PROJECT

CARLYLE HOUSE
HVAC SYSTEM RETROFIT

PROJECT SITE

CARLYLE HOUSE HISTORIC PARK
121 n. Fairfax Street
Alexandria, VA 22314

VOLUME 1 OF 1

ISSUED FOR: 100% CONSTRUCTION DOCUMENTS / PERMIT
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GENERIC HVAC ABBREVIATIONS

(REFER TO CONTROLS LEGEND ABBREVIATIONS FOR ADDITIONAL NOMENCLATURE)

°F	DEGREES FAHRENHEIT
°C	DEGREES CELSIUS
Ø	DIAMETER
AD	ACCESS DOOR
ADA	AMERICANS WITH DISABILITIES ACT
ADJ	ADJUSTABLE
ADDL	ADDITIONAL
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
ALT	ALTERNATE
AP	ACCESS PANEL
ARCH	ARCHITECT
ATC	AUTOMATIC TEMPERATURE CONTROL
ATCC	ATC COMPRESSOR
ATCD	ATC COMPRESSOR DRYER
ATCR	ATC COMPRESSOR RECEIVER
ATV	ATMOSPHERIC VENT
AVG	AVERAGE
BBD	BOILER BLOW DOWN
BDT	BLOWDOWN TANK
BF	BOILER FEED WATER
BFF	BELOW FINISHED FLOOR
BHP	BRAKE HORSEPOWER
BLDG	BUILDING
BLR	BOILER
BOP	BOTTOM OF PIPE
BSMT	BASEMENT
BTU	BRITISH THERMAL UNIT
BTUH	BRITISH THERMAL UNIT PER HOUR
C	CONVECTOR
CA	COMPRESSED AIR
CF	CEILING FAN
CL	CENTERLINE
CLG	CEILING
CO	CLEAN-OUT
COL	COLUMN
COMP	COMPRESSOR
CONC	CONCRETE
CONN	CONNECTION
CONTR	CONTRACTOR
CORR	CORRIDOR
CUF	CUBIC FEET
CUH	CABINET UNIT HEATER
CYL	CYLINDER
D	DRAIN
DB	DRY BULB TEMPERATURE
DC	DRY COOLER
DDC	DIRECT DIGITAL CONTROL
DDCFP	DIRECT DIGITAL CONTROL FIELD PANEL
DIA	DIAMETER
DIM	DIMENSION
DN	DOWN
DWG	DRAWING
EA	EACH
EFF	EFFICIENCY
ECUH	ELECTRIC CABINET UNIT HEATER
ELEC	ELECTRICAL
ELEV	ELEVATION
EMER	EMERGENCY
EMS	ENERGY MANAGEMENT SYSTEM
ENT	ENTERING
EQUIP	EQUIPMENT
EUH	ELECTRIC UNIT HEATER
EXH	EXHAUST
EXP	EXPANSION
FTR	FINNED TUBE RADIATION
FCV	FLOW CONTROL VALVE
FFOP	FIREFIGHTERS OVERRIDE PANEL
FG	FIBERGLASS
FLEX	FLEXIBLE
FLR	FLOOR
FLRDR	FLOOR DRAIN
FP	FIRE PROTECTION
FPM	FEET PER MINUTE
FT	FEET
FT/SEC	FEET PER SECOND
FURN	FURNISHED
FVNR	FULL VOLTAGE NON-REVERSING
G	GAS
GA	GAUGE
GAL	GALLONS
GALV	GALVANIZED
GC	GENERAL CONTRACTOR
GND	GROUND
GPH	GALLONS PER HOUR
GPM	GALLONS PER MINUTE
GRD	GRADE (GROUND LEVEL)
GWB	GYPSUM WALL BOARD
H	HEIGHT
HCPD	HANDICAPPED
HD	HEAD
HP	HORSEPOWER
HPG	HIGH PRESSURE GAS
HR	HOUR
HZ	HERTZ
HX	HEAT EXCHANGER
ID	INSIDE DIAMETER
IN	INCHES
INSUL	INSULATION
KW	KILOWATT
KVA	KILOVOLT AMPERE
L	LENGTH
LB	POUND
LAB	LABORATORY
LF	LINEAR FEET
LVG	LEAVING
M	ONE THOUSAND
MAX	MAXIMUM
MBH	THOUSAND BRITISH THERMAL UNITS PER HOUR
MCA	MINIMUM CIRCUIT AMPS
MCC	MOTOR CONTROL CENTER
MECH	MECHANICAL
MEZZ	MEZZANINE
MFR	MANUFACTURER
MH	MANHOLE
MIN	MINIMUM
MOCP	MAXIMUM OVER CURRENT PROTECTION
MTD	MOUNTED
MU	MAKEUP WATER
N/A	NOT APPLICABLE
NC	NORMALLY CLOSED
NC	NOISE CRITERIA
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN
NO.	NUMBER
NOM	NOMINAL
NTS	NOT TO SCALE
OB	OCTAVE BAND
OC	ON CENTER
OD	OUTSIDE DIAMETER
ODP	OPEN DRIP PROOF
OFCI	OWNER FURNISHED CONTRACTOR INSTALLED
OFOI	OWNER FURNISHED OWNER INSTALLED
OV	OUTLET VELOCITY
PCF	POUNDS PER CUBIC FOOT
PD	PRESSURE DROP
PH	PHASE
PLBG	PLUMBING
POS	PROVIDED BY OTHER SECTION(S)
PRESS	PRESSURE
PRIM	PRIMARY
PSIA	POUNDS PER SQUARE INCH ABSOLUTE
PSID	POUNDS PER SQUARE INCH DIFFERENTIAL
PSIG	POUNDS PER SQUARE INCH GAUGE
PVC	POLYVINYL CHLORIDE
REP	REPRESENTATIVE
RET	RETURN
REQD	REQUIRED
REQS	REQUIREMENTS
RH	RELATIVE HUMIDITY
RM	ROOM
RPM	REVOLUTIONS PER MINUTE
SCCR	SHORT CIRCUIT CURRENT RATING
SCH	SCHEDULE
SOV	SOLENOID OPERATED VALVE
SPECS	SPECIFICATIONS
SQ	SQUARE
SQFT	SQUARE FEET
SS	STAINLESS STEEL
STD	STANDARD
STDBY	STANDBY
STL	STEEL
SUCT	SUCTION
SUP	SUPPLY
TA	THROW-AWAY
TAV	THERMOSTATIC AIR VENT
TEFC	TOTALLY ENCLOSED FAN COOLED
TEL	TELEPHONE
TEMP	TEMPERATURE
TOD	TOP OF DUCT
TOP	TOP OF PIPE
TYP	TYPICAL
UH	UNIT HEATER
V	VENT
VEL	VELOCITY
VERT	VERTICAL
VFC	VARIABLE FREQUENCY CONTROLLER
VTR	VENT THROUGH ROOF
W	WIDTH
W/	WITH
W/O	WITHOUT
WB	WET BULB TEMPERATURE
WF	WIDE FLANGE
WG	WATER GAUGE
WRT	WITH RESPECT TO
X	EXISTING EQUIPMENT TO BE REMOVED
XM	EXISTING EQUIPMENT TO REMAIN
XN	NEW LOCATION OF RELOCATED EQUIPMENT
XR	EXISTING EQUIPMENT TO BE RELOCATED

HYDRONIC SYSTEM SPECIFIC ABBREVIATIONS

ACV	AUTOMATIC CONTROL VALVE
AS	AIR SEPARATOR
AAV	AUTOMATIC AIR VENT
CH	CHILLER
CHEM	CHEMICAL FEED
CHW	CHILLED WATER
CHWR	CHILLED WATER RETURN
CHWS	CHILLED WATER SUPPLY
CT	COOLING TOWER
CTBD	COOLING TOWER BLOW DOWN
CTW	COOLING TOWER WATER
CTWR	COOLING TOWER WATER RETURN
CTWS	COOLING TOWER WATER SUPPLY
CWR	CONDENSER WATER RETURN
CWS	CONDENSER WATER SUPPLY
DOV	DRAIN OFF VALVE
ET	EXPANSION TANK
EWT	ENTERING WATER TEMPERATURE
GR	GLYCOL RETURN
GS	GLYCOL SUPPLY
HB	HOSE BIBB CONN W/CHAINED CAP
HCR	HOT OR COLD WATER RETURN (DUAL TEMP)
HCS	HOT OR COLD WATER SUPPLY (DUAL TEMP)
HRC	HEAT RECOVERY COIL - GLYCOL
HW	HOT WATER
HWCUH	HOT WATER CABINET UNIT HEATER
HWHC	HOT WATER HEATING COIL
HWPHC	HOT WATER PREHEAT COIL
HWRHC	HOT WATER REHEAT COIL
HWR	HOT WATER RETURN
HWS	HOT WATER SUPPLY
HWUH	HOT WATER UNIT HEATER
LWT	LEAVING WATER TEMPERATURE
MAV	MANUAL AIR VENT
NPSH	NET POSITIVE SUCTION HEAD
OS&Y	OUTSIDE STEM AND YOKE
P	PUMP
PHX	PLATE HEAT EXCHANGER
PROCHW	PROCESS CHILLED WATER
PROCHWR	PROCESS CHILLED WATER RETURN
PROCHWS	PROCESS CHILLED WATER SUPPLY
REFG	REFRIGERANT PIPING
S(XXX)	SECONDARY (SYSTEM DEPENDANT PREFIX)
T(XXX)	TERTIARY (SYSTEM DEPENDANT PREFIX)
TDH	TOTAL DYNAMIC HEAD
UV	UNIT VENTILATOR
WCC	WATER COOLED CONDENSER
WCCU	WATER COOLED CONDENSING UNIT

ALTERNATE HYDRONIC PIPING SYSTEM LABELING:

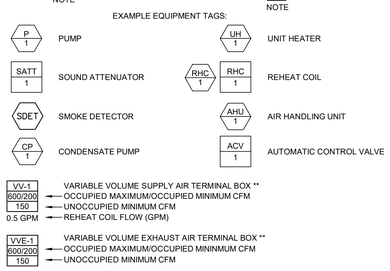
HWS180	HOT WATER SUPPLY 180 DEG F SYSTEM
HWR180	HOT WATER RETURN 180 DEG F SYSTEM
CHWS42	CHILLED WATER SUPPLY 42 DEG F SYSTEM
CHWR42	CHILLED WATER RETURN 42 DEG F SYSTEM

AIR SYSTEM SPECIFIC ABBREVIATIONS

AC	AIR CONDITIONING
ACC	AIR COOLED CONDENSER
ACCU	AIR COOLED CONDENSING UNIT
ACD	AUTOMATIC CONTROL DAMPER
ACU	AIR CONDITIONING UNIT
AF	AIR FOIL
AHU	AIR HANDLING UNIT
ALD	ACOUSTICALLY LINED DUCTWORK
ATD	AIR TERMINAL DEVICE
AVS	AIR VOLUME TRAVERSE STATION
BDD	BACKDRAFT DAMPER
BI	BACKWARD INCLINED
BOD	BOTTOM OF DUCT
CACU	COMPUTER ROOM AIR CONDITIONING UNIT
CC	COOLING COIL
CD	CEILING DIFFUSER
CFM	CUBIC FEET PER MINUTE
CG	CEILING GRILLE
DD	DUAL DUCT SUPPLY AIR TERMINAL
DIFF	DIFFUSER
DWDI	DOUBLE WIDTH DOUBLE INLET
DWSI	DOUBLE WIDTH SINGLE INLET
DX	DIRECT EXPANSION
EAT	ENTERING AIR TEMPERATURE
EF	EXHAUST FAN
EG	EXHAUST GRILLE
EHC	ELECTRICAL HEATING COIL
EPHC	ELECTRIC PREHEAT COIL
ER	EXHAUST REGISTER
ERHC	ELECTRIC REHEAT COIL
ESP	EXTERNAL STATIC PRESSURE
F	FAN
F&B	FACE AND BYPASS
FB	FAN BOX
FC	FORWARD CURVED
FA	FREE AREA
FCU	FAN COIL UNIT
FD	FIRE DAMPER (W/ ACCESS DOOR)
FLTR	FILTER
FPI	FINS PER INCH
GE	GENERAL EXHAUST
GH	GRAVITY HOOD
HC	HEATING COIL
HEGA	HIGH EFFICIENCY GAS ABSORBER AIR FILTER
HEPA	HIGH EFFICIENCY PARTICULATE AIR FILTER
HPU	HEAT PUMP UNIT
HRU	HEAT RECOVERY UNIT
HV	HEATING & VENTILATING UNIT
HU	HUMIDIFIER
IH	INTAKE HOOD
LAT	LEAVING AIR TEMPERATURE
LD	LINEAR DIFFUSER
LUVR	LOUVER
LVDR	LOUVERED DOOR
OA	OUTSIDE AIR
OAI	OUTSIDE AIR INTAKE
OBD	OPPOSED BLADE DAMPER
OED	OPEN END DUCT
PHC	PREHEAT COIL
RA	RETURN AIR
RD	REFRIGERANT DISCHARGE (HOT GAS)
RF	RETURN FAN
RG	RETURN GRILLE
RHC	REHEAT COIL
RL	REFRIGERANT LIQUID
RLF	RELIEF
RR	RETURN REGISTER
RS	REFRIGERANT SUCTION
RTU	ROOF TOP UNIT
RV	ROOF VENT
SA	SUPPLY AIR
SATT	SOUND ATTENUATOR
SCR	SCREEN
SD	SMOKE DAMPER
SDET	SMOKE DETECTOR
SEF	SMOKE EXHAUST FAN
SF	SUPPLY FAN
SFD	COMBINATION AUTOMATIC SMOKE/FIRE DAMPER
--	WITH ACCESS DOOR
SG	SUPPLY GRILLE
SGD	SLIDE GATE DAMPER
SM	SHEETMETAL
SP	STATIC PRESSURE
SR	SUPPLY REGISTER
SWDI	SINGLE WIDTH DOUBLE INLET
SWSI	SINGLE WIDTH SINGLE INLET
TE	TOILET EXHAUST
TF	TRANSFER FAN
TG	TRANSFER GRILLE
TR	TRANSFER
TSP	TOTAL STATIC PRESSURE
UC	UNDERCUT DOOR
VD	VOLUME DAMPER
VV	VARIABLE VOLUME SUPPLY AIR TERMINAL BOX
VVE	VARIABLE VOLUME EXHAUST AIR TERMINAL BOX
WMS	WIRE MESH SCREEN

EQUIPMENT TAG SYMBOLS & ABBREVIATIONS

EXAMPLE EQUIPMENT TAGS:



** NOTE: CONSTANT VOLUME BOX INDICATED WHEN MAX AND MIN CFM'S ARE EQUAL

HVAC GENERAL NOTES

GENERAL:

1. HVAC GENERAL NOTES, SYMBOLS LIST AND DETAILS ARE APPLICABLE TO ALL "M" SERIES DRAWINGS.
2. DRAWINGS ARE DIAGRAMMATIC AND ARE INTENDED TO INDICATE CAPACITY, SIZE, APPROXIMATE LOCATION AND GENERAL ARRANGEMENT. DETERMINE EXACT LOCATION OF SYSTEMS AND COMPONENTS IN FIELD.
3. DRAWINGS CANNOT BE FULLY AND CORRECTLY INTERPRETED WITHOUT REFERENCE TO LEGENDS, DETAILS, SCHEDULES AND SPECIFICATIONS. IT IS THE INTENT OF THE DRAWINGS TO SHOW THE INSTALLATION, AS DETAILED BY THE TYPICAL ARRANGEMENTS. ITEMS SHOWN ONCE ON FLOOR PLANS, ELEVATIONS, DETAILS OR DIAGRAMS MAY NOT BE REPEATED IN FULL FOR OTHER TYPICAL INSTANCES.
4. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.
5. PROVIDE INFORMATION AND HARDWARE TO COORDINATE CONCRETE PADS AND STEEL PLATFORMS REQUIRED FOR MECHANICAL WORK.
6. COORDINATE ROOF AND WALL PENETRATIONS WITH WORK OF OTHER SECTIONS AND WITH FLASHING REQUIREMENTS. COORDINATE SLAB PENETRATIONS WITH WORK OF OTHER SECTIONS AND WITH EXISTING POST-TENSION CABLES.
7. RUN DUCTS AND PIPING CONCEALED, UNLESS SPECIFIED OTHERWISE, AND CLEAR OF CEILING INSERTS. ALL DUCTWORK SHALL BE INSTALLED AS CLOSE AS POSSIBLE TO WALL AND UNDERSIDE OF BEAMS AND JOISTS.
8. INSTALL SENSORS (TEMPERATURE, HUMIDITY, CO2, THERMOSTATS) AT LOCATIONS SHOWN ON PLANS OR AS DIRECTED BY ARCHITECT. MOUNTING HEIGHT AFF SHALL COMPLY WITH ADA AND SHALL BE MOUNTED LEVEL WITH ADJACENT SWITCHES (E.G. LIGHT SWITCHES).
9. COORDINATE WORK OF THIS SECTION WITH THAT OF OTHER SECTIONS. ALL WORK SHALL BE COORDINATED WITH ALL TRADES INVOLVED. OFFSETS IN PIPING AND DUCTS (INCLUDING DIVIDED DUCTS) AND TRANSITIONS AROUND OBSTRUCTIONS SHALL BE PROVIDED AT NO ADDITIONAL COST.
10. ACCESS PANELS SHALL BE PROVIDED TO CLEAN COILS AND SERVICE DAMPERS, HEATERS, VALVES AND ALL CONCEALED MECHANICAL EQUIPMENT. PROVIDE ACCESS PANELS THROUGH BUILDING ASSEMBLIES TO SERVICE AND MAINTAIN EQUIPMENT UNLESS SUCH EQUIPMENT IS INSTALLED IN EXPOSED LOCATIONS OR ABOVE LAY-IN CEILINGS. COORDINATE THE LOCATION OF ACCESS DOORS AND PANELS AND VERIFY THE EXACT QUANTITY, SIZE, AND LOCATIONS AFTER THE SYSTEMS AND EQUIPMENT REQUIRING ACCESS HAVE BEEN INSTALLED AND PRIOR TO THE CLOSURE OF THE AFFECTED CEILINGS AND BUILDING ASSEMBLIES. MINIMUM ACCESS PANEL AND DOOR SIZE SHALL BE 18"x18" UNLESS OTHERWISE NOTED. OBTAIN APPROVAL FOR ALL PANEL LOCATIONS FROM ARCHITECT
14. ELEMENTS OF THE WORK SHALL BE INSTALLED IN A MANNER SUCH THAT AT SUBSTANTIAL COMPLETION THE FOLLOWING ITEMS, NEW OR EXISTING SHALL BE "FULLY AND REASONABLY ACCESSIBLE": HVAC CONTROL BOXES, JUNCTION BOXES, VALVES (OF EVERY SHAPE, SORT AND FUNCTION), DDC CONTROL BOXES, ELECTRICAL PANELS, FILTERS, BELTS, WATER COILS, DISCONNECT SWITCHES, AND MAINTENANCE ACCESS ELEMENTS INCLUDING PULL SPACE.
    a. "FULLY AND REASONABLY ACCESSIBLE" SHALL BE DEFINED AS: NATIONAL ELECTRIC CODE REQUIRED CLEARANCE FOR POWERED EQUIPMENT AND CAPABLE OF BEING ACCESSED FOR SERVICE, REPAIR OR REPLACEMENT BY AN AVERAGE SIZED INDIVIDUAL (ON A LADDER IF NECESSARY) AND CAPABLE OF BEING SERVICED OR REMOVED WITHOUT REMOVING OR MODIFYING OR DISTORTING OTHER COMPONENTS OF THE WORK. THE DESIGN INTENT PROVIDES A MINIMUM 2' x 2' x 2' ZONE FOR MAINTENANCE. INCREASE WHERE REQUIRED BY MANUFACTURER INSTALLATION INSTRUCTIONS.
    b. CONFLICT WITH MEETING THESE REQUIREMENTS SHALL BE BROUGHT TO THE ATTENTION OF THE OWNER'S REPRESENTATIVE IN A TIMELY MANNER AND SHALL BE CORRECTED AT NO ADDITIONAL COST.
15. SUPPORT ALL EQUIPMENT, PIPING AND DUCTWORK FROM BUILDING STRUCTURE. PROVIDE VIBRATION ISOLATION. FOR ROTATING EQUIPMENT, DUCTWORK AND PIPING IN ACCORDANCE WITH THE SPECIFICATIONS. PROVIDE TO THE CONSTRUCTION MANAGER OR GENERAL CONTRACTOR A LIST OF ALL WEIGHTS AND METHODS OF SUPPORT FOR COORDINATION. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.
16. ALL CONTROL WIRE AND CONDUIT SHALL COMPLY WITH NATIONAL ELECTRIC CODE AND DIVISION 26.
17. ALL MATERIAL AND EQUIPMENT SHALL BE NEW.

