWINGS AND REFLECTED CEILING PLANS FOR EXACT LOCATIONS OF DOORS,

- WINDOWS, CEILING DIFFUSERS, ETC. 2. EXTEND ALL DRAIN LINES TO NEAREST FLOOR DRAIN OR AS INDICATED.
- ROUTE TO AVOID INTERFERENCE WITH PASSAGEWAYS. CONDENSATE DRAINS SHALL BE TRAPPED. SLOPE DRAIN LINES 1/8" PER FOOT. 3. ALL PIPING SHALL PITCH DOWN IN DIRECTION OF FLOW OR AS INDICATED
- ON DRAWINGS: 1" PER 40 FEET WITH MANUAL AIR VENTS AT ALL HIGH POINTS, AND 3/4" DRAIN VALVES AT ALL LOW POINTS. 4. ALL PIPING AND DUCTWORK INSULATION SHALL BE RUN CONTINUOUSLY
- THROUGH FLOORS, ROOFS AND PARTITIONS EXCEPT WHERE PROHIBITED BY FIRE CODES.
- 5. LOCATE ALL THERMOSTATS, HUMIDISTATS AND SWITCHES 4'-0" ABOVE FINISH FLOOR; ALIGN WITH LIGHT SWITCHES UNLESS NOTED
- 6. ALL PIPING AND DUCTWORK LOCATIONS SHALL BE COORDINATED WITH THE WORK UNDER OTHER DIVISIONS OF THE SPECIFICATIONS TO AVOID
- INTERFERENCE. 7. CORRECT SETTINGS ON ALL BALANCING FITTINGS SHALL BE
- PERMANENTLY MARKED. 8. 45 DEGREE TAKEOFFS SHALL BE USED ON ALL HARD DUCTED SUPPLY
- BRANCHES. 9. PROVIDE ALL TRANSITIONS REQUIRED FOR INSTALLATION OF DUCT, DUCT HEATERS, AIR VOLUME CONTROLLERS, FAN COIL UNITS, EXHAUST FANS, SUPPLY FANS, AND ALL OTHER EQUIPMENT AND APPURTENANCES.

10. BLANK-OFF ALL UNUSED PORTIONS OF LOUVERS (WHICH HAVE

- MECHANICAL DUCT CONNECTIONS) WITH 20 GAGE GALVANIZED SHEET 11. ALL DUCT IS GALVANIZED SHEET METAL EXCEPT AS NOTED.
- 12. DUCT SIZES ARE CLEAR INSIDE DIMENSIONS. 13. INTAKES FOR AIR HANDLING EQUIPMENT SHALL BE A MINIMUM OF TEN FEET AWAY FROM ANY EXHAUST OR VENT.

MECHANICAL DEMOLITION NOTES

- 1. DRAWINGS SHOW GENERAL INTENT OF DEMOLITION. QUANTITIES, LOCATIONS, SIZES AND EQUIPMENT ARE SHOWN TO INDICATE TYPE OF SYSTEM INSTALLED AND DOES NOT NECESSARILY REPRESENT EXACT CONDITIONS. CONTRACTOR SHALL FIELD VERIFY BEFORE BIDDING.
- 2. DEMOLITION OF EQUIPMENT, SYSTEMS, AND COMPONENTS SHALL INCLUDE ALL SUPPORTS, PADS, HANGERS, INSULATION, CONTROLS, STARTERS, ACCESSORIES, AND APPURTENANCES NOT REQUIRED FOR THE INSTALLATION OF THE NEW SYSTEM.
 - 3. WHEN PARTIAL DEMOLITION OF A SYSTEM IS INDICATED, THE PART OF THE SYSTEM SHOWN TO REMOVED SHALL BE REMOVED TO THE ACTIVE MAIN OR BRANCH IF NOT REQUIRED FOR THE INSTALLATION OF THE NEW SYSTEM. THE ACTIVE MAIN OR BRANCH SHALL BE REPAIRED TO MATCH NEW INSTALLATION AS MUCH AS PRACTICAL. IF SYSTEM IS INSULATED, INSULATION SHALL BE PATCHED AND FINISHED REPAIR (IE: VAPOR BARRIER, COATING, ETC.)
- 4. PATCHING OF BUILDING STRUCTURES AND FINISHES SHALL PERTAIN TO ALL WALLS, FLOORS, SLABS, ROOFS, STRUCTURES, AND FINISHES. PATCHES SHALL MATCH EXISTING STRUCTURE, FIRE RATING AND FINISH.
- 5. ALL OPENINGS CREATED BY THE ABANDONMENT OR REMOVAL OF EXISTING SYSTEMS SHALL BE PATCHED.
- 6. ALL WALLS, ROOFS, SLABS, STRUCTURES, AND FINISHES WHOSE FINISH ACCESSORIES, AND APPURTENANCES SHALL BE PATCHED.
- 7. ALL FINISHES SHALL MATCH EXISTING FINISH. WHEN FINISH OBVIOUSLY DOES NOT MATCH EXISTING FINISH SUCH AS SHADE OF PAINT, AGE OF FINISH, ETC., THE FINISH SHALL BE APPLIED TO THE PATCH AND THE SURFACE IN ALL DIRECTIONS UNTIL A SURFACE CHANGE OF A MINIMUM OF 45 DEGREES.
- 8. REMOVAL OF SYSTEMS SHALL INCLUDE COMPLETE SYSTEM WHENEVER PRACTICAL. IF NOT, SYSTEM (IE: PIPE, CONDUIT, ETC.) SHALL BE REMOVED TO 1 INCH BELOW SURFACE.

	AIR COOLED CONDENSER SCHEDULE														
EQUIPMENT TAG	TONS	SYSTEM	REFRIGERANT	CONDENS	ER FANS	COMPF	RESSOR	ELECTRICAL			EER	MANUFACTURER	MODEL	NOTES	
	TONS	SISIEW	REFRIGERAINI	FAN NO.	HP (EA.)	COMP. NO.	COMP. RLA	MCA (A)	MOCP (A)	VOLTAGE/PHASE	LEK	WANUFACTURER	MODEL	NOTES	
ACC-1	15	AHU-1	R410-A	2	1.0	2	12.90	34	45	45 460/3		TRANE	TTA18044DAB	1,2,3,4,5	
		•													

2. CRANKCASE HEATERS LOW AMBIENT COOLING 3. SINGLE POINT POWER CONNECTION

4. HOT GAS BYPASS

									MC	DULAR AIR	HANDLEF	R SCHEDU	LE								
EQUIPMENT TAG			SUPPLY FAN					DX COOLING					FILTER ELECTRICAL								
	AIRFLOW	AIRFLOW	AIRFLOW OA	OA CFM	ESP	TSP	HP	FAN RPM	OUTDOOR TEMP	TOTAL MBH	SENSIBLE MBH	EAT DB (F)	EAT WB (F)	LAT (DB) F	LAT (WB) F		PHASE	MCA	MOCP	MANUFACTURER	MODEL
AHU-1	4800	1000	2.0	3.40	5.0	2198	95	184.2	132.3	80.0	67.0	54.9	54.6	2" - MERV 8	460	3	10 A	15 A	TRANE	UCCAG10	1,2,3,4,5
NOTES:																					

 ECONOMIZER 4. MOTORIZED OUTSIDE AIR DAMPER 2. DUCT DETECTOR 5. MOTORIZED RETURN AIR DAMPER 6. UNIT MOUNTED VARIABLE FREQUENCY DRIVE WITH INTEGRAL DISCONNECT 3. SINGLE POINT CONNECTION

7. IAQ DUAL SLOPED DRAIN PAN

1. HAIL/VANDAL GUARDS

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CONTRACTORS SHALL USE THESE DRAWINGS AS ESTABLISHING A LEVEL OF QUALITY

AND REGULATIONS SHALL BE FURNISHED AND INCLUDED IN THE CONTRACTORS PRICE. REQUEST FOR ADDITIONAL FUNDS TO INCLUDE MATERIALS AND LABOR TO MEET CODES AND COMPLY WITH REGULATIONS WILL NOT BE ALLOWED.

MIDLANDS TECHNICAL COLLEGE BELTLINE CAMPUS 316 S. BELTLINE BLVD.

COLUMBIA, SC 29205

AHU REPLACEMENT

H59-N127-FW

AUTO TRAINING FACILITY

project name

project number

21060.01

seals/signature

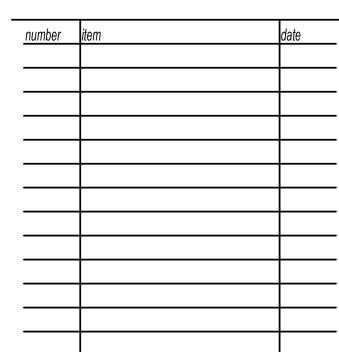
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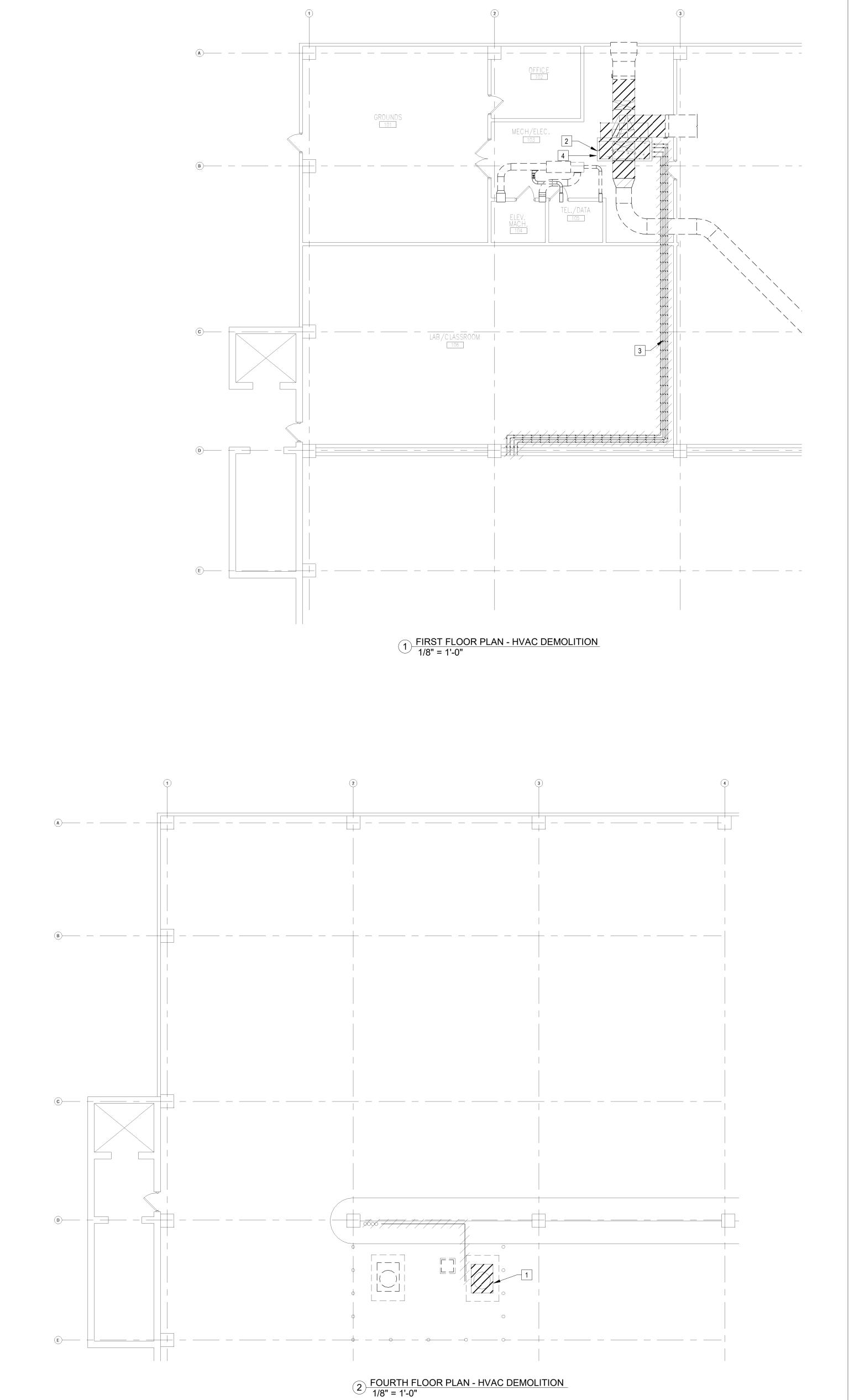


key plan





HVAC LEGENDS, NOTES, ABBREVIATIONS, AND **SCHEDULES**



KEYED NOTES:

- 1 REMOVE EXISTING CONDENSING UNIT AND ALL ASSOCIATED REFRIGERANT PIPING AND CONTROLS.
- 2 REMOVE EXISTING AIR HANDLER AND ALL ASSOCIATED REFRIGERANT PIPING AND
- 3 REMOVE REFRIGERANT PIPING BETWEEN INDOOR AIR HANDLER AND OUTDOOR
- CONDENSING UNIT. 4 CONTRACTOR SHALL CAPTURE AND DISPOSE OF EXISTING REFRIGERANT IN ACCORDANCE WITH EPA AND DHEC REQUIREMENTS.

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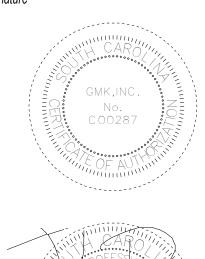
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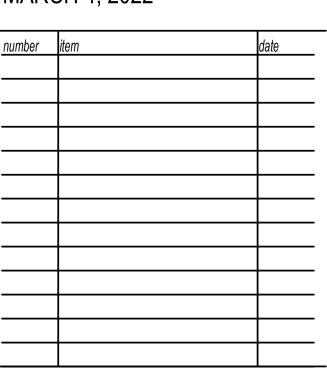
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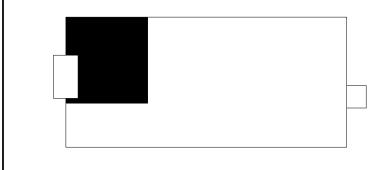
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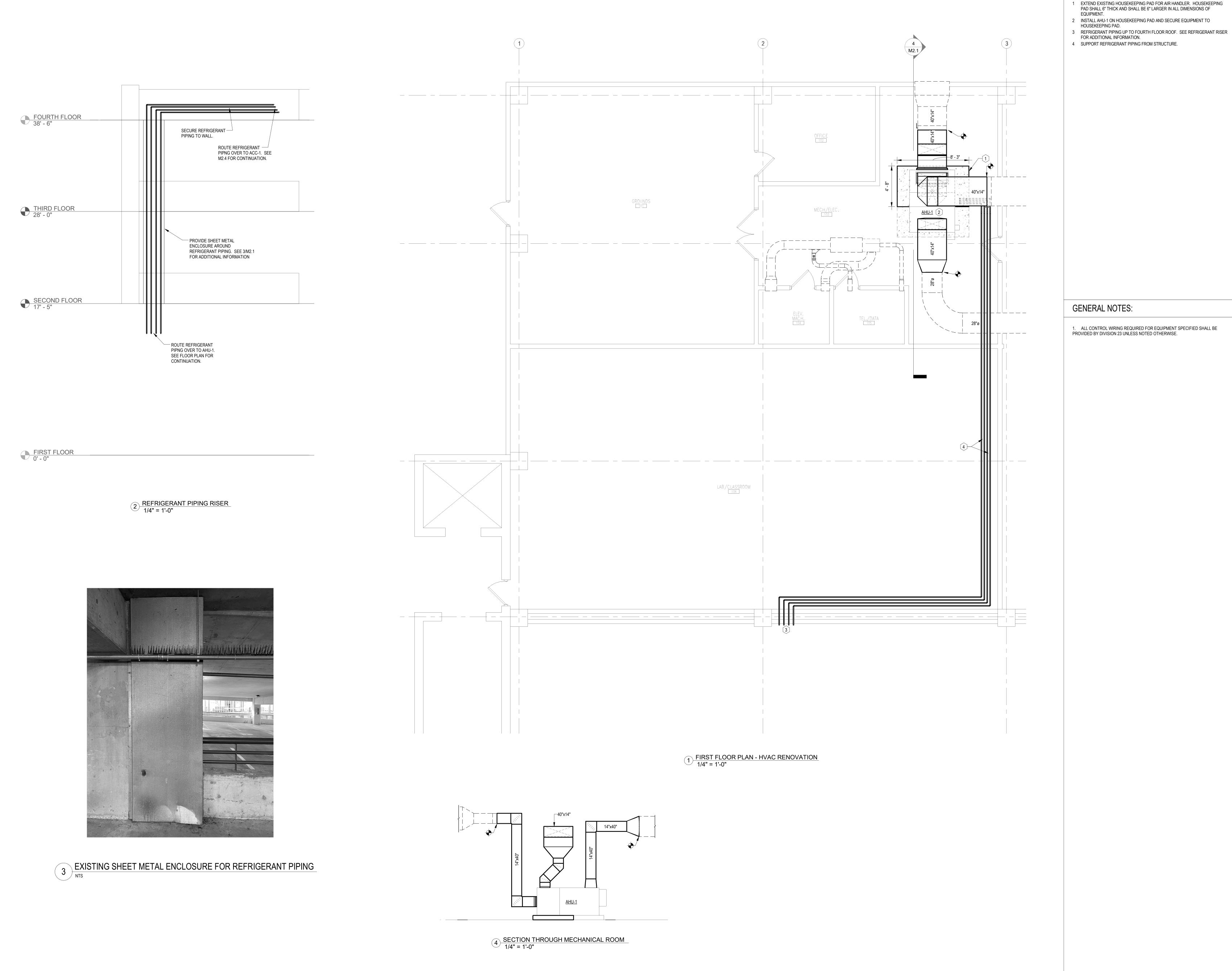
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FIRST AND FOURTH FLOOR PLAN - HVAC DEMOLITION



KEYED NOTES: <

1 EXTEND EXISTING HOUSEKEEPING PAD FOR AIR HANDLER. HOUSEKEEPING PAD SHALL 6" THICK AND SHALL BE 6" LARGER IN ALL DIMENSIONS OF

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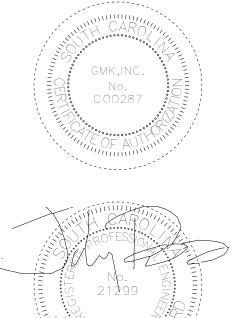
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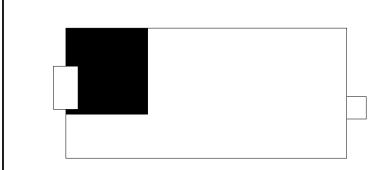
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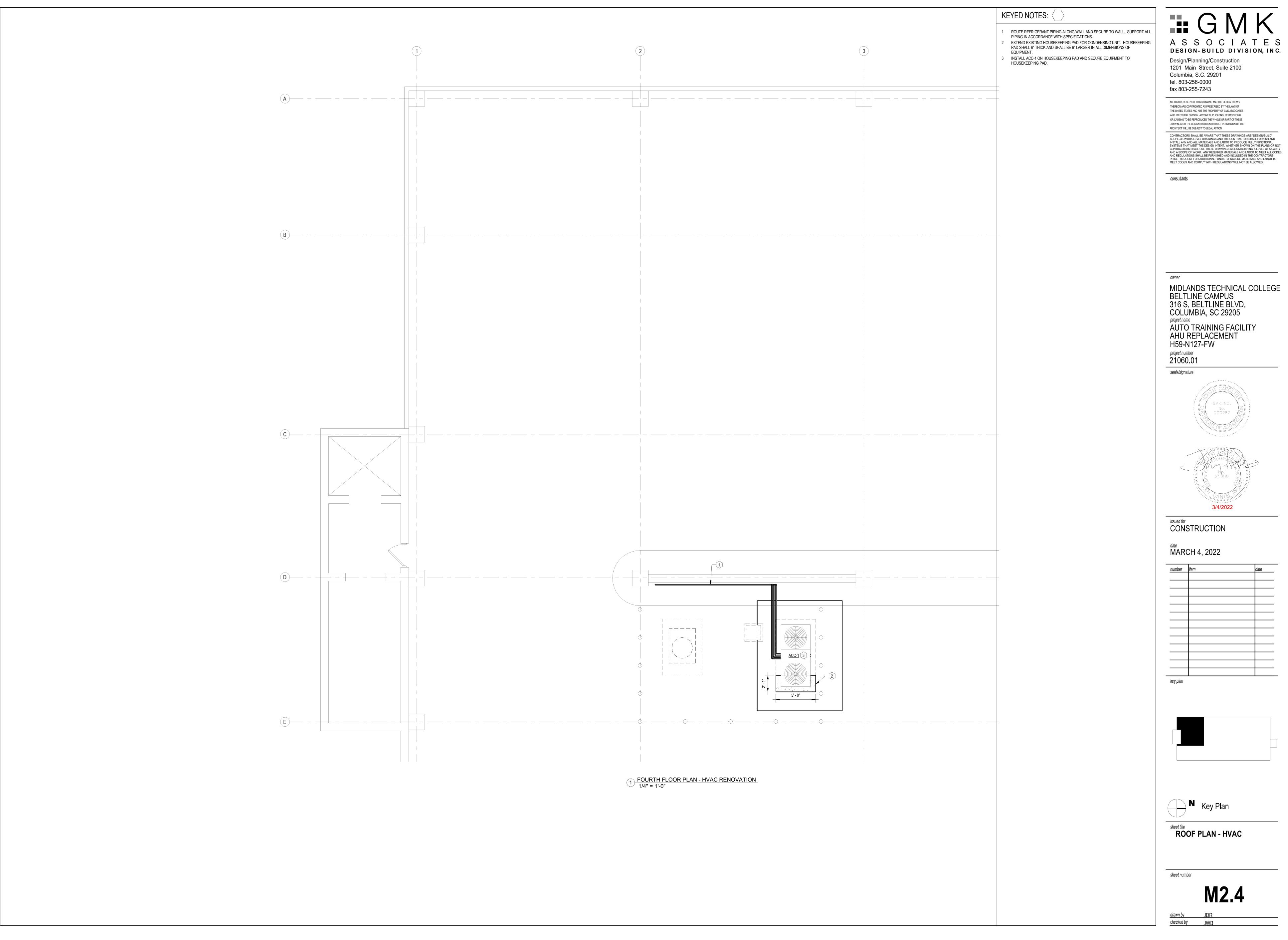
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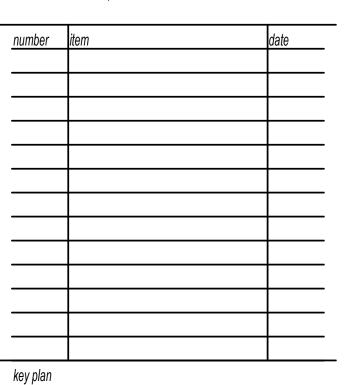
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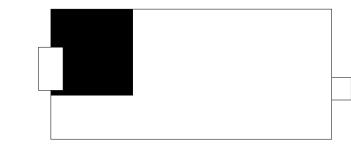


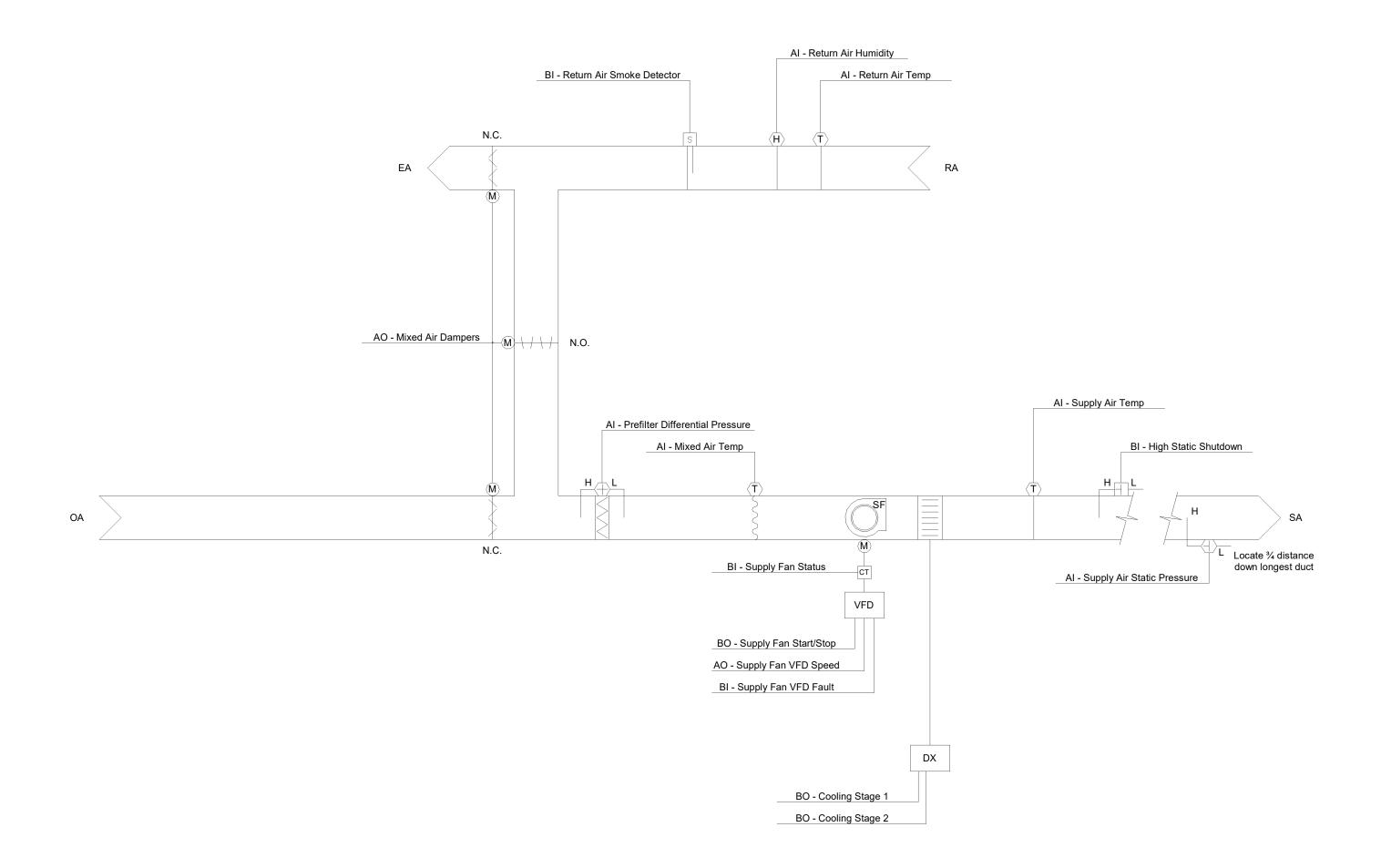


FIRST FLOOR PLAN - HVAC RENOVATION









Run Conditions - Requested: The unit shall run whenever:

Any zone is occupied. OR a definable number of unoccupied zones need heating or cooling.

High Static Shutdown: The unit shall shut down and generate an alarm upon receiving an high static shutdown signal.

Return Air Smoke Detection: The unit shall shut down and generate an alarm upon receiving a return air smoke detector

The supply fan shall run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the supply fan shall have a user definable (adj.) minimum runtime.

Alarms shall be provided as follows: Supply Fan Failure: Commanded on, but the status is off. Supply Fan in Hand: Commanded off, but the status is on.

limit (adj.). Supply Air Duct Static Pressure Control:

The controller shall measure duct static pressure and shall modulate the supply fan VFD speed to maintain a duct static pressure setpoint of 1.5in H2O (adj.). The supply fan VFD

speed shall not drop below 30% (adj.).

Alarms shall be provided as follows: High Supply Air Static Pressure: If the supply air static pressure is 25%

Supply Fan Runtime Exceeded: Status runtime exceeds a user definable

(adj.) greater than setpoint. Low Supply Air Static Pressure: If the supply air static pressure is 25% (adj.) less than setpoint. Supply Fan VFD Fault.

Supply Air Temperature Setpoint - Optimized:

The controller shall monitor the supply air temperature and shall maintain a supply air temperature setpoint reset based on zone cooling and heating requirements

The supply air temperature setpoint shall be reset for cooling based on zone cooling

requirements as follows: The initial supply air temperature setpoint shall be 55°F (adj.). As cooling demand increases, the setpoint shall incrementally

reset down to a minimum of 53°F (adj.). As cooling demand decreases, the setpoint shall incrementally

reset up to a maximum of 72°F (adj.). If more zones need heating than cooling, then the supply air temperature setpoint shall be

reset for heating as follows: The initial supply air temperature setpoint shall be 82°F (adj.).

As heating demand increases, the setpoint shall incrementally reset up to a maximum of 85°F (adj.). As heating demand decreases, the setpoint shall incrementally reset down to a minimum of 72°F (adj.).

Cooling Stages: The controller shall measure the supply air temperature and stage the cooling to maintain

its cooling setpoint. To prevent short cycling, there shall be a user definable (adj.) delay between stages, and each stage shall have a user definable (adj.) minimum runtime.

The cooling shall be enabled whenever: Outside air temperature is greater than 60°F (adj.). AND the economizer (if present) is disabled or fully open.

AND the supply fan status is on. AND the heating (if present) is not active.

Alarms shall be provided as follows: High Supply Air Temp: If the supply air temperature is 5°F (adj.)

greater than setpoint. Low Supply Air Temperature Alarm:

The controller shall alarm if the supply air temperature is less than 45°F (adj.).

The controller shall measure the mixed air temperature and modulate the economizer dampers in sequence to maintain a setpoint 2°F (adj.) less than the supply air temperature setpoint. The outside air dampers shall maintain a minimum adjustable position of 20% (adj.) open whenever occupied.

The economizer shall be enabled whenever:

Outside air temperature is less than 65°F (adj.). AND the outside air temperature is less than the return air

AND the supply fan status is on.

The economizer shall close whenever: Mixed air temperature drops from 40°F to 35°F (adj.). OR the freezestat (if present) is on.

 OR on loss of supply fan status. The outside and exhaust air dampers shall close and the return air damper shall open

Minimum Outside Air Ventilation - Fixed Percentage:

when the unit is off. If Optimal Start Up is available the mixed air damper shall operate as

described in the occupied mode except that the outside air damper shall modulate to fully

The outside air dampers shall maintain a minimum adjustable position during building occupied hours and be closed during unoccupied hours.

Prefilter Differential Pressure Monitor: The controller shall monitor the differential pressure across the prefilter.

Alarms shall be provided as follows: Prefilter Change Required: Prefilter differential pressure exceeds a user definable limit (adj.).

Alarms shall be provided as follows:

Mixed Air Temperature: The controller shall monitor the mixed air temperature and use as required for economizer control (if present) or preheating control (if present).

High Mixed Air Temp: If the mixed air temperature is greater than 90° F (adj.). Low Mixed Air Temp: If the mixed air temperature is less than 45°F

Return Air Humidity: The controller shall monitor the return air humidity and use as required for economizer control (if present) or humidity control (if present).

Alarms shall be provided as follows: High Return Air Humidity: If the return air humidity is greater

than 70% (adj.). Low Return Air Humidity: If the return air humidity is less than 35% (adj.).

Return Air Temperature: The controller shall monitor the return air temperature and use as required for setpoint control or economizer control (if present).

Alarms shall be provided as follows:

 High Return Air Temp: If the return air temperature is greater than 90° Low Return Air Temp: If the return air temperature is less than 45°F

Supply Air Temperature: The controller shall monitor the supply air temperature.

Alarms shall be provided as follows: High Supply Air Temp: If the supply air temperature is greater than 120°F (adj.).

Low Supply Air Temp: If the supply air temperature is less than 45°F (adj.).