AIR SYSTEM SPECIFIC NOTES:

1. VERIFY ALL EQUIPMENT CONNECTIONS WITH MANUFACTURER CERTIFIED DRAWINGS. VERIFY AND PROVIDE DUCT TRANSITIONS TO FURNISHED EQUIPMENT. FIELD VERIFY AND COORDINATE ALL DIMENSIONS BEFORE FABRICATION.
2. SHEETMETAL FITTINGS SHOWN ARE TO BE PROVIDED. NO SUBSTITUTES SHALL BE ALLOWED WITHOUT PRIOR CONSENT FROM ARCHITECT/ENGINEER.
3. REFER TO SPECIFICATIONS FOR DUCTWORK CONSTRUCTION CLASSES, SEAL, AND LEAKAGE CLASSES.
4. EXTERIOR LOUVERS ARE INDICATED FOR LOCATION ONLY.
5. SMOKE DETECTORS SHALL BE FURNISHED AND WIRED TO THE FIRE ALARM SYSTEM BY DIVISION 28. DIVISION 23 SHALL MOUNT THE DETECTORS IN DUCTWORK, WHERE REQUIRED BY CODE AND DIVISION 23, DIVISION 23 SHALL WIRE THE DETECTORS TO THE BAS SYSTEM AND FAN STARTERS FOR SHUTDOWN.
6. SMOKE DAMPERS SHALL BE UL555S LISTED. FIRE DAMPERS SHALL BE UL555 LISTED. PROVIDE FIRE DAMPERS, SMOKE DAMPERS AND SMOKE/FIRE DAMPERS AND ASSOCIATED ACCESS PANELS WHERE DAMPERS ARE SHOWN ON DRAWINGS IN COMPLIANCE WITH APPLICABLE BUILDING AND MECHANICAL CODES AND NFPA 90A. ACCESS DOOR DIMENSIONS SHALL MEET REQUIREMENTS OF NFPA 90A AND NFPA 80.
7. REFER TO REFLECTED CEILING PLANS FOR EXACT LOCATIONS OF AIR TERMINAL DEVICES.
8. INTERNAL AIR FLOW DIMENSIONS ARE SHOWN FOR DUCTS. CONTRACTOR SHALL INCREASE SIZE FOR LINER IF APPLICABLE.
9. DIFFUSER SIZES SHOWN ARE NECK SIZES; REGISTER AND GRILLE SIZE ARE NOMINAL. REFER TO DIFFUSER SCHEDULE FOR DUCT RUN-OUT SIZES.
10. PROVIDE FLEXIBLE CONNECTIONS ON ALL DUCTS CONNECTING TO FANS AND AIR HANDLING UNITS UNLESS INTERNALLY ISOLATED. ALL DUCTS TO BE GROUNDED ACROSS FLEXIBLE CONNECTION WITH FLEXIBLE COPPER GROUNDING STRAPS.
11. THE INSIDE OF DUCTWORK AND ALL MECHANICAL COMPONENTS VISIBLE THROUGH A GRILLE OR DIFFUSER SHALL BE PAINTED FLAT BLACK.
12. ALL RETURN AIR OPENINGS ABOVE CEILING SHALL BE PROVIDED WITH A 1/2" MESH ALUMINUM SCREEN (80% FREE AREA MINIMUM).
13. INSULATE DUCTWORK: PERFORM TESTS BEFORE INSULATING.
14. ELBOWS IN DUCT SYSTEMS SHALL BE FULL RADIUS (CENTERLINE RADIUS = 1.5 DUCT WIDTH) WHERE SPACE PERMITS. WHERE LIMITED CLEARANCE OCCURS, PROVIDE SHORT RADIUS ELBOW WITH FULL LENGTH SPLITTER VANES PER SMACNA. MITERED (SQUARE) ELBOWS WITH TURNING VANES SHALL NOT BE USED.
15. UNLESS INDICATED OTHERWISE AND AS A MINIMUM PROVIDE 24"x24" MINIMUM SIZE CLEANOUTS IN KITCHEN EXHAUST DUCTS AT CHANGES IN DIRECTION, AT BASES OF RISERS, AND EVERY 10 FEET IN STRAIGHT RUNS.
16. MANUAL DAMPERS ARE NOT SHOWN ON THE DRAWINGS IN ORDER FOR DRAWING CLARITY. PROVIDE MANUAL ADJUSTABLE DAMPERS ON EACH LOW PRESSURE SUPPLY RETURN AND EXHAUST DUCT TAKE OFF, AND AT EACH TAKE OFF TO REGISTERS, GRILLES AND DIFFUSERS.

PIPING SPECIFIC NOTES:

1. VERIFY ALL EQUIPMENT CONNECTIONS WITH MANUFACTURER CERTIFIED DRAWINGS. VERIFY AND PROVIDE FITTINGS TO TRANSITION TO FURNISHED EQUIPMENT CONNECTION SIZES. FIELD VERIFY AND COORDINATE ALL DIMENSIONS BEFORE FABRICATION.
2. ALL CONDENSATE DRAIN LINES SHALL BE PIPED FULL SIZE OF THE UNIT DRAIN OUTLET, WITH "P" TRAP, CONNECTED TO BUILDING DRAINAGE SYSTEMS. SIZE DEPTH OF TRAP FOR ASSOCIATED AIR PRESSURE DIFFERENTIAL. REFER TO DETAIL ON DRAWINGS.
3. PERFORM TEST BEFORE INSULATING PIPING.
4. PROVIDE HANGERS, CLAMPS, OFFSETS, EXPANSION JOINTS, ANCHORS AND GUIDES TO PREVENT STRESS ON PIPING.
5. PROVIDE VENTS AT HIGH POINTS IN PIPING SYSTEMS AND DRAIN VALVES AT LOW POINTS.
6. PROVIDE AT LEAST THREE-ELBOW SWING FOR PIPE TAKE-OFFS TO TERMINAL EQUIPMENT AND RISERS.
7. ISOLATION VALVES IN PIPING SYSTEMS ARE NOT SHOWN ON PLANS (FOR CLARITY) BUT ARE REQUIRED AT ALL PIPE BRANCHES AND CONNECTIONS TO EQUIPMENT REFER TO DETAIL SHEETS AND FLOW DIAGRAMS.
8. PITCH HYDRONIC (WATER) PIPING UPWARD IN DIRECTION OF FLOW. PITCH STEAM AND CONDENSATE PIPING DOWNWARD IN DIRECTION OF FLOW. PITCH FUEL OIL PIPING TOWARD TANK. REFER TO SPECIFICATIONS FOR REQUIRED PITCH (I.E. GRADE OR SLOPE).
9. REFER TO EQUIPMENT SCHEDULES FOR PIPE RUN-OUT SIZES TO INDIVIDUAL PIECES OF EQUIPMENT.

RENOVATION DEMOLITION NOTES

DEMOLITION NOTES

1. SITE VISIT: BEFORE SUBMITTING BID, VISIT AND CAREFULLY EXAMINE SITE TO IDENTIFY EXISTING CONDITIONS AND DIFFICULTIES THAT WILL AFFECT WORK OF THIS SECTION. NO EXTRA PAYMENT WILL BE ALLOWED FOR ADDITIONAL WORK CAUSED BY UNFAMILIARITY WITH SITE CONDITIONS THAT ARE VISIBLE OR READILY CONSTRUED BY EXPERIENCED OBSERVER. SITE VISIT IS PARTICULARLY IMPORTANT BECAUSE THIS IS RENOVATION WORK.
2. EXISTING CONDITIONS AND PREPARATORY WORK: BEFORE STARTING WORK IN A PARTICULAR AREA OF THE PROJECT, VISIT SITE AND EXAMINE CONDITIONS UNDER WHICH WORK MUST BE PERFORMED INCLUDING PREPARATORY WORK DONE UNDER OTHER SECTIONS OR CONTRACTS BY OWNER. REPORT CONDITIONS THAT MIGHT AFFECT WORK ADVERSELY IN WRITING TO ARCHITECT AND OWNER. DO NOT PROCEED WITH WORK UNTIL DEFECTS HAVE BEEN CORRECTED AND CONDITIONS ARE SATISFACTORY. COMMENCEMENT OF WORK SHALL BE CONSTRUED AS COMPLETE ACCEPTANCE OF EXISTING CONDITIONS AND PREPARATORY WORK.
3. DEMOLITION SHALL BE COORDINATED WITH OWNER, ARCHITECT, GENERAL CONTRACTOR, CONSTRUCTION MANAGER AND ENGINEER.
4. PROVIDE MECHANICAL DEMOLITION TERMINATION; CUT, VALVE AND CAP. DROP MECHANICAL DISTRIBUTION TO FLOOR. REMOVAL OF SYSTEM EQUIPMENT SHALL BE BY THE HVAC CONTRACTOR.
5. PROVIDE 2 WEEKS NOTICE TO OWNER OPERATIONS FOR SHUT DOWN OF ANY SERVICES AND/OR SYSTEMS.
6. REFER TO ALL DRAWINGS FOR GENERAL DESCRIPTION OF AREAS REQUIRING DEMOLITION.
7. REFER TO CONSTRUCTION MANAGER INSTRUCTIONS FOR ALL EXISTING EQUIPMENT AND MATERIALS THAT SHALL REMAIN THE PROPERTY OF THE OWNER.
8. ITEMS OF VALUE WHICH ARE NOT DIRECTED TO BE RETURNED TO THE OWNER, SHALL BECOME THE PROPERTY OF THE CONTRACTOR AND SHALL BE REMOVED FROM SITE AND LEGALLY DISPOSED OF. STORAGE OR SALE OF ITEMS ON THE PROJECT SITE IS PROHIBITED.
9. PROTECTION: ENSURE THE SAFE PASSAGE OF PERSONS IN AND AROUND THE BUILDING DURING DEMOLITION. PREVENT INJURY TO PERSONS AND DAMAGE TO PROPERTY. PROVIDE ADEQUATE SHORING AND BRACING TO PREVENT COLLAPSE. IMMEDIATELY REPAIR DAMAGED PROPERTY TO THE CONDITION BEFORE BEING DAMAGED. TAKE EFFECTIVE MEASURES TO PREVENT WINDBLOWN DUST.
10. UTILITIES: MAINTAIN ALL UTILITIES EXCEPT THOSE REQUIRING REMOVAL OR RELOCATION. KEEP UTILITIES IN SERVICE AND PROTECT FROM DAMAGE. DO NOT INTERRUPT UTILITIES SERVING OCCUPIED AREAS WITHOUT FIRST OBTAINING PERMISSION FROM THE CLINET IN WRITING. PROVIDE TEMPORARY SERVICES.
11. DRAWINGS ARE DIAGRAMMATIC ONLY AND REFLECT OVERALL SYSTEM REMOVAL. NOT EVERY ITEM OR COMPONENT OF A SYSTEM IS SHOWN.
12. PROVIDE SHUT DOWN OF SERVICES (FANS, PUMPS, AHUS, ETC.) AND TRACING OF ALL RISERS WITHIN BASE BID.

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Drawing Title

MECHANICAL
LEGEND SHEET #1

COMMONWEALTH OF VIRGINIA
KENNETH M. SCHRAM
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PROFESSIONAL ENGINEER
Prepared by:
12/10/2020

M-001

PIPING LEGEND

- GATE VALVE
- BALL VALVE
- BALL VALVE WITH MEMORY STOP (BALANCING VALVE)
- BALL VALVE WITH HOSE BIBB, CAP & CHAIN (DRAIN VALVES)
- BUTTERFLY VALVE
- BUTTERFLY VALVE WITH MEMORY STOP (BALANCING VALVE)
- GLOBE VALVE
- PLUG VALVE
- PRESSURE REDUCING VALVE
- CHECK VALVE
- STRAINER W/BALL VALVE, HOSE BIBB & CAP (GATE VALVE FOR STEAM)
- FLOAT OPERATED VALVE
- STRAINER, DUPLEX
- ANGLE VALVE (SECTION VIEW)
- ANGLE VALVE (PLAN VIEW)
- STRAINER, BASKET TYPE W/DRAIN VALVE, HOSE BIBB & CAP
- SOLENOID VALVE
- AUTOMATIC CONTROL VALVE, MODULATING ACTUATOR
- AUTOMATIC CONTROL VALVE, TWO POSITION ACTUATOR
- THREE WAY AUTOMATIC CONTROL VALVE, MODULATING ACTUATOR
- THREE WAY AUTOMATIC CONTROL VALVE, TWO POSITION ACTUATOR
- AUTOMATIC FLOW CONTROL VALVE (PRESSURE INDEPENDENT)
- COMBINATION FLOWMETER/SHUT OFF/BALANCING VALVE (CIRCUIT SETTER)
- FM — FLOW MEASURING DEVICE
- FLOW SWITCH
- SAFTEY RELIEF VALVE
- UNION OR FLANGE (AS INDICATED BY PIPE SIZE - SEE SPEC.)
- BLIND FLANGE
- END CAP
- PRESSURE GAUGE WITH GAUGE CLOCK
- STEAM PRESSURE GAUGE WITH A GAUGE COCK AND COIL SYPHON
- THERMOMETER
- FAT — FLOAT & THERMOSTATIC STEAM TRAP
- IB — INVERTED BUCKET STEAM TRAP
- T — THERMOSTATIC STEAM TRAP
- TD — THERMODYNAMIC STEAM TRAP
- VB — VACUUM BREAKER
- PT — PRESSURE/TEMPERATURE WELL
- OR AAV — AUTOMATIC AIR VENT WITH ISOLATION VALVE
- MAV — MANUAL AIR VENT
- TAV — THERMOSTATIC AIR VENT (STEAM ONLY)
- REDUCER (ECCENTRIC-FLAT ON BOTTOM OR FLAT ON TOP)
- REDUCER (CONCENTRIC)
- FLEXIBLE CONNECTION
- E — EXPANSION JOINT
- PIPE GUIDE
- ANCHOR
- QUICK OPENING VALVE (USED WITH BLOW DOWN)
- QUICK CLOSING VALVE, FUSIBLE LINK (USED WITH FUELS)
- RISE (SINGLE LINE - PLAN VIEW)
- DROP (SINGLE LINE - PLAN VIEW)
- VALVE IN VERTICAL
- TOP TAKEOFF
- BOTTOM TAKEOFF
- PIPE BREAK (SINGLE LINE)
- W — WATER METER DIAL TYPE
- DIRT LEG
- CO — CLEAN-OUT FOR CONDENSATE DRAIN
- RISE (DOUBLE LINE - PLAN VIEW)
- DROP (DOUBLE LINE - PLAN VIEW)
- PIPE BREAK (DOUBLE LINE)
- DIRECTION OF FLOW IN PIPE
- UP — PITCH PIPE UP IN DIRECTION OF FLOW
- DN — PITCH PIPE DOWN IN DIRECTION OF FLOW
- NEW WORK
- NEW SUPPLY LINES
- NEW RETURN LINES
- EXISTING PIPING TO REMAIN
- OR — DEMO/EXISTING TO BE REMOVED
- FUTURE

FLOW DIAGRAM EQUIPMENT SYMBOLS

- HUMIDIFIER
- FILTER BANK
- HEATING COIL
- PREHEAT COIL
- REHEAT COIL
- COOLING COIL
- CABINET HEATER
- UNIT HEATER
- VFD — VARIABLE FREQUENCY DRIVE
- FINNED TUBE RADIATION
- HOOD — LABORATORY HOOD
- SHELL AND TUBE HEAT EXCHANGER
- AAV — AIR SEPARATOR
- BOILER
- BLOW DOWN SEPARATOR
- CONDENSATE PUMP
- CONDENSER / EVAPORATOR — CHILLER
- PUMP
- CENTRIFUGAL FAN WITH INLET GUIDE VANES
- CENTRIFUGAL FAN
- PROPELLER FAN
- TUBEAXIAL OR VANEAXIAL FAN
- INLINE CENTRIFUGAL FAN
- UPBLAST PROPELLAR FAN
- UPBLAST CENTRIFUGAL FAN
- ROOF FAN
- AIR VALVE
- OPPOSED BLADE DAMPER W/ TWO POSITION ACTUATOR
- OPPOSED BLADE DAMPER W/ MODULATING ACTUATOR
- PARALLEL BLADE DAMPER W/ TWO POSITION ACTUATOR
- PARALLEL BLADE DAMPER W/ MODULATING ACTUATOR
- BACKDRAFT DAMPER
- AIR TERMINAL BOX
- W — AIR TERMINAL BOX WITH REHEAT COIL
- PLATE AND FRAME HEAT EXCHANGER
- CHEMICAL FEED SYSTEM
- COOLING TOWER (OPEN CIRCUIT)
- COOLING TOWER (CLOSED CIRCUIT)
- FLASH TANK
- EXPANSION TANK

CALL OUT SYMBOLS

- CONNECT NEW TO EXISTING
- POINT OF DISCONNECT
- 1 / H3.1 — SECTION DESIGNATION / SHEET NUMBER
- 1 / H3.1 — DETAIL DESIGNATION / SHEET NUMBER
- 1 — REVISION NUMBER
- S/R 1 — SUPPLY OR RETURN AIR RISER DESIGNATION
- HWS 1 — PIPING SYSTEM RISER DESIGNATION
- EQUIPMENT ACCESS ZONE
- TEXT INDICATES DRAWING TO REFERENCE FOR CONTINUATION
- SYMBOL DESIGNATES ASSOCIATED SYSTEM OR SERVICE (CHW, HW, S15, LPS, LPR)
- DIFFUSER, GRILLE, REGISTER LETTER DESIGNATOR (SEE SCHEDULE FOR ATD TYPE)
- DESIGN CFM
- A(200) / (200) — ALTERNATE CFM LOCATION

REFER TO CONTROLS LEGEND SHEET FOR SYMBOLS USED ON FLOOR PLANS TO INDICATE LOCATION OF TEMPERATURE SENSORS/THERMOSTATS, HUMIDITY SENSORS, PRESSURE SENSORS AND GAS SENSORS (E.G. CARBON DIOXIDE)

DUCTWORK

SINGLE LINE	DOUBLE LINE	SINGLE LINE	DOUBLE LINE
NEW DUCT LINETYPE		EXISTING DUCT LINETYPE	
ROUND SUPPLY DUCT UP		ROUND RETURN OR EXHAUST DUCT UP	
SUPPLY DUCT UP		RETURN/EXHAUST DUCT UP	
ROUND SUPPLY DUCT DN		RETURN/EXHAUST DUCT DOWN	
SUPPLY DUCT DOWN		ROUND RETURN OR EXHAUST DUCT DN	
STANDARD RADIUS ELBOW (R = W) SUPPLY/RETURN EXHAUST	R, W	HORIZONTAL OFFSET SUPPLY/RETURN /EXHAUST	
BULLHEAD SPLIT SUPPLY	GOOD FOR TAKEOFF TO RING DUCT	RISE/DROP — RISE OR DROP SUPPLY/RETURN/ EXHAUST	RISE/DROP
TAKEOFF TO DIFF/GRILLE W/BRANCH TAKE-OFF VOLUME DAMPER	HARD ELBOW	90° TAKE-OFF W/BRANCH TAKE-OFF VOLUME DAMPER (VD IN LOW PRESSURE SYSTEMS ONLY)	RING DUCT
CEILING DUCT MTD DIFF/GRILLE W/BRANCH TAKE-OFF VOLUME DAMPER		BULLHEAD CONVERGE RETURN/EXHAUST W/BRANCH TAKE-OFF VOLUME DAMPER	
ACOUSTICALLY LINED DUCT		SIDEWALL DUCT MTD REGISTER/GRILLE W/BRANCH TAKE-OFF VOLUME DAMPER	
EXISTING DUCT TO REMAIN		SUPPLY SIDEWALL LINEAR DIFFUSER (W/ 1" INTERNALLY LINED SM PLENUM) BRANCH CONN W/VD FOR EVERY 4' OF LINEAR	
OR — EXISTING DUCT TO BE REMOVED	OR	SUPPLY CEILING LINEAR DIFFUSER (W/ 1" INTERNALLY LINED SM PLENUM) BRANCH CONN W/VD FOR EVERY 4' OF LINEAR	BOOT BY LD MFR
OPEN END DUCT W/VD & 1/2"x1/2" WMS		FLEXIBLE DUCT	

- AVS — AIR VOLUME TRAVERSE STATION
- SGD — SLIDE GATE DAMPER
- VD — MANUAL VOLUME DAMPER
- FD — SELF-CLOSING FIRE DAMPER W/ACCESS DOOR
- ACD — AUTOMATIC CONTROL DAMPER W/ACCESS DOOR
- SD — AUTOMATIC SMOKE DAMPER W/ACCESS DOOR
- FSD — COMBINATION FIRE/SMOKE DAMPER W/ACCESS DOOR
- BDD — BACKDRAFT DAMPER
- STANDARD 4-WAY BLOW SUPPLY DIFFUSER
- BLANKED FOR 3-WAY BLOW SUPPLY DIFFUSER
- OR — BLANKED FOR 2-WAY BLOW SUPPLY DIFFUSER
- BLANKED FOR 1-WAY BLOW SUPPLY DIFFUSER
- OR — ROOF EXHAUST FAN SHOWN ON ROOF
- OR — ROOF EXHAUST FAN SHOWN ON FLOOR PLAN
- UC 1/2" — UNDERCUT DOOR
- LVDR 1.5 SF — LOUVERED DOOR
- RETURN OR EXHAUST AIR FLOW
- SUPPLY AIR FLOW

NOVA PARKS

NOVA Parks
5400 Ox Road
Fairfax Station, VA 22039

Carlyle House, HVAC System Retrofit

CARLYLE HOUSE HISTORIC PARK
121 n. Fairfax Street
Alexandria, VA 22314

VANDERWEIL
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68 Canal Center Plaza, Suite 200
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Drawing Title

MECHANICAL LEGEND SHEET #2

COMMONWEALTH OF VIRGINIA
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PROFESSIONAL ENGINEER

Date: 12/10/2020

M-002

23 00 00 - GENERAL

A. THIS PROJECT INVOLVES CONSTRUCTION INSIDE AN EXISTING STRUCTURE. CONTRACTORS, BY SUBMITTING A BID, ARE DEEMED TO BE COMPLETELY FAMILIAR WITH THE EXISTING CONDITION OF THE BUILDING AS IT INFLUENCES THE WORK DESCRIBED. POTENTIAL PROBLEM AREAS SHALL BE BROUGHT TO THE ATTENTION OF THE ARCHITECT IMMEDIATELY.

B. ANY DEMOLITION SHALL BE COORDINATED WITH OWNER, ARCHITECT, G.C.. AND ENGINEER.

C. REVIEW THE ARCHITECTURAL, STRUCTURAL, ELECTRICAL, PLUMBING DRAWINGS FOR NOTES, DIMENSIONS, ETC., AND COORDINATE WITH OTHER TRADES INVOLVED. THE WORK REQUIREMENTS DESCRIBED WITHIN DIVISION 20 SPECIFICATION SECTION "COMMON MECHANICAL / ELECTRICAL REQUIREMENTS" FORM COMPLIMENTARY REQUIREMENTS TO THE SCOPE OF WORK CONTAINED WITHIN DIVISION 23.

D. WORK SHALL CONFORM TO THE CURRENT EDITIONS OF THE FOLLOWING:

1. SHEET METAL SMACNA STANDARDS (2005 - 3RD EDITION)
2. INTERNATIONAL MECHANICAL CODE (IMC-2015)
3. INTERNATIONAL ENERGY CONSERVATION CODE (IECC-2015)
4. INTERNATIONAL EXISTING BUILDING CODE (2015)
5. ALL OTHER APPLICABLE STATE AND LOCAL CODES AND ORDINANCES

E. WORK SHALL ALSO CONFORM TO BASE BUILDING SPECIFICATIONS AND STANDARDS.

F. SHUTDOWN OF EXISTING SYSTEMS FOR CONNECTION OF NEW WORK SHALL BE COORDINATED IN ADVANCE WITH THE CONSTRUCTION MANAGER AND BUILDING OWNER.

G. ALL MATERIALS AND EQUIPMENT SHALL BE UNUSED AND OF NEW MANUFACTURE, EXCEPT FOR EXISTING COMPONENTS INDICATED TO REMAIN AND BE REUSED. INSPECT EXISTING EQUIPMENT AND MATERIALS PRIOR TO BIDDING TO VERIFY CONDITION.

H. PROVIDE ACCESS PANELS IN WALLS AND GYPSUM WALL BOARD CEILINGS TO FACILITATE CLEANING, ACCESS AND SERVICE TO: DAMPERS, HEATERS, VALVES, VARIABLE AIR VOLUME BOXES, FAN BOXES AND ALL CONCEALED MECHANICAL EQUIPMENT. NOT ALL ACCESS PANELS ARE INDICATED ON THE PLANS. REVIEW ARCHITECTURAL AND MECHANICAL PLANS TO DETERMINE THE LOCATION AND QUANTITY OF ACCESS PANELS REQUIRED. WITHIN THE MECHANICAL BID ALL ACCESS PANELS SHALL BE CLEARLY ENUMERATED, AND PRICING SHALL BE ALLOCATED FOR STANDARD STYLE ACCESS PANELS. AN ALTERNATE PRICE SHALL BE INDICATED FOR AN INCREASE IN QUALITY FROM STANDARD ACCESS PANELS TO DECORATIVE ACCESS PANELS.

I. INSTALL THERMOSTATS AT MOUNTING HEIGHTS ABOVE FINISHED FLOOR IN ACCORDANCE WITH "ADA" REQUIREMENTS, OR AS DIRECTED OTHERWISE BY ARCHITECT.

J. CONTRACTORS SHALL VERIFY, LAYOUT AND BE RESPONSIBLE FOR ALL MEASUREMENTS OF ALL EXISTING CONDITIONS BEFORE COMMENCING WORK AND SHALL NOTIFY ARCHITECT AND/OR ENGINEER IF A CONDITION EXISTS THAT PREVENTS THE CONTRACTOR FROM ACCOMPLISHING THE INTENT OF THE DRAWINGS.

K. GIVE NOTICES, FILE PLANS, OBTAIN AND PAY FOR ALL PERMITS, PAY FEES AND BACK CHARGES, AND OBTAIN NECESSARY APPROVALS REQUIRED FOR THE WORK.

L. DIFFUSER & REGISTER LOCATIONS SHALL BE COORDINATED WITH ARCHITECTURAL REFLECTED CEILING PLANS.

M. THOUGH SOME OFFSETS & TRANSITIONS ARE SHOWN IN PIPING & SHEET METAL TO HELP INDICATE THE PHYSICAL RELATIONSHIP BETWEEN THEM, IT IS NOT THE INTENT OF THE DRAWINGS TO SHOW ALL PIPING & SHEET METAL OFFSETS & TRANSITIONS REQUIRED. THE CONTRACTOR SHALL FULLY COORDINATE THE MECHANICAL WORK WITHIN ITSELF & WITH THE WORK OF ALL TRADES TO PROVIDE COMPLETE & OPERABLE SYSTEMS WITHOUT INTERFERENCES.

N. EXISTING SYSTEMS AND EQUIPMENT

1. EXISTING TO BE REUSED/RELOCATED EQUIPMENT: REPORT ANY EXISTING EQUIPMENT DEFICIENCIES TO THE OWNER AND THE ARCHITECT AND/OR ENGINEER.

2. CONNECT WORK TO VARIOUS EXISTING SYSTEMS AS INDICATED ON THE DRAWINGS. WORK SHALL BE COMPATIBLE WITH THE EXISTING SYSTEM CONDITIONS. ALL WORK SHALL BE COORDINATED WITH ALL TRADES INVOLVED AS WELL AS WITH EXISTING SYSTEMS, THE STRUCTURE, AND OTHER OBSTRUCTIONS.

3. PROVIDE THE FOLLOWING SERVICES ON ALL EXISTING HVAC EQUIPMENT INDICATED TO REMAIN:

a. CLEAN CONDENSATE PAN AND TRAP
b. CALIBRATE CONTROLS
c. FILTER CHANGES
d. VERIFY FAN ROTATION AND OPERATION
e. BALANCING
f. VERIFY PITCH OF CONDENSATE DRAIN PIPES AND DRAIN PAN
g. VERIFY EQUIPMENT CONTROL OPERATION
h. LUBRICATION OF FANS, MOTORS, ETC.
i. CLEAN HEATING/COOLING COILS

O. PRE-DEMO TESTING

1. PRIOR TO ANY DEMOLITION OR NEW WORK, TESTING AND BALANCING CONTRACTOR SHALL TAKE AIRFLOW AND STATIC PRESSURE READINGS AT ALL LOCATIONS WHERE NEW SYSTEMS ARE TO CONNECT TO EXISTING, AND ELSEWHERE AS NOTED ON PLANS. SUBMIT TO ARCHITECT AND ENGINEER PRIOR TO STARTING NEW WORK.

P. SUBMITTALS

1. SUBMIT FOR REVIEW, ELECTRONIC SHOP DRAWINGS IN SEARCHABLE PDF FORMAT FOR THE FOLLOWING.

a. SUBMITTAL DATA FOR ALL MATERIAL AND EQUIPMENT. CLEARLY IDENTIFY DEVIATIONS OF THE SUBMITTED PRODUCTS FROM THE DESIGN.

b. DUCTWORK SHOP DRAWINGS AND DETAILS. THE ROUTING OF DUCTWORK ON THE DESIGN DRAWINGS IS SHOWN DIAGRAMMATICALLY AND APPROXIMATELY, AS ARE THE POSITIONS OF NEW VAV BOXES AND OTHER ABOVE-THE-CEILING COMPONENTS. THE CONTRACTOR SHALL DETERMINE EXACT ROUTING AND LOCATIONS, PROVIDING PROPER CLEARANCES, MAKING PROVISIONS FOR MAINTENANCE ACCESS, AND COORDINATING WITH EXISTING AND NEW COMPONENTS OF OTHER TRADES, THE STRUCTURE, AND OTHER OBSTRUCTIONS. THE DUCTWORK SHOP DRAWING SUBMITTAL SHALL BE BASED ON THIS COORDINATION EFFORT AND SHALL SHOW ALL AIR DISTRIBUTION COMPONENTS. DUCTWORK AND COMPONENTS SHALL BE DRAWN TO SCALE, AND DUCT SIZES SHALL BE INDICATED.

c. PIPING SHOP DRAWINGS SHOWING LAYOUT, COMPONENTS, AND DETAILS.

d. CONTROLS SHOP DRAWINGS, INCLUDING EQUIPMENT AND SYSTEM CONTROL SCHEMATICS, SEQUENCES OF OPERATIONS, LOGIC DIAGRAMS AND SYSTEM COMPONENTS INCLUDING DETAILS OF TIE-IN TO EXISTING BUILDING CONTROL MANAGEMENT SYSTEM. SUBMIT A POINT BY POINT STATEMENT OF COMPLIANCE WITH THE SPECIFICATIONS, SEQUENCE OF OPERATIONS AND DRAWING P&ID'S. THIS STATEMENT SHALL CONSIST OF A LIST OF ALL NUMBERED PARAGRAPHS. WHERE THE SYSTEM COMPLIES FULLY, SUCH SHALL BE INDICATED BY PLACING THE WORD "COMPLY" OPPOSITE THE PARAGRAPH NUMBER. WHERE THE SYSTEM DOES NOT COMPLY OR ACCOMPLISHES THE STATED FUNCTION IN A MANNER DIFFERENT FROM THAT DESCRIBED, A FULL DESCRIPTION OF THE DEVIATION SHALL BE PROVIDED.

2. SCHEDULE AT LEAST TEN WORKING DAYS EXCLUSIVE OF TRANSMITTAL TIME, FOR SUBMITTAL REVIEW.

Q. AS-BUILT DRAWINGS

1. MAINTAIN ONE SET OF PRINTS ON THE SITE AND NOTE ALL CHANGES OR DEVIATIONS FROM THE ORIGINAL DESIGN THEREON. AT THE COMPLETION OF THE PROJECT, INCORPORATE ALL CHANGES INTO RECORD AS-BUILT DRAWINGS IN ELECTRONIC FORMAT AND SUBMIT FOR APPROVAL.

R. OPERATING AND MAINTENANCE INSTRUCTIONS

1. PROVIDE THREE SETS OF MANUFACTURERS OPERATING AND MAINTENANCE INSTRUCTIONS FOR EACH PIECE OF EQUIPMENT AND SYSTEM. COMPILE INTO THREE HARD COVER THREE RING BINDERS WITH INDEX PAGE AND INDEXING TABS. ALL NAME TAG INFORMATION SUCH AS MAKE, TYPE, SIZE, CAPACITY, SERIAL NUMBER, ETC. SHALL BE INCLUDED AS PART OF THE MANUAL.

S. WARRANTY

1. WARRANT WORK OF THIS SECTION IN WRITING FOR ONE YEAR FROM DATE OF OWNERS ACCEPTANCE OF SUBSTANTIAL COMPLETION. REPAIR OR REPLACE DEFECTIVE MATERIALS, EQUIPMENT, WORKMANSHIP AND INSTALLATION THAT DEVELOP WITHIN THIS PERIOD, PROMPTLY AND TO OWNER'S SATISFACTION AND CORRECT DAMAGE CAUSED IN MAKING NECESSARY REPAIRS AND REPLACEMENTS UNDER WARRANTY WITHIN CONTRACT PRICE.

T. CLEANING

1. ALL WORK AREAS SHALL BE LEFT AS CLEAN AS NEW. CLEAN INTERNALS OF ALL DUCTWORK AND AIR HANDLING UNITS AND REPLACE FILTERS AFTERWARDS.

2. DUCTWORK: DUCTS SHALL BE THOROUGHLY CLEANED SO THAT NO DIRT OR DUST SHALL BE DISCHARGED FROM DIFFUSERS, REGISTERS, OR GRILLES, WHEN SYSTEM IS OPERATED.

3. PIPING: AFTER CONDENSATE PIPING HAS BEEN PRESSURE TESTED AND APPROVED FOR TIGHTNESS, CLEAN AND FLUSH PIPING.

4. EQUIPMENT: AFTER COMPLETION OF PROJECT, CLEAN THE EXTERIOR SURFACE OF EQUIPMENT INCLUDED IN THIS SECTION, INCLUDING REMOVAL OF CONCRETE RESIDUE.

5. WORK AREA: AFTER COMPLETION OF PROJECT, REMOVE ALL CONSTRUCTION DEBRIS, TEMPORARY FACILITIES AND EQUIPMENT FROM WORK AREA. CLEAN WORK AREA TO PERMIT OCCUPATION.

23 05 05 - DEMOLITION

A. REFER TO DRAWINGS FOR GENERAL DESCRIPTION OF AREAS REQUIRING DEMOLITION.

B. REFER TO GENERAL CONTRACTOR'S/CONSTRUCTION MANAGER'S INSTRUCTIONS FOR EXISTING EQUIPMENT AND MATERIALS THAT SHALL REMAIN THE PROPERTY OF THE OWNER.

C. WHERE IT IS NOTED THAT ITEMS OF VALUE ARE NOT TO BE RETURNED TO THE OWNER, THE ITEMS SHALL BECOME THE PROPERTY OF THE CONTRACTOR. STORAGE OR SALE OF ITEMS ON THE PROJECT SITE IS PROHIBITED. ITEMS SHALL BE REMOVED FROM SITE AND LEGALLY DISPOSED OF.

D. PROTECTION: ENSURE THE SAFE PASSAGE OF PERSONS IN AND AROUND THE BUILDING/SITE DURING DEMOLITION. PREVENT INJURY TO PERSONS AND DAMAGE TO PROPERTY. PROVIDE ADEQUATE SHORING AND BRACING TO PREVENT COLLAPSE. IMMEDIATELY REPAIR DAMAGE TO THE CONDITION BEFORE BEING DAMAGED TO THE SATISFACTION OF THE ARCHITECT AND OWNER. TAKE EFFECTIVE MEASURES TO PREVENT WINDBLOWN DUST.

E. UTILITIES: MAINTAIN UTILITIES EXCEPT THOSE REQUIRING REMOVAL OR RELOCATION. KEEP UTILITIES IN SERVICE AND PROTECT FROM DAMAGE. DO NOT INTERRUPT UTILITIES SERVING IN-USE AREAS WITHOUT FIRST OBTAINING PERMISSION FROM THE UTILITY COMPANY AND THE OWNER. PROVIDE TEMPORARY SERVICES AS REQUIRED.

F. DISCONNECT, DEMOLISH, AND REMOVE HVAC SYSTEMS, EQUIPMENT, AND COMPONENTS INDICATED TO BE REMOVED.PIPING TO BE REMOVED: REMOVE PORTION OF PIPING INDICATED TO BE REMOVED AND CAP REMAINING PIPING WITH SAME OR COMPATIBLE PIPING MATERIAL.