HARDWARE POINTS SOFTWARE POINTS AI AO BI BO AV BV LOOP SCHEDULE TREND ALARM POINT NAME MIXED AIR TEMPERATURE PREFILTER DIFFERENTIAL PRESSURE RETURN AIR HUMIDITY RETURN AIR TEMPERATURE Χ | X | X SUPPLY AIR STATIC PRESSURE SUPPPLY AIR TEMPERATURE MIXED AIR DAMPERS Χ SUPPLY FAN VFD SPEED Χ Χ HIGH STATIC SHUTDOWN X X RETURN AIR SMOKE DETECTOR SUPPLY FAN STATUS Χ SUPPLY FAN VFD FAULT X Χ COOLING STAGES Χ SUPPLY FAN START/STOP Χ ECONOMIZER MIXED AIR TEMPERATURE SETPOINT Χ SUPPLY AIR STATIC PRESSURE SETPOINT Χ SUPPLY AIR TEMPERATURE SETPOINT Χ COMPRESSOR RUNTIME EXCEEDED X FINAL FILTER CHANGE REQUIRED X X HIGH MIXED AIR TEMPERTURE HIGH RETURN AIR HUMIDITY HIGH SUPPLY AIR STATIC PRESSURE X HIGH SUPPLY AIR TEMPERATURE X HIGH RETURN AIR TEMPERATURE LOW MIXED AIR TEMPERATURE X LOW RETURN AIR HUMIDITY LOW RETURN AIR TEMPERATURE X LOW SUPPLY AIR HUMIDITY LOW SUPPLY AIR STATIC PRESSURE X X LOW SUPPLY AIR TEMPERATURE PREFILTER CHANGE REQUIRED X Χ SUPPLY FAN FAILURE X X SUPPLY FAN IN HAND X SUPPY FAN RUNTIME EXCEEDED

AHU-1/CU-1 POINT SCHEDULE SHOW ON GRAPHIC

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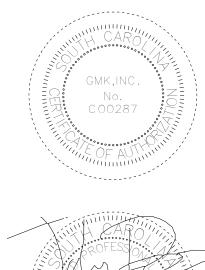
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MIDLANDS TECHNICAL COLLEGE BELTLINE CAMPUS 316 S. BELTLINE BLVD COLUMBIA, SC 29205 project name **AUTO TRAINING FACILITY** AHU REPLACEMENT H59-N127-FW

seals/signature

project number

21060.01



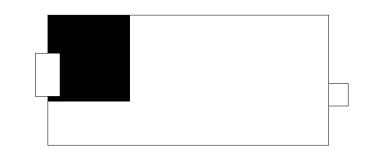


CONSTRUCTION

MARCH 4, 2022

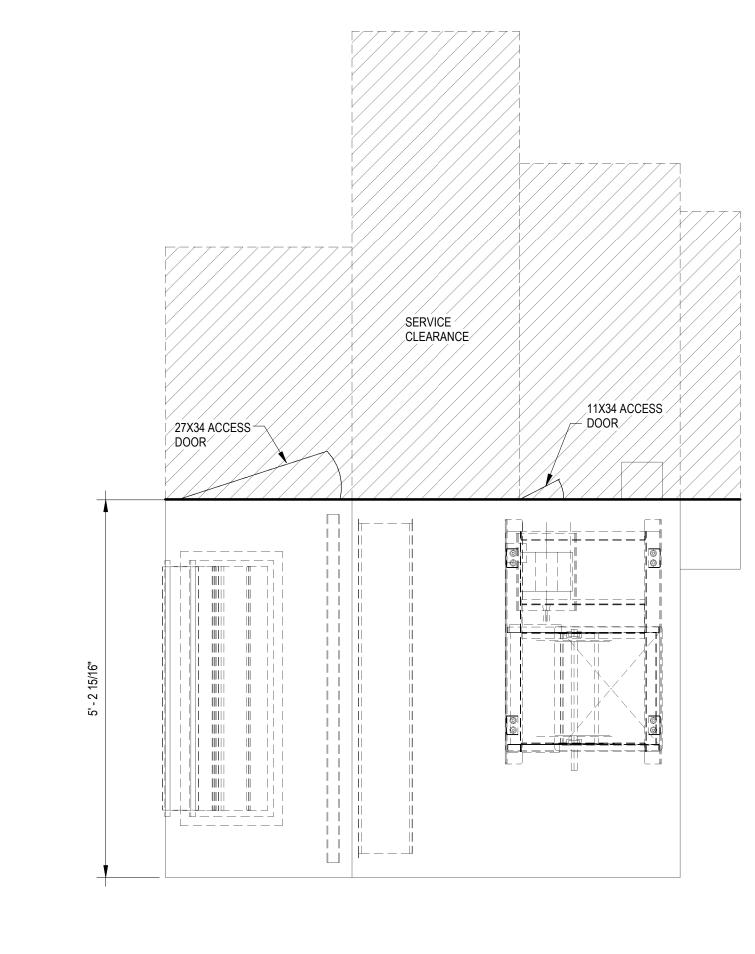
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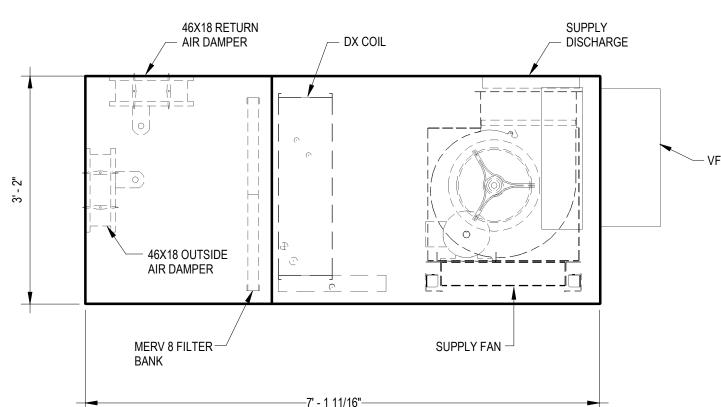
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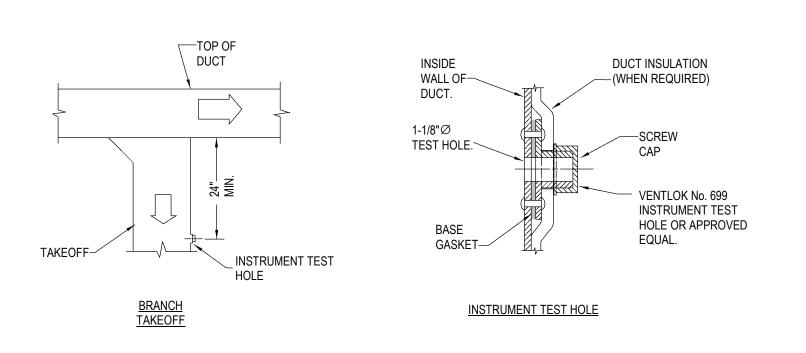


HVAC CONTROLS SCHEMATICS

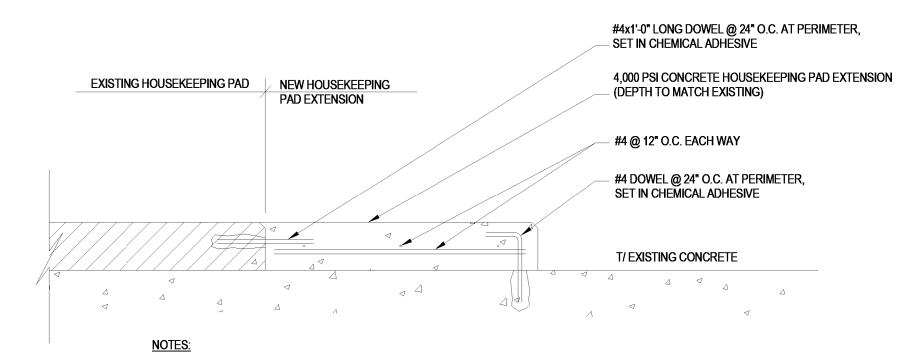




4 AHU-1 CONFIGURATION DETAIL

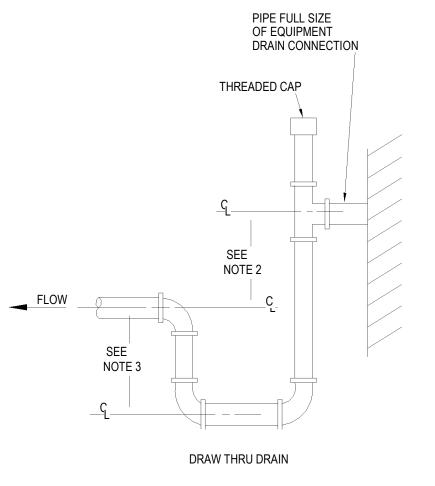


6 TYPICAL LOW PRESSURE DUCT DETAILS



1. REMOVE ALL DETERIORATED CONCRETE, DIRT, OIL, GREASE, AND ALL BOND-INHIBITING MATERIALS FROM SURFACE. PREPARATION WORK SHOULD BE DONE BY SCABBLER, OR OTHER APPROPRIATE MECHANICAL MEANS TO OBTAIN AN EXPOSED AGGREGATE SURFACE WITH A MINIMUM SURFACE PROFILE OF ±1/8 IN. (CSP-7). SATURATE SURFACE WITH CLEAN WATER. SUBSTRATE SHOULD BE SATURATED SURFACE DRY (SSD) WITH NO STANDING WATER DURING APPLICATION.

1 EXTENDING EXISTING HOUSEKEEPING PAD DETAIL



NOTE:

1. LOCATE TRAPS SO AS TO BE ACCESSIBLE FOR CLEANING.

2. HEIGHT SHALL BE EQUAL TO UNIT MAXIMUM NEGATIVE STATIC PRESSURE PLUS 1".

3. HEIGHT SHALL BE 1/2 OF HEIGHT INSTALLED.

4. PIPE TO NEAREST FLOOR DRAIN.

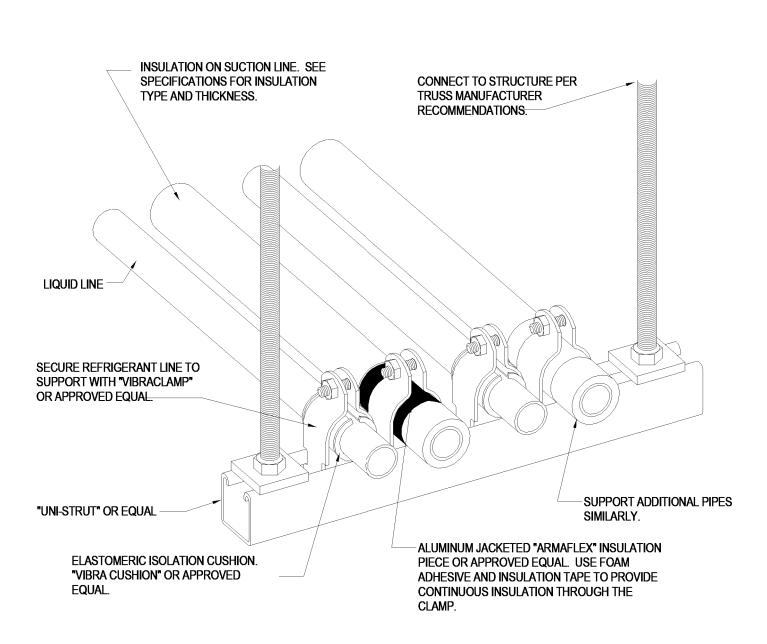
5. TRAP SHALL NOT BLOCK ACCESS TO EQUIPMENT.

6. INSULATE TRAPS

7. PROVIDE UNIONS ON EACH SIDE OF P-TRAP

8. CONDESATE PIPNG MATERIAL PIPING SHALL BE TYPE "K" COPPER.

2 EQUIPMENT CONDENSATE DRAIN DETAIL



REFRIGERANT PIPING SUPPORT DETAI

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consultants

21060.01

MIDLANDS TECHNICAL COLLEGE
BELTLINE CAMPUS
316 S. BELTLINE BLVD.
COLUMBIA, SC 29205
project name
AUTO TRAINING FACILITY
AHU REPLACEMENT
H59-N127-FW
project number

Seals/signature

GMK,INC.
No.
CO0287

CARO

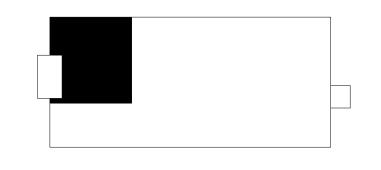
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N Key Pla

sheet title

HVAC DETAILS

sheet number

M6.

drawn by JDF

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SECTION 23 0100 - GENERAL MECHANICAL
                                                                                                                               SECTION 23 0548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT
1.01 SECTION INCLUDES
                                                                                                                              1.01 SECTION INCLUDES
   A. WORK UNDER DIVISION 23 SHALL INCLUDE FURNISHING OF ALL LABOR, ACCESSORIES, TOOLS, EQUIPMENT AND MATERIAL
                                                                                                                                  A. VIBRATION ISOLATORS.
                                                                                                                                  B. SEISMIC SNUBBER ASSEMBLIES.
   REQUIRED TO COMPLETELY EXECUTE INSTALLATION OF THE ENTIRE HEATING, VENTILATING AND AIR CONDITIONING SYSTEMS
   AS SPECIFIED. WORK SHALL INCLUDE BUT NOT BE LIMITED TO THE FURNISHING, UNLOADING, HANDLING DISTRIBUTION,
                                                                                                                                  C. SEISMIC RESTRAINTS FOR SUSPENDED COMPONENTS AND EQUIPMENT.
                                                                                                                              1.02 REFERENCE STANDARDS
    SETTING, SUPPORTING AND INSTALLATION OF ALL COMPONENTS REQUIRED FOR THE MECHANICAL SYSTEMS.
                                                                                                                                  A. ASCE 7 - MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES; 2010, WITH 2013 SUPPLEMENTS AND
   B. DRAWINGS SHALL NOT BE SCALED. REFER TO ARCHITECTURAL AND STRUCTURAL DRAWINGS FOR BUILDING
    CONSTRUCTION AND DIMENSIONS AND TO ROOM FINISH SCHEDULE ON ARCHITECTURAL DRAWINGS FOR MATERIAL, FINISH AND
    CONSTRUCTION METHOD OF WALLS, FLOOR AND CEILING IN ORDER TO INSURE PROPER ROUGH-IN AND INSTALLATION OF
                                                                                                                                  B. ASHRAE (HVACA) - ASHRAE HANDBOOK - HVAC APPLICATIONS; 2015.
                                                                                                                                  C. FEMA 412 - INSTALLING SEISMIC RESTRAINTS FOR MECHANICAL EQUIPMENT; 2002.
 1.02 REFERENCES
                                                                                                                              1.03 SUBMITTALS
   A. FM P7825 - APPROVAL GUIDE: FACTORY MUTUAL.
                                                                                                                                 A. PRODUCT DATA:
                                                                                                                                        PROVIDE MANUFACTURER'S PRODUCT LITERATURE DOCUMENTING COMPLIANCE WITH PART 2 PRODUCTS.
     B. NEMA MG 1 - MOTORS AND GENERATORS.
      NFPA 70 - NATIONAL ELECTRICAL CODE.
                                                                                                                                        . INCLUDE SEISMIC RATING DOCUMENTATION FOR EACH ISOLATOR AND RESTRAINT COMPONENT ACCOUNTING FOR
      SSPC-PAINT 15 - STEEL JOIST SHOP PAINT: STEEL STRUCTURES PAINTING COUNCIL.
                                                                                                                                      HORIZONTAL, VERTICAL, AND COMBINED LOADS.
      ASME AMERICAN SOCIETY OF MECHANICAL ENGINEERS
                                                                                                                                  B. SHOP DRAWINGS:
      ASTM AMERICAN SOCIETY FOR TESTING MATERIALS
                                                                                                                                        PROVIDE SCHEDULE OF VIBRATION ISOLATOR TYPE WITH LOCATION AND LOAD ON EACH.
                                                                                                                                      2. FULLY DIMENSIONED FABRICATION DRAWINGS AND INSTALLATION DETAILS FOR VIBRATION ISOLATION BASES.
    G. NEMA NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
   H. NFPA NATIONAL FIRE PROTECTION ASSOCIATION
                                                                                                                                      MEMBER SIZES, ATTACHMENTS TO ISOLATORS, AND SUPPORTED EQUIPMENT.
   I. OSHA OCCUPATIONAL SAFETY AND HEALTH ACT
                                                                                                                                      3. INCLUDE THE CALCULATIONS THAT INDICATE COMPLIANCE WITH THE APPLICABLE BUILDING CODE FOR SEISMIC
      SMACNA SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION, INC.
                                                                                                                                      CONTROLS AND THE VIBRATION ISOLATOR MANUFACTURER'S REQUIREMENTS.
      IBC INTERNATIONAL BUILDING CODE
                                                                                                                                      4. INCLUDE THE SEAL OF THE PROFESSIONAL STRUCTURAL ENGINEER REGISTERED IN THE STATE OF SOUTH
      IMC INTERNATIONAL MECHANICAL CODE
                                                                                                                                      CAROLINA IN WHICH THE PROJECT IS LOCATED, ON THE DRAWINGS AND CALCULATIONS WHICH AT A MINIMUM INCLUDE
   M. IPC INTERNATIONAL PLUMBING CODE
   N. IFC INTERNATIONAL FIRE CODE
                                                                                                                                         a. SEISMIC RESTRAINT DETAILS: DETAILED DRAWINGS OF SEISMIC RESTRAINTS AND SNUBBERS INCLUDING
    O. FACILITY GUIDELINES INSTITUTE (FGI)
                                                                                                                                          ANCHORAGE DETAILS THAT INDICATE QUANTITY, DIAMETER, AND DEPTH OF PENETRATION, EDGE DISTANCE, AND
 1.03 INTERPRETATION OF CONTRACT DOCUMENTS:
                                                                                                                                          SPACING OF ANCHORS.
   A. EXCEPT WHERE MODIFIED BY A SPECIFIC NOTATION TO THE CONTRARY, IT SHALL BE UNDERSTOOD THAT THE INDICATION
                                                                                                                                         b. EQUIPMENT SEISMIC QUALIFICATION CERTIFICATION: CERTIFICATION BY THE MANUFACTURER OR
                                                                                                                                          RESPONSIBLE PARTY THAT EACH PIECE OF EQUIPMENT PROVIDED WILL WITHSTAND SEISMIC FORCE LEVELS AS
    AND/OR DESCRIPTION OF ANY ITEM, IN THE DRAWINGS OR SPECIFICATIONS OR BOTH, CARRIES WITH IT THE INSTRUCTION TO
                                                                                                                                          SPECIFIED IN THE APPLICABLE BUILDING CODE FOR SEISMIC CONTROLS.
   FURNISH AND INSTALL THE ITEM, REGARDLESS OF WHETHER OR NOT THIS INSTRUCTION IS EXPLICITLY STATED AS PART OF
                                                                                                                                             1) BASIS FOR CERTIFICATION: INDICATE WHETHER THE WITHSTAND CERTIFICATION IS BASED ON ACTUAL
    THE INDICATION OR DESCRIPTION.
    B. IT SHALL BE UNDERSTOOD THAT THE SPECIFICATIONS AND DRAWINGS ARE COMPLIMENTARY AND ARE TO BE TAKEN
                                                                                                                                              TESTING OF ASSEMBLED COMPONENTS, ON CALCULATIONS, OR ON HISTORIC DATA.
    TOGETHER FOR A COMPLETE INTERPRETATION OF THE WORK.
                                                                                                                                             2) INDICATE EQUIPMENT TO BE SUFFICIENTLY DURABLE TO RESIST DESIGN FORCES AND OR REMAIN
     C. NO EXCLUSIONS FROM, OR LIMITATIONS IN, THE LANGUAGE USED IN THE DRAWINGS OR SPECIFICATIONS SHALL BE
                                                                                                                                              FUNCTIONAL AFTER THE SEISMIC EVENT
                                                                                                                                         c. DIMENSIONED OUTLINE DRAWINGS OF EQUIPMENT IDENTIFYING CENTER OF GRAVITY, LOCATIONS, AND
    INTERPRETED AS MEANING THAT THE APPURTENANCES OR ACCESSORIES NECESSARY TO COMPLETE ANY REQUIRED SYSTEM
                                                                                                                                          PROVISIONS FOR MOUNTING AND ANCHORAGE.
   OR ITEM OF EQUIPMENT ARE TO BE OMITTED

    THE DRAWINGS OF NECESSITY UTILIZE SYMBOLS AND SCHEMATIC DIAGRAMS TO INDICATE VARIOUS ITEMS OF WORK.

                                                                                                                              1.04 QUALITY ASSURANCE
    NEITHER OF THESE HAVE ANY DIMENSIONAL SIGNIFICANCE NOR DO THEY DELINEATE EVERY ITEM REQUIRED FOR THE
                                                                                                                                  A. PERFORM DESIGN AND INSTALLATION IN ACCORDANCE WITH APPLICABLE CODES.
    INTENDED INSTALLATIONS. THE WORK SHALL BE INSTALLED IN ACCORDANCE WITH THE DIAGRAMMATIC INTENT EXPRESSED ON

    MANUFACTURER QUALIFICATIONS: COMPANY SPECIALIZING IN MANUFACTURING PRODUCTS SPECIFIED IN THIS SECTION,

     THE DRAWINGS, AND IN CONFORMITY WITH THE DIMENSIONS INDICATED ON FINAL ARCHITECTURAL AND STRUCTURAL
                                                                                                                                  WITH NOT LESS THAN THREE YEARS OF DOCUMENTED EXPERIENCE.
    WORKING DRAWINGS AND ON EQUIPMENT SHOP DRAWINGS.
                                                                                                                               PART 2 PRODUCTS
    E. NO INTERPRETATION SHALL BE MADE FROM THE LIMITATIONS OF SYMBOLS AND DIAGRAMS THAT ANY ELEMENTS
                                                                                                                              2.01 MANUFACTURERS
                                                                                                                                  A. KINETICS NOISE CONTROL. INC: WWW.KINETICSNOISE.COM.
    NECESSARY FOR COMPLETE WORK ARE EXCLUDED.
    F. CERTAIN DETAILS APPEAR ON THE DRAWINGS WHICH ARE SPECIFIC WITH REGARD TO THE DIMENSIONING AND
                                                                                                                                  B. MASON INDUSTRIES: WWW.MASON-IND.COM.
    POSITIONING OF THE WORK. THESE DETAILS ARE INTENDED ONLY FOR THE PURPOSE OF ESTABLISHING GENERAL FEASIBILITY.
                                                                                                                                  C. VIBRATION ELIMINATOR COMPANY, INC: WWW.VECO-NYC.COM.
    THEY DO NOT OBVIATE FIELD COORDINATION FOR THE INTENDED WORK.
                                                                                                                              2.02 PERFORMANCE REQUIREMENTS
    G. INFORMATION AS TO THE GENERAL CONSTRUCTION SHALL BE DERIVED FROM STRUCTURAL AND ARCHITECTURAL
                                                                                                                                 A. GENERAL:
                                                                                                                                      1. ALL VIBRATION ISOLATORS, BASE FRAMES AND INERTIA BASES TO CONFORM TO ALL UNIFORM DEFLECTION AND
    DRAWINGS AND SPECIFICATIONS ONLY
   H. THE USE OF WORDS IN THE SINGULAR SHALL NOT BE CONSIDERED AS LIMITING WHERE OTHER INDICATIONS DENOTE THAT
                                                                                                                                      STABILITY REQUIREMENTS UNDER ALL OPERATING LOADS.
                                                                                                                                      2. STEEL SPRINGS TO FUNCTION WITHOUT UNDUE STRESS OR OVERLOADING.
   MORE THAN ONE ITEM IS REFERRED TO.
 1.04 PERFORMANCE REQUIREMENTS
                                                                                                                              2.03 VIBRATION ISOLATORS
   A. WORK SHALL BE INSTALLED TO CONFORM WITH ANY CITY OR STATE LAW, REGULATION, CODE, ORDINANCE, RULING OR
                                                                                                                                  A. SEISMIC TYPE:
   FIRE UNDERWRITERS REQUIREMENT APPLICABLE TO THIS CLASS OF WORK.
                                                                                                                                  1. COIL SPRINGS CONSISTING OF SINGLE ELEMENTS:
   B. ALL INSTALLATIONS FOR CONSTRUCTION PURPOSES SHALL CONFORM WITH THE DEPARTMENT OF LABOR "SAFETY AND
                                                                                                                                      a. HOUSING: MANUFACTURED FROM CAST IRON MATERIAL.
                                                                                                                                     b. DUCTILE MATERIAL: DESIGNED AND RATED FOR SEISMIC APPLICATIONS.
   HEALTH REGULATIONS FOR CONSTRUCTION".
   C. ALL EQUIPMENT WITH ELECTRICAL COMPONENTS SHALL BEAR THE UL LABEL.
                                                                                                                                      c. SPRING: RESTRAINED BY HOUSING WITHOUT SIGNIFICANT DEGRADATION OF VIBRATION ISOLATION CAPABILITIES
                                                                                                                                      DURING NORMAL EQUIPMENT OPERATING CONDITIONS.
                                                                                                                                      d. RESILIENT SNUBBING GROMMET SYSTEM: INCORPORATED AND DESIGNED WITH CLEARANCES OF NO MORE THAN
2.01 MATERIALS AND MANUFACTURERS:
   A. EQUIPMENT AND MATERIALS INSTALLED UNDER THIS CONTRACT SHALL BE NEW AND WITHOUT BLEMISH OR DEFECT.
                                                                                                                                      0.25 INCH (6 MM) IN ANY DIRECTION PREVENTING DIRECT METAL-TO-METAL CONTACT BETWEEN SUPPORTED MEMBER
     B. EACH MAJOR COMPONENT OF EQUIPMENT SHALL HAVE THE MANUFACTURER'S NAME, ADDRESS, MODEL NUMBER AND
                                                                                                                                      AND FIXED RESTRAINT HOUSING.
                                                                                                                                      e. RESILIENT PAD: LOCATED IN SERIES WITH SPRING.
   RATING ON A PLATE SECURELY AFFIXED IN A CONSPICUOUS PLACE. THE NAMEPLATE OF A DISTRIBUTING AGENT WILL NOT BE
                                                                                                                                      f. COIL SPRINGS: COLOR CODED ELEMENTS TO HAVE A LATERAL STIFFNESS GREATER THAN 0.8 TIMES THE RATED
   ACCEPTABLE. ASME CODE RATINGS, UL LABEL, OR OTHER DATA WHICH IS DIE-STAMPED INTO THE SURFACE OF THE
                                                                                                                                      VERTICAL STIFFNESS WITH 50 PERCENT OVERLOAD CAPACITY.
   EQUIPMENT SHALL BE STAMPED IN A LOCATION EASILY VISIBLE.
     C. IN ALL CASES THE CONTRACTOR SHALL BE COMPLETELY RESPONSIBLE FOR CHANGES IN DIMENSION OF OTHER THAN
                                                                                                                                        . FINISH: SUITABLE FOR THE APPLICATION.
    FIRST NAMED MANUFACTURER EQUIPMENT, ELECTRICAL CHANGES, ETC. REQUIRED FOR PROPER FUNCTION AND FINAL
                                                                                                                                  2. ALL DIRECTIONAL ELASTOMERIC:
    PERFORMANCE, ITEM SHALL COMPLY WITH ALL REQUIREMENTS HEREIN SET FORTH AND AS REQUIRED TO PERFORM AS
                                                                                                                                     a. MATERIAL: MOLDED FROM OIL, OZONE, AND OXIDANT RESISTANT COMPOUNDS.
                                                                                                                                      b. OPERATING PARAMETERS: DESIGNED TO OPERATE WITHIN THE ISOLATOR STRAIN LIMITS PROVIDING MAXIMUM
   DESIGNED.
2.02 ELECTRICAL EQUIPMENT
                                                                                                                                      PERFORMANCE AND SERVICE LIFE.
                                                                                                                                     c. ATTACHMENT METHOD: ENCAPSULATED LOAD TRANSFER PLATE BOLTED TO EQUIPMENT AND BASE PLATE WITH
   A. IN GENERAL MOTOR STARTERS AND ADJUSTABLE FREQUENCY DRIVES ARE FURNISHED UNDER DIVISION 26. HOWEVER, IF
    INTEGRAL CONTROLS AND ELECTRICAL COMPONENTS ARE SPECIFIED WITH THE EQUIPMENT AND ARE FACTORY INSTALLED,
                                                                                                                                      ANCHOR HOLE BOLTED TO SUPPORTING STRUCTURE.
                                                                                                                                     d. RATING: CAST IRON AND ALUMINUM HOUSINGS RATED FOR SEISMIC RESTRAINT APPLICATIONS.
    THEY SHALL BE FURNISHED UNDER DIVISION 23. REFER TO THE SPECIFIC EQUIPMENT SPECIFICATIONS TO DETERMINE IF
                                                                                                                                      e. MINIMUM OPERATING STATIC DEFLECTIONS: DEFLECTIONS INDICATED IN PROJECT DOCUMENTS ARE NOT TO
    B. WITHIN 60 DAYS OF AWARD OF CONTRACT, THE PERSON RESPONSIBLE FOR WORK IN THIS DIVISION SHALL VERIFY THAT
                                                                                                                                      EXCEED PUBLISHED LOAD CAPACITIES.
    THE APPROPRIATE NUMBER OF CONTACTS HAVE BEEN PROVIDED IN THE STARTERS OR DRIVES AND IF A CONTROL POWER
                                                                                                                              2.04 SEISMIC SNUBBER ASSEMBLIES
     TRANSFORMER IS REQUIRED
     C. IF ADDITIONAL DEVICES ARE REQUIRED, IT IS THE RESPONSIBLITY OF THIS DIVISION TO COORDINATE AND PROVIDE THE

    FEMA 412.

    DEVICES REQUIRED TO CONTROL THE EQUIPMENT AS SPECIFIED WITHIN THE STARTERS, ADJUSTABLE FREQUENCY DRIVES
                                                                                                                                  B. ALL DIRECTIONAL EXTERNAL
    AND MOTOR CONTROL CENTERS PROVIDED UNDER DIVISION 23.
                                                                                                                                      1. APPLICATION: MINIMUM THREE (3) SNUBBERS ARE REQUIRED FOR EACH EQUIPMENT INSTALLATION, ORIENTED
2.03 SPECIFIED MATERIALS:
                                                                                                                                      PROPERLY TO RESTRAIN ISOLATED EQUIPMENT IN ALL DIRECTIONS.
   A. THROUGHOUT THE DRAWINGS AND SPECIFICATIONS, EQUIPMENT AND SYSTEMS HAVE BEEN SELECTED AND ARE
                                                                                                                                      2. CONSTRUCTION: INTERLOCKING STEEL CONSTRUCTION ATTACHED TO THE BUILDING STRUCTURE AND EQUIPMENT
   REFERENCED BY NAME, MANUFACTURER, MODEL NUMBER, ETC. THESE REFERENCES ARE NOT INTENDED TO LIMIT
                                                                                                                                      IN A MANNER CONSISTENT WITH ANTICIPATED DESIGN LOADS.
   COMPETITION. PRODUCTS BY OTHER LISTED MANUFACTURERS WILL BE ACCEPTABLE
                                                                                                                                     3. PERFORMANCE: EQUIPMENT MOVEMENT AT EACH SNUBBER LOCATION LIMITED TO A MAXIMUM OF 0.25 INCHES (6
   B. IF A LISTED MANUFACTURER OTHER THAT THE BASIS OF DESIGN IS USED, IT IS THE CONTRACTOR'S RESPONSIBLITY FOR
                                                                                                                                      MM) IN ANY DIRECTION WITHOUT SIGNIFICANTLY DEGRADING THE VIBRATION ISOLATION CAPABILITY OF THE ISOLATOR
    CHANGES IN DIMENSION, STRUCTURAL, ELECTRICAL CHANGES, ETC. REQUIRED FOR PROPER INSTALLATION, FUNCTION AND
                                                                                                                                      DURING NORMAL OPERATING CONDITIONS.
                                                                                                                                      4. RESILIENT PAD: MINIMUM 0.25 INCH (6 MM) THICK CUSHIONS ANY IMPACT AND PREVENTS METAL-TO-METAL
   FINAL PERFORMANCE.
2.04 SUBSTITUTION OF SPECIFIED MATERIALS:
   A. THROUGHOUT THE DRAWINGS AND SPECIFICATIONS, EQUIPMENT AND SYSTEMS HAVE BEEN SELECTED AND ARE
                                                                                                                               PART 3 EXECUTION
    REFERENCED BY NAME, MANUFACTURER, MODEL NUMBER, ETC. THESE REFERENCES ARE NOT INTENDED TO LIMIT
                                                                                                                              3.01 INSTALLATION - GENERAL
    COMPETITION AND IN MOST CASES MATERIALS AND METHODS OF CONSTRUCTION EQUAL TO THAT SPECIFIED WILL BE
                                                                                                                                 A. INSTALL IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.
    ACCEPTED PROVIDED PRIOR APPROVAL OF ANY SUBSTITUTE ITEM IS OBTAINED FROM THE ARCHITECT/ENGINEER. ONLY
                                                                                                                              3.02 INSTALLATION - SEISMIC
    PRODUCTS BY THE LISTED MANUFACTURERS WILL BE ACCEPTABLE. CONTRACTORS AND OTHER MANUFACTURERS MAY SUBMIT
                                                                                                                                 A. COMPLY WITH:
    REQUESTS TO BE LISTED AS AN ACCEPTABLE MANUFACTURER ON THE SPECIFIED ITEM BY SUBMITTING DOCUMENTATION IN

    ASHRAE (HVACA) HANDBOOK - HVAC APPLICATIONS.