1. PIPING TO BE ABANDONED IN PLACE: DRAIN PIPING AND CAP PIPING WITH SAME OR COMPATIBLE PIPING MATERIAL.

2. DUCTS TO BE REMOVED: REMOVE PORTION OF DUCTS INDICATED TO BE REMOVED AND CAP REMAINING DUCTS WITH SAME OR COMPATIBLE DUCTWORK MATERIAL.

3. DUCTS TO BE ABANDONED IN PLACE: CAP DUCTS WITH SAME OR COMPATIBLE DUCTWORK MATERIAL.

4. EQUIPMENT TO BE REMOVED: DISCONNECT AND CAP SERVICES AND REMOVE EQUIPMENT.

5. EQUIPMENT TO BE REMOVED AND REINSTALLED: DISCONNECT AND CAP SERVICES AND REMOVE, CLEAN, AND STORE EQUIPMENT; WHEN APPROPRIATE, REINSTALL, RECONNECT, AND MAKE EQUIPMENT OPERATIONAL.

6. EQUIPMENT TO BE REMOVED AND SALVAGED: DISCONNECT AND CAP SERVICES AND REMOVE EQUIPMENT AND DELIVER TO OWNER.

G. IF PIPE, INSULATION, OR EQUIPMENT TO REMAIN IS DAMAGED IN APPEARANCE OR IS UNSERVICEABLE, REMOVE DAMAGED OR UNSERVICEABLE PORTIONS AND REPLACE WITH NEW PRODUCTS OF EQUAL CAPACITY AND QUALITY.

23 05 13 - MOTORS, STARTERS AND WIRING

A. PROVIDE MOTORS AND CONTROLS, AND FURNISH STARTERS FOR HVAC EQUIPMENT, EXCEPT UNITS SERVED BY MCC PROVIDED UNDER ELECTRICAL SECTION. PROVIDE CONTROL AND OTHER RELATED WIRING INCLUDING INTERLOCKS. ALL MOTORS SHALL TO BE PREMIUM EFFICIENCY. ALL THREE PHASE MOTORS SHALL BE RATED FOR INVERTER DUTY SERVICE.

B. STARTERS THAT REQUIRE INTERLOCKS OR REMOTE CONTROL SHALL BE MAGNETIC WITH HAND-OFF-AUTOMATIC SWITCH (FAST-SLOW-OFF-AUTO FOR TWO SPEED MOTORS) IN COVER. STARTERS SHALL BE BY SINGLE MANUFACTURER: CUTLER-HAMMER, CLARK, ARROW HART OR SQUARE D.

23 05 17 - SLEEVES AND PENETRATIONS

A. GENERAL REQUIREMENTS

1. LAY OUT PENETRATION AND SLEEVE OPENINGS IN ADVANCE. COORDINATE WORK CAREFULLY WITH ARCHITECTURAL AND STRUCTURAL WORK. PROVIDE CORE DRILLING OF EXISTING CONSTRUCTION WHERE REQUIRED. SUBMIT PROPOSED LOCATIONS FOR REVIEW PRIOR TO CORE DRILLING.

2. MAINTAIN FIRE RATING OF WALLS, PARTITIONS, CEILINGS, AND FLOORS AT PENETRATIONS. SEAL PENETRATIONS WITH APPROVED FIRESTOP MATERIALS.

3. SLEEVES FOR INSULATED PIPE AND DUCT IN NON-FIRE RATED CONSTRUCTION SHALL ACCOMMODATE CONTINUOUS INSULATION WITHOUT COMPRESSION.

B. PIPE SLEEVES:

1. PROVIDE HOT-DIPPED GALVANIZED SCHEDULE 40 STEEL PIPE SLEEVES FOR PIPES PASSING THROUGH CONCRETE AND MASONRY WALLS AND CONCRETE FLOOR AND ROOF SLABS.

2. PROVIDE 26 GAUGE GALVANIZED STEEL SLEEVES THROUGH PARTITIONS AND NON-FIRE-RATED CONSTRUCTION.

3. PROVIDE MECHANICAL SLEEVE SEALS CONSISTING OF INTERLOCKING MODULES AT EXTERIOR PIPE PENETRATIONS.

4. PROVIDE ADJUSTABLE ESCUTCHEONS ON EXPOSED PIPING THAT PASSES THROUGH FINISHED FLOORS, WALLS AND CEILINGS. ESCUTCHEONS SHALL BE CHROMIUM-PLATED CAST BRASS, SIZED TO COVER SLEEVE OPENING AND TO ACCOMMODATE PIPE AND INSULATION.

C. DUCT SLEEVES AND OPENINGS:

1. PROVIDE GALVANIZED-STEEL SHEET DUCT SLEEVES FOR ROUND DUCTS 15 INCHES AND SMALLER. PROVIDE PREPARED, FRAMED OPENINGS FOR ROUND DUCTS LARGER THAN 15 INCHES AND FOR SQUARE, RECTANGULAR AND FLAT OVAL DUCTS, EXCEPT AS SPECIFIED OTHERWISE. SLEEVES SHALL MEET SMACNA REQUIREMENTS.

2. PROVIDE GALVANIZED-STEEL SHEET DUCT SLEEVES FOR SLEEVES THROUGH FIRE-RATED CONSTRUCTION AND THROUGH SMOKE PARTITIONS. SLEEVE AND SEAL MATERIALS, CONSTRUCTION AND CLEARANCES SHALL MEET REQUIREMENTS OF SMACNA FIRE DAMPER AND HEAT STOP GUIDE FOR AIR HANDLING SYSTEMS. WHERE FIRE DAMPERS ARE REQUIRED, INSTALL SLEEVE AND DAMPER ASSEMBLY IN ACCORDANCE WITH DAMPER LISTING.

23 05 29 - HANGERS AND SUPPORTS

A. PROVIDE SUPPORTS, HANGERS AND OTHER SUPPORTING APPLIANCES AS NECESSARY TO SUPPORT WORK REQUIRED BY CONTRACT DOCUMENTS. SPACING OF HANGERS SHALL BE INSTALLED IN ACCORDANCE WITH APPLICABLE BUILDING AND MECHANICAL CODES. STRUCTURAL STEEL SUPPORTS, HANGERS, ETC. SHALL BE ANGLE IRON, STEEL CHANNEL OR STEEL ROD USED WITH APPROVED CLAMPS, INSERTS, ETC. ALL SUPPORTS, HANGERS, BRACKETS, ETC., SHALL BE AS APPROVED BY THE ENGINEER.

B. ALL HANGERS SHALL BE GALVANIZED.

C. ATTACH HANGERS AND SUPPORTS DIRECTLY ONTO THE STRUCTURE BY FIRST REMOVING EXISTING FIRE PROOFING AND AFTER SECURING THE ATTACHMENT, REPAIRING THE FIRE PROOFING TO ITS ORIGINAL CONDITION, CONTINUOUSLY OVER THE ATTACHMENT.

D. FOR EXPANSION BOLTS/SHIELDS USE RED HEAD, HILTI OR WEJ-IT SELF DRILLING OR STEEL SHIELD, LOAD RATED. DO NOT USE DRILLED ANCHORS IN POST TENSION SLABS WITHOUT APPROVAL OF OWNER. DO NOT CUT REINFORCING STEEL WITH DRILLED INSERTS.

E. SUPPORT ALL GALVANIZED DUCTWORK WITH GALVANIZED HANGERS AND MOUNTS AS REQUIRED BY SMACNA (8 FT SPACING). DO NOT SUPPORT RISERS FROM SLEEVES IN SLABS.

23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

A. PROVIDE VIBRATION ISOLATION FOR EACH PIECE OF ROTATING OR RECIPROCATING HVAC EQUIPMENT SHOWN ON THE DRAWINGS. ALL ISOLATION COMPONENTS SHALL BE SUPPLIED BY A SINGLE MANUFACTURER - MASON INDUSTRIES, KINETICS OR AMBER BOOTH. TYPES OF ISOLATORS, REQUIRED DEFLECTIONS, AND INSTALLATION PRACTICES SHALL BE IN STRICT ACCORDANCE WITH THE RECOMMENDATIONS OF THE VIBRATION ISOLATION MANUFACTURER.

23 05 53 - PIPE AND DUCT IDENTIFICATION

A. DUCTWORK SHALL BE STENCILED AT EACH JUNCTION OR BRANCH TAKEOFF, AT LEAST ONCE IN EACH ROOM, AND AT INTERVALS NOT LONGER THAN 20 FT. STENCIL SHALL CLEARLY IDENTIFY DUCT SERVICE (S FOR SUPPLY, R FOR RETURN, X FOR EXHAUST), AREA SERVED BY BRANCH, AND ARROW INDICATING DIRECTION OF FLOW.

B. PROVIDE COLOR-CODED PIPE IDENTIFICATION MARKERS ON PIPING INSTALLED UNDER THIS SECTION. PIPE MARKERS SHALL BE SNAP-ON LAMINATED PLASTIC PROTECTED BY CLEAR ACRYLIC COATING. PIPE MARKERS SHALL BE APPLIED AFTER ARCHITECTURAL PAINTING WHERE SUCH IS REQUIRED.

C. PROVIDE ARROW MARKER WITH EACH PIPE CONTENT MARKER TO INDICATE DIRECTION OF FLOW. IF FLOW CAN BE IN EITHER DIRECTION, USE DOUBLE-HEADED ARROW MARKER.

D. NEW EQUIPMENT SUCH AS HEAT PUMP, ETC., SHALL BE STENCILED WITH EQUIPMENT NAME CORRESPONDING TO DRAWING SCHEDULE NUMBERS. STENCIL SHALL BE AT LEAST 2" HIGH. EQUIPMENT TAGS SHALL HAVE BLACK CHARACTERS ON WHITE FACE.

23 05 93 - TESTING ADJUSTING AND BALANCING

A. PROVIDE QUALIFIED PERSONNEL, EQUIPMENT, APPARATUS AND SERVICES FOR START-UP, TESTING AND BALANCING OF MECHANICAL SYSTEMS, TO PERFORMANCE DATA SHOWN IN SCHEDULES, AS SPECIFIED, AND AS REQUIRED BY CODES, STANDARDS, REGULATIONS AND AUTHORITIES HAVING JURISDICTION INCLUDING CITY INSPECTORS, OWNERS AND ARCHITECT.

B. START UP ALL SYSTEMS, PRESSURE TEST DUCTWORK AND PIPING, AND BALANCE SYSTEMS INCLUDING, BUT NOT LIMITED TO, ALL NEW AND EXISTING REGISTERS, GRILLES, DIFFUSERS, TERMINAL UNITS, FANS, ETC. WITHIN THE AREA OF WORK TO PERFORMANCE DATA SHOWN ON PLANS, SCHEDULES, AND AS SPECIFIED.

C. DO NOT COVER OR CONCEAL WORK BEFORE TESTING AND INSPECTION AND OBTAINING APPROVAL.

D. LEAKS, DAMAGE AND DEFECTS DISCOVERED OR RESULTING FROM STARTUP, TESTING, AND BALANCING SHALL BE REPAIRED OR REPLACED TO LIKE-NEW CONDITION WITH ACCEPTABLE MATERIALS. TEST SHALL BE CONTINUED UNTIL SYSTEM OPERATES WITHOUT ADJUSTMENT OR REPAIR.

E. REPORT ON REPORTING FORMS, SUBMITTED TO ARCHITECT FOR APPROVAL IN ADVANCE.

F. SUBMIT PROCEDURES, RECORDING FORMS, AND TEST EQUIPMENT FOR REVIEW PRIOR TO BALANCING, AS DESCRIBED IN SPECIFICATIONS. SUBMIT ELECTRONIC COPY OF TESTING AND BALANCING REPORTS TO ARCHITECT FOR APPROVAL.

G. THIS CONTRACTOR SHALL FURNISH ALL TEST MEDIUMS AND DISPOSE OF ALL TEST MEDIUMS AT AN APPROVED OFF-SITE LOCATION AFTER TESTING IS COMPLETE.

H. NOTE REQUIREMENT ABOVE FOR CFM AND STATIC PRESSURE READINGS PRIOR TO DEMOLITION.

I. THE BALANCING CONTRACTOR SHALL BE RESPONSIBLE FOR FINAL DIRECTIONAL ADJUSTMENT OF ALL LINEAR DIFFUSERS AS INDICATED ON PLANS. IF NO DIRECTIONAL FLOW IS INDICATED INTERIOR LINEAR DIFFUSERS SHALL BE DIRECTED HORIZONTALLY AND PERIMETER LINEAR DIFFUSER SHALL BE DIRECTED VERTICALLY, IF PERIMETER LINEAR DIFFUSERS HAVE MULTIPLE SLOTS THE PERIMETER SLOT DIRECTED VERTICALLY, AND THE INTERIOR SLOT DIRECTED HORIZONTALLY TOWARDS THE INTERIOR SPACE.

23 07 13 - HVAC INSULATION (EXTERNAL)

A. GENERAL REQUIREMENTS

1. INSULATION SHALL BE CERTAIN-TEED, KNAUF, MANVILLE, OR OWENS CORNING. MATERIALS SHALL MEET REQUIREMENTS OF ADHESIVE AND SEALANT COUNCIL STANDARDS AND SMACNA. INSTALL INSULATION, MASTICS, ADHESIVES, COATINGS, COVERS, WEATHER-PROTECTION AND OTHER WORK IN STRICT ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS. ASTM E-84 FIRE HAZARD RATINGS SHALL BE 25 FLAME SPREAD, 50 SMOKE DEVELOPED.

2. INSULATION AND VAPOR BARRIER SHALL BE CONTINUOUS AROUND ENTIRE PERIMETER OF DUCTS. DUCTS SUPPORTED BY METAL STRAPS SHALL HAVE INSULATION ENCOMPASSING STRAPS, WHERE STRAPS PENETRATE AT TOP OF DUCT TIGHTLY SEAL AROUND STRAP WITH INSULATING TAPE. DUCTS SUPPORTED BY TRAPEZE TYPE HANGERS UNDER DUCTS SHALL HAVE 6 LB. DENSITY RIGID INSULATION PROVIDED BETWEEN DUCT AND HANGER, INSULATION SHALL BE SAME THICKNESS AND VAPOR BARRIER AS SPECIFIED FOR SPECIFIC DUCT TYPE. RIGID INSULATION SECTION SHALL BE FULL WIDTH OF DUCT AND MINIMUM 12" LONG. TAPE AND SEAL ALL SEAMS WHERE RIGID INSULATION MEETS OTHER INSULATION.

3. ACOUSTICALLY LINED DUCTWORK SHALL NOT BE INSULATED EXTERNALLY, EXCEPT AS NOTED OTHERWISE.

4. FITTINGS, VALVES AND FLANGES SHALL BE INSULATED WITH SAME MATERIAL AND TO SAME THICKNESS AS ADJOINING PIPE INSULATION, WITH PRESENT SECTIONS.

5. FOR STRAINERS AND OTHER VALVES OR FITTINGS WHICH NEED MAINTENANCE, PROVIDE PREFORMED REMOVABLE INSULATION SECTION.

B. PRODUCTS AND APPLICATIONS

1. FOR SUPPLY DUCTS LOCATED WITHIN CONCEALED SPACES, INSULATION SHALL BE MINERAL FIBER BLANKET DUCT INSULATION WITH FACTORY APPLIED FSK JACKET. PROVIDE MINIMUM OF R-6 (AS INSTALLED) INSULATION. ACCEPTABLE MANUFACTURERS: CERTAIN-TEED, KNAUF, MANVILLE, OR OWENS CORNING.

2. WHERE NOTED ON THE FLOOR PLANS, SUPPLY DUCT INSULATION SHALL BE RIGID FIBER BOARD DUCT INSULATION: MINERAL OR GLASS FIBERS BONDED WITH A THERMOSETTING RESIN, WITH FACTORY-APPLIED PAINTABLE FSK JACKET. PROVIDE MINIMUM R-2 (AS INSTALLED) INSULATION, 1.5 IN. THICK, 3 LB/CU. FT. ACCEPTABLE MANUFACTURERS: CERTAIN-TEED, KNAUF, MANVILLE, OR OWENS CORNING.

23 09 00 - INSTRUMENTATION AND CONTROLS

A. PROVIDE COMPLETE SYSTEM OF AUTOMATIC TEMPERATURE CONTROLS (ATC). CONTROL SYSTEM SHALL BE CAPABLE OF PERFORMING ALL SEQUENCES OF OPERATION SHOWN ON THE DRAWINGS OR DESCRIBED IN THESE SPECIFICATIONS. INDIVIDUAL CONTROL COMPONENTS MAY NOT BE SHOWN ON CONTRACT DOCUMENTS, BUT THE CONTRACTOR SHALL SUPPLY ALL COMPONENTS, AND CONTROL WIRING NECESSARY FOR A COMPLETE OPERABLE SYSTEM. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL SYSTEM COMPONENTS, WHETHER THE ELECTRICAL OR OTHER WORK IS SUBCONTRACTED OR NOT.

B. ALL SAFETY SWITCHES AND CUT OUTS SHALL BE FIELD CALIBRATED AND SET PRIOR TO START-UP EQUIPMENT.

C. ALL CONTROL WIRING SHALL COMPLY WITH THE REQUIREMENTS OF THE ELECTRICAL SPECIFICATIONS.

D. PNEUMATIC TUBING SHALL BE TYPE FR POLYETHYLENE.

E. WIRING BETWEEN FIRE ALARM SYSTEM AND TEMPERATURE CONTROL SYSTEM SHALL BE BY MECHANICAL CONTRACTOR.

F. THERMOSTATS

1. FOR PRIVATE OFFICES SHALL HAVE EXPOSED DIAL FOR SETPOINT ADJUSTMENT. HEATING/COOLING THERMOSTATS SHALL HAVE AN ADJUSTABLE DEADBAND.

2. THERMOSTATS SHALL BE COMPATIBLE WITH EXISTING TRANE VAV BOXES AND EXISTING PNEUMATIC CONTROLS SYSTEM.

3. THERMOSTATS SHALL BE WHITE IN COLOR.

23 21 00 - REFRIGERANT PIPING

A. GENERAL REQUIREMENTS

1. REFRIGERANT PIPING INDICATED ON DRAWINGS IS SCHEMATIC ONLY. SIZE PIPING AND DESIGN ACTUAL PIPING LAYOUT, INCLUDING OIL TRAPS, DOUBLE RISERS, SPECIALTIES, AND PIPE AND TUBE SIZES TO ACCOMMODATE, AS A MINIMUM, EQUIPMENT PROVIDED, ELEVATION DIFFERENCE BETWEEN COMPRESSOR AND EVAPORATOR, AND LENGTH OF PIPING TO ENSURE PROPER OPERATION AND COMPLIANCE WITH WARRANTIES OF CONNECTED EQUIPMENT.

2. COPPER TUBE: ASTM B88, TYPE K .

3. WROUGHT-COPPER FITTINGS AND UNIONS: ASME B16.22.

4. SUCTION LINES: COPPER, TYPE K, DRAWN-TEMPER TUBING AND WROUGHT-COPPER FITTINGS WITH **BRAZED** JOINTS.

5. HOT-GAS AND LIQUID LINES: COPPER, TYPE K, DRAWN-TEMPER TUBING AND WROUGHT-COPPER FITTINGS WITH BRAZED JOINTS

6. SAFETY-RELIEF-VALVE DISCHARGE PIPING: COPPER TYPE L, DRAWN-TEMPER TUBING AND WROUGHT-COPPER FITTINGS WITH SOLDERED JOINTS.