   ACCORDANCE WITH THE REQUIREMENTS. ANY ITEM INSTALLED ON THE JOB WHICH HAS NOT BEEN APPROVED IN ACCORDANCE
                                                                                                                                      2. FEMA 412.
    WITH THE NOTED PROCEDURE SHALL BE REMOVED AND REPLACED WITH THE APPROPRIATE APPROVED ITEM AT THE
                                                                                                                              END OF SECTION
    CONTRACTOR'S EXPENSE.
    B. IN ALL CASES THE CONTRACTOR SHALL BE COMPLETELY RESPONSIBLE FOR CHANGES IN DIMENSION OF OTHER THAN
                                                                                                                               SECTION 23 0553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
    FIRST NAMED MANUFACTURER EQUIPMENT, ELECTRICAL CHANGES, ETC. REQUIRED FOR PROPER FUNCTION AND FINAL
                                                                                                                               PART 1 GENERAL
    PERFORMANCE. ITEM SHALL COMPLY WITH ALL REQUIREMENTS HEREIN SET FORTH AND AS REQUIRED TO PERFORM AS
                                                                                                                              1.01 SECTION INCLUDES
   DESIGNED.
                                                                                                                                  A. NAMEPLATES.
 PART 3 EXECUTION
                                                                                                                                B. TAGS.
3.01 PROTECTION OF EQUIPMENT
                                                                                                                              PART 2 PRODUCTS
   A. PROTECT ALL MATERIALS AND EQUIPMENT FROM DAMAGE DURING STORAGE AT THE SITE AND THROUGHOUT THE
                                                                                                                              2.01 IDENTIFICATION APPLICATIONS
                                                                                                                                  A. ROOFTOP UNITS AND FANS: NAMEPLATES.
    CONSTRUCTION PERIOD
    B. PROTECTION FROM DAMAGE FROM RAIN, DIRT, SUN AND GROUND WATER SHALL BE ACCOMPLISHED BY STORING THE
                                                                                                                                  B. CONTROL PANELS: NAMEPLATES.
    EQUIPMENT ON ELEVATED SUPPORTS AND COVERING THEM ON ALL SIDES WITH PROTECTIVE RIGID OR FLEXIBLE WATER
                                                                                                                              2.02 NAMEPLATES
    PROOF COVERINGS SECURELY FASTENED
                                                                                                                                  A. LETTER COLOR: WHITE.
     C. PIPING SHALL BE PROTECTED BY STORING IT ON ELEVATED SUPPORTS AND CAPPING THE ENDS WITH SUITABLE MATERIAL
                                                                                                                                  B. LETTER HEIGHT: 1/4 INCH (6 MM).
                                                                                                                                    BACKGROUND COLOR: BLACK.
    TO PREVENT DIRT ACCUMULATION IN THE PIPING.
3.02 COORDINATION OF WORK
                                                                                                                                   D. PLASTIC: CONFORM TO ASTM D709.
    A. ALL WORK SHALL BE COORDINATED TO AVOID CONFLICT WITH OTHER CONTRACTORS.
                                                                                                                               PART 3 EXECUTION
      THE CONTRACTOR SHALL BE RESPONSIBLE FOR CHECKING TO INSURE THAT THE EQUIPMENT TO BE INSTALLED WILL FIT IN
                                                                                                                              3.01 PREPARATION
                                                                                                                                  A. DEGREASE AND CLEAN SURFACES TO RECEIVE ADHESIVE FOR IDENTIFICATION MATERIALS.
    THE SPACE SHOWN ON THE DRAWINGS. IF THERE IS A CONFLICT, THE CONTRACTOR SHALL NOTIFY THE ENGINEER BEFORE BID.
   BY SUBMITTING A BID THE CONTRACTOR ASSURES THAT THE EQUIPMENT TO BE INSTALLED WILL FIT OR THAT PREVISIONS
                                                                                                                                 A. INSTALL NAMEPLATES WITH CORROSIVE-RESISTANT MECHANICAL FASTENERS, OR ADHESIVE. APPLY WITH SUFFICIENT
    HAVE BEEN INCLUDED IN THE BID TO MOVE THE EQUIPMENT TO A LOCATION WHERE IT CAN BE INSTALLED WITHOUT CONFLICT.
                                                                                                                                  ADHESIVE TO ENSURE PERMANENT ADHESION AND SEAL WITH CLEAR LACQUER.
    A. IF ANY PART OF THE CONTRACTOR'S WORK IS DEPENDENT FOR ITS PROPER EXECUTION OR FOR ITS SUBSEQUENT
    EFFICIENCY OR APPEARANCE ON THE CHARACTER OR CONDITIONS OF CONTIGUOUS WORK NOT EXECUTED BY HIM, THIS
                                                                                                                              END OF SECTION
    CONTRACTOR SHALL EXAMINE AND MEASURE SUCH CONTIGUOUS WORK AND REPORT TO THE ENGINEER IN WRITING ANY
    IMPERFECTION THEREIN, OR CONDITIONS THAT RENDER IT UNSUITABLE FOR THE RECEPTION OF THIS WORK. SHOULD THE
                                                                                                                               SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC
    CONTRACTOR PROCEED WITHOUT MAKING SUCH WRITTEN REPORT, HE SHALL BE HELD TO HAVE ACCEPTED SUCH WORK AND
                                                                                                                               PART 1 GFNERAL
    THE EXISTING CONDITIONS AND HE SHALL BE RESPONSIBLE.
                                                                                                                              1.01 SECTION INCLUDES
                                                                                                                                  A. TESTING, ADJUSTMENT, AND BALANCING OF AIR SYSTEMS.
3.04 CERTIFICATES OF INSPECTION AND APPROVAL:
   A. UPON COMPLETION OF WORK, FURNISH TO THE OWNER CERTIFICATES OF INSPECTION OR APPROVAL FROM THE
                                                                                                                                  B. MEASUREMENT OF FINAL OPERATING CONDITION OF HVAC SYSTEMS.
   AUTHORITIES HAVING JURISDICTION IF CERTIFICATES OF INSPECTION OR APPROVAL ARE REQUIRED BY LAW OR REGULATION.
3.05 SLEEVES AND OPENINGS:
                                                                                                                                  A. AABC MN-1 - AABC NATIONAL STANDARDS FOR TOTAL SYSTEM BALANCE; ASSOCIATED AIR BALANCE COUNCIL; 2002.
  A. FURNISH, LOCATE, INSTALL, AND FIREPROOF ALL SLEEVES AND OPENINGS REQUIRED FOR INSTALLATION OF THE WORK.
                                                                                                                                  B. ASHRAE STD 111 - MEASUREMENT, TESTING, ADJUSTING, AND BALANCING OF BUILDING HVAC SYSTEMS; 2008.
3.06 ACCESS TO EQUIPMENT AND VALVES:
                                                                                                                                     NEBB (TAB) - PROCEDURAL STANDARDS FOR TESTING ADJUSTING AND BALANCING OF ENVIRONMENTAL SYSTEMS; 2015,
   A. SHOULD ANY WORK, SUCH AS PIPING, DUCTS, CONDUIT, ETC. BE INSTALLED WITHOUT DUE REGARD TO THE ACCESSIBILITY
                                                                                                                                  EIGHTH EDITION.
    OF DEVICES INSTALLED BY OTHER CONTRACTORS, THE INSTALLATION SHALL BE RELOCATED, OFFSET OR REROUTED WITHOUT
                                                                                                                              1.03 SUBMITTALS
    COST TO THE OWNER.
                                                                                                                                  A. QUALIFICATIONS: SUBMIT NAME OF ADJUSTING AND BALANCING AGENCY AND TAB SUPERVISOR FOR APPROVAL WITHIN
3.07 CUTTING AND PATCHING:
                                                                                                                                  30 DAYS AFTER AWARD OF CONTRACT.
   A. PERFORM ALL CUTTING AND PATCHING REQUIRED FOR INSTALLATION OF THE WORK.
                                                                                                                                  B. FINAL REPORT: INDICATE DEFICIENCIES IN SYSTEMS THAT WOULD PREVENT PROPER TESTING, ADJUSTING, AND
                                                                                                                                  BALANCING OF SYSTEMS AND EQUIPMENT TO ACHIEVE SPECIFIED PERFORMANCE.
3.08 PROJECT CLOSEOUT:
                                                                                                                                      1. SUBMIT UNDER PROVISIONS OF SECTION 01 4000.
   A. MAINTENANCE MANUALS: AT THE END OF CONSTRUCTION, FURNISH TO THE ENGINEER THREE (3) BOUND AND INDEXED
    SETS OF MAINTENANCE AND OPERATING INSTRUCTIONS, PARTS LISTS, ELECTRICAL WIRING DIAGRAMS, BALANCE DATA, AND
                                                                                                                                       REVISE TAB PLAN TO REFLECT ACTUAL PROCEDURES AND SUBMIT AS PART OF FINAL REPORT.
    MANUFACTURER'S LITERATURE SUFFICIENT FOR OPERATION AND COMPLETE MAINTENANCE OF ALL EQUIPMENT BY THE
                                                                                                                                       3. SUBMIT DRAFT COPIES OF REPORT FOR REVIEW PRIOR TO FINAL ACCEPTANCE OF PROJECT, PROVIDE FINAL
                                                                                                                                      COPIES FOR ARCHITECT AND FOR INCLUSION IN OPERATING AND MAINTENANCE MANUALS
   B. APPROVED SUBMITTALS AND SHOP DRAWINGS MAY BE INCLUDED IN THE MAINTENANCE MANUALS INSTEAD OF BEING
                                                                                                                                      4. PROVIDE REPORTS IN SOFT COVER, LETTER SIZE, 3-RING BINDER MANUALS, COMPLETE WITH INDEX PAGE AND
                                                                                                                                      INDEXING TABS, WITH COVER IDENTIFICATION AT FRONT AND SIDE. INCLUDE SET OF REDUCED DRAWINGS WITH AIR
    SEPARATELY FURNISHED. IF DESIRED
                                                                                                                                      OUTLETS AND EQUIPMENT IDENTIFIED TO CORRESPOND WITH DATA SHEETS, AND INDICATING THERMOSTAT LOCATIONS.
      . IT IS INTENDED THAT THE DOCUMENTATION PROVIDED IN MAINTENANCE MANUALS, ALONG WITH AS-BUILT DRAWINGS,
    SHALL BE COMPLETE AND DETAILED ENOUGH TO PERMIT AND FACILITATE TROUBLESHOOTING, ENGINEERING ANALYSIS, AND
                                                                                                                                        . INCLUDE ACTUAL INSTRUMENT LIST, WITH MANUFACTURER NAME, SERIAL NUMBER, AND DATE OF CALIBRATION.
    DESIGN WORK FOR FUTURE CHANGES, WITHOUT EXTENSIVE FIELD INVESTIGATIONS AND TESTING, MANUALS SHALL BE
                                                                                                                                      6. FORM OF TEST REPORTS: WHERE THE TAB STANDARD BEING FOLLOWED RECOMMENDS A REPORT FORMAT USE
     PREPARED SO AS TO EXPLAIN SYSTEM OPERATION AND EQUIPMENT TO THOSE NOT ACQUAINTED WITH THE JOB.
                                                                                                                                      THAT: OTHERWISE, FOLLOW ASHRAE STD 111.
    D. MANUALS SHALL BE DURABLY BOUND AND CLEARLY IDENTIFIED ON THE FRONT COVER (AND ON THE SPINE OF THICK
                                                                                                                                      7. UNITS OF MEASURE: REPORT DATA IN BOTH I-P (INCH-POUND) AND SI (METRIC) UNITS.
    VOLUMES). IDENTIFICATION SHALL INCLUDE THE BUILDING OR PROJECT NAME, APPLICABLE TRADE (SUCH AS HVAC),
                                                                                                                                     8. INCLUDE THE FOLLOWING ON THE TITLE PAGE OF EACH REPORT:
    APPROXIMATE DATE OF COMPLETION (MONTH AND YEAR) AND CONTRACTOR'S NAME.
                                                                                                                                         a. NAME OF TESTING, ADJUSTING, AND BALANCING AGENCY.
      . MANUALS SHALL BE ORGANIZED INTO WELL DEFINED AND EASY TO LOCATE SECTIONS, WITH INDEX TABS OR SEPARATORS
                                                                                                                                         b. ADDRESS OF TESTING, ADJUSTING, AND BALANCING AGENCY
     TO DIVIDE THE SECTIONS. A COMPLETE TABLE OF CONTENTS SHALL BE PROVIDED AT THE FRONT INDICATING THE SECTION OR
                                                                                                                                          c. TELEPHONE NUMBER OF TESTING, ADJUSTING, AND BALANCING AGENCY.
    PAGE NUMBER FOR EACH SYSTEM. SUBSYSTEM. OR SUPPLIER/MANUFACTURER.
                                                                                                                                          d. PROJECT NAME.
    F. MANUALS SHALL INCLUDE COMPLETE INFORMATION AND DIAGRAMS ON ALL CONTROLS, INDICATORS, SENSORS, AND
                                                                                                                                         e. PROJECT LOCATION
   SIGNAL SOURCES, CONTROL DIAGRAMS ARE TO SHOW THE LOCATIONS OF COMPONENTS AND MAJOR EQUIPMENT BY ROOM
                                                                                                                                         f. PROJECT ARCHITECT
    NUMBER OR OTHER IDENTIFICATION WHEN ROOM NUMBERS ARE NOT APPLICABLE. LOCATIONS OF OUT-OF-SIGHT
                                                                                                                                          g. PROJECT ENGINEER.
    COMPONENTS, SUCH AS DUCT MOUNTED SENSORS, FLOW SWITCHES, ETC. SHOULD BE CLEARLY INDICATED. CONTROL
                                                                                                                                          h. PROJECT CONTRACTOR
    DIAGRAMS MUST INCLUDE IDENTIFICATION OF COMPONENTS BY MAKE AND MODEL NUMBER, OPERATING RANGES,
                                                                                                                                            PROJECT ALTITUDE.
    RECOMMENDED SET POINTS, RESET SCHEDULES, AND OTHER JOB-SPECIFIC DATA USEFUL FOR TROUBLESHOOTING,
                                                                                                                                            REPORT DATE.
                                                                                                                                     PROJECT RECORD DOCUMENTS: RECORD ACTUAL LOCATIONS OF FLOW MEASURING STATIONS AND BALANCING VALVES
     CALIBRATION AND MAINTENANCE. COMPLETE NARRATIVE DESCRIPTIONS OF OPERATING SEQUENCES OF CONTROL SYSTEM
    AND SUBSYSTEMS SHALL BE INCLUDED ON THE PRINTS ADJACENT TO THE CORRESPONDING SCHEMATICS. CATALOG DATA AND
                                                                                                                                  AND ROUGH SETTING.
                                                                                                                              PART 2 PRODUCTS - NOT USED
    CUTS SHALL BE CLEARLY MARKED TO INDICATE MODEL NUMBERS, SIZES, CAPACITIES, OPERATING POINTS, AND OTHER
    CHARACTERISTICS OF EACH ITEM USED. THIS SHOULD INCLUDE ACCESSORIES OR SPECIAL FEATURES PROVIDED. WHERE
                                                                                                                              PART 3 EXECUTION
    VARIOUS SIZES OR VARIATIONS OF A SERIES OR MODEL ARE USED, DOCUMENTS SHOULD CLEARLY SHOW WHICH ARE USED
                                                                                                                              3.01 GENERAL REQUIREMENTS
    WHERE. WHERE QUANTITIES ARE APPROPRIATE, SCHEDULE OF USAGE SHOULD BE PROVIDED. MAINTENANCE LITERATURE
                                                                                                                                 A. PERFORM TOTAL SYSTEM BALANCE IN ACCORDANCE WITH ONE OF THE FOLLOWING:
    SHALL INCLUDE COMPLETE INFORMATION FOR IDENTIFYING AND ORDERING REPLACEMENT PARTS, SUCH AS ILLUSTRATED
                                                                                                                                        AABC MN-1, AABC NATIONAL STANDARDS FOR TOTAL SYSTEM BALANCE.
                                                                                                                                        ASHRAE STD 111, PRACTICES FOR MEASUREMENT, TESTING, ADJUSTING AND BALANCING OF BUILDING HEATING,
   G. MAINTENANCE MANUALS MUST INCLUDE COMPLETE BALANCE DATA ON ALL SYSTEMS.
                                                                                                                                      VENTILATION, AIR-CONDITIONING, AND REFRIGERATION SYSTEMS.
                                                                                                                                      NEBB PROCEDURAL STANDARDS FOR TESTING ADJUSTING BALANCING OF ENVIRONMENTAL SYSTEMS.
3.09 SPARE FILTERS:
   A. SPARE FILTERS SHALL BE DELIVERED TO OWNER'S REPRESENTATIVE.
                                                                                                                                      4. SMACNA HVAC SYSTEMS TESTING, ADJUSTING, AND BALANCING.
                                                                                                                                  B. BEGIN WORK AFTER COMPLETION OF SYSTEMS TO BE TESTED, ADJUSTED, OR BALANCED AND COMPLETE WORK PRIOR
3.10 WARRANTIES:
   A. THIS CONTRACTOR WARRANTS THE MECHANICAL SYSTEMS TO BE FREE OF DEFECTS IN MATERIALS AND WORKMANSHIP
                                                                                                                                   TO SUBSTANTIAL COMPLETION OF THE PROJECT.
   FOR A PERIOD OF ONE YEAR AFTER DATE OF FINAL PAYMENT. THE EFFECTIVE DATES OF THIS WARRANTY APPLY TO ALL
                                                                                                                                   C. WHERE HVAC SYSTEMS AND/OR COMPONENTS INTERFACE WITH LIFE SAFETY SYSTEMS, INCLUDING FIRE AND SMOKE
   COMPONENTS OF THE MECHANICAL SYSTEMS REGARDLESS OF ANY EQUIPMENT MANUFACTURER'S WARRANTIES WHICH MAY
                                                                                                                                  DETECTION, ALARM, AND CONTROL, COORDINATE SCHEDULING AND TESTING AND INSPECTION PROCEDURES WITH THE
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AUTHORITIES HAVING JURISDICTION.

PERFORMANCE GUARANTY.

CERTIFIED BY ONE OF THE FOLLOWING:

b. NEBB, NATIONAL ENVIRONMENTAL BALANCING BUREAU: WWW.NEBB.ORG.

COMPANY SPECIALIZING IN THE TESTING, ADJUSTING, AND BALANCING OF SYSTEMS SPECIFIED IN THIS SECTION.

a. AABC, ASSOCIATED AIR BALANCE COUNCIL: WWW.AABCHQ.COM; UPON COMPLETION SUBMIT AABC NATIONAL

c. TABB. THE TESTING. ADJUSTING. AND BALANCING BUREAU OF NATIONAL ENERGY MANAGEMENT INSTITUTE:

TAB SUPERVISOR AND TECHNICIAN QUALIFICATIONS: CERTIFIED BY SAME ORGANIZATION AS TAB AGENCY.

D. TAB AGENCY QUALIFICATIONS:

EXPIRE AT AN EARLIER DATE. ANY SYSTEM MALFUNCTIONS, OR ANY PREVIOUSLY UNDISCOVERED NON-COMPLIANCE WITH THE

PLANS AND SPECIFICATIONS, DURING THE WARRANTY PERIOD SHALL BE REPAIRED AT NO COST TO THE OWNER.

B. DELIVER TO OWNER ALL WARRANTIES, GUARANTEES, ETC. AND OBTAIN WRITTEN RECEIPTS.

END OF SECTION

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SECTION 23 0713 - DUCT INSULATION
                                                                                                                                                                            SECTION 232300
                                                                                                                                                                            REFRIGERANT PIPING
PART 1 GENERAL
1.01 SECTION INCLUDES
                                                                                                                                                                                      PART 1 GENERAL
A. DUCT INSULATION.
                                                                                                                                                                                      1.01 SECTION INCLUDES
PART 2 PRODUCTS
                                                                                                                                                                                          A. Piping.
                                                                                                                                                                                             . Refrigerant.
2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION
   A. SURFACE BURNING CHARACTERISTICS: FLAME SPREAD/SMOKE DEVELOPED INDEX OF 25/50, MAXIMUM, WHEN TESTED IN
                                                                                                                                                                                              Moisture and liquid indicators.
    ACCORDANCE WITH ASTM E 84, NFPA 255, OR UL 723.
                                                                                                                                                                                      1.02 DELIVERY, STORAGE, AND HANDLING
   B. INSULATION SHALL COMPLY WITH CONTINENTAL MES - PIPING AND INSULATION STANDARD
                                                                                                                                                                                          A. Deliver and store piping and specialties in shipping containers with labeling in place.
2.02 GLASS FIBER, FLEXIBLE
                                                                                                                                                                                              Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
   A. INSULATION: ASTM C553; FLEXIBLE, NONCOMBUSTIBLE BLANKET.
                                                                                                                                                                                          C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.
           'K' VALUE: 0.25 AT 75 DEGREES F, WHEN TESTED IN ACCORDANCE WITH ASTM C518.
                                                                                                                                                                                      PART 2 PRODUCTS
             MAXIMUM SERVICE TEMPERATURE: 250 DEGREES F.
             MAXIMUM WATER VAPOR SORPTION: < 3.0 PERCENT BY WEIGHT AT 120 DEGREES F.
                                                                                                                                                                                          A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.
            INSULATION SHALL BE OWNENS CORNING TYPE 150 OR EQUAL.

    Fittings: ASME B16.22 wrought copper.

                                                                                                                                                                                                  Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper allov.
   B. VAPOR BARRIER JACKET:
           KRAFT PAPER WITH GLASS FIBER YARN AND BONDED TO ALUMINIZED FILM.
                                                                                                                                                                                           B. Pipe Supports and Anchors:
             MOISTURE VAPOR PERMEABILITY: 0.029 NG/PA S M (0.02 PERM INCH), WHEN TESTED IN ACCORDANCE WITH ASTM E96/E96M.
                                                                                                                                                                                                   Hangers for Pipe Sizes 1/2 to 1-1/2 Inch (13 to 38 mm): Malleable iron adjustable swivel, split ring.
            SECURE WITH PRESSURE SENSITIVE TAPE.
                                                                                                                                                                                                   Hangers for Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
                                                                                                                                                                                                  . Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
            KRAFT PAPER REINFORCED WITH GLASS FIBER YARN AND BONDED TO ALUMINIZED FILM, WITH PRESSURE SENSITIVE
                                                                                                                                                                                                4. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
         RUBBER BASED ADHESIVE.
                                                                                                                                                                                       2.02 REFRIGERANT
2.03 GLASS FIBER, RIGID
                                                                                                                                                                                          A. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.
   A. INSULATION: ASTM C612; RIGID, NONCOMBUSTIBLE BLANKET.
                                                                                                                                                                                      PART 3 EXECUTION
            'K' VALUE: 0.24 AT 75 DEGREES F, WHEN TESTED IN ACCORDANCE WITH ASTM C518.
                                                                                                                                                                                      3.01 INSTALLATION
             MAXIMUM SERVICE TEMPERATURE: 450 DEGREES F.
                                                                                                                                                                                          A. Install refrigeration specialties in accordance with manufacturer's instructions.
             MAXIMUM WATER VAPOR ABSORPTION: 5.0 PERCENT.
                                                                                                                                                                                              Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
           MAXIMUM DENSITY: 8.0 LB/CU FT.
                                                                                                                                                                                               Install piping to conserve building space and avoid interference with use of space.
   B. VAPOR BARRIER JACKET:
                                                                                                                                                                                              Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
           KRAFT PAPER WITH GLASS FIBER YARN AND BONDED TO ALUMINIZED FILM.
                                                                                                                                                                                       3.02 SCHEDULES
             MOISTURE VAPOR PERMEABILITY: 0.029 NG/PA S M (0.02 PERM INCH), WHEN TESTED IN ACCORDANCE WITH ASTM E96/E96M.
                                                                                                                                                                                          A. Hanger Spacing for Copper Tubing.
            SECURE WITH PRESSURE SENSITIVE TAPE.
                                                                                                                                                                                                1. 1/2 inch (13 mm), 5/8 inch (16 mm), and 7/8 inch (22 mm) OD: Maximum span, 5 feet (1500 mm); minimum rod size, 1/4 inch (6.3 mm).
      C. VAPOR BARRIER TAPE:
            KRAFT PAPER REINFORCED WITH GLASS FIBER YARN AND BONDED TO ALUMINIZED FILM, WITH PRESSURE SENSITIVE
         RUBBER BASED ADHESIVE.
PART 3 EXECUTION
                                                                                                                                                                            SECTION 230719
3.01 EXAMINATION
   A. VERIFY THAT DUCTS HAVE BEEN TESTED BEFORE APPLYING INSULATION MATERIALS.
                                                                                                                                                                            HVAC PIPING INSULATION
   B. VERIFY THAT SURFACES ARE CLEAN, FOREIGN MATERIAL REMOVED, AND DRY.
                                                                                                                                                                                      PART 1 GENERAL
                                                                                                                                                                                      1.01 SECTION INCLUDES
3.02 INSTALLATION
     A. INSTALL IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.

    A. Piping insulation

       INSTALL IN ACCORDANCE WITH NAIMA NATIONAL INSULATION STANDARDS.
                                                                                                                                                                                              Jackets and accessories.
       INSULATED DUCTS CONVEYING AIR BELOW AMBIENT TEMPERATURE:
                                                                                                                                                                                              Engineered wall outlet seals and refrigerant piping insulation protection.
           PROVIDE INSULATION WITH VAPOR BARRIER JACKETS.
                                                                                                                                                                                      1.02 DELIVERY, STORAGE, AND HANDLING
             FINISH WITH TAPE AND VAPOR BARRIER JACKET.
                                                                                                                                                                                        A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.
             CONTINUE INSULATION THROUGH WALLS, SLEEVES, HANGERS, AND OTHER DUCT PENETRATIONS.
                                                                                                                                                                                       PART 2 PRODUCTS
             INSULATE ENTIRE SYSTEM INCLUDING FITTINGS, JOINTS, FLANGES, FIRE DAMPERS, FLEXIBLE CONNECTIONS, AND
                                                                                                                                                                                      2.01 REGULATORY REQUIREMENTS
                                                                                                                                                                                         A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.
         EXPANSION JOINTS.
3.03 SCHEDULES
                                                                                                                                                                                      2.02 GLASS FIBER, RIGID
   A. DUCTWORK IN MECHANICAL ROOMS

    A. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.

           RIGID GLASS FIBER DUCT INSULATION: 2 INCHES THICK.
                                                                                                                                                                                                1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
                                                                                                                                                                                                  . Maximum Service Temperature: 850 degrees F (454 degrees C).
SECTION 233100 HVAC DUCTS AND CASINGS
                                                                                                                                                                                                3. Maximum Moisture Absorption: 0.2 percent by volume.
         PART 1 GENERAL
                                                                                                                                                                                              Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM
         1.01 SECTION INCLUDES
                                                                                                                                                                                            E96/E96M of 0.02 perm-inches (0.029 ng/Pa s m).

 A. Metal ductwork.

                                                                                                                                                                                              Vapor Barrier Lap Adhesive: Compatible with insulation.

 B. Duct cleaning.

                                                                                                                                                                                              Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
         1.02 REFERENCE STANDARDS
                                                                                                                                                                                              Indoor Vapor Barrier Finish:
             A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals Most Recent Edition Cited by Referring Code or Reference Standard.

    Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.

                  ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
                                                                                                                                                                                                2. Vinyl emulsion type acrylic, compatible with insulation, black color.
                 ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by
                                                                                                                                                                                      2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION
             the Hot-Dip Process 2020.
                                                                                                                                                                                          A. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
                ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
                                                                                                                                                                                                   Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
                  NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
                                                                                                                                                                                                   Maximum Service Temperature: 180 degrees F (82 degrees C).
                 SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2005 (Revised 2009).
                                                                                                                                                                                                 3. Connection: Waterproof vapor barrier adhesive.
             G. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors current edition, including all revisions.
                                                                                                                                                                                          B. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.
          PART 2 PRODUCTS
                                                                                                                                                                                          A. Flexible Weather-Proofing Outdoor Jacket: Self-healing, field-applied outdoor cladding.
        2.01 DUCT ASSEMBLIES
             A. Regulatory Requirements: Construct ductwork to comply with NFPA 90A standards.
                                                                                                                                                                                                1. Material: Aluminum foil/polymer laminate with rubberized asphalt layer and acrylic adhesive.
             B. Ducts: Galvanized steel, unless otherwise indicated.
                                                                                                                                                                                                  Thickness: 34 mils (0.86 mm).
         2.02 MATERIALS
                                                                                                                                                                                                  . Finish: Embossed.
               A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
             B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
                                                                                                                                                                                                   Water Vapor Transmission: 0.002 perm inch (0.0029 ng/Pa s m), maximum, when tested in accordance with ASTM E96/E96M.
                                                                                                                                                                                                   Mold Resistance: Pass when tested in accordance with ASTM C1338.
                   1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and
                                                                                                                                                                                                  Emissivity: 0.30 when tested in accordance with ASTM C1371.
                   recommended by manufacturer for pressure class of ducts.
                                                                                                                                                                                       2.05 ENGINEERED WALL OUTLET SEALS AND REFRIGERANT PIPING INSULATION PROTECTION
                       Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with
                                                                                                                                                                                          A. Manufacturers:
                   3. For Use with Flexible Ducts: UL labeled.
                                                                                                                                                                                                  . Airex Manufacturing, Inc: www.airexmfg.com/#sle.
                 Gasket Tape: Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF),
                                                                                                                                                                                           B. Basis of Design: Airex Manufacturing, Inc; www.airexmfg.com/#sle.
                                                                                                                                                                                                   Pipe Penetration Wall Seal: Airex Titan Outlet.
              applied flange connections, and angle rings connections.
                Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
                                                                                                                                                                                                    Refrigeration Pipe Insulation Protection System: Airex E-Flex Guard.
         2.03 DUCTWORK FABRICATION
                                                                                                                                                                                                  . Pipe Penetration Wall Seal and Insulation Protection System: Airex Pro-System Kit.
                                                                                                                                                                                          C. Pipe Penetration Wall Seal: Seals HVAC piping wall penetrations with compression gasket wall mounted rigid plastic outlet cover.
             A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.
              B. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts
                                                                                                                                                                                                1. Wall Outlet Size, Siding and Compact Applications: 6-7/8 inch wide by 3-7/8 inch high (175 mm wide by 99 mm high).
              in accordance with ASHRAE (FUND) Handbook - Fundamentals.
                                                                                                                                                                                                     a. Elastomeric Sleeve Diameter: 1-11/16 inch (43 mm).
                  Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
                                                                                                                                                                                                   Outlet Cover Color: Gray.
                 Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where
                                                                                                                                                                                                   Water Penetration: Comply with ASTM E331
              rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.
                                                                                                                                                                                                Air Leakage: Comply with ASTM E283.
                Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
                                                                                                                                                                                                5. Air Permeance: Comply with ASTM E2178.
                 Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of
                                                                                                                                                                                               Insulation Protection System: Refrigerant piping insulation PVC protective cover.
              equipment and 45 degrees convergence downstream.
                                                                                                                                                                                                  PVC Insulation Cover Color: Black with full-length velcro fastener.
                Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).
                                                                                                                                                                                                   Weatherization and Ultraviolet Exposure Protection: Comply with ASTM G153.
                . Duct shall be rated for 2.0" in. Pressure Class with an "A" Seal Classification.
                                                                                                                                                                                                   Water/Vapor Permeability: Comply with ASTM E96/E96M.
          PART 3 EXECUTION
                                                                                                                                                                                                  Anti-Fungal and Anti-Microbial Resistance: Comply with ASTM G21.
         3.01 INSTALLATION
                                                                                                                                                                                                  Flame Spread and Smoke Development Rating of 24/450: Comply with ASTM E84 or UL 723.
             A. Install, support, and seal ducts in accordance with SMACNA (DCS).
                                                                                                                                                                                                   Carbon Arc Light Exposure: Comply with ASTM G153.
             B. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from
                                                                                                                                                                                                   Tensile Strength After UV Exposure and Water Immersion: Comply with ASTM D412.
                                                                                                                                                                                                8. Water Absorption of Plastics: Comply with ASTM D570.
              entering ductwork system.
                                                                                                                                                                                                9. Adhesive free.
                 Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
                 Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where
                                                                                                                                                                                       PART 3 EXECUTION
                                                                                                                                                                                     3.01 INSTALLATION
             required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are
             provided in insulated ductwork, install insulation material inside a metal ring.
                                                                                                                                                                                          A. Install in accordance with manufacturer's instructions.
                 Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
                                                                                                                                                                                              Install in accordance with NAIMA National Insulation Standards.
                 Use crimp joints with or without bead for joining round duct sizes 8 inch (200 mm) and smaller with crimp in direction of air flow.
                                                                                                                                                                                              Insulated Pipes Conveying Fluids Below Ambient Temperature:

    Use double nuts and lock washers on threaded rod supports.