7. CONDENSATE DRAIN: 125 PSI WORKING PRESSURE. TYPE L COPPER WITH SOLDERED COPPER JOINTS.

8. T-DRILL SHALL NOT BE ALLOWED.

23 31 00 - HVAC DUCTS

A. GENERAL REQUIREMENTS

1. FOR GALVANIZED DUCTWORK, SEAL AIR DUCT JOINTS AND JOINTS BETWEEN FITTINGS AND DUCTS WITH HARDCAST SEALANT OR APPROVED EQUAL IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.

2. DUCTWORK SHALL BE FREE FROM VIBRATION UNDER ALL CONDITIONS OF OPERATION.

3. DIFFUSER SIZES SHOWN ARE NECK SIZES; REGISTER AND GRILLE SIZES ARE NOMINAL.

4. ALL DUCTS PENETRATING RATED FIRE WALLS SHALL BE PROVIDED WITH FIRE DAMPERS AND ACCESS DOORS.

5. DUCTWORK SHALL NOT RUN ALONG FULL HEIGHT PARTITIONS.

6. PATCH AND SEAL ALL EXISTING OPENINGS IN DUCTWORK NOT UTILIZED FOR NEW LAYOUT.

7. THE INSIDE OF ALL UNLINED DUCTWORK VISIBLE THROUGH A GRILLE OR DIFFUSER SHALL BE PAINTED FLAT BLACK.

8. WHEN SECTION OF DUCTWORK IS NOT LABELED FOR SIZE, THE LARGER SIZE INDICATED ON THE CONNECTED DUCT SHALL PREVAIL. SIZE OF DUCT RUN-OUTS TO DIFFUSER SHALL EQUAL DIFFUSER NECK SIZE.

9. DUCT BRANCH CONNECTIONS AND TAKE OFFS SHALL BE MADE WITH 45° CONNECTION, BELLMOUTH OR CONICAL ONLY. SPIN IN COLLARS AND STRAIGHT TAPS SHALL NOT BE USED.

10. ELBOWS AND BENDS FOR RECTANGULAR DUCTS SHALL HAVE CENTER LINE RADIUS OF 1.5 TIMES DUCT WIDTH WHEREVER POSSIBLE. WHERE CENTERLINE RADIUS IS LESS THAN 1.5 TIMES DUCT WITH, ELBOWS SHALL BE RADIUS THROAT WITH RADIUS HEEL AND FULL-LENGTH SPLITTER VANES.

11. NO PIPE, CONDUIT, HANGER, ARCHITECTURAL ELEMENT NOR STRUCTURAL MEMBER SHALL PASS THROUGH DUCT WITHOUT ARCHITECT'S AND/OR ENGINEER'S WRITTEN APPROVAL.

B. SHEETMETAL DUCTWORK

1. SHEET METAL DUCTS SHALL BE CONSTRUCTED OF HOT DIPPED G90 GALVANIZED SHEET METAL UNLESS OTHERWISE SPECIFIED. MATERIAL, CONSTRUCTION AND INSTALLATION SHALL MEET REQUIREMENTS OF MOST RECENT EDITIONS OF SMACNA STANDARDS (EXCEPT FOR MORE STRINGENT REQUIREMENTS SPECIFIED OR SHOWN ON DRAWINGS). ALL MEDIUM PRESSURE DUCTWORK BETWEEN MAIN SYSTEM FAN AND AIR TERMINAL DEVICE SHALL BE MINIMUM 4"(wg) PRESSURE CLASS, SEAL CLASS A, LEAKAGE CLASS 6. ALL LOW-PRESSURE DUCTWORK BETWEEN TERMINAL DEVICE AND AIR OUTLETS SHALL BE MINIMUM 2"(wg) PRESSURE CLASS. SEAL CLASS B, LEAKAGE CLASS 12

C. FLEXIBLE DUCTWORK

1. FLEXIBLE DUCTWORK, CONNECTING TO UNINSULATED OR UNLINED DUCT, SHALL BE VINYL COATED FIBERGLASS CLOTH 0.0057" MINIMUM THICKNESS, 25 STRANDS PER INCH MINIMUM THREAD COUNT WITH CORROSION-RESISTANT HELICAL WIRE REINFORCEMENT. FLEX DUCT SHALL BE UL RATED FOR 12" W.C. POSITIVE PRESSURE, 2" W.C. NEGATIVE PRESSURE WITH A MAXIMUM VELOCITY OF 4000 FPM. FLEXDUCT MUST BE LISTED AS A CLASS 1 CONNECTOR ACCORDING TO UL 181 AND SHALL MEET THE REQUIREMENTS OF NFPA 90A - MAXIMUM ASTM E-84 FIRE HAZARD RATING SHALL BE 25 FLAME SPREAD, 50 FUEL CONTRIBUTED, AND 50 SMOKE DEVELOPED. UNINSULATED FLEXIBLE DUCT SHALL BE EQUIVALENT TO FLEXMASTER TYPE 4.

2. FLEXIBLE DUCT CONNECTED TO INSULATED OR LINED DUCT SHALL BE INSULATED WITH 1-1/2", 1/2 LB. DENSITY FIBERGLASS INSULATION AND FLAME RETARDANT (UL LISTED) VAPOR BARRIER, MEETING ASTM E-84 RATING AS REFERENCED ABOVE.

3. FLEXIBLE DUCTS SHALL NOT EXCEED 6 FEET LONG. MAXIMUM SAG OF 1/2" PER 1"-0".

4. HANGER AND SADDLE IN CONTACT WITH FLEXIBLE DUCT SHALL BE WIDE ENOUGH TO PREVENT RESTRICTION OF INTERNAL DUCT DIAMETER WHEN WEIGHT OF SUPPORTED SECTION RESTS ON HANGER OR SADDLE MATERIAL.

5. COLLARS TO WHICH FLEXIBLE DUCTS ARE ATTACHED SHALL BE AT LEAST 2" LONG. SLEEVES FOR JOINING SECTIONS OF FLEXIBLE DUCT SHALL BE AT LEAST 4" LONG.

6. APPLY SEALING COMPOUND TO METALLIC SURFACE AT CONNECTION OF FLEXIBLE DUCT WITH SHEET METAL DUCTS, COLLARS AND MIXING BOXES. SLIP FLEXIBLE DUCTWORK OVER SEALING COMPOUND. COMPLETE SEAL WITH 1/2" WIDE, COMMERCIALLY-MADE METAL DRAW BANDS.

23 33 00 - AIR DUCT ACCESSORIES

A. ACOUSTICAL DUCT LINING

1. PROVIDE UL-LISTED, 1" THICK (UNLESS OTHERWISE NOTED) 1.5 LB DENSITY, BY CERTAIN-TEED, KNAUF, OWENS CORNING OR MANVILLE FIBERGLASS ACOUSTICAL LINING FOR THE FOLLOWING DUCTWORK:

a. TRANSFER DUCTS

b. DUCTWORK INDICATED AS LINED ON DRAWINGS.

2. DIMENSIONS SHOWN ON DRAWINGS FOR DUCTWORK ARE NET INSIDE DIMENSIONS. INCREASE SHEETMETAL SIZE FOR LINING WHERE SPECIFIED.

3. MATERIALS AND INSTALLATION SHALL MEET THE FOLLOWING STANDARDS, AS APPLICABLE: NFPA-90A, UL723, NFPA-255; SMACNA DUCT LINER APPLICATIONS STANDARD; SMACNA MECHANICAL FASTENERS STANDARD; ADHESIVE AND SEALANT COUNCIL; ADHESIVES STANDARD FOR DUCT LINER - ASC-A-7001A; ASTM E-84 FIRE HAZARD CLASSIFICATIONS OF 25 FLAME SPREAD, 50 SMOKE DEVELOPED, AND 50 FUEL CONTRIBUTED.

B. ADJUSTABLE MANUAL BALANCING DAMPERS:

1. GENERAL: NOT ALL MANUAL BALANCING DAMPERS MAY BE SHOWN ON THE PLANS FOR CLARITY. PROVIDE MANUAL ADJUSTABLE VOLUME DAMPERS, WITH EXTENDED MOUNT INDICATING AND LOCKING QUADRANTS ON EACH SUPPLY, RETURN, AND GENERAL EXHAUST DUCT TAKEOFF, AND AT EACH TAKEOFF TO A REGISTER, GRILLE, OR DIFFUSER. DAMPERS SHALL BE LOCATED AS FAR UPSTREAM AS POSSIBLE IN THE BRANCH DUCT OR TAKE OFF TO MINIMIZE DOWNSTREAM NOISE.

2. REMOTE ADJUSTABLE VOLUME DAMPERS: PROVIDE REMOTE ADJUSTABLE VOLUME DAMPERS IN AREAS WHERE CEILING CAVITY ACCESS IS LIMITED BY HARD (SOLID) CEILINGS, EQUIPMENT OBSTRUCTIONS, ARCHITECTURAL FEATURES, ETC. COORDINATE BETWEEN MECHANICAL PLANS AND ARCHITECTURAL CEILING PLANS TO DETERMINE IF AND WHERE REMOTE ADJUSTABLE VOLUME DAMPERS ARE REQUIRED. MANUALLY ADJUSTED REMOTE VOLUME DAMPERS SHALL BE SIMILAR TO YOUNG REGULATOR MODEL 270.

C. FLEXIBLE CONNECTIONS

1. MAKE ALL CONNECTIONS BETWEEN HEAT PUMP AND DUCTWORK WITH FLEXIBLE CONNECTIONS. FLEXIBLE CONNECTIONS SHALL BE NEOPRENE-COATED FIBROUS GLASS FIRE RETARDANT FABRIC, BY VENTFABRICS, OR DURODYNE.

23 37 00 - AIR OUTLETS AND INLETS

A. PROVIDE DIFFUSERS, REGISTERS, AND GRILLES FOR SUPPLY, RETURN, AND EXHAUST OUTLETS, OF SIZE, TYPE, MATERIAL AND DESIGN SHOWN ON DRAWINGS. ACCEPTABLE MANUFACTURERS: NAILOR, METALAIRE, TITUS, OR PRICE. SOUND PRESSURE LEVELS SHALL NOT EXCEED NC 30. COLOR AND FINISH SHALL BE SELECTED BY THE ARCHITECT.

B. EXISTING TO REMAIN/BE REUSED DIFFUSERS/REGISTIERS/GRILLES SHALL BE CLEANED, TOUCH-UP PAINTED AND RENDERED IN 'LIKE-NEW-CONDITION' BY THE CONTRACTOR.

23 81 00 - DECENTRALIZED UNITARY HVAC EQUIPMENT

A. WATER-SOURCE HEAT PUMPS

1. PROVIDE WATER SOURCE HEAT PUMPS OF TYPES, SIZES, AND CAPACITIES SHOWN ON SCHEDULES. PROVIDE THERMOSTATS AND ALL NECESSARY OPERATING CONTROLS. REFRIGERANT SHALL BE R-410A. PROVIDE UNIT MOUNTED DISCONNECT, VIBRATION ISOLATION, BRAIDED STAINLESS STEEL SUPPLY AND RETURN HOSE KIT, ISOLATION VALVES, AUTOMATIC FLOW CONTROL VALVE AND MOTORIZED CONTROL VALVE. ACCEPTABLE MANUFACTURERS: DAIKIN, CARRIER, MCQUAY, CLIMATE MASTER, OR TRANE.

2. ALL CEILING RECESSED HEAT PUMPS SHALL BE PROVIDED WITH MANUFACTURER'S ELECTRONIC CONDENSATE OVERFLOW PROTECTION SWITCH OR AN AUXILIARY DRAIN PAN WITH A MOISTURE SENSOR. UPON INDICATION OF WATER PRESENCE IN THE AUXILIARY DRAIN PAN THE HEAT PUMP SHALL BE DE-ENERGIZED AND AN ALARM SHALL BE ISSUED TO THE BMS.

3. PROVIDE OPERATIONS MANUAL TO TENANT WITHIN NINETY DAYS OF SYSTEM ACCEPTANCE.

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CARLYLE HOUSE
HVAC SPECIFICATION

COMMONWEALTH OF VIRGINIA
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12/10/2020

M-003

VARIABLE REFRIGERANT FLOW SYSTEM

A. GENERAL

1. THIS SECTION INCLUDES THE DESIGN, PERFORMANCE, REFRIGERANT DETAILS, CONTROLS AND INSTALLATION REQUIREMENTS FOR VARIABLE FLOW REFRIGERANT SYSTEM.
2. ALL UNITS SHALL BE LISTED AND RATED BY ANSI/AHRI STANDARD 1230-2010 AND MEET ALL MINIMUM IEER PERFORMANCE REQUIREMENTS AS SCHEDULED.
3. THE UNITS SHALL BE ANSI/UL STD 1995 LISTED AND LISTED BY ELECTRICAL TESTING LABS (ETL) AND BEAR THE CETL LABEL.
4. ALL WIRING SHALL BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC).
5. THE SYSTEM WILL BE PRODUCED IN AN ISO 9001 AND ISO 14001 FACILITY, WHICH ARE STANDARDS SET BY THE INTERNATIONAL STANDARD ORGANIZATION (ISO). THE SYSTEM SHALL BE FACTORY TESTED FOR SAFETY AND FUNCTION.
6. THE SYSTEM AND THE DESIGN SHALL BE IN COMPLIANCE WITH ASHRAE 15 MECHANICAL REFRIGERANT CODE.
7. ACCEPTABLE MANUFACTURER : DAIKIN, MITSUBISHI, LG, AND TOSHIBA.

B. SYSTEM DESCRIPTION

1. VRF SYSTEM SHALL AUTOMATICALLY VARY THE TARGET EVAPORATING AND CONDENSING TEMPERATURES BASED ON BUILDING LOAD AND WEATHER CONDITIONS TO INCREASE PART LOAD EFFICIENCY (VARIABLE REFRIGERANT TEMPERATURE). THE CONDENSING UNIT SHALL ALSO FEATURE CUSTOMIZABLE OPERATING MODES WHICH ALLOWS FOR THE MANUAL SETTING OF TARGET EVAPORATING AND CONDENSING TEMPERATURES.

C. HEAT RECOVERY

1. SYSTEM SHALL PERMIT SIMULTANEOUS HEATING AND COOLING OF EACH INDOOR UNIT. MULTIPLE INDOOR UNITS CONNECTED TO A SINGLE BRANCH SELECTOR PORT SHALL OPERATE IN THE SAME MODE (HEATING OR COOLING), SIMILAR TO A TWO PIPE HEAT PUMP SYSTEM. REFER TO THE CONTROLS SECTION OF THIS SPECIFICATION FOR ANY CENTRAL CONTROLLER AND/OR MODE SWITCHOVER SEQUENCE THAT MAY BE REQUIRED.

D. START-UP AND WARRANTY

1. INSTALLING CONTRACTOR MUST BE CERTIFIED BY VRF MANUFACTURER. THE BIDDERS SHALL BE REQUIRED TO SUBMIT TRAINING CERTIFICATION PROOF WITH BID DOCUMENTS AND SUBMITTAL DOCUMENTS.
2. THE WARRANTY PERIOD ON ALL PARTS AND COMPRESSORS SHALL COMMENCE ON THE DATE OF INITIAL START-UP AND SHALL CONTINUE FOR A PERIOD OF TEN (10) YEARS NOT TO EXCEED ONE HUNDRED AND TWENTY SIX (126) MONTHS FROM DATE OF SHIPMENT.
3. ALL MANUFACTURER WARRANTY SHALL BE FOR PARTS ONLY. ALL DIAGNOSIS AND LABOUR WARRANTY SHALL BE CARRIED OUT BY INSTALLING CONTRACTOR AS PER THE WARRANTY REQUIREMENTS OF THIS PROJECT.

E. REFRIGERANT PIPING

1. ALL PIPING SHALL BE BRAZED.
2. STANDARD T STYLE JOINTS ARE **NOT ACCEPTABLE** FOR A VARIABLE REFRIGERANT VOLUME SYSTEM.
3. MANUFACTURER SPECIFIC Y JOINTS SHALL BE SUPPLIED BY THE VRF MANUFACTURER.