                                                                                                                                                                                                  Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
              H. Connect diffusers or light troffer boots to low pressure ducts directly or with 5 feet (1.5 m) maximum length of flexible duct held in place
                                                                                                                                                                                              Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see
         3.02 CLEANING
                                                                                                                                                                                      3.02 SCHEDULE
             A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the
                                                                                                                                                                                         A. Heating Systems:
                                                                                                                                                                                                  . Low Pressure Steam Piping: 2" Rigid Glass Fiber
              system at a time. Protect equipment that could be harmed by excessive dirt with temporary filters, or bypass during cleaning.
                                                                                                                                                                                                  Low Pressure Steam Condensate: 2" Rigid Glass Fiber
     END OF SECTION 233100
                                                                                                                                                                                          B. Cooling Systems:
SECTION 233300 AIR DUCT ACCESSORIES
                                                                                                                                                                                                    Condensate Drains from Cooling Coils: 1/2" Flexible elastomeric cellular insulation.
                                                                                                                                                                                                   Refrigerant Suction: 1/2" Flexible Elastomeric Cellular Insulation.
         PART 1 GENERAL
         1.01 SECTION INCLUDES
                                                                                                                                                                                                   Refrigerant Hot Gas: 1/2" Flexible Elastomeric Cellular Insulation.
                Backdraft dampers - metal.
                                                                                                                                                                                                4. Refrigerant Piping (Suction and Hot Gas) located outdoors: 1/2" Flexible Elastomeric Cellular Insulation with Flexible weather proofing outdoor jacket.
                 Duct access doors.
                  Duct test holes.
                  Flexible duct connectors
                                                                                                                                                                            INSTRUMENTATION AND CONTROL DEVICES FOR HVAC
                  Volume control dampers.
                                                                                                                                                                                      PART 1 GENERAL
                 Miscellaneous products:

    Duct opening closure film.

                                                                                                                                                                                      1.01 SECTION INCLUDES
          1.02 REFERENCE STANDARDS

 Control panels.

                NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
                                                                                                                                                                                          B. Damper Operators:
                  NFPA 92 - Standard for Smoke Control Systems 2018.

    Electric operators

                  NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations 2021.
                                                                                                                                                                                              Input/Output Sensors:
                  SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2005 (Revised 2009).
                                                                                                                                                                                                  Temperature sensors
                 UL 33 - Safety Heat Responsive Links for Fire-Protection Service Current Edition, Including All Revisions.
                                                                                                                                                                                                   Humidity sensors.
             F. UL 555 - Standard for Fire Dampers Current Edition, Including All Revisions.
                                                                                                                                                                                                3. Static pressure (air pressure) sensors.
          PART 2 PRODUCTS
                                                                                                                                                                                       1.02 REFERENCE STANDARDS
         2.01 BACKDRAFT DAMPERS - METAL
                                                                                                                                                                                          A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
             A. Gravity Backdraft Dampers, Size 18 by 18 inches (450 by 450 mm) or Smaller, Furnished with Air Moving Equipment: Air moving
                                                                                                                                                                                       PART 2 PRODUCTS
                                                                                                                                                                                      2.01 EQUIPMENT - GENERAL
             equipment manufacturer's standard construction.
         2.02 COMBINATION FIRE AND SMOKE DAMPERS
                                                                                                                                                                                          A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
         2.03 DUCT ACCESS DOORS
             A. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts,
                                                                                                                                                                                          A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot
             install minimum 1 inch (25 mm) thick insulation with sheet metal cover.
                                                                                                                                                                                           lights, push buttons and switches flush on cabinet panel face.
                                                                                                                                                                                              NEMA 250, general purpose utility enclosures with enameled finished face panel.
             A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-
                                                                                                                                                                                           C. Provide common keying for all panels.
             B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.
                                                                                                                                                                                          A. General: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal
         2.05 FLEXIBLE DUCT CONNECTORS
                                                                                                                                                                                           against maximum system pressures. Provide spring return for two position control and for fail safe operation.
             A. Fabricate in accordance with SMACNA (DCS) and as indicated.
                                                                                                                                                                                                  Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
             B. Flexible Duct Connections: Fabric crimped into metal edging strip.
                                                                                                                                                                                          B. Electric Operators:
                                                                                                                                                                                                1. Spring return, adjustable stroke motor having oil immersed gear train, with auxiliary end switch.
                   1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd (1.0
                                                                                                                                                                                       2.04 INPUT/OUTPUT SENSORS
                   2. Metal: 3 inches (75 mm) wide, 24 gauge, 0.0239 inch (0.61 mm) thick galvanized steel.
                                                                                                                                                                                          A. Temperature Sensors:
                                                                                                                                                                                                1. Use thermistor or RTD type temperature sensing elements with characteristics resistant to moisture, vibration, and other conditions consistent with the
         2.06 VOLUME CONTROL DAMPERS
             A. Fabricate in accordance with SMACNA (DCS) and as indicated.
                                                                                                                                                                                                application without affecting accuracy and life expectancy.
                                                                                                                                                                                                   Construct RTD of nickel or platinum with base resistance of 1000 ohms at 70 degrees F (26 degrees C).
             B. Single Blade Dampers:
                                                                                                                                                                                                    100 ohm platinum RTD is acceptable if used with project DDC controllers.
                       Fabricate for duct sizes up to 6 by 30 inch (150 by 760 mm).
                    Blade: 24 gauge, 0.0239 inch (0.61 mm), minimum.
                                                                                                                                                                                                   Temperature Sensing Device: Compatible with project DDC controllers.
                 Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inch (200 by 1825 mm). Assemble center
                                                                                                                                                                                                5. Performance Characteristics:
                                                                                                                                                                                                  a. RTD:
             and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

    Blade: 18 gauge, 0.0478 inch (1.21 mm), minimum.

                                                                                                                                                                                                           . Duct Averaging Accuracy: Plus/minus 0.50 degrees F (0.28 degrees C) minimum.
               D. End Bearings: Except in round ducts 12 inches (300 mm) and smaller, provide end bearings. On multiple blade dampers, provide oil-
                                                                                                                                                                                                   Duct Mounted Sensor: Voltage type encased in a die-cast metal, weather-proof housing
               mpregnated nylon, thermoplastic elastomer, or sintered bronze bearing
                                                                                                                                                                                                        Input Power, Voltage Type: Class 2; 12-30 VDC/24 VAC, 15mA max.
                Quadrants:

    Provide locking, indicating quadrant regulators on single and multi-blade dampers.

                                                                                                                                                                                                       Input Power, mA Type: Class 2; Loop powered 12-30 VDC only, 30 mA max.
                   2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
                                                                                                                                                                                                        Output Voltage Type: 3-wire observed polarity.
                       Where rod lengths exceed 30 inches (750 mm) provide regulator at both ends.
                                                                                                                                                                                                        Output mA Type: 2-wire, not polarity sensitive (clipped and capped)
         2.07 MISCELLANEOUS PRODUCTS
                                                                                                                                                                                                      Humidity:
             A. Duct Opening Closure Film: Mold-resistant, self-adhesive film to keep debris out of ducts during construction.
                                                                                                                                                                                                           HS Element: Digitally profiled thin-film capacitive.
                                                                                                                                                                                                           Accuracy 1 percent at 10 to 80 percent relative humidity at 77 degrees F (25 degrees C), multi-point calibration, NIST traceable,
                       Thickness: 2 mils (0.6 mm).
                       High tack water based adhesive.
                                                                                                                                                                                                             a. Plus/minus 1 percent at 20 to 40 percent RH in mA output mode; (multi-point calibration, NIST traceable).
                       UV stable light blue color.
                                                                                                                                                                                                        3. Scaling: 0 to 100 percent RH.
                   4. Elongation Before Break: 325 percent, minimum.
                                                                                                                                                                                          2. Static Pressure (Air Pressure) Sensors:
          PART 3 EXECUTION
                                                                                                                                                                                                a. Unidirectional with ranges not exceeding 150 percent of maximum expected input.
         3.01 INSTALLATION
                                                                                                                                                                                                b. Temperature compensate with typical thermal error or 0.06 percent of full scale in temperature range of 40 to 100 degrees F (5 to 40 degrees C).
             A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 233100 for
                                                                                                                                                                                                c. Accuracy: One percent of full scale with repeatability 0.3 percent.
             duct construction and pressure class.
                                                                                                                                                                                                d. Output: 0 to 5 vdc with power at 12 to 28 vdc.
                                                                                                                                                                                  a. PART 3 EXECUTION
             B. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers,
             combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96
                                                                                                                                                                                         INSTALLATION
             Provide minimum 8 by 8 inch (200 by 200 mm) size for hand access, size for shoulder access, and as indicated. Provide 4 by 4 inch (100
                                                                                                                                                                                               Install in accordance with manufacturer's instructions.
                                                                                                                                                                                              Check and verify location of thermostats with plans and room details before installation. Locate 60 inches (1500 mm) above floor. Align with lighting switches
             by 100 mm) for balancing dampers only. Review locations prior to fabrication.
                 Provide duct test holes where indicated and required for testing and balancing purposes.
                                                                                                                                                                                               and humidistats. See Section 262726.
                  At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
                                                                                                                                                                                              Provide conduit and electrical wiring in accordance with Section 260583. Electrical material and installation shall be in accordance with appropriate requirements
                Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required
                                                                                                                                                                                               of Division 26.
             for air balancing. Install minimum 2 duct widths from duct take-off.
                                                                                                                                                                                  END OF SECTION
          END OF SECTION 233300
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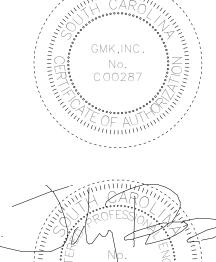
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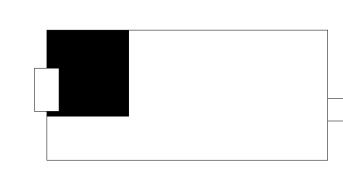
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CONSTRUCTION

MARCH 4, 2022

key plan



HVAC SPECIFICATIONS

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SECTION 230923
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC
        PART 1 GENERAL
        1.01 SECTION INCLUDES

 A. System description.

    B. Operator interface.

                  Controllers.
                  Power supplies and line filtering.
                 System software.

    Controller software.

              G. HVAC control programs
         1.02 RELATED REQUIREMENTS
              A. Section 230913 - Instrumentation and Control Devices for HVAC.
               B. Section 230993 - Sequence of Operations for HVAC Controls.
              C. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.
        1.03 REFERENCE STANDARDS
             A. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks
             2020, with Errata and Amendments (2021).
            B. MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests 2019h.
        2.01 MANUFACTURERS
           A. CONTROL MANAGEMENT (CMI)
        2.02 SYSTEM DESCRIPTION
             A. Automatic temperature control field monitoring and control system using field programmable micro-
             processor based units.
              B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-
             tasking, multi-user environment on token passing network, with central and remote hardware, software, and
             interconnecting wire and conduit.
             C. Include computer software and hardware, operator input/output devices, control units. local area
             networks (LAN), sensors, control devices, actuators.
              D. Controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, and the like
             when directly connected to the control units. Individual terminal unit control is specified in Section 230913.
              E. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating
             devices, interface equipment and other apparatus and accessories required to operate mechanical systems,
             and to perform functions specified
             F. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete
             and fully operational system.
         2.03 CONTROLLERS
             A. Building Controllers:

    General:

                      a. Manage global strategies by one or more, independent, standalone, microprocessor based
                      b. Provide sufficient memory to support controller's operating system, database, and
                        programming requirements.

    c. Share data between networked controllers.

                      d. Controller operating system manages input and output communication signals allowing
                        distributed controllers to share real and virtual object information and allowing for central
                        monitoring and alarms.

 e. Utilize real-time clock for scheduling.

                          Continuously check processor status and memory circuits for abnormal operation.
                      g. Controller to assume predetermined failure mode and generate alarm notification upon
                        detection of abnormal operation.
                      h. Communication with other network devices to be based on assigned protocol.
                  Communication:
                      a. Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical
                      b. Perform routing when connected to a network of custom application and application specific
                       c. Provide service communication port for connection to a portable operator's terminal or hand
                        held device with compatible protocol.
                 3. Anticipated Environmental Ambient Conditions:
                     a. Outdoors and/or in Wet Ambient Conditions:
                                Mount within waterproof enclosures.
                                Rated for operation at 40 to 150 degrees F (4 to 65 degrees C).
                      b. Conditioned Space:
                                Mount within dustproof enclosures.
                                Rated for operation at 32 to 120 degrees F (0 to 50 degrees C).
                  4. Provisions for Serviceability:
                       a. Diagnostic LEDs for power, communication, and processor.
                      b. Make all wiring connections to field removable, modular terminal strips, or to a termination
                            card connected by a ribbon cable.
                  5. Memory: In the event of a power loss, maintain all BIOS and programming information for a
                 6. Power and Noise Immunity:
                     a. Maintain operation at 90 to 110 percent of nominal voltage rating.

    b. Perform orderly shutdown below 80 percent of nominal voltage.

                      c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W.
                           at 3 feet (1 m).
              B. Application Specific Controllers:

    General:

                     a. Not fully user programmable, microprocessor based controllers dedicated to control specific
                      b. Customized for operation within the confines of equipment served.
                          Communication with other network devices to be based on assigned protocol.
                       a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
                      b. Provide service communication port for connection to a portable operator's terminal or hand
                            held device with compatible protocol.
                  Anticipated Environmental Ambient Conditions:
                     a. Outdoors and/or in Wet Ambient Conditions:
                                Mount within waterproof enclosures.
                                Rated for operation at 40 to 150 degrees F (4 to 65 degrees C).
                     b. Conditioned Space:
                                Mount within dustproof enclosures.
                                Rated for operation at 32 to 120 degrees F (0 to 50 degrees C)
                   Provisions for Serviceability
                      a. Diagnostic LEDs for power, communication, and processor.
                      b. Make all wiring connections to field removable, modular terminal strips, or to a termination
                            card connected by a ribbon cable.
                 5. Memory: In the event of a power loss, maintain all BIOS and programming information for a
                        minimum of 72 hours.
                 Power and Noise Immunity:
                      a. Maintain operation at 90 to 110 percent of nominal voltage rating.

    b. Perform orderly shutdown below 80 percent of nominal voltage.

    Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W

                           at 3 feet (1 m).
              C. Input/Output Interface:

    Hardwired inputs and outputs tie into the DDC system through building, custom application, or

                        application specific controllers.
                   2. All Input/Output Points:
                      a. Protect controller from damage resulting from any point short-circuiting or grounding and from
                             voltage up to 24 volts of any duration
                      b. Provide universal type for building and custom application controllers where input or output is
                            software designated as either binary or analog type with appropriate properties.
                  3. Binary Inputs:

    Allow monitoring of On/Off signals from remote devices.

                      b. Provide wetting current of 12 mA minimum, compatible with commonly available control
                            devices and protected against the effects of contact bounce and noise.
                       c. Sense dry contact closure with power provided only by the controller.
                  4. Pulse Accumulation Input Objects: Comply with all requirements of binary input objects and
                       accept up to 10 pulses per second.
                  Analog Inputs:
                     a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or resistance signals
                            (thermistor, RTD).
                      b. Compatible with and field configurable to commonly available sensing devices.
                 6. Binary Outputs:
                      a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
                       b. Outputs provided with three position (On/Off/Auto) override switches.
                      c. Status lights for building and custom application controllers to be selectable for normally open
                           or normally closed operation.
                  7. Analog Outputs:
                      a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
                      b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom
                            application controllers with manually adjustable potentiometer for manual override on building
                            and custom application controllers.

    Drift to not exceed 0.4 percent of range per year.

                 Tri State Outputs:
                      a. Coordinate two binary outputs to control three point, floating type, electronic actuators without
                     b. Limit the use of three point, floating devices to the following zone and terminal unit control
                      c. Control algorithms run the zone actuator to one end of its stroke once every 24 hours for
                             verification of operator tracking.
                   9. System Object Capacity:
                      a. System size to be expandable to twice the number of input output objects required by
                            providing additional controllers, including associated devices and wiring.
                      b. Hardware additions or software revisions for the installed operator interfaces are not to be
                            required for future, system expansions.
        2.04 POWER SUPPLIES AND LINE FILTERING
                  Power Supplies:

    Provide UL listed control transformers with Class 2 current limiting type or over-current protection

                        in both primary and secondary circuits for Class 2 service as required by the NEC.

    Limit connected loads to 80 percent of rated capacity.

                     Match DC power supply to current output and voltage requirements.
                   4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
                   5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50
                       percent load changes.
                 6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3
                        seconds minimum without trip-out or failure.
                    7. Operational Ambient Conditions: 32 to 120 degrees F (0 to 50 degrees C).
                   8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD-810 for shock and vibration.
                   Line voltage units UL recognized and CSA approved.
             B. Power Line Filtering:
                 1. Provide external or internal transient voltage and surge suppression component for all
                        workstations and controllers.
                 2. Minimum surge protection attributes:
                      a. Dielectric strength of 1000 volts minimum.

 Response time of 10 nanoseconds or less.

 Transverse mode noise attenuation of 65 dB or greater.
```

d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

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2.05 LOCAL AREA NETWORK (LAN)

    A. Provide communication between control units over local area network (LAN).

               B. LAN Capacity: Not less than 60 stations or nodes.
                 Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.
                 LAN Data Speed: Minimum 19.2 Kb.
               E. Communication Techniques: Allow interface into network by multiple operation stations and by auto-
                   answer/auto-dial modems. Support communication over telephone lines utilizing modems.
                 Transmission Median: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.
               G. Network Support: Time for global point to be received by any station, shall be less than 3
                   seconds. Provide automatic reconfiguration if any station is added or lost. If transmission cable is cut,
                    reconfigure two sections with no disruption to system's operation, without operator intervention.
             CONTROLLER SOFTWARE
               A. All applications reside and operate in the system controllers and editing of all applications occurs at the
                   operator workstation.
               B. System Security:
                      User access secured via user passwords and user names.
                  2. Passwords restrict user to the objects, applications, and system functions as assigned by the
                  User Log On/Log Off attempts are recorded.
                   4. Automatic Log Off occurs following the last keystroke after a user defined delay time.
               C. Object or Object Group Scheduling:
                    1. Weekly Schedules Based on Separate, Daily Schedules:

    Include start, stop, optimal stop, and night economizer.

 b. 10 events maximum per schedule.

                           Start/stop times adjustable for each group object.
               D. Provide standard application for equipment coordination and grouping based on function and location to
                   be used for scheduling and other applications.
                  1. Binary object is set to alarm based on the operator specified state.
                      Analog object to have high/low alarm limits.
                    3. All alarming is capable of being automatically and manually disabled.
                  Alarm Reporting:
                       a. Operator determines action to be taken for alarm event.
                       b. Alarms to be routed to appropriate workstation.
                       c. Reporting Options:
               F. Maintenance Management: System monitors equipment status and generates maintenance messages
                    based upon user-designated run-time limits.
                 6. Sequencing: Application software based upon specified sequences.
               H. PID Control Characteristics:
                      Direct or reverse action.
                   Anti-windup.
                  3. Calculated, time-varying, analog value, positions an output or stages a series of outputs.
                   4. User selectable controlled variable, set-point, and PED gains.

    Staggered Start Application:

                      Prevents all controlled equipment from simultaneously restarting after power outage.
                      Order of equipment startup is user selectable.
              J. Energy Calculations:
                      Accumulated instantaneous power or flow rates are converted to energy use data.
                  2. Algorithm calculates a rolling average and allows window of time to be user specified in minute
                  3. Algorithm calculates a fixed window average with a digital input signal from a utility meter defining
                       the start of the window period that in turn synchronizes the fixed-window average with that used by
             K. Anti-Short Cycling:
                   1. All binary output objects protected from short-cycling.
                      Allows minimum on-time and off-time to be selected.
             L. On-Off Control with Differential:
                       Algorithm allows binary output to be cycled based on a controlled variable and set-point.
                       Algorithm to be direct-acting or reverse-acting incorporating an adjustable differential.
               M. Run-Time Totalization:
                      Totalize run-times for all binary input objects.
                      Provides operator with capability to assign high run-time alarm.
                 HVAC CONTROL PROGRAMS
             A. General:
                       Support Inch-pounds and SI (metric) units of measurement.
                       Identify each HVAC Control system.
PART 3 EXECUTION
            A. Install control units and other hardware in position on permanent walls where not subject to excessive
              B. Install software in control units and in operator work station. Implement all features of programs to
                    specified requirements and appropriate to sequence of operation. Refer to Section 230993.
                    installation shall be in accordance with appropriate requirements of Division 26.
PACKAGED AIR-COOLED REFRIGERANT COMPRESSOR AND CONDENSER UNITS
         PART 1 GENERAL
         1.01 SECTION INCLUDES

    A. Condensing unit package

 B. Charge of refrigerant and oil.

                  Controls and control connections
                   Refrigerant piping connections.
                Motor starters.

 F. Electrical power connections.

         1.02 REFERENCE STANDARDS
             A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat
               Pump Equipment 2008, Including All Addenda.
               B. ASHRAE Std 23.1 - Methods for Performance Testing Positive Displacement Refrigerant Compressors
               and Condensing Units that Operate at Subcritical Pressures of the Refrigerant 2019.
               C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings Most
               Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and
             D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
          PART 2 PRODUCTS
         2.01 MANUFACTURERS
             A. Trane, a brand of Ingersoll Rand: www.trane.com/#sle.
               B. York International Corporation/Johnson Controls, Inc: www.york.com/#sle.
         2.02 MANUFACTURED UNITS
            A. Units: Self-contained, packaged, factory assembled and pre-wired units suitable for outdoor use
               consisting of cabinet, compressors, condensing coil and fans, integral sub-cooling coil, controls, liquid
               receiver, wind deflector, and screens.
              B. Construction and Ratings: In accordance with AHRI 210/240. Test in accordance with ASHRAE Std
                 Performance Ratings: Energy Efficiency Rating (EER) and Coefficient of Performance (COP) not less
              than prescribed by ASHRAE Std 90.1.
          2.03 CASING
            A. House components in welded steel frame with galvanized steel panels with weather resistant, baked
              enamel finish.
              B. Mount starters, disconnects, and controls in weatherproof panel provided with full opening access
               doors. Provide mechanical interlock to disconnect power when door is opened.
                C. Provide removable access doors or panels with quick fasteners and piano hinges.
         2.04 CONDENSER COILS
             A. Coils: Aluminum fins mechanically bonded to seamless copper tubing. Provide sub-cooling
               circuits. Air test under water to 425 psig (2900 kPa), and vacuum dehydrate. Seal with holding charge of
               B. Coil Guard: Expanded metal with lint screens.
         2.05 FAN REQUIREMENTS
              A. Vertical discharge direct driven propeller type condenser fans with fan guard on discharge. Equip with
               roller or ball bearings with grease fittings extended to outside of casing.
             B. Weatherproof motors suitable for outdoor use, single phase permanent split capacitor or 3 phase, with
               permanent lubricated ball bearings and built in current and thermal overload protection.
         2.06 COMPRESSORS
               A. Compressor: Hermetic scroll type.
                 . Mounting: Statically and dynamically balance rotating parts and mount on spring vibration isolators.
                C. Lubrication System: Reversible, positive displacement oil pump with oil charging valve, oil level sight
               glass, and magnetic plug or strainer.
                D. Motor: Constant speed 1800 rpm suction gas cooled with electronic sensor and winding over
               temperature protection, designed for across-the-line starting.
               E. Capacity Reduction Equipment: Suction valve unloaders, with lifting mechanism operated by electrically
               actuated solenoid valve, with unloaded compressor start; controlled from suction pressure.
              F. Sump Oil Heater: Evaporates refrigerant returning to sump during shut down. Energize heater
               continuously when compressor is not operating.
         2.07 REFRIGERANT CIRCUIT
            A. For each refrigerant circuit, provide:

    Filter dryer replaceable core type.

                      Liquid line sight glass and moisture indicator.
                      Thermal expansion valve for maximum operating pressure.
                   4. Insulated suction line.
                   Suction and liquid line service valves and gauge ports.
                    Liquid line solenoid valve.

    Charging valve.

                   8. Discharge line check valve.
                  9. Compressor discharge service valve.
                    Condenser pressure relief valve.
          2.08 CONTROLS
             A. On unit, mount weatherproof steel control panel, NEMA 250, containing power and control wiring,
               molded case disconnect switch, factory wired with single point power connection.
              B. For each compressor, provide across-the-line starter, non-recycling compressor overload, starter relay,
               and control power transformer or terminal for controls power. Provide manual reset current overload
               protection. For each condenser fan, provide across-the-line starter with starter relay.
                C. Provide safety controls arranged so any one will shut down machine:
                      High discharge pressure switch (manual reset) for each compressor.
                      Low suction pressure switch (automatic reset) for each compressor.
                    3. Oil Pressure switch (manual reset).
               D. Provide the following operating controls:
                     . One minute off timer prevents compressor from short cycling.
                     . Periodic pump-out timer to pump down on high evaporator refrigerant pressure.

    Low ambient temperature controls.

             E. Provide controls to permit operation down to 0 degrees F (minus 18 degrees C) ambient temperature.
                     Head pressure switch to cycle fan motors in response to refrigerant condensing pressure.
               F. Gauges: Prepiped for suction and discharge refrigerant pressures and oil pressure for each
          PART 3 EXECUTION
         3.01 INSTALLATION
            A. Install in accordance with manufacturer's installation instructions.
             B. Complete structural, mechanical, and electrical connections in accordance with manufacturer's
```

installation instructions. 3.02 SYSTEM STARTUP

END OF SECTION

refrigerant prior to end of correction period.

leaks, put system into operation, and test equipment performance.

A. Supply initial charge of refrigerant and oil for each refrigeration system. Replace losses of oil or

C. Shut-down system if initial start-up and testing takes place in winter and machines are to remain

inoperative. Repeat start-up and testing operation at beginning of first cooling season.

B. Charge system with refrigerant and test entire system for leaks after completion of installation. Repair

```
SECTION 23 73 13
Modular Indoor Central-Station Air-Handling Units
PART 1 - GENERAL
   1.01 WORK INCLUDED
    1.02 REFERENCES
   1.03 QUALITY ASSURANCE
   1.04 SUBMITTALS
   1.05 REGULATORY REQUIREMENTS
   1.06 DELIVERY, STORAGE, AND HANDLING
    1.07 START-UP AND OPERATING REQUIREMENTS
   1.08 WARRANTY
PART 2 - PRODUCTS
   2.01 ACCEPTABLE MANUFACTURERS
   2.02 GENERAL
   2.03 UNIT CASING
   2.04 ACCESS DOORS
   2.05 PRIMARY DRAIN PANS
   2.06 SUPPLY FAN
   2.07 MOTORS AND DRIVES
```

A. Applied Air Handling Units.

Efficiency by Particle Size.

A. AMCA Publication 99 - Standards Handbook

ANSI/NEMA MG 1 - Motors and Generators.

N. NFPA 70 - National Electrical Code

Owner's approved representative.

A. Agency Listings/Certifications

maneuverability on the jobsite.

manufacturer's catalog and bulletins.

A. Trane

B. Daikin

C. York.

support the unit.

access of interior surfaces.

the unit height.

floor shall not be accepted.

up to rated RPM.

average life per ANSI/AFBMA Standard 9

requirements of NEC and shall be UL Listed.

applicable, motor efficiency shall meet or exceed NEMA Premium efficiencies.

assist air balance contractor in start up and service personnel in maintenance:

as the interior and exterior wall panels.

the casing leakage and thermal performance.

prevent moisture entrainment into the unit during transit.

no more than .005-inches when sitting on a support structure.

insulation is prevented. Panel assembly shall comply with NFPA 90A.

D. Handle hardware shall be designed to prevent unintended closure.

K. ANSI/UL 900 - Standard for Safety Air Filter Units.

connection method recommendations

and shall submit to the Owner electronic copies of the IOM.

D. The AHU manufacturer shall list any exceptions to the specification.

capacities shall be the sole responsibility of the contractor.

corrected to actual operating conditions, temperatures, and altitudes.

ANSI/ABMA Standard 9 - Load Ratings and Fatigue Life for Ball Bearings.

ANSI/AHRI Standard 430 - Central Station Air Handling Units.

M. ASTM B117 - Standard Practice for Operation Salt Spray Apparatus.

P. UL 1995 - Standard for Safety Heating and Cooling Equipment

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A. Coils section header end panel shall be removable to allow for removal and replacement of coils without
                                                                                                                                                impacting the structural integrity of the unit.
                                                                                                                                                B. Install coils such that headers and return bends are enclosed by unit casing to ensure that if condensate
                                                                                                                                                forms on the header or return bends, it is captured by the drain pan under the coil.
                                                                                                                                                C. Coils shall be manufactured with plate fins to minimize water carryover and maximize airside thermal
                                                                                                                                                efficiency. Fin tube holes shall have drawn and belled collars to maintain consistent fin spacing to ensure
                                                                                                                                                performance and air pressure drop across the coil as scheduled. Tubes shall be mechanically expanded and
  B. AMCA Standard 500-D - Laboratory Methods of Testing Dampers for Rating.
                                                                                                                                                bonded to fin collars for maximum thermal conductivity. Use of soldering or tinning during the fin-to-tube bonding
                                                                                                                                                process is not acceptable due to the inherent thermal stress and possible loss of bonding at that joint.
     ANSI/AMCA Standard 204 - Balance Quality and Vibration Levels for Fans.
                                                                                                                                                D. Construct coil casings of galvanized steel. End supports and tube sheets shall have belled tube holes to
     ANSI/AHRI Standard 410 - Forced Circulation Air-Cooling and Air-Heating Coils.
                                                                                                                                                minimize wear of the tube wall during thermal expansion and contraction of the tube.
                                                                                                                                                E. All coils shall be completely cleaned prior to installation into the air handling unit. Complete fin bundle in
  G. ANSI/ASHRAE Standard 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal
                                                                                                                                                direction of airflow shall be degreased and steam cleaned to remove any lubricants used in the manufacturing of
                                                                                                                                                the fins, or dirt that may have accumulated, in order to minimize the chance for water carryover.
 H. ANSI/ASHARE Standard 62.1 - Ventilation for Acceptable Indoor Air Quality.
                                                                                                                                                F. On units with two (or more) coils in the airstream, no space between the coils shall be supplied.
    ANSI/ASHARE Standard 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
                                                                                                                                                G. With two coils in the airstream, space shall be provided by the unit manufacturer to facilitate cleaning and
                                                                                                                                                inspection of the fin surfaces. Access door(s) shall be located in the unit casing between the two coils. Construct
                                                                                                                                                door(s) in accordance with Section 2.04.
                                                                                                                                               H. Refrigerant Cooling Coils
    . ASHRAE Standard 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems.
  O. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilation Systems.
 A. Air Coils: Certify capacities, pressure drops and selection procedures in accordance with current AHRI
B. Air handling units shall be rated and/or rated and certified in accordance with AHRI Standard.
A. No equipment shall be fabricated or delivered until the receipt of approved shop drawings from the Owner or
                                                                                                                                                A. Provide factory-fabricated filter section of the same construction and finish as unit casings. Filter section
B. AHU manufacturer shall provide the following information with each shop drawing/product data submission:
                                                                                                                                                shall have side access filter guides and access door(s) extending the full height of the casing to facilitate filter
               Dimensioned arrangement drawings for each AHU including a plan and elevation view of the
                                                                                                                                                removal. Construct doors in accordance with Section 2.04. Provide fixed filter blockoffs as required to prevent air
            assembled unit with overall dimensions, lift points, unit shipping split locations and dimensions,
                                                                                                                                                bypass around filters. Blockoffs shall not need to be removed during filter replacement. Filters to be of size, and
            installation and operating weights, and installation, operation and service clearances.
                                                                                                                                                quantity needed to maximize filter face area of each particular unit size.
          2. All electrical, piping, and ductwork requirements, including sizes, connection locations, and
                                                                                                                                                B. Filter type, MERV rating, and arrangement shall be provided as defined in project plans and schedule
           3. Each component of the unit shall be identified and mechanical specifications shall be provided for
                                                                                                                                               A. All dampers shall be internally mounted. Dampers shall be premium ultra low leak and located as indicated
                                                                                                                                                on the schedule and plans. Parallel blade arrangement shall be provided as indicated on the schedule and
           unit and accessories describing construction, components, and options.
                                                                                                                                                drawings. Dampers shall be Ruskin CD60 double-skin airfoil design or equivalent for minimal air leakage and
          4. All performance data, including capacities and airside and waterside pressure drops, for
                                                                                                                                                pressure drop. Leakage rate shall not exceed 3 CFM/square foot at one inch water gauge complying with
                                                                                                                                                ASHRAE 90.1 maximum damper leakage and shall be AMCA licensed for Class 1A. All leakage testing and
          5. Fan curves shall be provided for fans with the design operating points indicated. Data shall be
                                                                                                                                                pressure ratings shall be based on AMCA Standard 500-D. Manufacturer shall submit brand and model of
  C. The AHU manufacturer shall provide appropriate sets of submittals as referenced in the General Conditions
                                                                                                                                                damper(s) being furnished, if not Ruskin CD60.
                                                                                                                                           2.11 VARIABLE FREQUENCY DRIVE
                                                                                                                                              A. Service Conditions
           1. Unit shall be manufactured to conform to UL 1995 and shall be listed by either UL/CUL or ETL.
            Units shall be provided with listing agency label affixed to the unit. In the event the unit is not UL/CUL or
           ETL approved, the contractor shall, at his/her expense, provide for a field inspection by a UL/CUL or
          ETL representative to verify conformance. If necessary, contractor shall perform modifications to the
           unit to comply with UL/CUL or ETL as directed by the representative, at no additional expense to the
          2. Air handling units shall be certified in accordance with AHRI Standard 430. Units meeting AHRI
            Standard 430 certification shall have a label affixed to the unit. If the unit is not AHRI 430 certified, or
           tested in accordance with AHRI 430 then the contractor shall be responsible for expenses associated
           with testing of units after installation to verify performance of fan(s). Any costs incurred to adjust fans to
                                                                                                                                           2.12 FACTORY-INSTALLED MOTOR WIRE TERMINATION, VFD, AND STARTER ENCLOSURES
           meet scheduled capacities shall be the sole responsibility of the contractor.
                                                                                                                                                A. VFDs or starter shall be factory mounted on the drive side of the fan section.
          3. Certify air handling coils in accordance with AHRI Standard 410. Units shall be provided with
                                                                                                                                                B. VFDs or starter shall be supplied and installed by the installing contractor.
            certification label affixed to the unit. If air handling coils are not certified in accordance with AHRI
                                                                                                                                                 C. Any welds shall be properly finished with no rough edges. Enclosures shall house, Drive-OFF switches,
           Standard 410, contractor shall be responsible for expenses associated with testing of coils after
                                                                                                                                                manual speed controls, and control transformers.
           installation to verify performance of coil(s). Any costs incurred to adjust coils to meet scheduled
                                                                                                                                           2.13 FACTORY WIRING OF VFD'S AND STARTERS
                                                                                                                                              A. VFDs shall be wired per NEC, UL, and NFPA 90A requirements. Units with factory-mounted controls shall
                                                                                                                                                also include power wiring from the VFD or starter control transformer to the control system transformers. After
 A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
                                                                                                                                                mounting and wiring of VFDs, on the AHUs, trained factory personnel shall ensure proper operation of each VFD.
 B. Units shall ship fully assembled up to practical shipping and rigging limitations. Shipping splits shall be
                                                                                                                                                through a thorough factory test. Testing shall include a Hypot test of unit wiring to ensure that no weaknesses
  clearly defined on submittal drawings. Cost associated with non-conformance to shop drawings shall be the
                                                                                                                                                exist in wiring or motor. Each VFD shall be energized and the fan run to ensure the VFD will operate throughout
  responsibility of the manufacturer. AHU's less than 100-inches wide shall allow for forklift transport and
                                                                                                                                                the usable range of the drive and that the fan rotation is correct.
                                                                                                                                                B. On units provided with factory mounted and wired supply fan starter or VFD and DDC controls, the
    Deliver units to jobsite with fan motor(s), sheave(s), and belt(s) completely assembled and mounted in units.
                                                                                                                                                manufacturer shall provide a single point of power. Line-to-24v transformers shall be provided with sufficient vA to
     Indoor units shall be shipped in a clear shrink-wrap or stretch-wrap to protect unit from in-transit rain and
                                                                                                                                                power the factory installed control points.
                                                                                                                                       PARI3-EXECUTION
E. Outdoor unit openings not covered by an inlet hood shall be covered and protected from the elements to
                                                                                                                                          3.01 SHIPPING
                                                                                                                                                A. Paper copies of the IOM shall also be shipped with each AHU.
  F. Installing contractor shall be responsible for storing AHU in a clean, dry place and protect from weather and
                                                                                                                                               B. The AHU manufacturer shall identify all shipments with the order number. Enough information shall be
  construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.
                                                                                                                                                provided with each shipment to enable the Mechanical Contractor to confirm the receipt of units when they are
                                                                                                                                                received. For parts too small to mark individually, the AHU manufacturer shall place them in containers.
A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters in place,
                                                                                                                                                C. To protect equipment during shipment and delivery, all indoor units shall be stretch or shrink wrapped. Wrap
  bearings lubricated (if applicable), condensate properly trapped, piping connections verified and leak-tested, belts
                                                                                                                                                shall be a minimum of 7 mil plastic. Pipe ends and pipe connection holes in the casing shall be capped or plugged
  aligned and tensioned, all shipping braces removed, bearing set screws torqued, and fan has been test run under
                                                                                                                                                D. After loading the equipment for shipment, the AHU manufacturer shall contact the shipping contact on the
                                                                                                                                                order and provide the name of the carrier, description of equipment, order number, shipping point, and date of
A. AHU manufacturer shall provide, at no additional cost, a standard parts warranty that covers a period of one
  year from unit start-up or 18 months from shipment, whichever occurs first. This warrants that all products are
                                                                                                                                           3.02 ON-SITE STORAGE
  free from defects in material and workmanship and shall meet the capacities and ratings set forth in the equipment
                                                                                                                                               A. If equipment is to be stored for a period of time prior to installation, the Mechanical Contractor shall remove
                                                                                                                                                all stretch or shrink wrap from units upon receipt to prevent unit corrosion and shall either place the units in a
                                                                                                                                                controlled indoor environment or shall cover the units with canvas tarps and place them in a well-drained area.
                                                                                                                                                Covering units with plastic tarps shall not be acceptable.
                                                                                                                                           3.03 FIELD EXAMINATION
                                                                                                                                               A. The Mechanical Contractor shall verify that the mechanical room is ready to receive work and the opening
                                                                                                                                                dimensions are as indicated on the shop drawings and contract documents.
                                                                                                                                                B. The Mechanical Contractor shall verify that the proper power supply is available prior to starting of the fans.
A. Unit layout and configuration shall be as defined in project plans and schedule.
                                                                                                                                           3.04 INSTALLATION
                                                                                                                                                A. The Mechanical Contractor shall be responsible to coordinate ALL of his installation requirements with the
A. The entire air handler shall be constructed of galvanized steel. Casing finished to meet ASTM B117 250-hour
                                                                                                                                                Owner and the Owner's selected Mechanical Contractor to ensure that a complete installation for each unit is
  salt-spray test. The removal of access panels or access doors shall not affect the structural integrity of the unit. All
                                                                                                                                                being provided. Coordination efforts shall include such items as unloading and hoisting requirements, field wiring
  removable panels shall be gasketed. All doors shall have gasketing around full perimeter to prevent air leakage.
                                                                                                                                                requirements, field piping requirements, field ductwork requirements, requirements for assembly of field-bolted or
  Contractor shall be responsible to provide connection flanges and all other framework that is needed to properly
                                                                                                                                                welded joints, and all other installation and assembly requirements.
                                                                                                                                                 B. The AHU manufacturer shall provide all screws and gaskets for joining of sections in the field.
B. All panels shall be 2-inch double wall construction to facilitate cleaning of unit interior. Casing deflection shall
                                                                                                                                                  C. The Mechanical Contractor shall verify that the following items have been completed prior to scheduling the
  not exceed .005-inch deflection per linear inch under negative or positive pressure, up to unit 6" of pressure.
                                                                                                                                                AHU manufacturer's final inspection and start up:

    Unit floor shall be of sufficient strength to support 300-lb load during maintenance activities, and shall deflect

  D. Panel insulation shall provide a minimum thermal resistance (R) value of 13 ft^2*h*F/Btu throughout the
  entire unit. Insulation shall completely fill the panel cavities in all directions so that no voids exist and settling of
  E. Access panels and/or access doors shall be provided in all sections to allow easy access to drain pan,
  coil(s), motor, drive components and bearings for cleaning, inspection, and maintenance.
 F. Access panels and doors shall be fully removable without the use of specialized tools to allow complete
A. Access doors shall be 2-inch double-wall construction. Interior and exterior shall be of the same construction

    B. Gasketing shall be provided around the full perimeter of the doors to prevent air leakage.

   C. Door hardware shall be surface-mounted to prevent through-cabinet penetrations that could likely weaken
                                                                                                                                               A. The Mechanical Contractor shall level all unit sections in accordance with the unit manufacturer's
                                                                                                                                                instructions. The Mechanical Contractor shall provide and install all necessary permanent shim material to ensure
   E. Access doors shall be hinged and removable without the use of specialized tools to allow.
                                                                                                                                                individual sections and entire assembled units are level.
  F. All doors shall be a 60-inch high when sufficient unit height is available, or the maximum height allowed by
                                                                                                                                           3.06 FINAL INSPECTION AND START UP SERVICE
                                                                                                                                              A. After the Mechanical Contractor has provided all water and steam piping connections, ductwork connections,
                                                                                                                                                and field control wiring, and Electrical Contractor has provided all the field power wiring, the Mechanical Contractor
A. The drain pan shall be designed in accordance with ASHRAE 62.1 being of sufficient size to collect all
                                                                                                                                                shall inspect the installation. The Mechanical Contractor shall then perform startup of the equipment.
  condensation produced from the coil and sloped in two planes, pitched toward drain connections, promoting
                                                                                                                                                B. The Automatic Temperature Control (Building Direct Digital Control) Contractor shall be scheduled to be at
  positive drainage to eliminate stagnant water conditions when unit is installed level and trapped per manufacturer's
                                                                                                                                                 the job site at the time of the equipment start up.
  requirements. The outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude

    The Mechanical Contractor, shall perform the following tests and services and submit a report outlining the