F. VERTICAL BLOWER COIL UNITS

1. THE BLOWER COIL SHALL BE FURNISHED AS A VERTICAL DRAW-THROUGH STYLE AIR HANDLER.
2. THE BLOWER COIL UNIT SHALL INCLUDE A BLOWER, FAN HOUSING, COIL, AND DRAIN-PAN ENCLOSED WITHIN AND MOUNTED TO A RIGID CABINET. STEEL PARTS EXPOSED TO MOISTURE SHALL BE GALVANIZED AND INSULATED TO PREVENT CONDENSATION. THE COMPLETE FAN ASSEMBLY SHALL BE WIRED VIA QUICK CONNECT ELECTRICAL CONTACTS AND EASILY REMOVABLE FOR SERVICE AND MAINTENANCE
3. UNIT WILL BE SUPPLIED WITH 1-INCH, DOUBLE-WALL PANELS. THE CABINET IS TO BE THERMALLY ISOLATED THROUGH INJECTED FOAM INSULATION INSIDE EACH CABINET. SINGLE WALL CABINETS WITH FIBERGLASS INSULATION EXPOSED IN THE AIRSTREAM ARE NOT ACCEPTABLE. FRAME CHANNELS WHICH ALLOW HEAT CONDUCTANCE BETWEEN THE INSIDE AND OUTSIDE OF THE CABINET ARE NOT ACCEPTABLE. BASE RAILS USED FOR UNIT MOUNTING/HANGING ARE ACCEPTABLE. PANEL SHALL HAVE A MINIMUM THERMAL INSULATION OF R6. FOAM INJECTED INSULATION CONFORMS TO: A. A. ASTM C1071 (INCLUDING C665)B. B. UL 181 FOR EROSION C. C. 25/50 RATING FOR FLAME SPREAD/SMOKE DEVELOPED PER ASTM E-84, UL 723 AND NFPA 90A
4. SUPPLY FAN:
   a. SUPPLY FANS SHALL BE A DWDI FORWARD-CURVED TYPE. FAN ASSEMBLIES SHALL BE BALANCE TESTED DYNAMICALLY BY THE MANUFACTURER. MANUFACTURER MUST ENSURE MAXIMUM FAN RPM IS BELOW THE FIRST CRITICAL SPEED.
   b. FAN MOTOR(S) ASSEMBLY SHALL BE DIRECT-DRIVE STYLE.
   c. FAN MOTOR(S) SHALL BE OF DIRECT CURRENT BRUSHLESS TYPE OF MINIMUM MOTOR EFFICIENCY OF 85 PERCENT WHEN RATED IN ACCORDANCE OF NEMA STANDARD MG 1-2016 AT FULL LOAD CONDITIONS.
   d. MANUFACTURER'S SUPPLY FAN MOTOR MUST HAVE MEANS TO ADJUST MOTOR SPEED FOR FIELD BALANCING.
   e. SUPPLY FAN MUST BE CAPABLE OF DELIVERING 1.5" W.G. EXTERNAL STATIC PRESSURE AND 3.0" W.G. TOTAL STATIC PRESSURE AT NOMINAL CABINET CFM
5. ELECTRICAL:
   a. SUPPLY FANS SHALL BE DRIVEN BY ELECTRICALLY COMMUTATED MOTORS THAT ARE RUN-TESTED IN THE ASSEMBLED UNIT AND PERMANENTLY LUBRICATED. ALL MOTORS SHALL HAVE INTEGRAL THERMAL OVERLOAD PROTECTION WITH A MAXIMUM AMBIENT OPERATING TEMPERATURE OF 55°C. MOTORS SHALL BE CAPABLE OPERATING AT 90 PERCENT OF RATED VOLTAGE ON ALL SPEED SETTINGS. MOTORS CAN OPERATE UP TO 10 PERCENT OVER VOLTAGE.
   b. MOTOR WIRES SHALL INCLUDE A QUICK-DISCONNECT MOTOR PLUG.
   c. ALL CONTROLS EQUIPMENT INCLUDING ECM CONTROL MODULE, LOW VOLTAGE TRANSFORMERS, SAFETY SWITCHES, DISCONNECTS, FUSING, AND TERMINAL STRIPS MUST BE LOCATED INSIDE THE MAIN UNIT CABINET.
6. COOLING AND HEATING VRV DX COILS
   a. AIR HANDLING UNIT SHALL BE SUPPLIED WITH A HEAT PUMP VRV DX COIL, COMPATIBLE WITH A VRV CONDENSING UNIT(S) AS SCHEDULED.
   b. VRV MANUFACTURER SHALL PROVIDE ELECTRONIC EXPANSION VALVES AND CONTROLLERS TO ALLOW VRV SYSTEM TO SERVE THE VRV DX COILS IN AIR HANDLING UNITS AS SCHEDULED
   c. EXPANSION VALVE, EXPANSION VALVE CONTROLLER, AND THERMISTORS SHALL BE FIELD MOUNTED, POWERED, AND WIRED AT AIR HANDLING UNITS. EXPANSION VALVE CONTROLLER REQUIRES A SEPARATE 208/1 POWER FEED.
   d. ALL VRV CONDENSING UNITS ON THE PROJECT, FOR THE VRV INDOOR UNITS AND FOR THE AIR HANDLING UNITS, SHALL BE FROM THE SAME MANUFACTURER.
7. FILTERS:
   a. FILTERS SHALL BE ARRANGED IN A FLAT MANNER. FILTERS SHALL BE 2" IN DEPTH. PRE-FILTER SHALL BE MERV 8. FINAL-FILTER SHALL BE MERV 13.
8. CONTROLS
   a. UNIT SHALL BE SUPPLIED WITH A DIGITAL CONTROLS READY INTERFACE. THIS INTERFACE IS TO BE LOCATED INSIDE THE CONTROL BOX INTERNAL TO THE MAIN UNIT. THIS INTERFACE SHALL INCLUDE A 24VAC TRANSFORMER AND TERMINAL BLOCKS FOR CONNECTIONS TO FAN MOTOR CONTROL, SENSOR CONTROL, SAFETY SWITCHES, AND DAMPER CONTROL IF APPLICABLE.
   b. UNIT SHALL BE FURNISHED WITH A DISCONNECT SWITCH. THE DISCONNECT SWITCH SHALL BE OPERABLE FROM THE OUTSIDE OF THE CABINET TO REDUCE HAZARDS DURING FIELD SERVICE AND COMMISSIONING.

9. CONDENSING UNIT

a. THE CONDENSING UNIT SHALL BE FACTORY ASSEMBLED AND PRE-WIRED WITH ALL NECESSARY ELECTRONIC AND REFRIGERANT CONTROLS. THE REFRIGERATION CIRCUIT OF THE CONDENSING UNIT SHALL CONSIST OF INVERTER SCROLL COMPRESSORS, MOTORS, FANS, HEAT EXCHANGER, ELECTRONIC EXPANSION VALVES, SOLENOID VALVES, 4-WAY VALVE, DISTRIBUTION HEADERS, CAPILLARIES, FILTERS, SHUT OFF VALVES, OIL SEPARATORS, SERVICE PORTS, LIQUID RECEIVER (HEAT RECOVERY ONLY) AND SUCTION ACCUMULATOR.
b. THE SYSTEM WILL AUTOMATICALLY RESTART OPERATION AFTER A POWER FAILURE AND WILL NOT CAUSE ANY SETTINGS TO BE LOST.
c. THE UNIT SHALL INCORPORATE AN AUTO-CHARGING FEATURE TO ENSURE PROPER REFRIGERANT CHARGE.
d. THE FOLLOWING SAFETY DEVICES SHALL BE INCLUDED ON THE CONDENSING UNIT: HIGH PRESSURE SENSOR AND SWITCH, LOW PRESSURE SENSOR, CONTROL CIRCUIT FUSES, CRANKCASE HEATERS, FUSIBLE PLUG, OVERLOAD RELAY, INVERTER OVERLOAD PROTECTOR, THERMAL PROTECTORS FOR COMPRESSOR AND FAN MOTORS, OVER CURRENT PROTECTION FOR THE INVERTER, AND ANTI-RECYCLING TIMERS.
e. THE COMPRESSORS' MOTORS SHALL HAVE A COOLING SYSTEM USING DISCHARGE GAS, TO AVOID SUDDEN CHANGES IN TEMPERATURE RESULTING IN SIGNIFICANT STRESSES ON WINDING AND BEARINGS.
f. INVERTER BOARD SHALL BE REFRIGERANT-COOLED TO PREVENT INEFFICIENT AND UNSTABLE OPERATION THAT CAN RESULT FROM AIR-COOLED INVERTER BOARDS DUE TO VARYING AMBIENT CONDITIONS.
g. THE COMPRESSOR SHALL BE INTERNALLY ISOLATED TO AVOID THE TRANSMISSION OF VIBRATION.
h. IN THE CASE OF MULTIPLE CONDENSER MODULES, OPERATION HOURS OF THE COMPRESSORS SHALL BE BALANCED BY MEANS OF THE DUTY CYCLING FUNCTION.
i. **AIR COOLED:**
   i.a. THE FAN MOTOR SHALL HAVE INHERENT PROTECTION AND PERMANENTLY LUBRICATED BEARINGS. THE MOTOR SHALL BE PROVIDED WITH A FAN GUARD TO PREVENT CONTACT WITH MOVING PARTS. THE CONDENSING UNIT SHALL CONSIST OF ONE OR MORE PROPELLER TYPE, DIRECT-DRIVE FAN MOTORS THAT HAVE MULTIPLE SPEED OPERATION VIA A DC (DIGITALLY COMMUTATING) INVERTER. MOTORS SHALL BE CAPABLE OF DELIVERING DESIGN AIR AT HIGH EXTERNAL STATIC PRESSURES UP TO 0.32 IN WG (FACTORY SET AS STANDARD AT 0.12 IN. WG) TO ACCOMMODATE FIELD APPLIED CONDENSING UNIT DISCHARGE DUCTWORK..
   i.b. THE HEAT EXCHANGER ON THE CONDENSING UNITS SHALL BE MANUFACTURED FROM HI-X SEAMLESS COPPER TUBES WITH N-SHAPE INTERNAL GROOVES MECHANICALLY BONDED ON TO ALUMINUM FINS TO AN E-PASS DESIGN. THE HEAT EXCHANGER COIL SHALL BE OF A WAFFLE LOUVER FIN AND RIFLED BORE TUBE DESIGN TO ENSURE HIGH EFFICIENCY PERFORMANCE.

10. REYQ - HEAT RECOVERY VRV-IV

a. THE OUTDOOR UNIT SHALL BE CAPABLE OF HEATING OPERATION DOWN TO -13°F AMBIENT TEMPERATURE. TESTED FACTORY DATA ON HEATING CAPACITY AND EFFICIENCY SHALL BE AVAILABLE. CONTINUOUS HEATING SHALL BE PROVIDED DURING DEFROST MODE FOR MULTI-MODULE SYSTEMS.
b. THE OUTDOOR UNIT SHALL BE CAPABLE OF COOLING OPERATION DOWN TO +23°F WITHOUT ANY ADDITIONAL LOW AMBIENT CONTROLS.
c. THE OUTDOOR COIL SHALL HAVE A THREE-CIRCUIT HEAT EXCHANGER DESIGN. THE LOWER PART OF THE COIL SHALL BE USED FOR INVERTER COOLING, ENHANCING DEFROST DURING HEATING OPERATION.

11. BRANCH SELECTOR BOX

a. SELECTOR BOX CABINETS SHALL HAVE A GALVANIZED STEEL PLATE CASING AND SHALL HOUSE MULTIPLE ELECTRONIC EXPANSION VALVES AND A SUB-COOLING LOOP. THE UNIT SHALL CONTAIN SOUND ABSORPTION THERMAL INSULATING MATERIAL MADE OF FLAME AND HEAT RESISTANT FOAMED POLYETHYLENE.
b. BRANCH SELECTOR BOXES SHALL NOT REQUIRE DRAIN PAN AND DRAIN CONNECTIONS. MANUFACTURERS WITH BRANCH SELECTOR BOXES REQUIRING SECONDARY DRAIN PANS AND DRAIN CONNECTIONS SHALL COORDINATE WITH THE INSTALLING CONTRACTOR AT NO EXTRA COST TO THE OWNER.

12. CENTRAL CONTROLS

a. PROVIDE AN ADVANCED MULTI-ZONE CONTROLLER FOR INSTALLATION IN A COMMON AREA AS SHOWN ON THE PLANS, EQUAL TO DAIKIN ITOUCH MANAGER.

13. ELECTRICAL

a. INDEPENDENT ELECTRICAL POWER FOR FAN COILS AND BRANCH SELECTOR BOXES SHALL BE 208/230 VOLTS, 1 PHASE, 60 HERTZ.
b. UNLESS LIMITED BY LOCAL ELECTRICAL CODES AND STANDARDS, MULTIPLE FAN COILS AND BRANCH SELECTOR BOXES CAN BE CONNECTED TO THE SAME BREAKER. FIELD PROVIDED INDIVIDUAL DISCONNECT SWITCHES FOR EACH FAN COIL ARE REQUIRED.
c. ELECTRICAL POWER FOR CONDENSING UNITS SHALL BE 208/230 VOLTS, 3 PHASE, 60 HERTZ.
d. CONTROL WIRING SHALL BE INSTALLED AS PER MANUFACTURER RECOMMENDATIONS.

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Drawing Title

CARLYLE HOUSE
HVAC SPECIFICATION

COMMONWEALTH OF VIRGINIA
KENNETH M. SCHRAM
Lic. No. 023977
PROFESSIONAL ENGINEER
12/10/2020

M-004

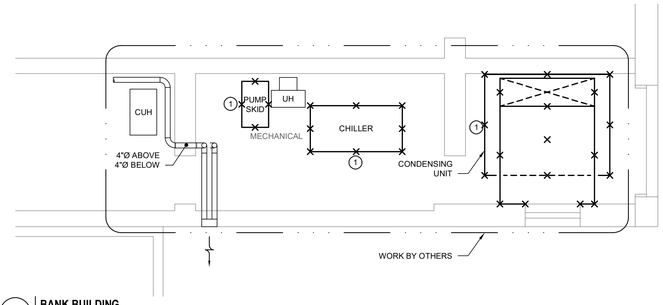
DEMO — EXISTING TO REMAIN

GENERAL NOTES

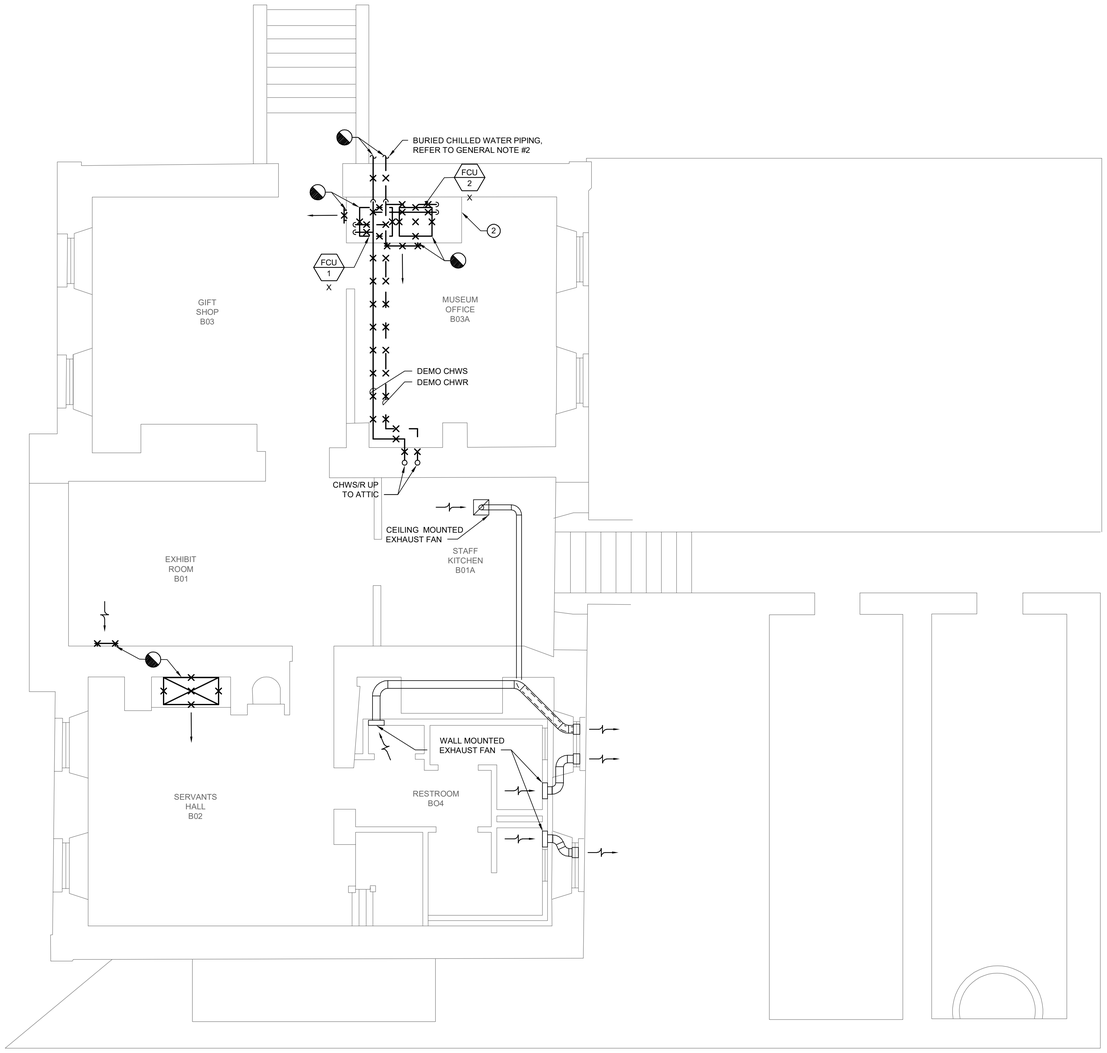
1. DEMOLISH DUCTWORK AND PIPING INCLUDING ALL ASSOCIATED HANGERS, SUPPORTS, AND OTHER APPURTENANCES AS INDICATED ON DRAWING. COORDINATE UTILITY SHUTDOWN TIME WITH OWNER TO AVOID UNEXPECTED LOSS OF SERVICE.
2. UNDERGROUND PIPING CONNECTING THE BANK BUILDING AND CARLYLE HOUSE SHALL BE ABANDONED. CUT, CAP, AND DRAIN PIPING AT THE ENTRANCE OF EACH BUILDING

KEYNOTES

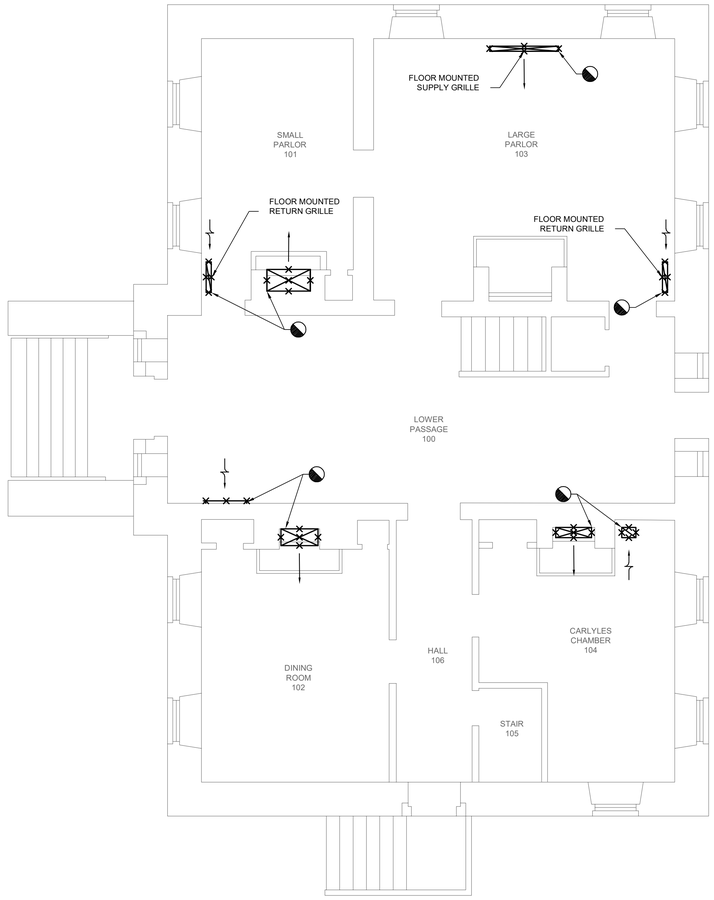
1. DEMOLITION WORK WITHIN THE "BANK BUILDING" BY OTHERS.
2. DEMOLISH ALL DUCTWORK, PIPING, EQUIPMENT, AND APPURTENANCES ASSOCIATED TO THE MECHANICAL SYSTEM WITHIN THE MECHANICAL CLOSET OF MUSEUM OFFICE 203A
3. DEMOLISH ALL DUCTWORK, PIPING, AND APPURTENANCES ASSOCIATED TO THE MECHANICAL EQUIPMENT, MARKED FOR DEMOLITION (X), LOCATED IN THE ATTIC.
4. DISASSEMBLE DORMER WINDOW FOR EQUIPMENT REMOVAL AND NEW EQUIPMENT DELIVERY. COORDINATE WITH THE OWNER FOR REMOVAL OF DORMER WINDOW ASSEMBLY. DISASSEMBLE COMPONENTS AS NECESSARY TO FIT THROUGH WINDOW OPENING.
5. DEMO DUCTWORK RISER IN ITS ENTIRETY



1 **BANK BUILDING**
SCALE: 1/4" = 1'-0"



3 **CARLYLE HOUSE: BASEMENT**
SCALE: 1/4" = 1'-0"



2 **CARLYLE HOUSE: FIRST FLOOR**
SCALE: 1/4" = 1'-0"

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Drawing Title

MECHANICAL
DEMOLITION PLAN
SHEET #1

COMMONWEALTH OF VIRGINIA
KENNETH M. SCHRAM
Lic. No. 023977
PROFESSIONAL ENGINEER
12/10/2020

M-101

DEMO — EXISTING TO REMAIN

GENERAL NOTES

1. DEMOLISH DUCTWORK AND PIPING INCLUDING ALL ASSOCIATED HANGERS, SUPPORTS, AND OTHER APPURTENANCES AS INDICATED ON DRAWING. COORDINATE UTILITY SHUTDOWN TIME WITH OWNER TO AVOID UNEXPECTED LOSS OF SERVICE.
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KEYNOTES