  drain pan overflow under any normally expected operating condition. Drainpan shall be stainless steel
 B. All drain pan threaded connections shall be visible external to the unit. Threaded connections under the unit
  C. Drain connections shall be of the same material as the primary drain pan and shall extend a minimum 2-1/2-
  inch beyond the base to ensure adequate room for field piping of condensate traps.
D. The installing contractor is responsible to ensure the unit is installed level, trapped in accordance with the
  manufacturer's requirements, and visually inspected to ensure proper drainage of condensate
A. Fan sections shall have a minimum of one hinged and latched access door located on the drive side of the
  unit to allow inspection and maintenance of the fan, motor, and drive components. Construct door(s) per Section
 B. Provide fans of type specified on the schedule. Belt drive fan shafts shall be solid steel, coated with a rust-
  inhibiting coating, and properly designed so that fan shaft does not pass through first critical speed as unit comes
    E. Belt drive fans with integral frame motors shall be internally isolated to inhibit noise and vibration through the
  ductwork and building structure. A flexible connection shall be installed between the fan and unit casing to ensure
  complete isolation. Fan and motor shall be internally isolated with spring isolators. If fans and motors are not
  internally isolated, then the entire unit shall be externally isolated from the building, including supply and return
  duct work, piping, and electrical connections. External isolation shall be furnished by the installing contractor in
  order to avoid transmission of noise and vibration through the ductwork and building structure.
  D. Belt-driven fans shall be provided with self-aligning, anti-friction bearings selected for L-50 200,000-hour
 A. All motors, and drives for belt drive fans, shall be factory-installed and run tested. Motors for belt driven fans
  shall be installed on a slide base to permit adjustment of belt tension. Slide base shall be designed to accept all
  motor sizes offered by the air-handler manufacturer for that fan size to allow a motor change in the future, should
                                                                                                                                     END OF SECTION
  airflow requirements change. Fan sections without factory-installed motors shall have motors field installed by the
  contractor. The contractor shall be responsible for all costs associated with installation of motor and drive,
  alignment of sheaves and belts, run testing of the motor, and balancing of the assembly.
  B. Integral horsepower motors shall meet or exceed all NEMA Standards Publication MG 1 - 2006 requirements
  and comply with NEMA Premium efficiency levels when applicable. Motors shall comply with applicable
   C. Integral horsepower fan motors shall be heavy duty, open drip-proof operable at the selected voltage. If
  D. All fan types utilizing integral horsepower motors, shall use 4-pole, 1800 rpm, motors, NEMA B design, with
  Class B insulation, capable to operate continuously at 104 deg F (40 deg C) without tripping overloads.
  E. Motors shall have a +/- 10 percent voltage utilization range to protect against voltage variation.
  F. V-Belt drives for housed fans shall be fixed for variable pitch rated at 1.5 times the motor nameplate. Drives
  20 hp and larger or any drives on units equipped with VFDs and housed fans shall be fixed pitch.
  G. All housed fans with motors 15 hp and larger shall be equipped with multiple belt drives.
 H. Manufacturer shall provide for each unit with a housed fan a nameplate with the following information to
```

DESIGN-BUILD DIVISION, INC.

Design/Planning/Construction 1201 Main Street, Suite 2100 Columbia, S.C. 29201 tel. 803-256-0000 fax 803-255-7243

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consultants

Refrigerant suction and liquid connections shall penetrate through unit casing to facilitate

2. Coils shall be proof tested to 450 psig and leak tested to 300 psig air pressure under water. After

testing, insides of tubes shall be air dried, charged with dry nitrogen or dry air, and sealed to prevent

3. Refrigerant suction and liquid headers shall be constructed of copper tubing. Suction and liquid

5. Coils shall have equalizing type vertical distributors sized in conjunction with capacities of coils.

VFDs shall provide full output in an ambient temperature from -10 to 50°C (14 to 104°F).

4. VFDs shall provide full output with an AC line voltage variation from -10 to +10% of nominal

5. No side clearance shall be required for cooling of any units. All power and control wiring shall be

The VFD shall be warranted by the manufacturer for a period of 42 months from date of shipment,

or 36 months from start-up, which ever occurs first. The warranty shall include parts, labor, travel costs

and living expenses incurred by the manufacturer to provide factory-authorized on-site service.

1. All isolated components have had their shipping restraints removed and the components have

2. On all field-joined units, that all interconnections have been completed, i.e., electrical and control

3. All water and steam piping connections have been completed and hydrostatically tested and all

4. All ductwork connections have been completed and all ductwork has been pressure tested for its

5. All power wiring, including motor starters and disconnects, serving the unit has been completed.

wiring, piping, casing joints, bolting, welding, etc.

All dampers are fully operational.

8. All shipping materials have been removed.

Clean filter media has been installed in the units.

Record date, time, and person(s) performing service.

Record fan motor voltage and amperage readings.

Verify all electrical power connections.

Check fan for excessive vibration.

temperature.

Check all control sequences.

Check all motor and starter power lugs and tighten as required.

10. Disengage all shipping fasteners on vibration isolation equipment.

11. Secure all access doors to the fan, the unit and the ductwork.

12. Switch electrical supply "on" and allow fan to reach full speed.

Conduct a start up inspection per the AHU manufacturer's recommendations.

Check fan rotation and spin wheel to verify that rotation is free and does not rub or bind.

accordance with the AHU manufacturer's directions. Check belt tension during the second and seventh

day's operation and re-adjust belts, as may be required, to maintain proper tension as directed by the

13. Physically check each fan at start up and shut down to insure no abnormal or problem conditions

14. Check entering and leaving air temperatures (dry bulb and wet bulb) and simultaneously record

entering and leaving chilled water temperatures and flow, steam pressures and flow, and outside air

9. Remove all foreign loose material in ductwork leading to and from the fan and in the fan itself.

8. If so equipped, check V belt drive for proper tension and alignment. Tighten the belts in

intended service.

water flow rates have been set in accordance with the capacities

All automatic temperature and safety controls have been completed.

VFDs shall provide full output in a relative humidity from 0 to 95%, non-condensing.

VFDs shall provide full output up to 3,300 feet elevation without derating.

connections shall penetrate unit casings to allow for sweat connections to refrigerant lines.

4. Tubes shall be 1/2 inch O.D., minimum .016 inch thick copper. Fins shall be aluminum.

refrigerant piping in the field.

done from the bottom.

MIDLANDS TECHNICAL COLLEGE **BELTLINE CAMPUS** 316 S. BELTLINE BLVD COLUMBIA, SC 29205 project name **AUTO TRAINING FACILITY**

AHU REPLACEMENT H59-N127-FW project number 21060.01

seals/signature



CONSTRUCTION

MARCH 4, 2022

key plan

HVAC SPECIFICATIONS

GENERAL NOTES

- 1 DO NOT SCALE DRAWINGS. LOCATE OUTLETS, EQUIPMENT AND OTHER ELECTRICAL DEVICES AS INDICATED AND COORDINATE WITH OTHER TRADES TO AVOID CONFLICTS. COORDINATE EXACT LIGHTING FIXTURE LOCATIONS WITH ARCHITECTURAL REFLECTED
- 2 MINIMUM SIZE CONDUCTOR FOR POWER SHALL BE #12 AWG. PROVIDE DEDICATED NEUTRAL FOR EACH MULTI-WIRE BRANCH CIRCUIT IN COMPLIANCE WITH NEC. 3 ALL FUSES SHALL BE DUAL-ELEMENT TYPE, "FUSETRON" BY BUSSMAN, "ECON" BY
- 4 BRANCH CIRCUIT TO BE 2#12, 12GND, 3/4"C MINIMUM. 20A 120V CIRCUITS LONGER THAN 75' TO BE 2#10, #10GND, 3/4"C MINIMUM FOR VOLTAGE DROP. 20A, 120V CIRCUITS LONGER THAN 150' TO BE 2#8, #8GND, 3/4"C MINIMUM FOR VOLTAGE DROP. UNLESS OTHERWISE NOTED IN PANELBOARD SCHEDULES OR ON DRAWINGS.
- 5 ALL BRANCH CIRCUIT LOADS SHALL BE BALANCED ACROSS PANELBOARD BUSSES TO OBTAIN MINIMUM NEUTRAL CURRENT. 6 ALL FLEXIBLE CONDUIT SHALL CONTAIN A GREEN WIRE BONDED TO RIGID RACEWAY, BOX
- OR FIXTURE AT EACH END OF FLEX. SIZE GROUND PER NEC TABLE 250-122. 7 PROVIDE PULL STRING IN ALL EMPTY RACEWAYS.
- 8 COORDINATE WITH OTHER TRADES TO CONCEAL ELECTRICAL WORK AND PROVIDE
- OUTLETS IN CORRECT LOCATIONS. 9 DO NOT FLUSH MOUNT JUNCTION BOXES BACK TO BACK, STAGGER TO REDUCE SOUND
- TRANSMISSION BETWEEN ROOMS. 10 CONCEAL OUTLETS FOR ALL EQUIPMENT IN FINISHED AREAS. OBTAIN ROUGH-IN
- DIAGRAMS FOR ALL EQUIPMENT AND INSTALL ELECTRICAL WORK ACCORDING TO 11 MOUNT BRACKET TYPE LIGHTING FIXTURES AT HEIGHTS SHOWN OR SCHEDULED ON
- DRAWINGS OR AS DIRECTED ON JOB BY ARCHITECT UNLESS NOTED OTHERWISE. 12 SEAL ALL PENETRATIONS TO RATED WALLS, CEILINGS AND FLOORS WITH UL LISTED FIREPROOFING SYSTEM. THIS IS TO INCLUDE BUT IS IN NO WAY LIMITED TO CONDUCTOR, RACEWAY AND DEVICE PENETRATIONS. SUBMIT SYSTEM AND INSTALLATION DETAILS AS
- PART OF SHOP DRAWING SUBMITTAL. 13 WHERE NOT INDICATED OTHERWISE, EQUIPMENT GROUNDING CONDUCTORS SHALL BE SIZED PER NEC TABLE 250-122.
- 14 ALL METAL CONDUITS 1" AND LARGER SHALL HAVE A GROUNDING BUSHING BONDING CONDUIT TO ENCLOSURE.
- 15 REMOVE DRYWALL DUST AND MUD FROM THE INTERIOR OF BOXES BEFORE INSTALLING 16 AT SUBSTANTIAL COMPLETION CLEAN ALL LIGHT FIXTURES AND CLEAN ALL DEVICES IN
- THE CONSTRUCTION AREAS. REPLACE DAMAGED DEVICES AND DEVICE PLATES AS 17 VERIFY ALL MECHANICAL EQUIPMENT LOCATIONS AND ELECTRICAL REQUIREMENTS
- WITH MECHANICAL PLANS. IF MECHANICAL EQUIPMENT BEING PROVIDED DOES NOT MATCH DESIGN NOTIFY ENGINEER IMMEDIATELY. 18 ELECTRICAL CONTRACTOR IS RESPONSIBLE FOR COORDINATING WORK WITH POWER,
- TELEPHONE AND CATV UTILITIES. ELECTRICAL CONTRACTOR TO PROVIDE ALL MATERIALS AND WORK FOR AS REQUIRED BY EACH UTILITY FOR A COMPLETE AND OPERABLE SYSTEM. PROVIDE RACEWAY(S) TO UTILITY CONNECTION POINT. 19 CONCEAL ALL CONDUIT AND RACEWAY. IF CONDITIONS REQUIRE CONDUIT OR RACEWAY

TO BE RUN EXPOSED COORDINATE ROUTING WITH ARCHITECT AND PAINT AS REQUIRED

- 20 ELECTRICAL WORK SHALL COMPLY WITH ALL NATIONAL, STATE AND LOCAL CODES,
- REQUIREMENTS AND ORDINANCES. 21 ELECTRICAL WORK SHALL COMPLY WITH LATEST NECA 1 STANDARDS FOR GOOD
- WORKMANSHIP IN ELECTRICAL CONSTRUCTION. 22 ALL BACKBOXES SHALL BE MINIMUM 4" SQUARE.
- 23 ALL EMT FITTINGS SHALL BE STEEL COMPRESSION TYPE WITH INSULATED THROAT. 27 PROVIDE ALL EQUIPMENT WITH 75°C OR 90°C TERMINATIONS. ALL WIRE SIZING INDICATED ON PLANS IS BASED ON 75°C TERMINATIONS. WHERE EQUIPMENT IS PROVIDED BY OTHERS AND IS NOT SPECIFICALLY LISTED AND MARKED WITH 75°C TERMINATIONS INCREASE CONDUCTOR SIZE BASED ON NEC TABLE 310.15(B)(16) 60°C
- COLUMN FOR CIRCUITS 100 AMPERES AND LESS IN SIZE. 28 ALL EMERGENCY CIRCUITING SHALL BE RUN IN SEPARATE CONDUIT FROM NORMAL POWER CIRCUITING.

DEVICES/EQUIPMENT	MOUNTING HEIGHT (AFF)	MEASURED TO:
RECEPTACLES	AS INDICATED ON LEGEND/PLANS	CENTER
TOGGLE SWITCHES	4'-0"	CENTER
VALL DIMMERS	4'-0"	CENTER
MANUAL MOTOR STARTERS	4'-0"	CENTER
OCCUPANCY SENSORS - WALL MOUNTED	4'-0"	CENTER
IGHTING CONTROL PANEL	6'-6"	ТОР
IGHTING CONTROL STATION	4'-0"	CENTER
UNCTION BOXES	AS INDICATED ON LEGEND/PLANS	CENTER
MONITORING/CONTROL PANEL	5'-0"	ТОР
SURFACE METAL RACEWAYS	AS INDICATED ON LEGEND/PLANS	TOP
PANELBOARDS	6'-6"	TOP
DISCONNECT SWITCHES	5'-0"	TOP
AUTOMATIC TRANSFER SWITCHES	6'-6"	TOP
MANUAL TRANSFER SWITCHES	6'-6"	TOP
CONTROL STATIONS	6'-6"	TOP
TVSS (NON-INTEGRAL)	6'-0" (NTE)	TOP
,	6'-6"	TOP
MAGNETIC MOTOR CONTROLLERS		
LIGHTING CONTACTORS ENCLOSURES NDIVIDUAL CKT BREAKERS ENCLOSURES	6'-6" 6'-6"	TOP TOP
EMERGENCY POWER OFF SWITCHES	5'-6"	CENTER
		-
TIME SWITCHES	6'-6"	TOP
FELECOMMUNICATIONS OUTLETS	1'-6"	CENTER
TELECOMMUNICATIONS OUTLETS - OVER COUNTER	6"	CENTER (OVER TOP OF COUNTE
GROUND FAULT CIRCUIT INTERRUPTER	4'-0"	CENTER
GROUND BUS BARS	2'-0"	CENTER
NTEGRATED COMMUNICATIONS PANELS	6'-0"	ТОР
GENERATOR REMOTE ALARM ANNUNCIATOR	5'-0"	TOP
GENERATOR TERMINAL BLOCKS	5'-0"	TOP
BAS TERMINAL BLOCKS	5'-0"	TOP
GENERATOR STOP SWITCH	5'-6"	CENTER
GENERATOR TANK FUEL LEVEL INDICATORS	5'-0"	ТОР
JPS REMOTE MONITORING PANEL	5'-0"	ТОР
JPS BATTERY MONITORING / CONTROL PANEL	5'-0"	ТОР
MAIN SWITCHGEAR BATTERY CHARGER	5'-0"	TOP
RELAY CONTROL PANELS	6'-6"	TOP
FIRE ALARM AUDIO/VISUAL DEVICES (NOTE 3)	6'-8"	воттом
FIRE ALARM VISUAL DEVICES (NOTE 3)	6'-8"	воттом
FIRE ALARM HORNS (NOTE 3)	6'-8"	воттом
FIRE ALARM PULL STATIONS	4'-0"	CENTER
FIRE FIGHTER PHONE JACKS	4'-6"	CENTER
FIRE FIGHTER MASTER PHONE CABINET	4'-6"	CENTER
FIRE ALARM SMOKE DETECTORS - WALL MOUNTED	6"	FROM CEILING
FIRE ALARM BEAM SMOKE DETECTORS	WITHIN 3'-0"	FROM CEILING
FIRE ALARM CONTROL PANEL	6'-0"	TOP
FIRE ALARM ANNUNCIATORS	6'-0"	TOP
FIRE ALARM GRAPHIC ANNUNCIATOR	6'-0"	TOP
FIRE PUMP CONTROL PANEL	6'-6"	TOP
SMOKE EXHAUST PANEL	6'-0"	TOP
REMOTE DUCT SMOKE DETECTOR STATUS INDICATOR	4'-6"	CENTER
FIRE ALARM BELL	8'-0"	CENTER

- 1. USE ABOVE INDICATED MOUNTING HEIGHTS UNLESS INDICATED OTHER WISE ON DRAWINGS OR SPECIFICATIONS. COORDINATE MOUNTING HEIGHTS WITH FIELD CONDITIONS, OTHER TRADES, AND RELATED EQUIPMENT.
- MOUNT IN ACCORDANCE WITH NFPA 72. REDUCE MOUNTING HEIGHTS OF FIRE ALARM VISUAL AND AUDIO/VISUAL ALARMS WHERE REQUIRED TO MAINTAIN 6" MINIMUM SPACING FROM CEILING.

	POWER DISTRIBUTION / EQUIPMENT LEGEND								
SYMBOLS	DESCRIPTION								
PP1	FLOOR OR SURFACE MOUNTED MAIN PROTECTIVE DEVICE PANELBOARD. TEXT DENOTES NAME, REFER TO DRAWINGS FOR LOCATION. SEE PANEL SCHEDULES. WHERE CONCRETE PAD SHOWN, PROVIDE 2" THICK CONCRETE PAD, 4" OFFSET FROM ENCLOSURE FRONT AND SIDES, 4" OFFSET FROM ENCLOSURE BACK.								
PP2	FLOOR OR SURFACE MOUNTED MAIN LUG ONLY PANELBOARD. TEXT DENOTES NAME, REFER TO DRAWINGS FOR LOCATION. SEE PANEL SCHEDULES.								
S1 🖊	HEAVY DUTY FUSED DISCONNECT SWITCH, SEE SCHEDULE. TEXT DENOTES DISCONNECT SWITCH TYPE (DISCONNECT TYPE S1 THIS EXAMPLE.)								
DESIGNATION	DEVICE DESIGNATION								
* C	MOUNTING HEIGHT AND/OR MOUNTING TO BE COORDINATED WITH WORK AND EQUIPMENT AT JUNCTION BOX LOCATION PROVIDED UNDER DIVISION 26 AND ALL OTHER DIVISIONS. MOUNTING ABOVE CEILING.								
S	SURFACE MOUNTED.								
DO	DOOR OPERATOR POWER. COORDINATE LOCATION WITH TELECOMMUNICATIONS DRAWINGS. MOUNT CONCEALED ABOVE CEILING ADJACENT TO DOOR OPERATOR CONTROLS. INSTALL POWER PER MANUFACTURERS INSTRUCTIONS.								
	LIGHTING LEGEND								
SYMBOLS	LIGHTING DESCRIPTION								
	NOTE: WHERE ALPHANUMERIC DESIGNATIONS ARE INDICATED ADJACENT OR WITHIN FIXTURE, SEE LIGHTING DESIGNATIONS FOR ADDITIONAL REQUIREMENTS. 1'x4' SUSPEND STRIP FIXTURE OR LUMINAIRE.								
	1 X4 SUSPEND STRIP FIXTURE OR LUIVIINAIRE.								

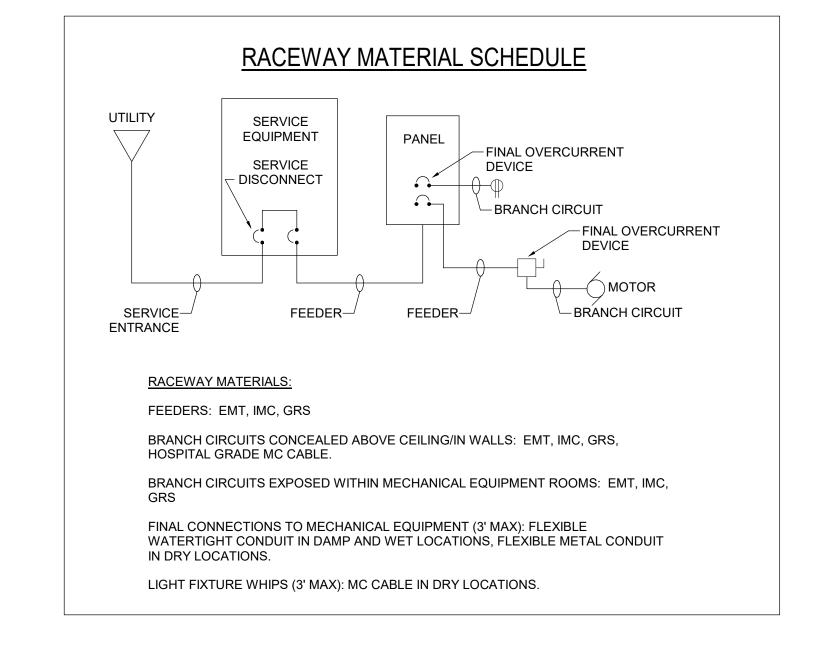
	DISCONNECT S	WITCH SCHEDULE
	S1	30A/2P
	S2	60A/2P
	S3	100A/2P
	S4	200A/2P
	S5	400A/2P
	S6	30A/3P
	S7	60A/3P
	S8	100A/3P
	S9	200A/3P
	S10	400A/3P
	S11	30A/4P
	S12	60A/4P
	S13	100A/4P
	S14	200A/4P
	S15	400A/4P
SW	/ITCH NOTES:	
1.	ALL DISCONNECT S TYPE.	SHALL BE HEADY DUTY
2.	240V OR 600V TO S	UIT CIRCUIT VOLTAGE.
3.	ALL DISCONNECTS	FUSIBLE UNLESS
	OTHERWISE NOTE	D, PROVIDE FUSES TO
	SUIT LOAD.	
4.	ENCLOSURES NEM	A 3R OUTDOORS AND IN
	,	IEMA 1 ELSEWHERE
	UNLESS OTHERWIS	
5.	ALL OUTDOOR DISC	CONNECST SERVING

GROUND MOUTED HVAC UNITS SHALL NOT BE MOUNTED HIGHER THAN 36" ABOVE

6. MAINTAIN A MINIMUM CLEARANCE IN FRONT

OF THE DISCONNECT AS PER NEC.

FINISHED GRADE.



ABBREVIATIONS ABBREVIATIONS

A, AMP	AMPERE			NO.	NUMBER				
AA ABBREV	AMBIENT AIR ABBREVIATION	g G, GND	GRAM GROUND	NOS NPF	NUMBERS NORMAL POWER FACTOR				
ABV	ABOVE	GA	GAUGE	NPT	NATIONAL PIPE THREAD				
AC ACT	ALTERNATING CURRENT ABOVE COUNTER TOP	GALV GC	GALVANIZED GENERAL CONTRACTOR, DIVISION 00 THROUGH 14	NTE NTS	NOT TO EXCEED NOT TO SCALE				
AF	AMP FRAME, CIRCUIT BREAKER FRAME AND TRIP DEVICE SENSOR	GEC	GROUNDING ELECTRODE CONDUCTOR	NIO	NOT TO SCALE				
AFF	SIZE (AMPS) ABOVE FINISHED FLOOR	GEN	GENERATOR CROWN FALL TO CROWN INTERPREPARED.	OPT	OPTIONAL ON CENTER				
AFG	ABOVE FINISHED FLOOR ABOVE FINISHED GRADE	GF GFE	GROUND FAULT CIRCUIT INTERRUPTER DENOTES GOVERNMENT FURNISHED EQUIPMENT, CONTRACTOR	O.C. OFE	ON CENTER OWNER FURNISHED EQUIPMENT, CONTRACTOR INSTALLED				
AHU	AIR HANDLING UNIT		INSTALLED						
AIC AL	AMPERE INTERRUPTING CAPACITY ALUMINUM	GFCI GFEPD	GROUND FAULT EQUIPMENT PROTECTIVE DEVICE GROUND FAULT EQUIPMENT PROTECTIVE DEVICE	P PB	POLE PRIVATE BRANCH EXCHANGE				
AM	AMPERE METER	GFP	GROUND FAULT PROTECTION	PCC	POINT OF COMMON COUPLING				
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE	GP	GENERAL PURPOSE	PDU	POWER DISTRIBUTION UNIT				
AS ASYM	AMMETER SWITCH ASYMMETRICAL	GRS	GALVANIZED RIGID STEEL CONDUIT	PH PLC	PHASE PROGRAMMABLE LOGIC CONTROLLER				
AT	AMP TRIP, TRIP DEVICE RATING PLUG SIZE (AMPS)	Н	HEIGHT	PMCS	POWER MONITORING AND CONTROL SYSTEM				
ATC ATS	AIR TERMINAL CHAMBER AUTOMATIC TRANSFER SWITCH, TRIP DEVICE LONG TIME PICKUP	HALOG HE	HALOGEN HIGH EXPOSURE	PBRD, PNL	PANEL				
AIG	SETTING (AMPS)	HID	HIGH INTENSITY DISCHARGE	PT	POTENTIAL TRANSFORMER				
AVG AWG	AVERAGE AMERICAN WIRE GAUGE	HORIZ	HORIZONTAL	PVC	POLYVINYL CHLORIDE				
AWG	AWERICAN WIRE GAUGE	HP HPF	HORSEPOWER HIGH POWER FACTOR	RECP(S)	RECEPTACLE(S)				
BAS	BUILDING AUTOMATION SYSTEM	HPS	HIGH PRESSURE SODIUM	REQMTS	REQUIREMENTS				
BATT BIAX	BATTERY, BATTERIES BIAXIAL	HRG HVAC	HIGH RESISTANCE GROUND HEATING, VENTILATING AND AIR CONDITIONING	R %R	RESISTANCE PERCENT RESISTANCE				
BIL	BASIC IMPULSE LEVEL	HZ	HERTZ	%R RCR	ROOM CAVITY RATIO				
BKR	BREAKER			R/I	RECTIFIER/INVERTER				
BLDG B. O. D.	BUILDING BOTTOM OF DUCT	IAW	IN ACCORDANCE WITH	REQD	REQUIRED RADIO ERECUENCY INTERESPENCE				
B. O. T.	BOTTOM OF TRAY	ICEA IEC	INSULATED CABLE ENGINEERS ASSOCIATION INTERNATIONAL ELECTROTECHNICAL COMMISSION	RFI RGS	RADIO FREQUENCY INTERFERENCE RIGID GALVANIZED STEEL				
		IEEE	INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS	RM	ROOM				
*C cm	CELSIUS CENTIMETER	IDS	INTRUSION DETECTION SYSTEM	RMS	ROOT MEAN SQUARE				
C, CND	CONDUIT	IESCR IESNA, IES	INTEGRATED EQUIPMENT SHORT CIRCUIT RATING ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA	RVAT	REDUCED VOLTAGE AUTOTRANSFORMER				
	CATALOG	IG	DEVICE SHALL HAVE ISOLATED GROUND. SEE SPECIFICATIONS	SCHED	SCHEDULE				
CATV	CABLE TELEVISION	IMC	INTERMEDIATE METAL CONDUIT	SE	SERVICE ENTRANCE				
CBM	CERTIFIED BALLAST MANUFACTURER	INC, INCAND	INCANDESCENT	SECT SHLD	SECTION SHIELDED, SHIELD				
CCTV	CLOSED CIRCUIT TELEVISION CAMERA COMMON EQUIPMENT GROUND	INST	INSTRUCTIONS, INSTRUMENT/INSTRUMENTATION	SKVA	STARTING KILO-VOLT AMPERES				
CEG CFM	CUBIC FEET PER MINUTE	INTER	INTERMEDIATE	S/MH SM	SPACING TO MOUNTING HEIGHT RATIO SOLID NEUTRAL				
CKT	CIRCUIT	JB OR	JUNCTION BOX	SMR	SURFACE METAL RACEWAY				
CLF CLO	CURRENT LIMITING FUSE CLOSET	J-BOX		SN	SHARED NEUTRAL				
COMPT	COMPARTMENT	*K	DEGREES KELVIN	SQ SS	SQUARE STAINLESS STEEL				
CONT	CONTINUOUS	K, KCMIL	ONE THOUSAND CIRCULAR MILS	SSBJ	SUPPLY-SIDE BONDING JUMPER				
CPT CPU	CONTROL POWER TRANSFORMER CENTRAL PROCESSING UNIT	KA KG	KILO-AMPERES KILO-GRAM	SSL	SOLID STATE LIGHT				
CRAC	COMPUTER ROOM AIR CONDITIONING UNIT	KM	KILO-METER	SSM SST	SOLID STATE METERING SOLID STATE TRIP				
CRI	COLOR RENDERING INDEX	KV	KILO-VOLTS	STA	STATION				
CS CSA	CONTROL SWITCH CANADIAN STANDARDS ASSOCIATION	KVA KVAC	KILO-VOLT AMPERES KILO-VOLT AMPERES CONNECTED	STP	SHIELDED TWISTED PAIR				
CSCCN	CENTRAL SCIENTIFIC COMMUNICATIONS NETWORK	KVAD	KILO-VOLT AMPERES DEMAND	SW SWBD	SWITCH SWITCHBOARD				
CT CU	CURRENT TRANSFORMER, CABLE TRAY COPPER, COEFFICIENT OF UTILIZATION	KVAR KW	KILO-VOLT AMPERES REACTIVE KILOWATT	SWGR	SWITCHGEAR				
CY	CYCLE(S)	KWD	KILOWATT DEMAND	SYM	SYMMETRICAL				
Б	DEDTH DEED		LUMEN LENGTH	T, TX	TRANSFORMER				
D DC	DEPTH, DEEP DIRECT CURRENT	L LA	LUMEN, LENGTH LIGHTNING ARRESTER	T & B	TOP AND BOTTOM				
DEPT	DEPARTMENT	LAN	LOCAL AREA NETWORK	TEL TEL CAB	TELEPHONE TELEPHONE CABINET				
DESIG	DESIGNATION DIAMETER	LB(S)	POUND(S)	TP	TRANSFORMER PROTECTION				
DIA DISC	DISCONNECT	LED('S) LRG	LIGHT EMITTING DIODE(S) LOW RESISTANCE GROUND	TYP TVSS	TYPICAL TRANSIENT VOLTAGE SURGE SUPPRESSOR				
DIST,	DISTRIBUTION	LSGM	LONG-TIME/SHORT-TIME TRIP	1 7 3 3	TRANSIENT VOLTAGE SURGE SUFFRESSOR				
DISTRIB DIV	DIVISION	LSI LSIM	LONG-TIME/SHORT-TIME/INSTANTANEOUS TRIP LONG-TIME/SHORT-TIME/INSTANTANEOUS TRIP AND METERING	UDS	UNITIZED DISTRIBUTION SUBSTATION				
	DISCONNECT SWITCH	LSIG	LONG-TIME/SHORT-TIME/INSTANTANEOUS/GROUND FAULT TRIP	UG, UGND UH	UNDERGROUND UNIT HEATER				
DWG(S)	DRAWING(S)	LSIGM	LONG-TIME/SHORT-TIME/INSTANTANEOUS/GROUND FAULT TRIP AND METERING	UL	UNDERWRITERS' LABORATORIES				
EC	ELECTRICAL CONTRACTOR, DIVISION 26 (DIV 26)	LT	LIQUID TIGHT	UNO	UNLESS NOTED OTHERWISE				
EF	EXHAUST FAN	LTG	LIGHTING	UPS UTP	UNINTERRUPTIBLE POWER SUPPLY UNSHIELDED TWISTED PAIR				
EGC ELEC	EQUIPMENT GROUNDING CONDUCTOR ELECTRICAL/ELECTRIC	LTS LPF	LIGHTS LOW POWER FACTOR	UV	ULTRAVIOLET				
		LPF	LOW POWER FACTOR						
EMER	EMERGENCY	m	METER	V VAC	VOLT(S) VOLTS ALTERNATING CURRENT				
EMH EMS	EXISTING MANHOLE ENERGY MANAGEMENT SYSTEM	mm MAX	MILLIMETER MAXIMUM	VAR	VOLT AMPERE REACTIVE				
EMT	ELECTRICAL METALLIC TUBING	MC	MECHANICAL CONTRACTOR, DIVISION 23 (DIV 23)	VDC VERT	VOLTS DIRECT CURRENT VERTICAL				
EO	ELECTRICALLY OPERATED	MCB	MAIN CIRCUIT BREAKER	VERT	VARIABLE FREQUENCY DRIVE				
EPP EPR	EXISTING POWER POLE ETHYLENE-PROPYLENE RUBBER	MCC MDP	MOTOR CONTROL CENTER MAIN DISTRIBUTION PANEL	VM	VOLT METER				
EQPT	EQUIPMENT	MECH	MECHANICAL	VPE VPI	VACUUM PRESSURE ENCAPSULATED				
E.T.	ELECTRONIC TRIP	MEZZ	MEZZANINE	VPI VS	VACUUM PRESSURE IMPREGNATED VOLTMETER SWITCH				
ETC ETL	ETCETERA ELECTRICAL TESTING LABORATORIES	MRF M/G	MANUFACTURER MOTOR/GENERATOR	VSD	VARIABLE SPEED DRIVE				
ES	ENERGY SAVING	MH	MOUNTING HEIGHT, MAN HOLE	W	WATT(S), WIRE, WIDTH				
EW	EACH WAY	MHL	METAL HALIDE LAMP	WC	WATER COOLER				
EWC EWH	ELECTRIC WATER COOLER ELECTRIC WATER HEATER	MI MIN	MINERAL INSULATED MINIMUM	WG	WATER GAGE				
EXST	EXISTING, EXHAUST	MIP	MEDICAL ISOLATION PANEL	W/ W/O	WITH WITHOUT				
_		MFR	MANUFACTURER	WP	WEATHERPROOF				
F FA	FAHRENHEIT FORCED AIR, FIRE ALARM	MLO MO	MAIN LUGS ONLY MECHANICALLY OPERATED						
FACP	FIRE ALARM CONTROL PANEL	MP	MOTOR PROTECTOR	X %X	REACTANCE PERCENT REACTANCE				
FBO FC	FURNISHED BY OTHERS, FURNISHED BY OWNER	MS MT	MASTER SUBSTATION	%X XFMR	TRANSFORMER				
FC FCU	FLEXIBLE CONDUIT FAN COIL UNIT	MT MTD	MOUNT MOUNTED	XLP	CROSS-LINK POLYETHYLENE INSULATION				
FFE	FINISHED FLOOR ELEVATION	MTG	MOUNTING	Z	IMPEDANCE				
FIXT	FIXTURE	MTTOE	MOUNTED TO TOP OF EQUIPMENT	Σ %Ζ	PERCENT IMPEDANCE				
FL FLUOR	FOOT LAMBERTS FLUORESCENT	MV	MEDIUM VOLTAGE	4/0	SINCLE CONDUCTOR CARLE				
FREQ	FREQUENCY	N, NEUT	NEUTRAL	1/C 3/C	SINGLE CONDUCTOR CABLE THREE CONDUCTOR CABLE				
FRP FT	FIBERGLASS-REINFORCED POLYESTER FOOT	N/A N. C.	NOT APPLICABLE NORMALLY CLOSED						
F I FU	FUSE	N. C. NEC	NATIONAL ELECTRICAL CODE (NFPA 70)	SPST	SINGLE POLE-SINGLE THROW				
FUT	FUTURE	NEMA	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION	DPST 3PST	DOUBLE POLE-SINGLE THROW THREE POLE-SINGLE THROW				
FVNR FVR	FULL VOLTAGE NON-REVERSING FULL VOLTAGE REVERSING	NFPA NIC	NATIONAL FIRE PROTECTION ASSOCIATION NOT IN CONTRACT	SPDT	SINGLE POLE-DOUBLE THROW				
FWE	FURNISHED WITH EQUIPMENT, INDICATES ITEM IS FURNISHED WITH	NMC	NONMETALLIC-SHEATHED CABLE	DPDT 3PDT	DOUBLE POLE-DOUBLE THROW THREE POLE-DOUBLE THROW				
	EQUIPMENT SUPPLIED UNDER OTHER DIVISIONS, BUT INSTALLED UNDER DIVISION 26.	N. O.	NORMALLY OPEN	וטוט	THALE FOLE-DOUBLE HINOW				

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SCOPE-OF-WORK LEVEL DRAWINGS AND THE CONTRACTOR SHALL FURNISH AND
INSTALL ANY AND ALL MATERIALS AND LABOR TO PRODUCE FULLY FUNCTIONAL
SYSTEMS THAT MEET THE DESIGN INTENT, WHETHER SHOWN ON THE PLANS OR NOT. CONTRACTORS SHALL USE THESE DRAWINGS AS ESTABLISHING A LEVEL OF QUALITY AND A SCOPE OF WORK. ANY REQUIRED MATERIALS AND LABOR TO MEET ALL CODES AND REGULATIONS SHALL BE FURNISHED AND INCLUDED IN THE CONTRACTORS PRICE. REQUEST FOR ADDITIONAL FUNDS TO INCLUDE MATERIALS AND LABOR TO MEET CODES AND COMPLY WITH REGULATIONS WILL NOT BE ALLOWED.

consultants

ABBREVIATIONS

MIDLANDS TECHNICAL COLLEGE **BELTLINE CAMPUS** 316 S. BELTLINE BLVD. COLUMBIA, SC 29205 project name **AUTO TRAINING FACILITY** AHU REPLACEMENT

H59-N127-FW project number 21060.01

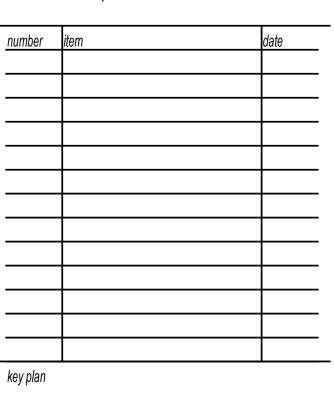
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CONSTRUCTION

MARCH 4, 2022





ELECTRICAL SYMBOLS, NOTES, SCHED., AND ABBR

		Location: Supply From: Mounting: SURFACE Enclosure: TYPE 1 Conduit Entry: BOTTOM						Volts: Phases: Wires:	EXISTING A.I.C. Rating: EXISTING Mains Type: MLO Bus Rating (Amps): 250								
СКТ	Breaker Acc.	Circuit Description	Circuit Size	Trip	Poles		A		В		С	Poles	Trip	Circuit Size	Circuit Description	Breaker Acc.	скт
1		EXISTING		20 A	1	0 VA	0 VA										2
3		EXISTING		20 A	1			0 VA	0 VA			3	40 A		EXISTING		4
5		EXISTING		20 A	1					0 VA	0 VA						6
7		EXISTING		20 A	1	0 VA	0 VA	0.1/4	0.1/4				40.4		EVICTING		8
9		EXISTING		20 A	1			0 VA	0 VA	0.1/4	0.1/4	3	40 A		EXISTING		10
11		EXISTING		20 A	1	0.1/4	0400) (4			0 VA	0 VA						12
13		EXISTING		20 A	1	0 VA	9422 VA	0.1/4	0400 \/A			_	45.0	240 4400.4110	011.4	NOTE 1	14
15		EXISTING EXISTING		20 A	1			0 VA	9422 VA	0 VA	9422 VA	3	45 A	3#8,#10G;1"C	CU-1	NOTET	16
17		EXISTING		20 A 20 A	1	0 VA	0 VA			UVA	9422 VA				SPACE		18
19 21		EXISTING		20 A	1	UVA	UVA	0 VA	0 VA					 	SPACE		20
23		EXISTING		20 A	1			UVA	UVA	0 VA	0 VA				SPACE		24
25		EXISTING		20 A	1	0 VA	0 VA			UVA	UVA			 	SPACE		26
27		EXISTING		20 A	1	UVA	0 7/	0 VA	0 VA						SPACE		28
29		EXIOTING		20 /	<u>'</u>			OVA	UVA		0 VA				SPACE		30
31		SPACE				0 VA	0 VA				0 1/1				SPACE		32
33		SPACE				0 7/1	0 7/1	0 VA	0 VA						SPACE		34
35		SPACE						0 771	0 7/1	0 VA	0 VA				SPACE		36
37		SPACE				0 VA	0 VA			0 171	3 171				SPACE		38
39		SPACE				0 171	0 171	0 VA	0 VA						SPACE		40
41		SPACE						, , , , , , , , , , , , , , , , , , ,	0 771	0 VA	0 VA				SPACE		42
lotes:				То	tal Load:	942	22 VA	942	2 VA		22 VA				,		

		Location: Supply From: Mounting: SURFACE Enclosure: TYPE 1 Conduit Entry: BOTTOM						Volts: Phases: Wires:		re					EXISTING sing: EXISTING type: MLO typs): 250A		
кт	Breaker Acc.	Circuit Description	Circuit Size	Trip	Poles	,	A	E	3			Poles	Trip	Circuit Size	Circuit Description	Breaker Acc.	СК
1						0 VA	0 VA					1	20 A		EXISTING		2
3		EXISTING		30 A	3	_	-	0 VA	0 VA			1	20 A		EXISTING		4
5										0 VA	0 VA	1	20 A		EXISTING		6
						0 VA	0 VA					1	20 A		EXISTING		8
)		EXISTING		30 A	3			0 VA	0 VA			1	20 A		EXISTING		1
										0 VA	0 VA	1	20 A		EXISTING		12
3						2901 VA	0 VA					1	20 A		EXISTING		1-
5	NOTE 1	AHU-1	3#12,#12G;3/4"C	15 A	3			2901 VA	0 VA			1	20 A		EXISTING		16
7										2901 VA	0 VA	1	20 A		EXISTING		18
9		EXISTING		20 A	1	0 VA	0 VA					1	20 A		EXISTING		2
1		EXISTING		20 A	1			0 VA	0 VA			1	20 A		EXISTING		2
3		EXISTING		20 A	1					0 VA	0 VA	1	20 A		EXISTING		2
5		EXISTING		20 A	1	0 VA	0 VA					1	20 A		EXISTING		2
7		EXISTING		20 A	1			0 VA	0 VA			1	20 A		EXISTING		28
		EXISTING		20 A	1					0 VA	0 VA	1	20 A		EXISTING		3
1		EXISTING		20 A	1	0 VA	0 VA					1	20 A		EXISTING		3:
3		EXISTING		20 A	1			0 VA	0 VA			1	20 A		EXISTING		34
5		EXISTING		20 A	1					0 VA	0 VA	1	20 A		EXISTING		30
'		EXISTING		20 A	1	0 VA	0 VA										3
)		EXISTING		20 A	1			0 VA	0 VA			3	20 A		EXISTING		40
1		EXISTING		20 A	1					0 VA	0 VA						42
es: 'ROV	IDE NEW I	HACR CIRCUIT BREAKER. NEW CIRCUI	T BREAKER TO MATCH EXIST		ER TYPE		1 VA	2901	I VA	290	I VA						

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project number
21060.01

seals/signature

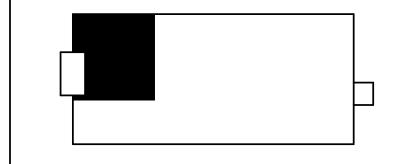




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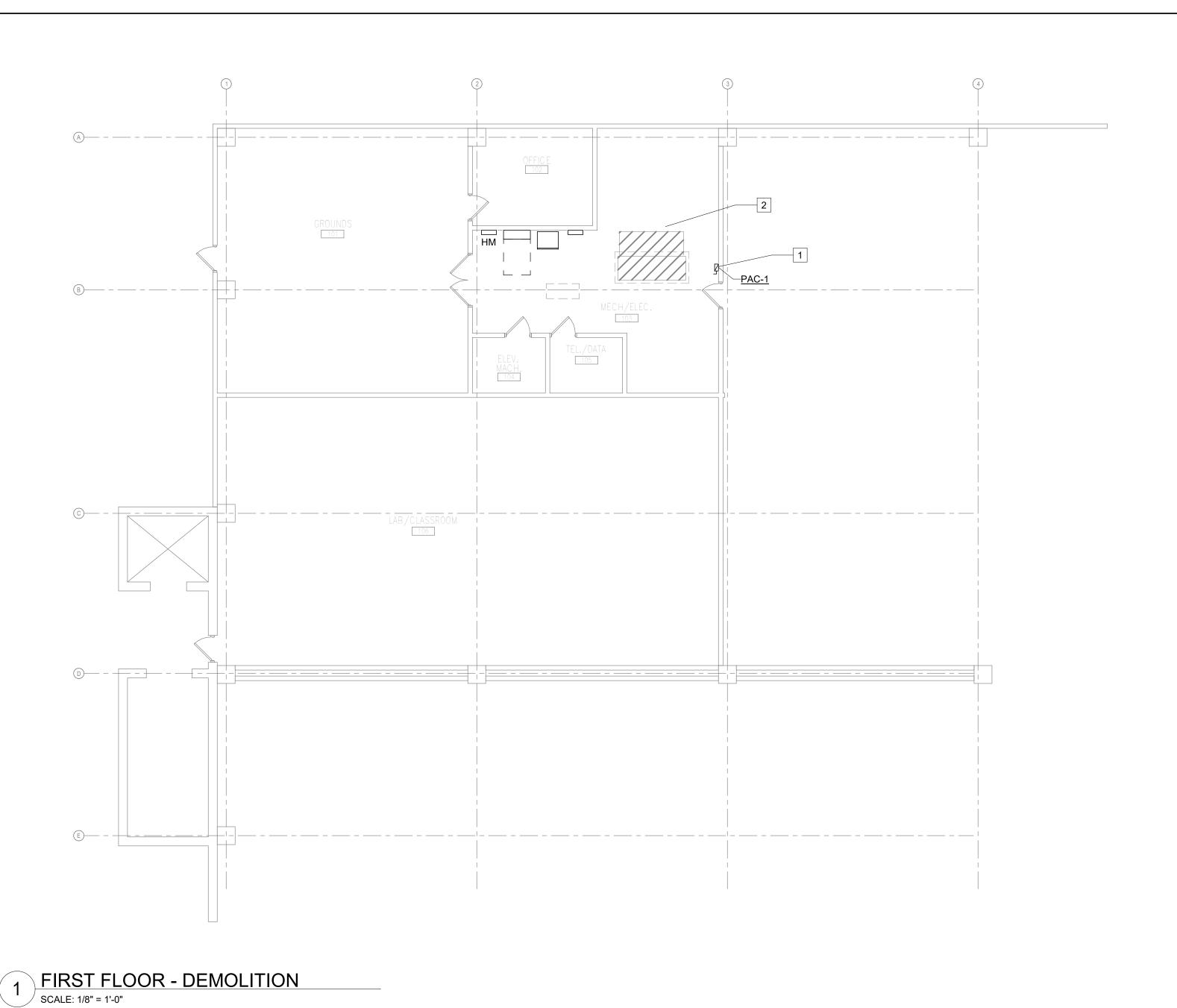
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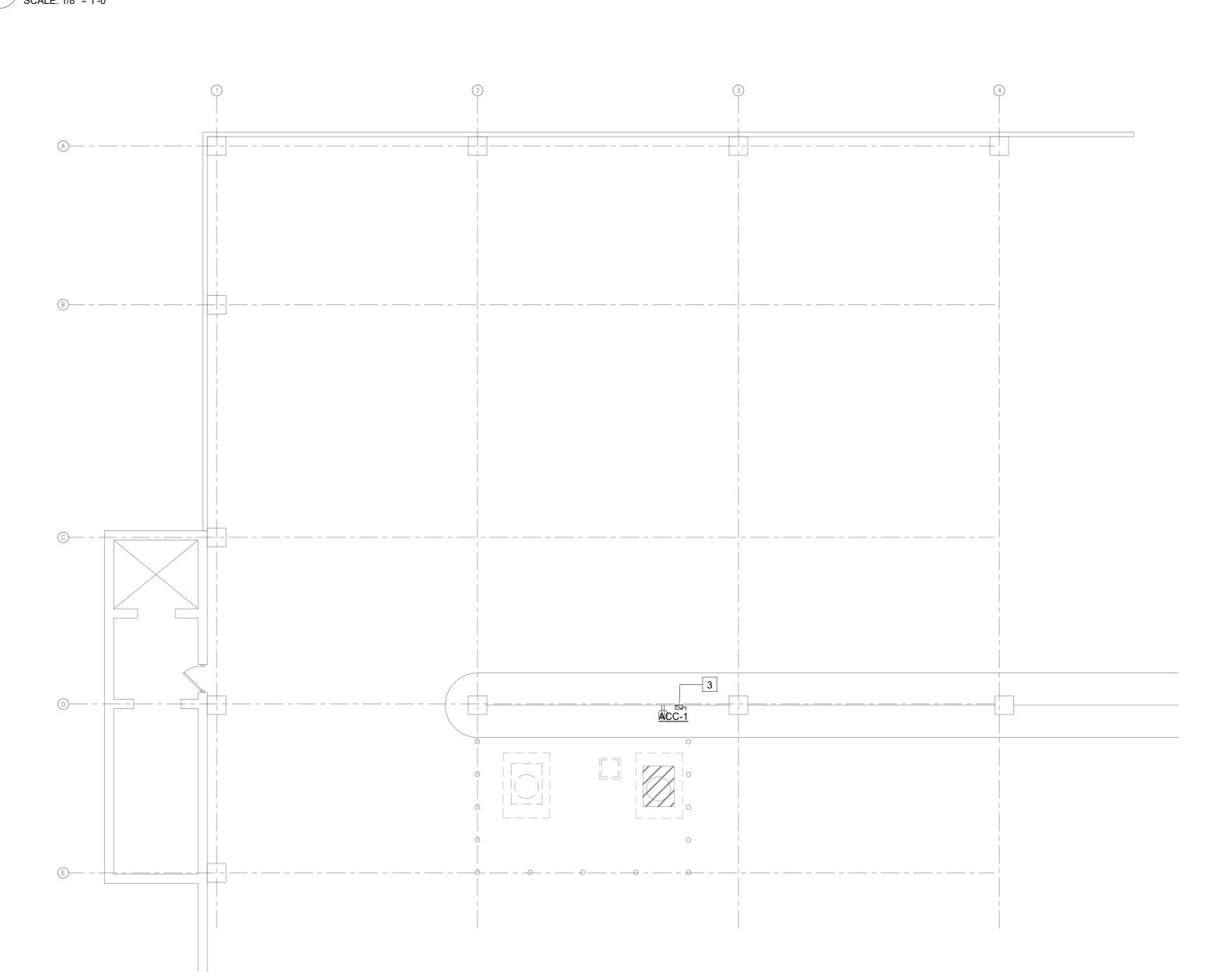
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ELECTRICAL DETAILS AND
PANEL SCHEDULES

sheet number

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awn by RM





2 FOURTH FLOOR - DEMOLITION
SCALE: 1/8" = 1'-0"

DEMOLITION KEYED NOTES:

- EXISTING AIR HANDLER BEING DEMOLISHED. REMOVE WIRING BACK TO EXISTING PANELBOARD "HM". EXISTING 45A/3P CIRCUIT BREAKER TO BE REMOVED AND TURNED OVER TO OWNER. EXISTING CONDUIT SHALL BE CAPPED AND ABANDONED IN PLACE.
 PROTECT EXISTING DUCT SMOKE DETECTOR DURING HVAC UNIT REMOVAL. IF DUCTWORK HAS TO BE REWORKED IN FIELD, REMOVE DUCT DETECTOR AND REINSTALL IN REWORKED DUCT WORK.
 EXISTING CONDENSING UNIT BEING DEMOLISHED. REMOVE WIRING
- 3. EXISTING CONDENSING UNIT BEING DEMOLISHED. REMOVE WIRING BACK TO EXISTING PANELBOARD "H3". EXISTING 20A/3P CIRCUIT BREAKER TO BE REMOVED AND TURNED OVER TO OWNER. EXISTING CONDUIT SHALL BE CAPPED AND ABANDONED IN PLACE.



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AUTO TRAINING FACILITY AHU REPLACEMENT H59-N127-FW project number 21060.01

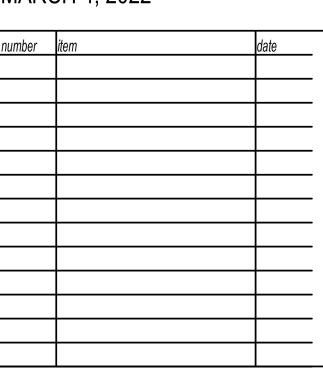
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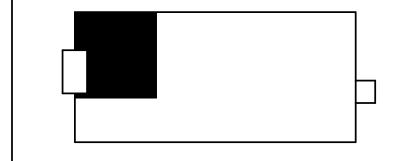


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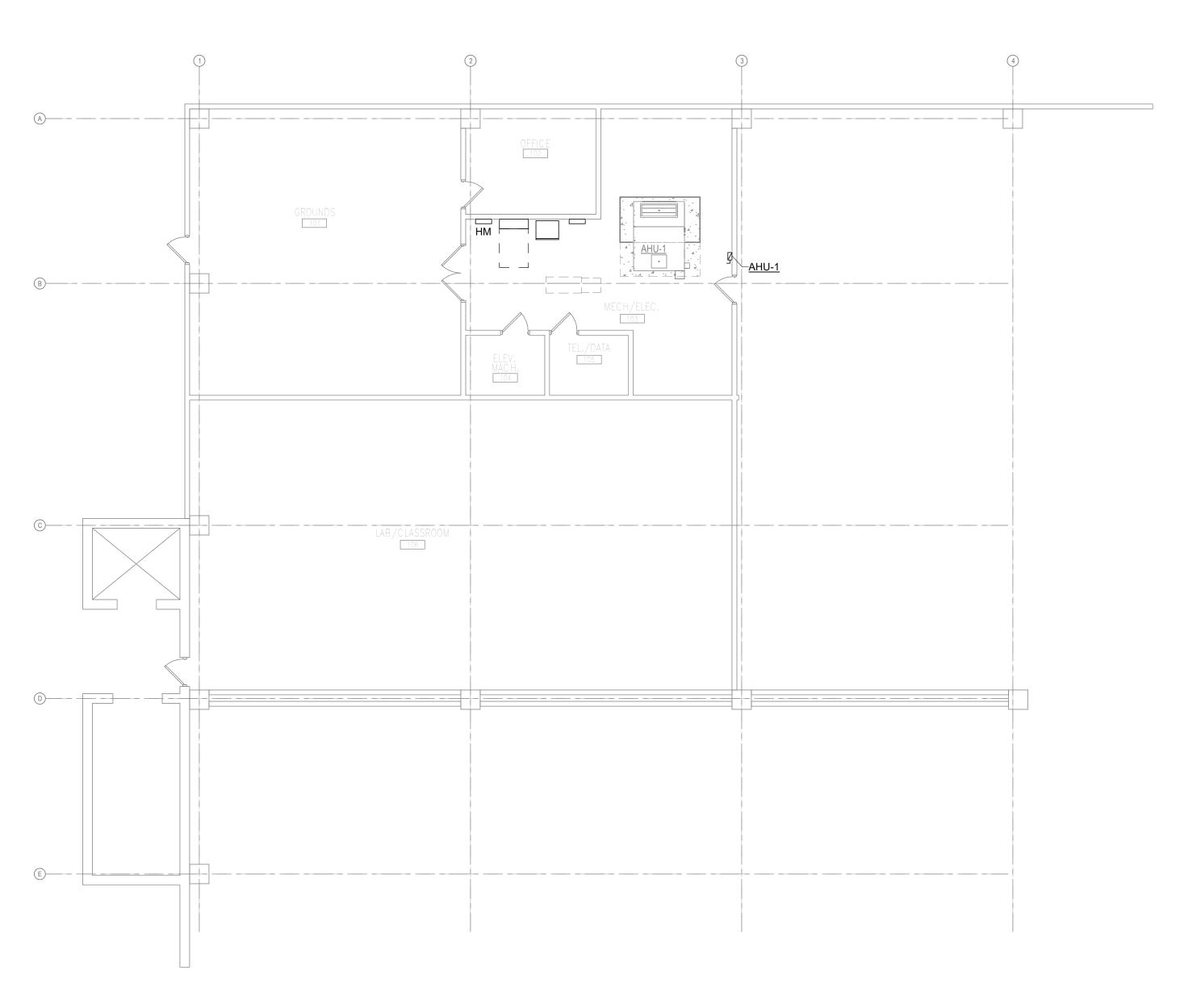
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ELECTRICAL MECHANICAL
EQUIPMENT PLANS DEMOLITION

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n by RMI ked by RMI



1 FIRST FLOOR - RENOVATION SCALE: 1/8" = 1'-0"

MECHANICAL EQUIPMENT SCHEDULE								
EQUIPMENT TAG	VOLTAGE	AMPERE RATING	NUMBER OF POLES	DISCONNECT TYPE	NEMA ENCLOSURE	PANEL	CIRCUIT#	COMMENTS
AHU-1	480 V	15 A	3	S6	NFMA 1	НМ	13 15 17	

RENOVATION KEYED NOTES:

. PROVIDE NEW LIGHT FIXTURES AS SHOWN. TIE INTO EXISTING ROOM LIGHT CIRCUITS AND SWITCHING. MOUNT FIXTURES 8' AFF. COORDINATE EXACT LOCATION OF FIXTURES IN FIELD WITH MECHANICAL PIPING.

EXISTING MAIN SWITCHBOARD. SEE EXISTING MAIN SWITCHGEAR SECTION DETAIL.

INSTALL NEW 20A, DUPLEX RECEPTACLE ADJACENT TO NEW BOILER CONDENSATE PUMP. TIE RECEPTACLE INTO EXISTING ROOM RECEPTACLE CIRCUIT.

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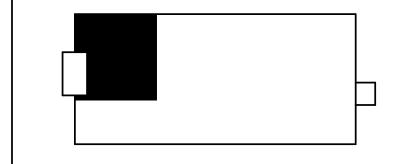
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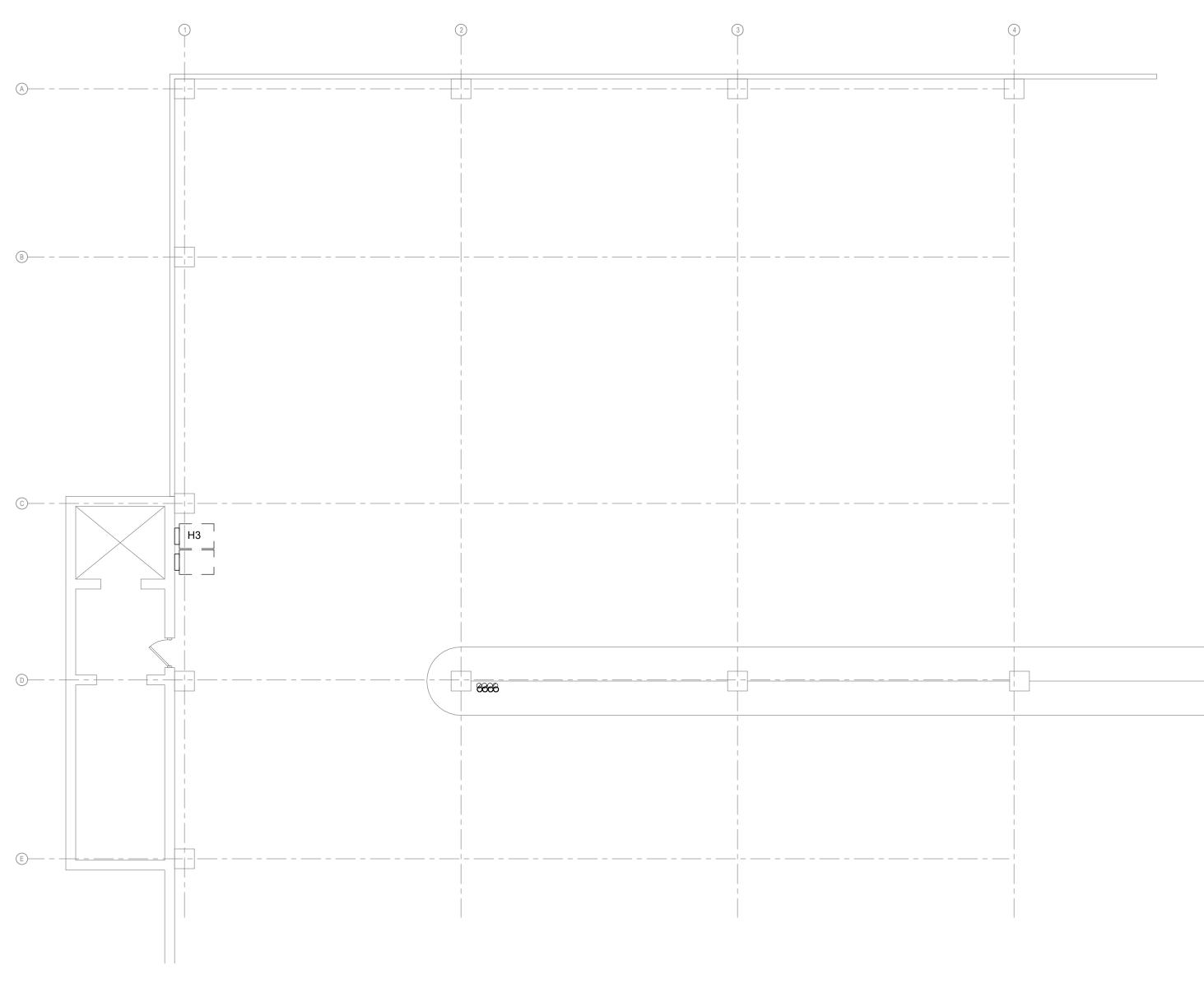


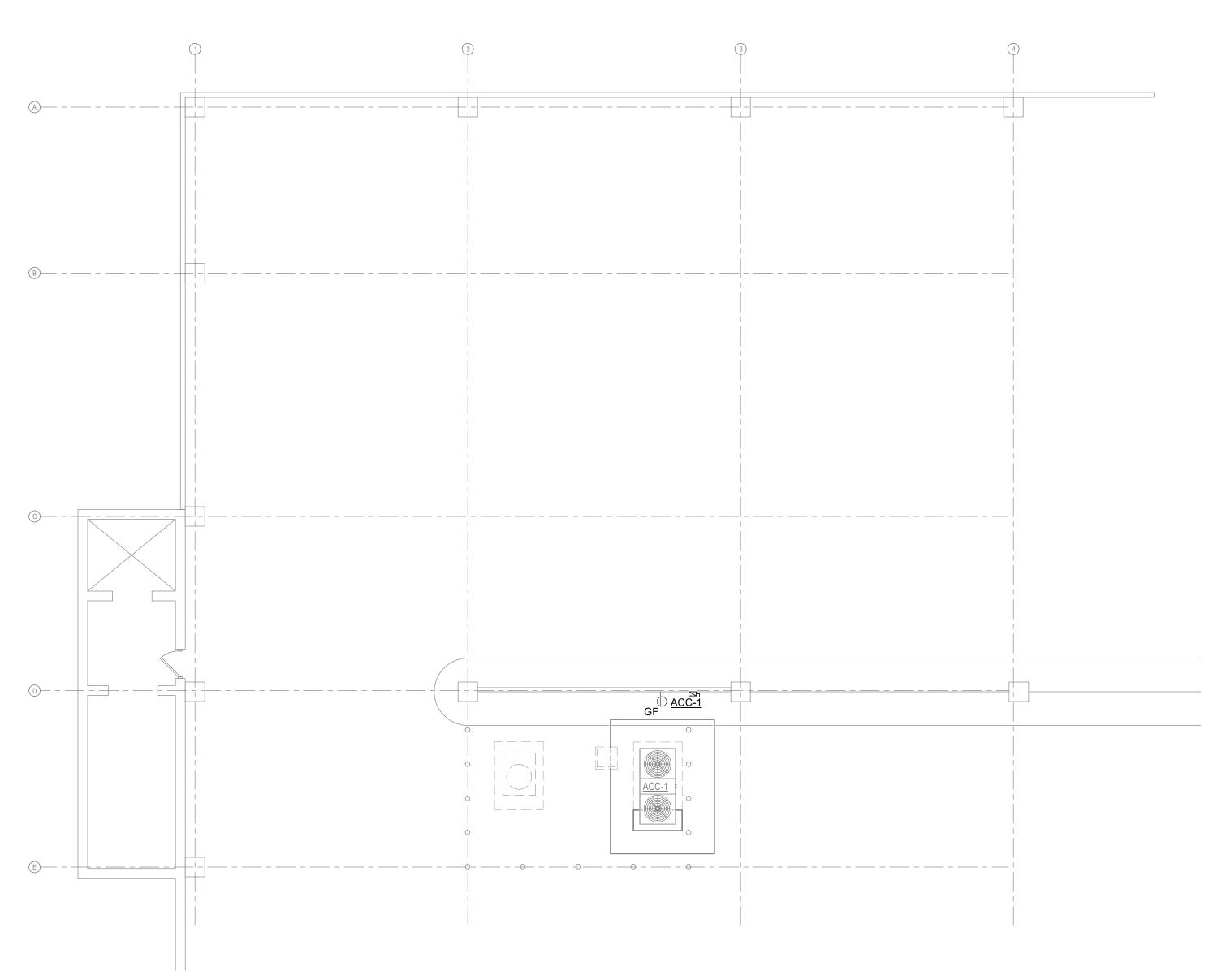
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sheet title
ELECTRICAL MECHANICAL **EQUIPMENT PLAN - FIRST FLOOR RENOVATION**





2 FOURTH FLOOR - RENOVATION
SCALE: 1/8" = 1'-0"

MECHANICAL EQUIPMENT SCHEDULE FOURTH FLOOR								
EQUIPMENT TAG	VOLTAGE	AMPERE RATING	NUMBER OF POLES	DISCONNECT TYPE	NEMA ENCLOSURE	PANEL	CIRCUIT#	COMMENTS
ACC-1	480 V	45 A	3	S7	NEMA 3R	НЗ	14,16,18	

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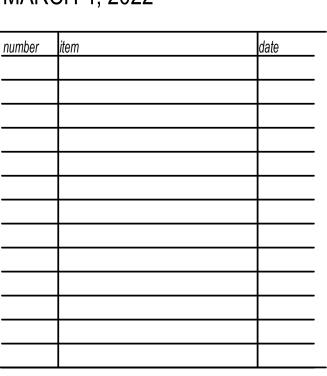
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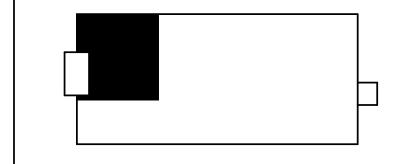
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ELECTRICAL MECHANICAL **EQUIPMENT PLAN -**

ELECTRICAL SPECIFICATIONS

- 1. GENERAL PROVISIONS
- A. WORK INCLUDED IN THESE SPECIFICATIONS AND INCLUDED ON THE DRAWINGS SHALL INCLUDE FURNISHING ALL LABOR, MATERIALS, SUPPLIES, AND EQUIPMENT TO PERFORM ALL WORK REQUIRED INCLUDING CUTTING, CHANNELING, CHASING, EXCAVATING AND BACKFILLING, DEMOLITION (IF ANY) TO INSTALL A COMPLETE AND WORKING ELECTRICAL SYSTEM(S) IN ACCORDANCE WITH THESE SECTIONS OF THE SPECIFICATIONS AND THE ACCOMPANYING DRAWINGS. THIS SHALL INCLUDE ALL REQUIRED PREPARATION WORK, DEMOLITION, RACEWAYS, COORDINATION, ETC. REQUIRED TO INSTALL THE ELECTRICAL SYSTEM.
- B. THE ELECTRICAL WORK SHALL INCLUDE, BUT IN NO WAY BE LIMITED TO THE FOLLOWING:
- 1. FIRE ALARM SYSTEM. 2. RACEWAYS (TO INCLUDE RACEWAYS FOR CONDUCTORS AND CABLES, BUT ALSO EMPTY FOR DESIGNATED SIGNAL SYSTEMS AND FUTURE USES.) 3. ELECTRICAL DISTRIBUTION SYSTEM.
- 4. EXTERIOR AND INTERIOR LIGHTING SYSTEMS.
- 5. EXTERIOR AND INTERIOR POWER SYSTEMS. 6. WIRING DEVICES.
- 7. TELEPHONE RACEWAY SYSTEM. 8. TELEVISION RACEWAY SYSTEM.
- 9. DATA RACEWAY SYSTEM 10. CONNECTION AND INSTALLATION OF EQUIPMENT FURNISHED UNDER OTHER DIVISIONS OF THE SPECIFICATION.
- 11. UTILITY SERVICE ENTRANCES ELECTRICAL, TELEPHONE, CABLE TV, ETC.

C. THE CONTRACTOR IS RESPONSIBLE FOR INCLUDING ANY AND ALL WORK RELATED TO THE ELECTRICAL THAT IS NOTED IN ANY PART OF THE SPECIFICATIONS OR ANY PART OF THE DRAWINGS, INCLUDING DIVISIONS 1, 23 AND ANY OTHER SECTIONS. THE CONTRACTOR WILL SUPPLY POWER TO EQUIPMENT AT THE VOLTAGE INDICATED ON THE DRAWINGS. THE CONTRACTOR WILL BE HELD RESPONSIBLE FOR COORDINATING THE EQUIPMENT VOLTAGES. CONTROL EQUIPMENT. WIRING. AND LOCATIONS AND TYPE OF TERMINATIONS/CONNECTIONS AND/OR DISCONNECTS REQUIRED TO COMPLY WITH THE NATIONAL ELECTRICAL CODE, INTERNATIONAL BUILDING CODE, INTERNATIONAL ENERGY CONSERVATION CODE, ALL LOCAL CODES, AND THE EQUIPMENT MANUFACTURER'S REQUIREMENTS.

D. ELECTRICAL DRAWINGS ARE DIAGRAMMATIC IN NATURE EXCEPT WHERE SPECIFIC DIMENSIONS, OR SPECIFIC DETAILS ARE SHOWN ON THE ELECTRICAL, MECHANICAL, OR ARCHITECTURAL DRAWINGS. THE CONTRACTOR SHALL REFER TO OTHER DRAWINGS FOR EXACT LOCATIONS OF EQUIPMENT, BUILDING DIMENSIONS, ARCHITECTURAL DETAILS AND CONDITIONS AFFECTING THE ELECTRICAL WORK; HOWEVER, FIELD MEASUREMENTS TAKE PRECEDENCE OVER DIMENSIONED DRAWINGS. THE ELECTRICAL CONTRACTOR SHALL PROVIDE ALL LABOR AND MATERIALS AND ALL INCIDENTAL ELEMENTS; JUNCTION AND PULL BOXES, FILTERS, PULL WIRES, CONNECTORS, SUPPORT MATERIALS, FUSES, DISCONNECT SWITCHES, LAMPS, AND LABELS, TO INSTALL, CONNECT, START-UP AND RESULT IN A COMPLETE AND WORKING SYSTEM IN ACCORDANCE WITH THE DRAWINGS AND SPECIFICATIONS. THE CONTRACTOR IS RESPONSIBLE FOR COORDINATING THE INSTALLATION OF ALL ELECTRICAL WORK WITH THE WORK OF OTHER CONTRACTORS AND/OR TRADES. THE ELECTRICAL DRAWINGS ARE SUCH THAT THE ELECTRICAL SERVICE TO EQUIPMENT FURNISHED AND INSTALLED UNDER OTHER SECTIONS OF THE CONTRACT DOCUMENTS (EXAMPLES, BUT NOT LIMITED TO: HVAC EQUIPMENT, WATER HEATERS, FANS, PUMPS, MOTORS, ETC) IS COORDINATED FOR THE SPECIFIED EQUIPMENT ONLY. IF THE EQUIPMENT INSTALLED UNDER OTHER DIVISIONS OF THE CONTRACT DOCUMENTS IS NOT THE SPECIFIED EQUIPMENT IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO COORDINATE THE ELECTRICAL SERVICE/INTERFACE REQUIREMENTS WITH THE ELECTRICAL CONTRACTOR.

E. PROVIDE ALL WIRING, CONNECTORS, FITTINGS, CONNECTIONS, AND ALL ACCESSORIES FOR THE COMPLETE INSTALLATION OF, AND FINAL CONNECTIONS TO, EQUIPMENT FURNISHED UNDER OTHER DIVISIONS OF THE SPECIFICATIONS AND WHERE INDICATED ON THE DRAWINGS OR OTHERWISE SPECIFIED.

F. ALL SAFETY DISCONNECT SWITCHES SHALL BE PROVIDED UNDER DIVISION 26. WHERE THE SWITCH DESIGNATION CALLS FOR THE SWITCH TO BE FUSED, THE ELECTRICAL CONTRACTOR SHALL FURNISH AND INSTALL FUSES THAT ARE SIZED IN ACCORDANCE TO THE EQUIPMENT NAMEPLATE OF THE EQUIPMENT SERVED.

G. THE CONTRACTOR IS RESPONSIBLE FOR OBTAINING ALL REQUIRED PERMITS AND COMPLYING WITH ALL NATIONAL (NEC, IBC, NFPA), STATE, COUNTY, AND MUNICIPAL CODES AND REGULATIONS. THIS SHALL INCLUDE, BUT NOT BE LIMITED TO, THE FOLLOWING: 1. FEDERAL OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA)

- 2. NFPA 70 (NATIONAL ELECTRICAL CODE) 3. NFPA 101 (LIFE SAFETY CODE)
- 4. AMERICANS WITH DISABILITIES ACT (ADA) 5. INTERNATIONAL BUILDING CODE (IBC).
- 6. INTERNATIONAL FIRE ALARM CODE.
- 7. INTERNATIONAL ENERGY CONSERVATION CODE (IECC) 2009 EDITION.
- H. ELECTRICAL WORK SHALL COMPLY WITH LATEST NECA 1 STANDARDS FOR GOOD WORKMANSHIP IN ELECTRICAL CONSTRUCTION.

I. THE CONTRACTOR SHALL KEEP A SET OF CONSTRUCTION DRAWINGS DURING THE LENGTH OF THE PROJECT ON WHICH HE SHALL NOTE ANY AND ALL CHANGES FROM THE ORIGINAL DRAWINGS. THIS RECORD SET OF DRAWINGS SHALL BE UPDATED DAILY.

J. ELECTRICAL SUBCONTRACTOR SHALL SUBMIT FOR REVIEW BY THE ENGINEER DETAILED SHOP DRAWINGS OF ALL MATERIAL LISTED BELOW. ALL SUBMITTAL DATA SHALL BE SUBMITTED AT ONE TIME. NO MATERIAL OR EQUIPMENT FOR WHICH ENGINEER'S REVIEW IS REQUIRED SHALL BE DELIVERED TO THE JOB SITE OR INSTALLED UNTIL THE ELECTRICAL CONTRACTOR HAS IN HIS POSSESSION THE REVIEWED AND APPROVED SHOP DRAWINGS FOR THE PARTICULAR MATERIAL AND/OR EQUIPMENT. THE ELECTRICAL CONTRACTOR SHALL ASSEMBLE, ORGANIZE, PREPARE AND REVIEW FOR CORRECTNESS SHOP DRAWINGS ON ALL MATERIALS, EQUIPMENT, FIXTURES AND DEVICES TO BE USED. IF MATERIAL SUBMITTED IS THE RESULT OF "VALUE ENGINEERING" OR "PRIOR APPROVAL" CHANGES THE SUBMITTAL MUST CONTAIN SUPPORTING DOCUMENTATION OF THE APPROVED CHANGES, OTHERWISE IT WILL BE REVIEWED AGAINST THE SPECIFIED PRODUCTS ON THESE PLANS. THE ELECTRICAL CONTRACTOR SHALL FURNISH THE NUMBER OF COPIES SPECIFIED BY THE ARCHITECT OR ONE (1) PDF ELECTRONIC COPY OF SHOP DRAWINGS IF NO NUMBER IS SPECIFIED BY THE ARCHITECT. SHOP DRAWINGS THAT ARE INCORRECTLY SUBMITTED, CONTAIN ERRORS OR OMISSIONS, OR NOT IN THE FORM AND SEQUENCE SPECIFIED SHALL BE REJECTED AS UNAPPROVED.

REVIEW OF SHOP DRAWINGS IN NO WAY RELIEVES THE CONTRACTOR OF HIS RESPONSIBILITY OF QUANTITY, DIMENSIONS, WEIGHTS, MEANS AND METHODS, SAFETY, OR COORDINATION WITH OTHERS.

FAILURE OF THE CONTRACTOR TO SUBMIT SHOP DRAWINGS TO THE ENGINEER WITH REASONABLE TIME FOR REVIEW SHALL NOT ENTITLE THE CONTRACTOR TO AN EXTENSION OF CONTRACT TIME. REASONABLE REVIEW TIME IS FIFTEEN WORKING DAYS UNLESS OTHERWISE SPECIFIED.

- AT MINIMUM SHOP DRAWINGS SHALL BE SUBMITTED FOR
- LIGHTING FIXTURES LIGHTING CONTROL SYSTEMS INCLUDING RELAY PANEL AND AUTOMATIC SWITCHES
- PANFI BOARDS SAFETY SWITCHES
- BASIC MATERIALS; WIRE, CONDUIT, FITTINGS, WIRING DEVICES 7. FIRE ALARM SYSTEMS
- K. REQUESTS FOR SUBSTITUTION

SUBMIT REQUESTS FOR SUBSTITUTION TO ENGINEER THROUGH THE ARCHITECT BY US MAIL OR COURIER NO FEWER THAN TEN (10) WORKING DAYS PRIOR TO BID TIME. REQUESTS SHALL CONTAIN CUTSHEETS, CATALOG NUMBERS, ETC. ANY APPROVAL WILL BE IN WRITING BY THE ENGINEER.

- SUBSTITUTED ITEMS WILL NOT RESULT IN AN INCREASE IN COST TO THE OWNER.
- CATALOG NUMBERS AND NAMES THAT APPEAR IN THE SPECIFICATIONS OR ON THE PLANS MAY BE INCOMPLETE OR OBSOLETE AND ARE FOR DESCRIPTIVE PURPOSES ONLY. AS SUCH THEY MAY NOT INDICATE ALL OF THE PARTS, PIECES AND SYSTEMS REQUIRED FOR A COMPLETE AND OPERATING INSTALLATION. IT IS THE RESPONSIBILITY OF THE ELECTRICAL CONTRACTOR, THE VENDOR AND THE SUPPLIER TO REVIEW THE PLANS, SPECIFICATIONS AND APPLICATIONS TO DETERMINE THE CORRECT ITEM(S) REQUIRED TO INCLUDE ALL INSTALLATION AND SUPPORT MATERIALS AND SYSTEMS FOR A COMPLETE AND WORKING INSTALLATION.
- 2. FIRE SPREAD PREVENTION MATERIAL
- A. THE WORK SHALL INCLUDE THE REQUIREMENT TO INSTALL FIRE SPREAD PREVENTION MATERIAL WHEREVER THE ELECTRICAL CONTRACTOR INSTALLS OR PENETRATES A MATERIAL (WALL, ETC.) TO INSTALL ELECTRICAL EQUIPMENT OR MATERIALS.

B. FIRE RESISTANCE RATING: WHENEVER A FIRE RATED WALL, FLOOR, FLOOR-CEILING OR ROOF-CEILING ASSEMBLY IS SHOWN WITH

- THROUGH-PENETRATIONS, PROVIDE MATERIALS AND APPLICATION PROCEDURES WHICH HAVE BEEN TESTED AND CLASSIFIED BY UL AND APPROVED BY FM FOR THE ASSEMBLY
- C. INSTALLATION SHALL BE IN ACCORDANCE WITH THE PRINTED INSTRUCTIONS AS SUPPLIED BY THE MANUFACTURER.
- 3. RACEWAYS/CONDUITS AND ASSOCIATED EQUIPMENT
- A. THE WORK SHALL INCLUDE ALL RACEWAYS, CONDUITS, FITTINGS, AND ALL OTHER EQUIPMENT REQUIRED TO INSTALL A RACEWAY SYSTEM. THIS SHALL INCLUDE, BUT NOT LIMITED TO THE FOLLOWING:
- 1. RIGID METAL CONDUIT AND FITTINGS. ELECTRICAL METALLIC TUBING AND FITTINGS 3. FLEXIBLE METAL CONDUIT AND FITTINGS.
- 4. LIQUID TIGHT FLEXIBLE METAL CONDUIT AND FITTINGS.
- 5. NON-METALLIC CONDUIT AND FITTINGS. B. UNLESS OTHERWISE NOTED ON THE DRAWINGS ROUTE ALL CONDUCTORS IN CONDUIT.
- C. UNLESS OTHERWISE NOTED, ALL SIGNAL SYSTEMS SHALL HAVE THEIR WIRING INSTALLED IN CONDUIT/RACEWAYS. CONDUIT ROUTING AND DEVICE WIRING FOR SIGNAL SYSTEM COMPONENTS IS NOT SHOWN ON THE DRAWINGS. THE CONTRACTOR SHALL COORDINATE WITH THE SIGNAL SYSTEM MANUFACTURER TO DETERMINE THE CONDUIT (SIZE AND ROUTING) AND WIRING REQUIREMENTS TO CIRCUIT THE EQUIPMENT SHOWN ON THE DRAWINGS.
- D. SPECIFIED PRODUCTS AND THEIR AREAS OF USE SHALL BE AS FOLLOWS:
- 1. SERVICE ENTRANCE: IMC, GRS, SCHED 40 PVC (WITH GRS 90 ELBOWS). IMC AND GRS TO HAVE BITUMINOUS COATING IF INSTALLED BELOW