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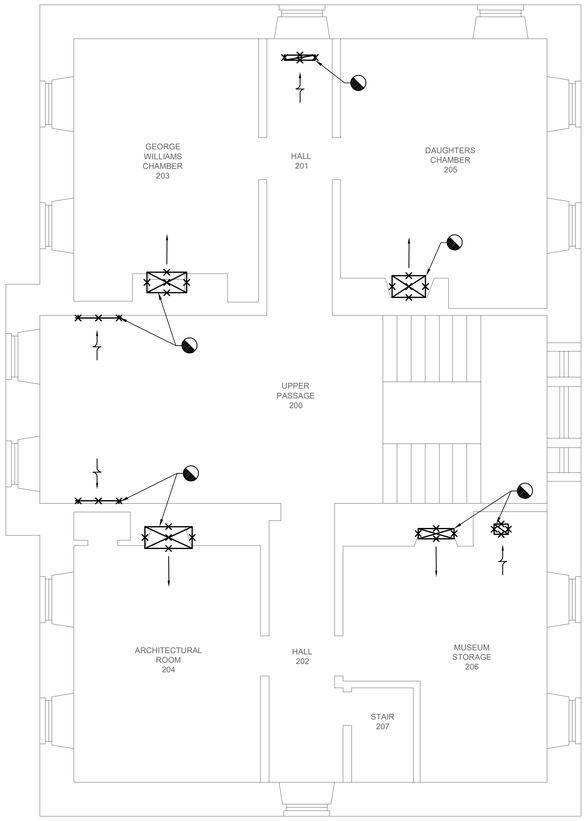
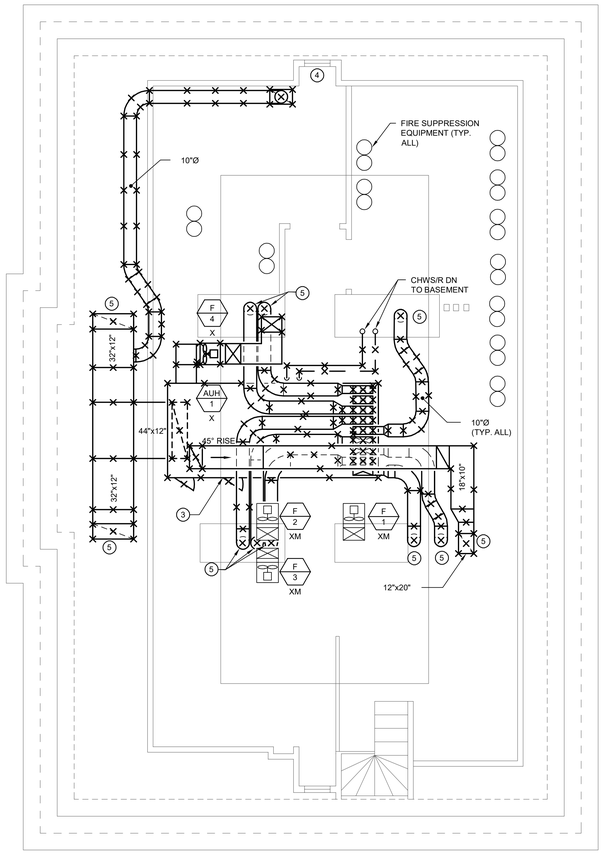
5. DEMO DUCTWORK RISER IN ITS ENTIRETY



1 **CARLYLE HOUSE: SECOND FLOOR**
SCALE: 1/4" = 1'-0"



2 **CARLYLE HOUSE: ATTIC**
SCALE: 1/4" = 1'-0"

NOVA PARKS

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Carlyle House, HVAC System Retrofit

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Drawing Title

MECHANICAL DEMOLITION PLAN SHEET #2

COMMONWEALTH OF VIRGINIA
KENNETH M. SCHRAM
Lic. No. 023977
PROFESSIONAL ENGINEER
12/10/2020

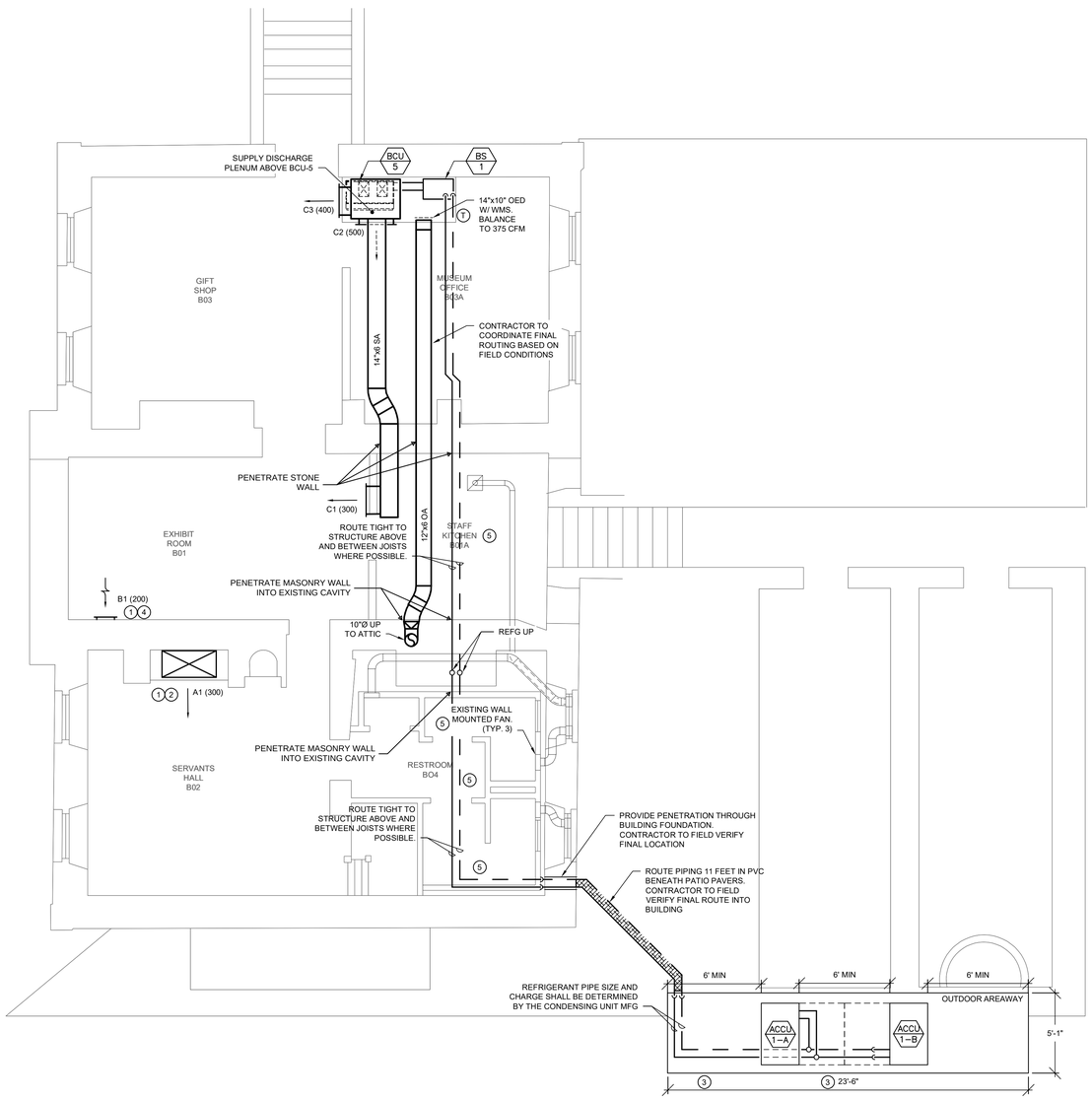
M-102

GENERAL NOTES

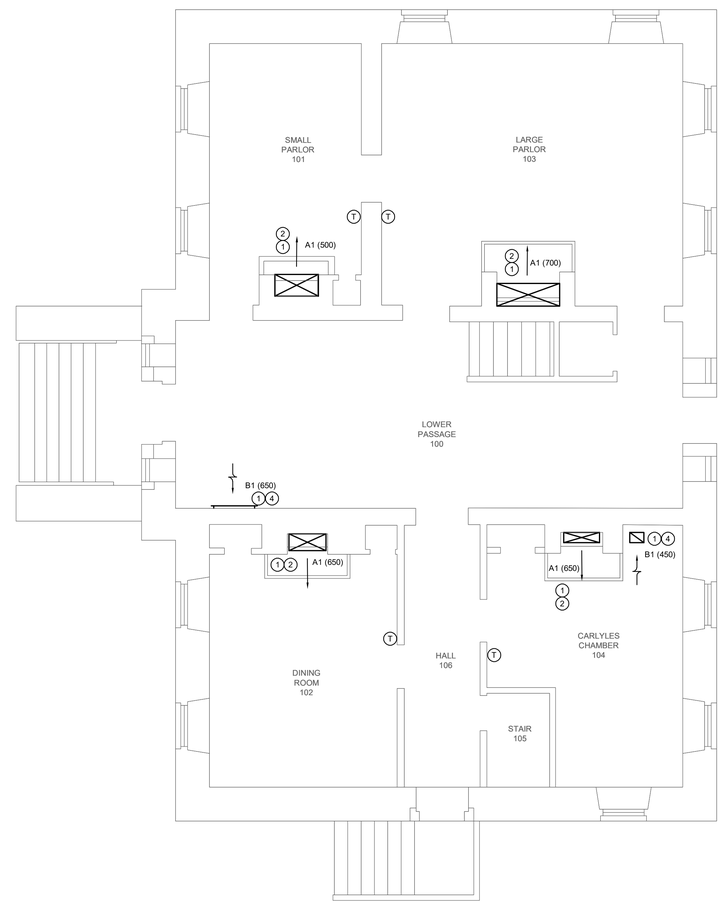
1. ALL BRANCH DUCTWORK CONNECTING SUPPLY & RETURN GRILLES TO THE ATTIC ARE NOT SHOWN BUT SHALL BE COORDINATED BY THE MECHANICAL CONTRACTOR.
2. FOR EACH BLOWER COIL UNIT, PROVIDE 3/4" CD PIPING FROM BCU DRIP PAN TO EXISTING FLOOR DRAIN. MECHANICAL CONTRACTOR TO FIELD VERIFY LOCATION AND ROUTING TO FLOOR DRAIN.
3. FOR EACH BLOWER COIL UNIT, ALL PIPING AND VALVING SHALL BE PROVIDED BY THE MANUFACTURER, INSTALLED BY THE MECHANICAL CONTRACTOR.
4. PROVIDE NEW MATERIAL TO REPLACE ANY COMPONENTS DAMAGED DURING CONSTRUCTION. ALL PAINT AND FINISHES SHALL MATCH EXISTING WALL COLORS.

KEYNOTES

1. REPLACE IN KIND. CONTRACTOR TO FIELD VERIFY GRILLE SIZE TO MATCH FIREPLACE FREE AREA OPENING.
2. PROVIDE TRANSITION FROM SUPPLY DUCT TO GRILLE NECK.
3. ELEVATE CONDENSING UNITS, TOP OF UNIT TO BE FLUSH WITH TOP OF SOUTH AREAWAY WALL. PIPES SHALL BE ROUTED UNDER THE UNIT AND INTO THE BUILDING. PROVIDE LADDER ON EITHER SIDE OF AREAWAY WALL FOR MAINTENANCE ACCESS TO UNITS.
4. REPLACE IN KIND EXISTING FIRE DAMPERS IN RETURN RISER AT FLOOR PENETRATION.
5. REMOVE AND REINSTALL ACOUSTICAL TILE CEILING FOR INSTALLATION OF MECHANICAL WORK. REPLACE IN KIND ANY DAMAGED ACOUSTICAL CEILING TILES



1 **CARLYLE HOUSE: BASEMENT**
SCALE: 1/4" = 1'-0"



2 **CARLYLE HOUSE: FIRST FLOOR**
SCALE: 1/4" = 1'-0"

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Drawing Title

MECHANICAL
NEW WORK
SHEET #1

COMMONWEALTH OF VIRGINIA
KENNETH M. SCHRAM
Lic. No. 023977
PROFESSIONAL ENGINEER
12/10/2020

M-201

GENERAL NOTES

1. ALL BRANCH DUCTWORK CONNECTING SUPPLY & RETURN GRILLES TO THE ATTIC ARE NOT SHOWN BUT SHALL BE COORDINATED BY THE MECHANICAL CONTRACTOR.
2. FOR EACH BLOWER COIL UNIT, PROVIDE 3/4" CD PIPING FROM BCU DRIP PAN TO EXISTING FLOOR DRAIN. MECHANICAL CONTRACTOR TO FIELD VERIFY LOCATION AND ROUTING TO FLOOR DRAIN.
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KEYNOTES

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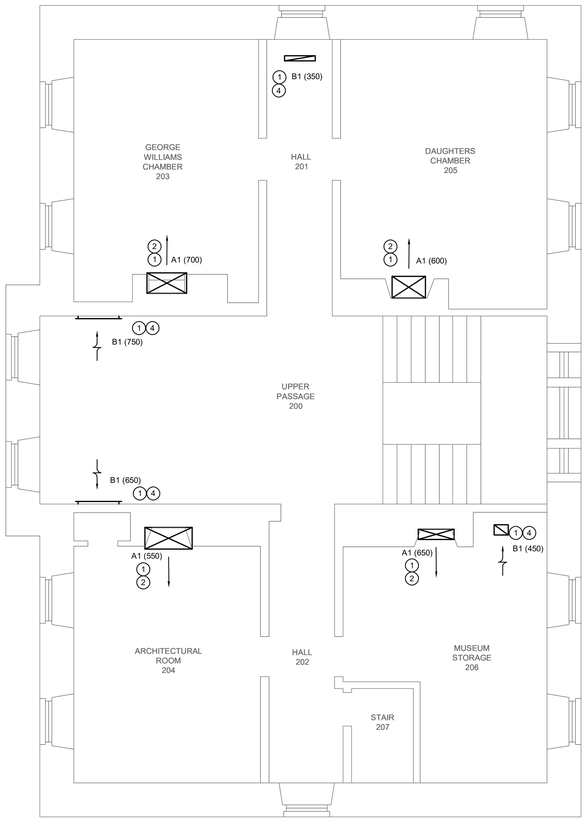
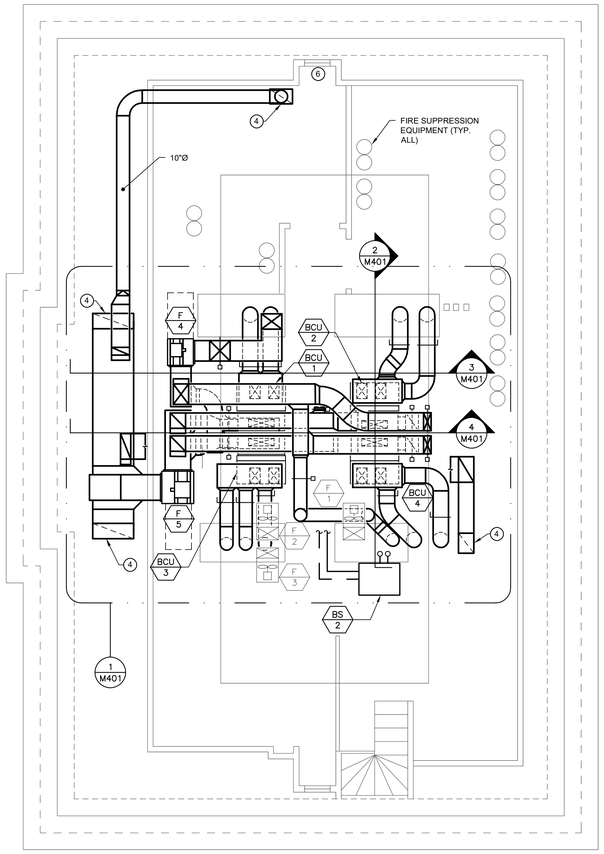
3. ELEVATE CONDENSING UNITS, TOP OF UNIT TO BE FLUSH WITH TOP OF SOUTH AREAWAY WALL. PIPES SHALL BE ROUTED UNDER THE UNIT AND INTO THE BUILDING. PROVIDE LADDER ON EITHER SIDE OF AREAWAY WALL FOR MAINTENANCE ACCESS TO UNITS.
4. REPLACE IN KIND EXISTING FIRE DAMPERS IN RETURN RISER AT FLOOR PENETRATION.
5. REPLACE IN KIND ANY DAMAGED ACOUSTICAL CEILING TILES WITHIN STAFF KITCHEN B01A
6. DISASSEMBLE DORMER WINDOW FOR EQUIPMENT REMOVAL AND NEW EQUIPMENT DELIVERY. COORDINATE WITH THE OWNER FOR REMOVAL AND RECONSTRUCTION OF DORMER WINDOWN AND FRAMING ASSEMBLY. PROTECT INTERIOR FROM WEATHER.