- 3. BRANCH CIRCUITS CONCEALED ABOVE CEILING/IN WALLS: EMT, IMC, GRS, AC/MC (WHERE PERMITTED BY CODE, WITH APPROVAL OF OWNER, AND CONCEALED IN WALLS OR ABOVE FINISHED CEILINGS.) 4. BRANCH CIRCUITS EXPOSED (INTERIOR): EMT
- 5. IN OR UNDER CONCRETE FLOORS: SAME AS SERVICE ENTRANCE
- 6. OUTDOORS BELOW GRADE: SAME AS SERVICE ENTRANCE. 7. OUTDOORS EXPOSED: IMC, GRS

2. FEEDERS: EMT, IMC, GRS

8. FINAL CONNECTIONS TO MECHANICAL EQUIPMENT (3' MAX): LIQUID TIGHT FLEXIBLE METAL CONDUIT (TYPE LFMC) IN DAMP AND WET LOCATIONS, FLEXIBLE METAL CONDUIT IN DRY LOCATIONS. 9. LIGHT FIXTURE WHIPS (3' MAX): AC/MC CABLE IN DRY LOCATIONS.

F. FITTINGS SHALL BE COMPRESSION TYPE, CONCRETE TIGHT FOR ALL EMT RACEWAYS. FOR PVC RACEWAYS, USE SLIP FITTINGS WITH GLUE JOINTS. FOR RIGID GALVANIZED STEEL AND IMC, FITTINGS SHALL BE THREADED GALVANIZED IRON, HEAVY STEEL, CONCRETE TIGHT.

F. SIZE CONDUIT FOR CONDUCTOR TYPE INSTALLED; 3/4 INCH MINIMUM SIZE.

G. FOR ALL EMPTY RACEWAYS, FURNISH AND INSTALL A NYLON PULL CORD. THE NYLON PULL CORD SHALL BE RATED FOR A 200 POUND FORCE PULL STRENGTH.

4. WIRE AND CABLE - 600 VOLTS AND LESS

A. WORK SHALL INCLUDE THE FURNISHING AND INSTALLING OF ALL REQUIRED WIRE AND CABLE TO COMPLETE THE WIRING AND ELECTRICAL SYSTEM. THIS SHALL INCLUDE, BUT NOT BE LIMITED TO THE FOLLOWING: 1. BUILDING WIRE.

2. WIRING CONNECTIONS AND TERMINATIONS.

B. ALL SERVICE ENTRANCE POWER CABLE SHALL BE TYPE USE, 75 DEGREE C, COPPER CONDUCTOR. FEEDERS AND BRANCH CIRCUITS LARGER THAN 6 AWG: COPPER, STRANDED CONDUCTOR, 600 VOLT INSULATION, THHN. FEEDERS AND BRANCH CIRCUITS 6 AWG AND SMALLER: COPPER CONDUCTOR, 600 VOLT INSULATION, THHN. 6 AND 8 AWG, STRANDED CONDUCTOR; SMALLER THAN 8 AWG, SOLID CONDUCTOR. MINIMUM SIZE SHALL BE #12 FOR ALL WIRING ABOVE 48 VOLTS. ALL CONDUCTORS IN DAMP OR WET LOCATIONS (INCLUDING BELOW GRADE) SHALL BE LISTED FOR THAT USE, THWN-2 OR EQUIVALENT.

- C. ALL CABLES SHALL BE COLOR CODED. COLOR CODING SHALL BE AS FOLLOWS: 208/120 VOLT 480/277 VOLT BROWN ORANGE
- BLUE YELLOW WHITE NEUTRAL WHITE GREEN GROUND GREEN

D. EACH WIRE OR CABLE IN A FEEDER AT ITS TERMINAL POINTS, AND IN EACH PULL-BOX, JUNCTION BOX, AND PANEL GUTTER THROUGH WHICH IT PASSES SHALL BE IDENTIFIED TO SHOW THE CIRCUIT NUMBER OF THE BREAKER THAT IT CONNECTS TO. EACH COMMON WIRE, COMMON CIRCUIT TO COMMON LOOP OF A SYSTEM, FIRE ALARM, SOUND SYSTEM, TV SYSTEM, OR ANY SIGNAL SYSTEM CONDUCTOR, SHALL BE IDENTIFIED.

E. ALL INSTALLATION SHALL BE IN ACCORDANCE WITH THE NEC. ALL SPLICES SHALL BE IN JUNCTION BOXES AND SHALL BE ELECTRICALLY AND MECHANICALLY SECURE. WHERE A CIRCUIT HOME RUN IS SHOWN ON THE PLANS WITHOUT ANY CONDUCTOR OR RACEWAY IDENTIFICATION, IT SHALL BE A MINIMUM OF 2 # 12, 1 # 12 GROUND, 3/4" CONDUIT. PLACE AN EQUAL NUMBER OF CONDUCTORS FOR EACH PHASE OF A CIRCUIT IN SAME RACEWAY OR CABLE. SPLICE ONLY IN JUNCTION OR OUTLET BOXES. NEATLY TRAIN AND LACE WIRING INSIDE BOXES. EQUIPMENT, AND PANELBOARDS. PERFORM CONTINUITY TEST ON ALL POWER AND EQUIPMENT BRANCH CIRCUIT CONDUCTORS. VERIFY PROPER PHASING CONNECTIONS.

5. WIRING DEVICES

A. THE SHALL INCLUDE THE FURNISHING AND INSTALLING OF ANY AND ALL WIRING DEVICES REQUIRED TO MAKE A COMPLETE AND FUNCTIONING WIRING SYSTEM. SEE THE DRAWINGS FOR SYMBOLS AND DESCRIPTIONS OF DEVICES.

B. DUPLEX RECEPTACLE SHALL BE 20 AMPERE, 120 VOLT, 2-POLE, 3-WIRE, NEMA 5-20R. UNIT SHALL BE SELF-GROUNDING, COMPLYING WITH NEMA WD 1 AND NEMA WD 6, AND LISTED AS COMPLYING WITH UL 498, AND WHERE APPLICABLE FS W-C-596; TYPES AND INDICATED ON DRAWINGS. RECEPTACLES SHALL HAVE TERMINAL SCREWS FOR SIDE WIRING OR SCREW ACTUATED BINDING CLAMP FOR BACK WIRING WITH SEPARATE GROUND TERMINAL SCREW. PROVIDE AND INSTALL UNBREAKABLE COVER PLATE ON DRY WALLS (COLOR PER ARCHITECT) OR OVERSIZED BRUSHED ALUMINUM FOR MASONRY WALLS.

C. GROUND FAULT RECEPTACLE SHALL COMPLY WITH REQUIREMENTS OF DUPLEX RECEPTACLE ABOVE, SHALL BE RECTANGULAR DECORATOR STYLE AND SHALL BE SELF-TESTING, WITH FEED THROUGH PROTECTION AND LIGHT TO INDICATE GROUND FAULT TRIPPED CONDITION AND LOSS OF PROTECTION: LISTED AS COMPLYING WITH UL 943, CLASS A.

D. LIGHT SWITCHES SHALL BE 20 AMPERE, 120-277 VOLT, INDUSTRIAL SPECIFICATION GRADE, COMPLYING WITH NEMA WD 1 AND NEMA WD 6, AND LISTED AS COMPLYING WITH UL 20 AND WHERE APPLICABLE, FS W-S-896; WITH STANDARD TOGGLE TYPE SWITCH ACTUATOR AND MAINTAINED CONTACTS: SINGLE POLE SINGLE THROW, DOUBLE POLE SINGLE THROW, THREE WAY, OR FOUR WAY AS INDICATED ON THE DRAWINGS. SWITCHES SHALL HAVE TERMINAL SCREWS FOR SIDE WIRING OR SCREW ACTUATED BINDING CLAMP FOR BACK WIRING WITH SEPARATE GROUND TERMINAL SCREW. PROVIDE AND INSTALL UNBREAKABLE COVER PLATE ON DRY WALLS (COLOR PER ARCHITECT) OR OVERSIZED BRUSHED ALUMINUM FOR

E. WALL DIMMERS SHALL BE SOLID-STATE WITH CONTINUOUS FULL-RANGE EVEN CONTROL FOLLOWING SQUARE LAW DIMMING CURVE, INTEGRAL RADIO FREQUENCY INTERFERENCE FILTERING. POWER FAILURE PRESET MEMORY. AIR GAP SWITCH ACCESSIBLE WITHOUT REMOVING WALL PLATE. COMPLYING WITH NEMA WD 1 AND NEMA WD 6, AND LISTED AS COMPLYING WITH UL 1472; TYPES AND RATINGS SUITABLE FOR LOAD CONTROLLED AS INDICATED ON THE DRAWINGS. DIMMERS SHALL HAVE TERMINAL SCREWS FOR SIDE WIRING OR SCREW ACTUATED BINDING CLAMP FOR BACK WIRING WITH SEPARATE GROUND TERMINAL SCREW. PROVIDE AND INSTALL UNBREAKABLE COVER PLATE ON DRY WALLS (COLOR PER ARCHITECT) OR OVERSIZED BRUSHED ALUMINUM FOR MASONRY WALLS. PROVIDE ACCESSORY WALL SWITCHES TO MATCH DIMMER APPEARANCE WHEN INSTALLED ADJACENT TO EACH OTHER.

F. INSTALLATION SHALL BE PER NEC. INCLUDE GROUND WIRE AND CONNECTION WITH ALL RECEPTACLE CIRCUITS. QUADRAPLEX RECEPTACLES SHALL BE TWO DUPLEX RECEPTACLES INSTALLED IN A TWO GANG BOX. INSTALL WALL SWITCHES 48 INCHES ABOVE FLOOR, OFF POSITION DOWN. INSTALL WALL DIMMERS 48 INCHES ABOVE FLOOR; DERATE GANGED DIMMERS AS INSTRUCTED BY MANUFACTURER; DO NOT USE COMMON NEUTRAL. INSTALL CONVENIENCE RECEPTACLES 18 INCHES ABOVE FLOOR, 6 INCHES ABOVE COUNTER, BACK SPLASH, GROUNDING POLE ON TOP. INSTALL DEVICES AND WALL PLATES FLUSH AND LEVEL. PROVIDE GROUND FAULT RECEPTACLE IN AREAS WHERE THE NEC REQUIRES GFCI DEVICES, GROUND FAULT RECEPTACLE SHALL NOT BE CIRCUITED TO PROTECT NON GROUND FAULT RECEPTACLES OR DEVICES.

6. PANELBOARDS

A. THIS SECTION INCLUDES FURNISHING AND INSTALLING PANELBOARDS AND RELATED EQUIPMENT TO FORM A COMPLETE AND FUNCTIONING ELECTRICAL SYSTEM. THIS SHALL INCLUDE, BUT NOT BE LIMITED TO THE FOLLOWING: 1. SERVICE AND DISTRIBUTION PANELBOARDS. 2. LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS.

B. PANELBOARDS SHALL BE AS MANUFACTURED BY GENERAL ELECTRIC, CUTLER—HAMMER, OR SQUARE D.

C. PROVIDE CABINET FRONT WITH CONCEALED TRIM CLAMPS, AND HINGED DOOR WITH FLUSH LOCK. FINISH IN MANUFACTURER'S STANDARD GRAY ENAMEL. PROVIDE PANELBOARDS WITH COPPER BUS, RATINGS AS SCHEDULED. PROVIDE COPPER GROUND BUS IN ALL PANELBOARDS. MINIMUM INTEGRATED SHORT CIRCUIT RATING: SEE DRAWINGS. MOLDED CASE CIRCUIT BREAKERS SHALL BE UL 489 LISTED; PROVIDE CIRCUIT BREAKERS WITH INTEGRAL THERMAL AND INSTANTANEOUS MAGNETIC TRIP IN EACH POLE. PROVIDE CIRCUIT BREAKERS UL LISTED AS TYPE HACR FOR AIR CONDITIONING EQUIPMENT BRANCH CIRCUITS. ALL BREAKERS SHALL BE BOLT ON TYPE.

B. FURNISH AND INSTALL ALL REQUIRED MATERIALS TO INSTALL AND MOUNT THE PANELBOARDS TO THE WALL SHOWN ON THE DRAWINGS. INSTALL PANELBOARDS PLUMB AND FLUSH WITH WALL FINISHES. IN CONFORMANCE WITH NEMA PB 1.1. PROVIDE FILLER PLATES FOR UNUSED SPACES IN PANELBOARDS. STUB 5 EMPTY ONE INCH CONDUITS TO ACCESSIBLE LOCATION ABOVE CEILING AND BELOW FLOOR OUT OF EACH PANELBOARD. PROVIDE TYPED CIRCUIT DIRECTORY FOR EACH CIRCUIT BREAKER IN EACH PANELBOARD. VISUAL AND MECHANICAL INSPECTION: INSPECT FOR PHYSICAL DAMAGE, PROPER ALIGNMENT, ANCHORAGE, AND GROUNDING. CHECK PROPER INSTALLATION AND TIGHTNESS OF CONNECTIONS FOR CIRCUIT BREAKERS, FUSIBLE SWITCHES, AND FUSES.

7. SECONDARY GROUNDING

A. WORK INCLUDED SHALL INCLUDE POWER SYSTEM GROUNDING, COMMUNICATION SYSTEM GROUNDING, AND ELECTRICAL EQUIPMENT AND RACEWAY GROUNDING AND BONDING. GROUND ELECTRICAL WORK IN ACCORDANCE WITH NEC ARTICLE 250, LOCAL CODES AS SPECIFIED HEREIN, AND AS

B. GROUND THE ELECTRICAL SERVICE SYSTEM NEUTRAL AT SERVICE ENTRANCE EQUIPMENT TO METALLIC WATER SERVICE AND TO SUPPLEMENTARY GROUNDING ELECTRODES. PROVIDE COMMUNICATIONS SYSTEM GROUNDING CONDUCTOR AT POINT OF SERVICE ENTRANCE. BOND TOGETHER SYSTEM NEUTRALS, SERVICE EQUIPMENT ENCLOSURES, EXPOSED NON-CURRENT CARRYING METAL PARTS OF ELECTRICAL EQUIPMENT, METAL RACEWAY SYSTEMS, GROUNDING CONDUCTOR IN RACEWAYS AND CABLES, RECEPTACLE GROUND CONNECTORS, AND PLUMBING SYSTEMS.

C. PROVIDE A GROUNDING SYSTEM THAT INCLUDES ALL CONNECTIONS AND TESTING OF: GROUND RODS, GROUND CABLES, GROUND BUSES, CONDUITS, FITTINGS, ANCHORS, SUPPORTS, CADWELD(R) MATERIALS AND EQUIPMENT, AND OTHER MATERIALS AS REQUIRED FOR A COMPLETE INSTALLATION. PROVIDE GROUND CABLES COMPOSED OF SOFT DRAWN, STRANDED BARE COPPER OF 98 PERCENT CONDUCTIVITY ENCASED IN NONMETALLIC CONDUIT ABOVE GRADE. CABLE TO BE BURIED BELOW FROST LEVEL, BUT NOT LESS THAN 24 INCHES BELOW GRADE. INSTALL AS REQUIRED TO PROVIDE SUFFICIENT MECHANICAL PROTECTION. ALL COPPER TO COPPER AND COPPER TO STEEL CONNECTIONS OF #6 AWG AND LARGER SHALL BE MADE WITH THE CADWELD(R).

D. GROUND RODS: COPPER-ENCASED STEEL, 3/4 INCH DIAMETER, MINIMUM LENGTH 10 FEET. NUMBER AS REQUIRED TO ACHIEVE 5 OHMS

- E. PROVIDE A SEPARATE, INSULATED EQUIPMENT GROUNDING CONDUCTOR IN FEEDER AND BRANCH CIRCUITS. TERMINATE EACH END ON A GROUNDING LUG, BUS, OR BUSHING. CONNECT GROUNDING ELECTRODE CONDUCTORS TO METAL WATER PIPE USING A SUITABLE GROUND CLAMP. MAKE CONNECTIONS TO FLANGED PIPING AT STREET SIDE OF FLANGE. PROVIDE BONDING JUMPER AROUND WATER METER. SUPPLEMENTARY GROUNDING ELECTRODE: USE DRIVEN GROUND ROD ON EXTERIOR OF BUILDING. PROVIDE GROUNDING AND BONDING AT METERING EQUIPMENT.
- F. INSTALL GROUND CABLES CONTINUOUS BETWEEN CONNECTIONS. SPLICES WILL NOT BE ALLOWED EXCEPT WHERE INDICATED ON THE DRAWINGS. CONNECTIONS MADE BY THE CADWELD(R) PROCESS ARE NOT CONSIDERED SPLICES. WHERE GROUND CABLES PASS THROUGH FLOOR SLABS, BUILDING WALLS, ETC., AND ARE NOT IN METALLIC ENCLOSURES, PROVIDE THE SLEEVES OF APPROVED NONMETALLIC MATERIAL.

G. INSTALL EQUIPMENT GROUNDING CONDUCTORS IN RACEWAY WITH FEEDER AND BRANCH CIRCUIT CONDUCTORS. GROUND INTERIOR LIGHTING FIXTURES WITH GROUNDING CONDUCTOR TO RIGID METAL RACEWAYS SERVING THEM. FLEXIBLE METAL CONDUIT SHALL HAVE A GROUND WIRE INSTALLED WITH THE POWER CONDUCTORS. WHERE CONNECTIONS ARE MADE TO MOTORS OR EQUIPMENT WITH FLEXIBLE METAL CONDUIT, GROUNDING CONDUCTOR SHALL BE STRANDED COPPER CONDUCTOR WITHIN THE CONDUIT, BONDED TO THE EQUIPMENT AND TO THE RIGID METAL RACEWAY SYSTEM. AT EACH CONVENIENCE OUTLET, INSTALL A GROUNDING CLIP ATTACHED TO THE OUTLET BOX AND LEAVE A SUFFICIENT LENGTH OF #12 WIRE WITH GREEN COLORED INSULATION TO CONNECT TO THE GROUNDING TERMINAL OF THE RECEPTACLE.

H. FIRE ALARM AND DETECTION — PROVIDE ONE NO. 6 AWG THW IN 1/2 INCH CONDUIT TO NEAREST GROUND BUS. TELEVISION DISTRIBUTION SYSTEM - PROVIDE ONE NO. 6 AWG THW IN 1/2 INCH CONDUIT TO NEAREST GROUND BUS.

- 8. FIRE ALARM AND DETECTION SYSTEM
- A. FURNISH AND INSTALL A COMPLETE AND WORKING FIRE ALARM SYSTEM FOR THE FACILITY AS SHOWN ON THE DRAWINGS. THIS SHALL INCLUDE, BUT IN NO WAY BE LIMITED TO THE FOLLOWING:
- 2. PULL STATIONS
- 3. A/V UNITS (HORNS WITH FLASHING STROBE LIGHTS). 4. VISUAL UNITS (FLASHING STROBE ONLY).
- 5. SMOKE DETECTORS.

1. FIRE ALARM CONTROL PANEL.

- 6. SHUT DOWN OF ALL CENTRAL HVAC UNITS.
- 7. AUTOMATIC REPORTING SYSTEM OF ALL ALARMS TO THE LOCAL FIRE DEPARTMENT. 8. DUCT DETECTORS (DUCT DETECTORS SHALL BE FURNISHED BY DIVISION 26, INSTALLED BY DIVISION 23, AND WIRED BY DIVISION 26. FIELD COORDINATE).

B. CONDUIT ROUTING AND DEVICE WIRING IS NOT SHOWN ON THE DRAWINGS. THE ELECTRICAL CONTRACTOR SHALL COORDINATE WITH THE FIRE ALARM MANUFACTURER TO DETERMINE THE CONDUIT (SIZE AND ROUTING) AND WIRING REQUIREMENTS TO CIRCUIT THE EQUIPMENT SHOWN ON THE

- C. THE TOTAL FIRE ALARM SYSTEM SHALL COMPLY WITH ALL NATIONAL, STATE, AND LOCAL CODES. THIS SHALL INCLUDE, BUT NOT BE LIMITED TO THE FOLLOWING:
- 1. NATIONAL ELECTRIC CODE

5. ANSI ELEVATOR CODE

WITH MECHANICAL SECTION.

- 2. INTERNATIONAL FIRE CODE 3. ALL NFPA CODES
- 4. AMERICANS WITH DISABILITIES ACT (ADA)
- D. EDWARDS, SIMPLEX AND NOTIFIER, ARE ACCEPTABLE.

E. THE SYSTEM OPERATION SHALL INCLUDE INDIVIDUAL ZONE SUPERVISION, ANNUNCIATION BY ZONE, BATTERY STANDBY POWER, DOUBLE SUPERVISION, AND NON-CODED, CONTINUOUS RINGING, WITH AUTOMATIC REPORTING OF ALARMS TO THE LOCAL FIRE DEPARTMENT. ELECTRICAL SUPERVISION SHALL INCLUDE ALL ALARM INITIATING CIRCUITS. ALL AUDIBLE AND VISUAL ALARM SIGNAL CIRCUITS. ALL POWER SUPPLIES. AUTOMATIC REPORTING SYSTEM, SUPERVISORY POWER AND OPERATING POWER. FAILURE OF ANY SUPERVISED CIRCUIT SHALL OPERATE THE SYSTEM TROUBLE SIGNALS. FURNISH AUDIBLE TROUBLE SIGNAL SILENCING SWITCHES WITH RING BACK OR AUTOMATIC RESET FEATURE. ALARM INITIATING CIRCUITS SHALL BE CLASS B SUPERVISED. ANY 'OFF-NORMAL' CONDITION OF ANY SWITCH IN THE SYSTEM SHALL OPERATE THE SYSTEM TROUBLE SIGNALS.

- F. OPERATION OF ANY MANUAL STATION OR AUTOMATIC DETECTOR IN THE SYSTEM SHALL: 1. SOUND ALL AUDIBLE ALARM HORNS IN THE SYSTEM UNTIL RESET PROCEDURES ARE INITIATED.
- 2. ILLUMINATE THE PROPER ZONE ALARM LAMP ON THE CONTROL PANEL. 3. FLASH ALL VISUAL ALARM INDICATORS. WHEN ALARM HORNS ARE SOUNDING.
- 4. SHUT DOWN ALL CENTRAL HVAC AIR HANDLING EQUIPMENT. 5. AUTOMATICALLY NOTIFY THE LOCAL FIRE DEPARTMENT. INCLUDE ANY AND ALL EQUIPMENT REQUIRED TO ACCOMPLISH THIS REQUIREMENT. ANY

AND ALL EQUIPMENT SHALL COMPLY WITH REQUIREMENTS OF THE LOCAL FIRE DEPARTMENT AS TO AUTOMATIC REPORTING.

- G. FIRE ALARM CONTROL PANEL (FACP) SHALL BE MOUNTED AS INDICATED ON PLANS, AND SHALL CONTAIN: 1. ALARM INITIATING ZONES WITH ONE ALARM LAMP AND ONE TROUBLE LAMP PER ZONE, ALTERNATIVELY, A DIGITAL DISPLAY PROVIDING INDICATION OF ZONES IN ALARM AND TROUBLE MAY BE UTILIZED.. ALL ZONES SHALL BE SMOKE VERIFICATION TYPE, WITH TIME DELAYED VERIFICATION ON
- SMOKE ALARMS. MANUAL STATION OPERATION SHALL INSTANTLY ALARM. 2. AUDIBLE AND VISUAL ALARM SYSTEM ZONES AS INDICATED ON PLANS FOR THE INDICATED ALARM HORNS AND VISUAL ALARM INDICATORS, DESIGNED TO SUPERVISE ALL CIRCUIT WIRING.
- 3. TROUBLE CIRCUITRY FOR GROUND DETECTION, OPEN CIRCUIT CONDITIONS, AND OTHER REQUIRED TROUBLE CONDITIONS. 4. 'POWER ON' LAMPS, TROUBLE SILENCING SWITCH(ES), AUDIBLE AND VISUAL TROUBLE INDICATORS, MASTER SMOKE RESET SWITCH, AUXILIARY CONTROL CIRCUITS, ACKNOWLEDGE SWITCHES, AND ALL OTHER REQUIRED CIRCUITRY AND COMPONENTS. 5. STANDBY BATTERIES. BATTERIES SHALL BE RATED FOR 48-HOUR STANDBY AND 10-MINUTE CONTINUOUS ALARM. 6. PROVIDE FAN SHUTDOWN CONTACTS, TO TRANSFER ON ANY ALARM CONDITION. VERIFY POINT OF CONNECTION TO AIR HANDLING EQUIPMENT
- H THE FIRE ALARM MANUAL STATIONS SHALL BE SEMI-FLUSH MOUNTED, NONCODED, DUAL-ACTION TYPE. THE STATION KEY LOCK SHALL MATCH THE CONTROL PANEL CABINET LOCK, AND SHALL BE USED FOR TEST AND RESET.

I. CEILING MOUNTED SMOKE DETECTORS SHALL BE PHOTOELECTRIC TYPE, WITH INTEGRAL ALARM INDICATOR LAMP. EACH DETECTOR SHALL CONTAIN AN INTERNAL TEST CONNECTION AND SENSITIVITY ADJUSTMENT TO PROVIDE CONTINUOUSLY VARIABLE SENSITIVITY SETTINGS.

J. HEAT DETECTORS SHALL BE FIXED TEMPERATURE TYPE. WITH REPLACEABLE HEAT COLLECTOR. RATED AT 135 DEGREES F. (200 DEGREES F. IF INDICATED).

K THE AIR DUCT SMOKE DETECTOR SHALL BE INSTALLED WHERE SHOWN ON THE DRAWINGS AND SHALL SAMPLE AIR AND ALLOW FOR THE DETECTION OF SMOKE AND COMBUSTION PARTICLES. AIR SAMPLING SHALL BE ACCOMPLISHED THROUGH SAMPLING AND RETURN TUBES WHICH EXTEND INTO THE AIR DUCT. THE SAMPLING TUBE SHALL EXTEND THE FULL WIDTH OF THE DUCT (COORDINATE WITH THE HVAC PLANS TO DETERMINE ALL DUCT WIDTHS) WHILE THE RETURN TUBE SHALL SET AT ONE-HALF THE TUBE WIDTH, OR 12 INCHES, WHICH EVER IS LESS. THE AIR DUCT SMOKE DETECTOR SHALL ACTUALLY BE PHOTOELECTRIC TYPE, MOUNTED IN A DEDICATED, SEPARATE HOUSING.

ALARM SIGNAL DEVICES SHALL BE COMBINATION AUDIOVISUAL HORN/LAMP UNITS, SEMI-FLUSH MOUNTED WITH HORN MECHANISM AND STROBE LAMP ASSEMBLY. BOTH HORN AND LAMP SHALL BE DESIGNED FOR CONNECTION TO SUPERVISED CIRCUITS. STROBE LAMP SHALL BE RATED AS SHOWN ON DRAWINGS. THE VISUAL ONLY INDICATOR SHALL BE IDENTICAL TO THE HORN/LAMP UNIT EXCEPT USING THE STROBE ONLY. ALL ALARM SIGNAL DEVICES CONTAINING VISUAL ALARM INDICATORS SHALL HAVE THE "FIRE" LETTERED ON EITHER SIDE OF THE VISUAL PORTION OF THE DEVICE.

M. ALL CONDUCTORS SHALL BE INSTALLED IN METALLIC RACEWAYS. ALL CONDUCTORS SERVING NOTIFICATION DEVICES SHALL BE COPPER, #14 MINIMUM, ALL OTHER CONDUCTORS SHALL BE COPPER #18 MINIMUM. ALL CONNECTIONS TO TERMINALS ON ANY EQUIPMENT IN FIRE ALARM SYSTEM SHALL BE MADE USING SPADE LUGS OF A SUITABLE SIZE AND TYPE FOR THE FURNISHED TERMINAL AND WIRE.

- GUARANTEE OF WORK, EQUIPMENT AND MATERIALS THE COMPLETE SYSTEM SHALL BE FREE OF FAULTS, SHORT CIRCUITS, GROUNDS AND OPEN CIRCUITS. BALANCE LOADS ACROSS PHASES
- TO OBTAIN MINIMUM NEUTRAL CURRENT IN FEEDERS AND BRANCH CIRCUITS. THE ELECTRICAL CONTRACTOR SHALL PERFORM INSPECTIONS AND TEST AS HEREIN SPECIFIED. THE ELECTRICAL CONTRACTOR SHALL PROVIDE ALL MATERIAL, EQUIPMENT, LABOR AND SUPERVISION TO PERFORM SUCH TESTS AND INSPECTIONS. 3. IT IS THE INTENT OF THESE TESTS TO ASSURE THAT ALL TESTED ELECTRICAL EQUIPMENT AND SYSTEMS ARE OPERATIONAL AND WITHIN INDUSTRY AND THE MANUFACTURER'S TOLERANCES AND IS INSTALLED IN ACCORDANCE WITH THE DESIGN SPECIFICATIONS. THE TEST AND INSPECTIONS SHALL DETERMINE SUITABILITY FOR ENERGIZATION. WRITTEN DOCUMENTATION OF THE TESTS AND INSPECTIONS SHALL BE PROVIDED AND SHALL INCLUDE THE COMPANY NAME PERFORMING THE WORK, PROJECT NAME, DATE AND TIME OF TESTS, WEATHER AND HUMIDITY
- B. SYSTEMS AND EQUIPMENT ARE TO BE TESTED AND OPERATED TO VERIFY COMPLIANCE WITH THE REQUIREMENTS OF THE CONTRACT DOCUMENTS AND APPLICABLE CODES.
- EQUIPMENT, SYSTEMS, CONDUCTORS AND DEVICES TO BE TESTED ARE AS FOLLOWS: 1. POWER DISTRIBUTION EQUIPMENT SHOWN ON THE ONE-LINE (POWER RISER) DIAGRAM.
- PROPER TORQUE VALUES ON LUGS AND CONNECTORS. PROPER OPERATION OF EQUIPMENT GROUND FAULT PROTECTIVE DEVICES.
- 2. CONDUCTORS CONDUCTORS RATED 100 AMPERES AND ABOVE.
- PROPER CONDUCTOR AND INSULATION TYPE INSULATION RESISTANCE TEST (MEGGER) AT 1000 VOLTS DC FOR 1 MINUTE OR PER CABLE MANUFACTURER SPECIFICATIONS. MINIMUM INSULATION RESISTANCE VALUES SHALL NOT BE LESS THAN FIFTY (50) MEGOHMS.
- TEST GROUND RESISTANCE USING THE ATTACHED ROD TECHNIQUE (ART) OR THE FALL OF POTENTIAL METHOD ACCORDING TO IEEE 81 AT
- THE SERVICE ENTRANCE. VERIFY PROPER TYPE AND SIZE OF GROUNDING CONDUCTORS AND PROPER GROUND CONNECTIONS. IF GROUND RESISTANCE EXCEEDS 25 OHMS OR VALUES OTHERWISE SPECIFIED IN THE SPECIFICATIONS, EQUIPMENT REQUIREMENTS OR GENERAL OR SPECIAL CONDITIONS NOTIFY THE ENGINEER IMMEDIATELY. THE ELECTRICAL CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING

ALTERNATE AND/OR ADDITIONAL MEANS OF GROUNDING TO REDUCE THE GROUND RESISTANCE TO 25 OHMS OR BELOW AT NO ADDITIONAL COST.

- D. GROUNDING AND GROUND FAULT PERSONNEL PROTECTION
- a. TEST GROUND FAULT RECEPTACLES AND GROUND FAULT BRANCH CIRCUIT BREAKERS. test ten (10) percent of all 120 volt receptacle outlets for proper wiring.
- ALL DEVICES WHICH MUST BE ADJUSTED OR SET TO OPERATE ON A SCHEDULE (TIME CLOCKS, PROGRAM MECHANISMS, ETC.) SHALL BE SET PRIOR TO SUBSTANTIAL COMPLETION TO OPERATE ON SCHEDULES DIRECTED BY THE OWNER. INSTRUCT THE OWNER ON THE PROPER OPERATION OF THESE DEVICES.

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CONTRACTORS SHALL BE AWARE THAT THESE DRAWINGS ARE "DESIGN/BUILD" SCOPE-OF-WORK LEVEL DRAWINGS AND THE CONTRACTOR SHALL FURNISH AND INSTALL ANY AND ALL MATERIALS AND LABOR TO PRODUCE FULLY FUNCTIONA YSTEMS THAT MEET THE DESIGN INTENT, WHETHER SHOWN ON THE PLANS OR NO CONTRACTORS SHALL USE THESE DRAWINGS AS ESTABLISHING A LEVEL OF QUALITY AND REGULATIONS SHALL BE FURNISHED AND INCLUDED IN THE CONTRACTORS MEET CODES AND COMPLY WITH REGULATIONS WILL NOT BE ALLOWED.

consultants

MIDLANDS TECHNICAL COLLEGE

BELTLINE CAMPUS 316 S. BELTLINE BLVD COLUMBIA, SC 29205 project name **AUTO TRAINING FACILITY** AHU REPLACEMENT

H59-N127-FW project number 21060.01

seals/signature

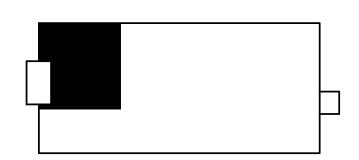




CONSTRUCTION

MARCH 4, 2022

number	item	date





key plan

ELECTRICAL SPECIFICATIONS