1 **CARLYLE HOUSE: SECOND FLOOR**
SCALE: 1/4" = 1'-0"



2 **CARLYLE HOUSE: ATTIC**
SCALE: 1/4" = 1'-0"

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MECHANICAL
NEW WORK
SHEET #2

COMMONWEALTH OF VIRGINIA
KENNETH M. SCHRAM
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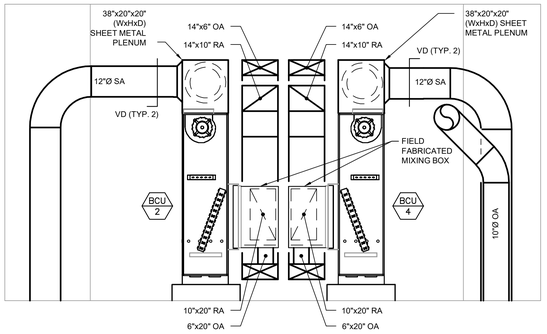
PROFESSIONAL ENGINEER
12/10/2020

M-202



2 **CARLYLE HOUSE: ATTIC SECTION**
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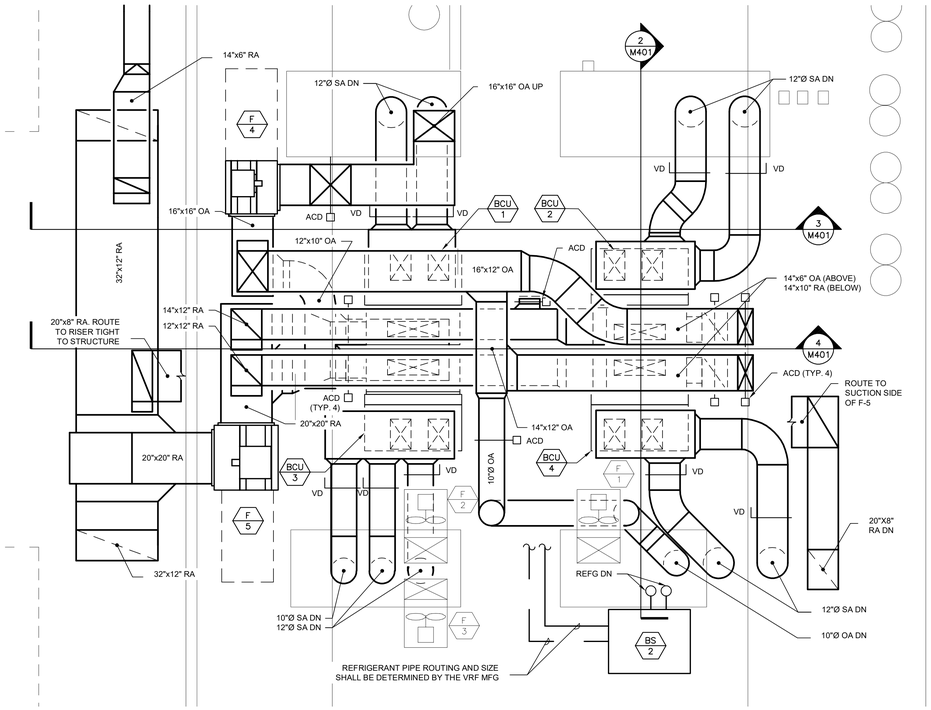
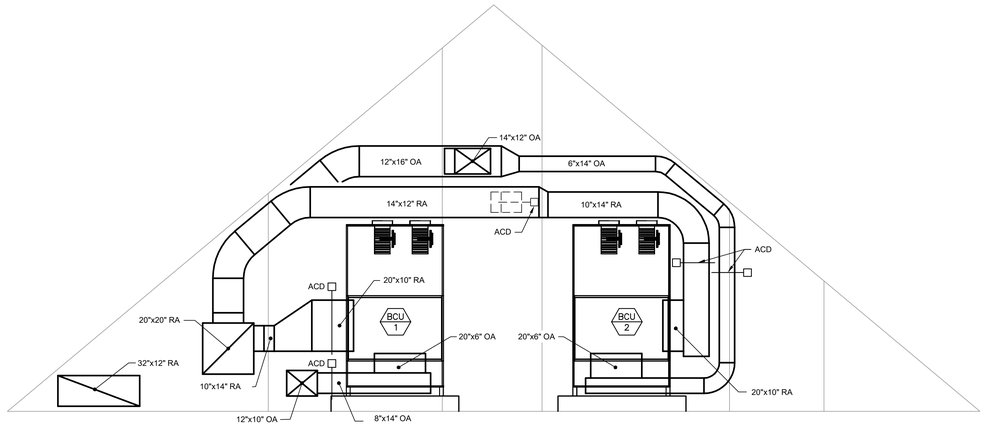


1 **CARLYLE HOUSE: ATTIC PART PLAN**
SCALE: 1/2"=1'-0"



4 **CARLYLE HOUSE: ATTIC SECTION**
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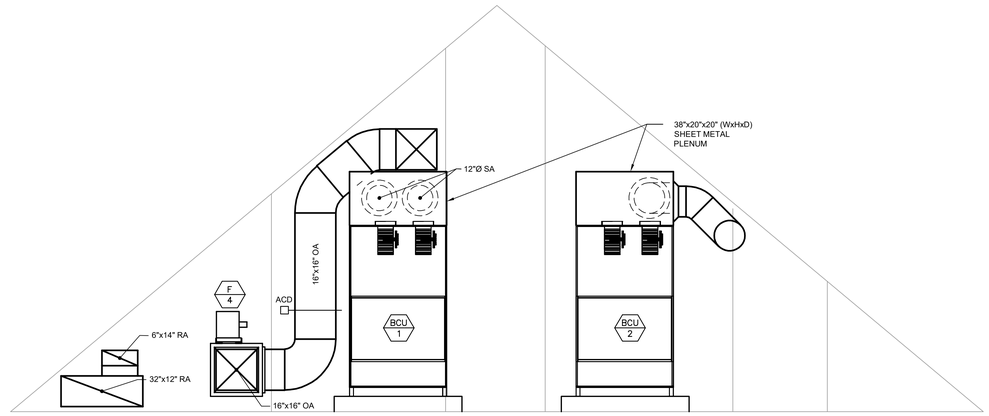

3 **CARLYLE HOUSE: ATTIC SECTION**
SCALE:1/2"=1'-0"

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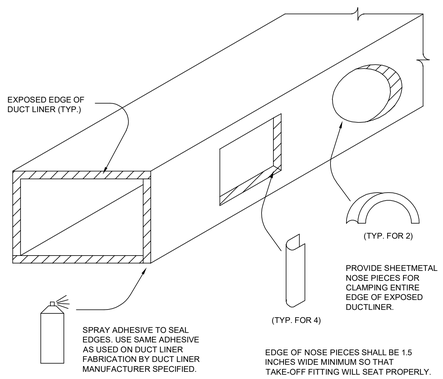
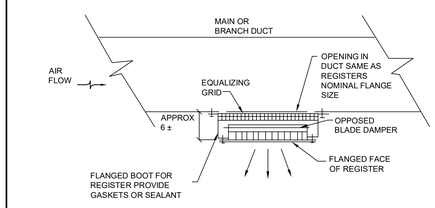
MECHANICAL SECTIONS

COMMONWEALTH OF VIRGINIA
KENNETH M. SCHRAM
Lic. No. 023977
PROFESSIONAL ENGINEER
12/10/2020

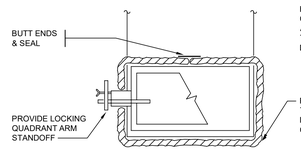
M-401



1 SEALING AND SECURING EXPOSED DUCTLINER
SCALE: NTS — H05–03



2 CLOSE COUPLED SUPPLY DUCT & REGISTER
SCALE: NTS — H05-19



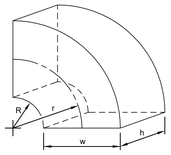
3 TYPICAL DUCT INSULATION & SUPPORTS NEAR VOLUME DAMPERS
SCALE: NTS — H05-10

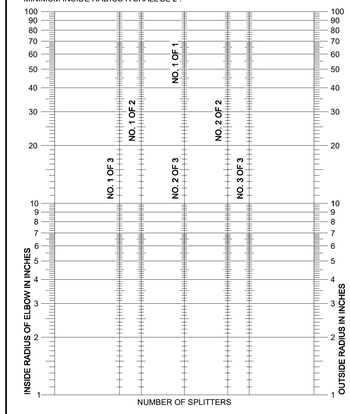
RADIUS ELBOW AND SPLITTER VANE REQUIREMENTS

r/w RATIO:	NO. OF VANES FOR 1 ELBOW:	NO. OF VANES WHEN 2 ELBOWS ARE WITHIN 2 EQUIV. DIA.:
r/w >= 1.50	0	1
1.5 > r/w >= 0.70	1	2
0.7 > r/w >= 0.60	2	3
0.6 > r/w >= 0.55	3	3

EQUIVALENT DIAMETER = (w+h)/2

NOTE:
r/w < 0.55 (SQUARE THROAT ELBOW) SHALL NOT BE USED.
MINIMUM INSIDE RADIUS R SHALL BE 2".





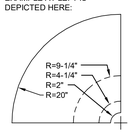
r = CENTERLINE RADIUS
R = INSIDE RADIUS
w = DUCT WIDTH
H = DUCT HEIGHT

TERMINOLOGY:

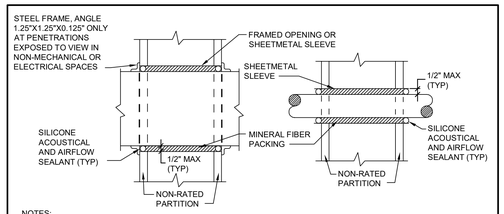
"NO. 1 OF 3" = NO. 1 VANE OF A TOTAL OF 3 VANES.

"NO. 2 OF 3" = NO. 2 VANE OF A TOTAL OF 3 VANES.

EXAMPLE AT LEFT IS DEPICTED HERE:

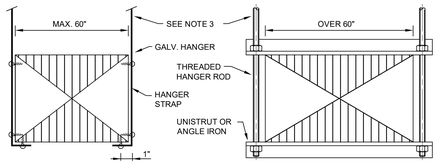


6 QUANTITY & SPACING OF DUCT SPLITTER VANES FOR SHORT RADIUS ELBOWS
SCALE: NTS — H05–21



NOTES:
1. AT FIRE RATED PARTITIONS WITHOUT FIRE DAMPER, REPLACE PACKING AND SILICONE SEALANT WITH UL LISTED FIRE STOP SYSTEM. INSTALL IN ACCORDANCE WITH UL LISTING.
2. FIRE STOP DUCT PENETRATIONS THRU RATED AND NON-RATED CORRIDOR WALLS ABOVE CEILINGS.

4 DUCT PENETRATION OF FULL HEIGHT PARTITIONS
SCALE: NTS — H01-01



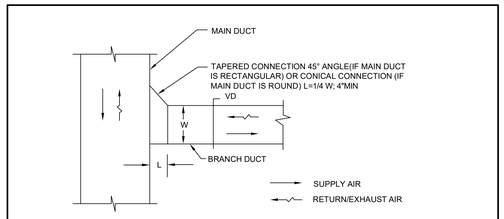
NOTES:
1. ON DUCTS OVER 48" WIDE, BOTTOM SHALL BE BRACED BY ANGLE. FOR CROSS SECTION AREA MORE THAN 8 SQ FT, DUCT SHALL BE BRACED BY ANGLES ON ALL FOUR SIDES.
2. CUTTING AND PATCHING SHALL BE LIMITED TO A MINIMUM AS REQUIRED FOR PROPER INSTALLATION.
3. SUPPORTS SHALL BE SPACED AND SIZED AS PER SMACNA.

5 DUCT HANGER SUPPORT
SCALE: NTS — H05-09

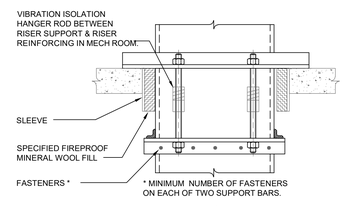
AIRFLOW MAX (CFM)	DUCT ARRANGEMENT				
	ROUND DUCT SIZE (IN)	EQUIVALENT RECTANGULAR DUCT SIZE (IN)			
60	6	4x8			
75	6	4x8	6x6		
110	8	4x12	6x8		
160	8	6x10	8x8		
220	10	6x12	8x10		
300	10	6x16	8x12	10x10	
380	12	6x18	8x14	10x10	
500	14	6x24	8x16	10x14	
600	14	8x20	10x16	12x12	
700	14	8x22	10x18	12x14	
850	16	8x26	10x20	12x16	14x14
1000	16	8x30	10x22	12x18	14x16
1400	18	10x30	12x24	14x20	16x18
1800	20	10x38	12x30	14x26	16x22
2100	22	12x34	14x28	16x24	18x22
2500	24	12x42	14x36	16x30	18x26
3000	26	12x50	14x42	16x36	18x32

NOTES:
1. WHERE DUCT SIZES ARE NOT INDICATED ON PLANS, SELECT SIZE FROM TABLE BASED ON THE CFM REQUIRED; SIZES BASED ON MAXIMUM STATIC PRESSURE DROP OF 0.05 INCHES PER 100 FEET OF DUCT.

7 LOW PRESSURE DUCT SIZING TABLE
SCALE: NTS — H05–29

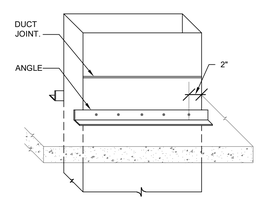


8 LOW PRESSURE BRANCH TAKE-OFFS
SCALE: NTS — H05-01



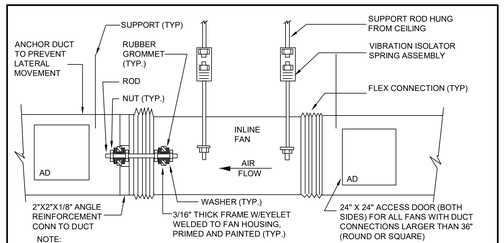
LARGEST DUCT DIM.	MINIMUM NUMBER OF FASTENERS
16" AND DOWN	2
17" - 24"	3
OVER 24"	LARGEST DUCT DIM DIVIDED BY 8

NOTE:
LOCATE A FASTENER WITHIN 2" OF THE DUCT EDGES.
LOCATE OTHERS AT EVENLY SPACED INTERVALS.



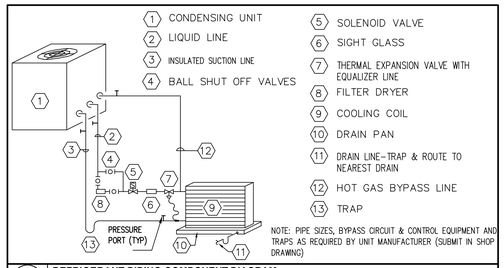
REFER TO SMACNA DUCT CONSTRUCTION MANUAL FOR SIZING OF DUCT SUPPORTS.

10 DUCT RISER SUPPORTS FROM FLOOR
SCALE: NTS — H05–27



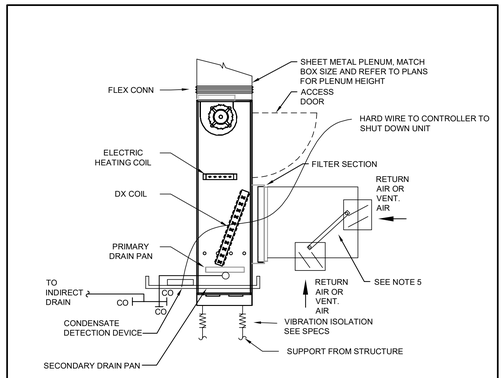
NOTE:
REFER TO CONSTRUCTION SPECIFICATIONS FOR MATERIALS, EQUIPMENT, AND INSTALLATION REQUIREMENTS.

11 INLINE FAN
SCALE: NTS — H10-07



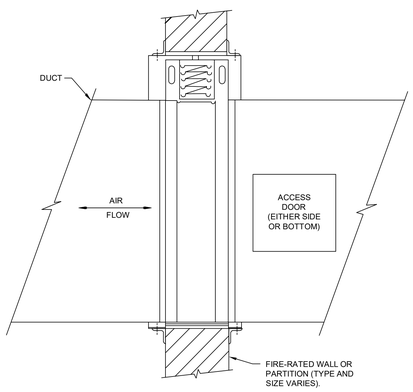
NOTE: PIPE SIZES, BYPASS CIRCUIT & CONTROL EQUIPMENT AND TRAPS AS REQUIRED BY UNIT MANUFACTURER (SUBMIT IN SHOP DRAWING)

9 REFRIGERANT PIPING COMPONENT DIAGRAM
SCALE: NTS — H08–04



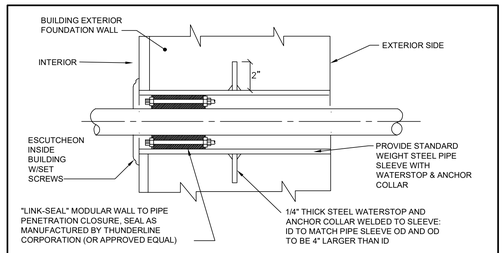
NOTES:
1. GALVANIZED SECONDARY DRAIN PAN SHALL BE MIN. 1 1/2" DEPTH AND 3" LARGER THAN COOLING COIL (PAN PROVIDED BY MECHANICAL CONTRACTOR).
2. PAN SHALL BE EQUIPPED WITH A WATER-LEVEL DETECTION DEVICE THAT WILL SHUT OFF THE EQUIPMENT SERVED PRIOR TO OVERFLOW OF THE PAN (DETECTOR BY ATC CONTRACTOR).
3. TERMINAL CONTROLLER MANUFACTURE SHALL PROVIDE 24VOLT RELAY AND TRANSFORMER.
4. INSULATE ALL PIPING COMPONENTS INCLUDING CONTROL VALVE, STRAINERS, VALVES, ETC.
5. CONTROLS CONTRACTOR SHALL PROVIDE MODULATING DAMPER LINKAGE ACTUATOR FOR ALL UNITS WITH CO2 MONITORING AND OUTSIDE AIR RESET.
6. MIXING BOX SHALL BE FIELD REVERSIBLE FROM BOTTOM/REAR TO TOP/REAR RETURN.
7. SHEET METAL DISCHARGE PLENUM PROVIDED BY MECHANICAL CONTRACTOR

14 VERTICAL FAN COIL UNIT WITH MIXING BOX AND SECONDARY DRAIN PAN
SCALE: NTS — H10–09



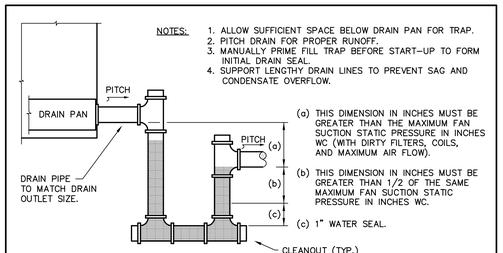
NOTES:
1. DAMPER BLADES SHALL BE OUT OF AIRSTREAM TYPE "3A,3B,7 OR 8" (SEE SMACNA FIRE DAMPER AND HEAT STOP GUIDE - 2ND EDITION PAGE 9 OR NEWER VERSION IF APPLICABLE) WHEN OPEN 100% FREE AREA IS REQUIRED. WHEN DUCT DIMENSIONS REQUIRE MULTIPLE DAMPER SECTIONS, TYPE "2" MAY BE USED.
2. PROVIDE SPRING LOADED CLOSURE FOR ALL FIRE DAMPERS.
3. WHEN DUCTWORK IS INSULATED OR LINED, PROVIDE INSULATED ACCESS DOOR.
4. WHERE DUCT SIZE PERMITS AND DAMPERS CAN BE REACHED BY AN ORDINARY PERSON'S ARM TO RESET THE FUSIBLE LINK, ACCESS DOORS SHALL BE MINIMUM 18" X 16" PER NFPA 90A. FOR LARGE DAMPERS AND WHERE ACCESS DOOR LOCATION REQUIRES A PERSON TO ENTER THE DUCT TO RESET THE FUSIBLE LINK, ACCESS DOOR SHALL BE 24" X16" MINIMUM. FOR SMALLER DUCTS PROVIDE THE LARGEST ACCESS DOOR POSSIBLE WITH A MINIMUM OF 12" X 12" PER NFPA 80. WHERE DUCT SIZE DOES NOT ALLOW INSTALLATION OF A 12" X 12" ACCESS DOOR, PROVIDE A 24" LONG REMOVABLE DUCT SECTION IN ADDITION TO A 6"X6" VIEW ONLY ACCESS DOOR FOR INSPECTION.
5. TYPE "1" FIRE DAMPERS (BLADES IN AIR STREAM) MAY BE SUBSTITUTED FOR TYPE "3A OR 3B" WHERE VELOCITIES ARE UNDER 500 FPM IN LOW PRESSURE DUCT SYSTEMS ONLY.
6. INSTALLATION SHOWN AS AN EXAMPLE. SPECIFIC INSTALLATION SHALL CONFORM WITH MANUFACTURER, UL APPROVED INSTRUCTIONS.

15 FIRE DAMPER PENETRATION
SCALE: NTS — H05–11A



12 EXTERIOR WALL SLEEVE
SCALE: NTS — H01–03

NOTES:
1. ALLOW SUFFICIENT SPACE BELOW DRAIN PAN FOR TRAP.
2. PITCH DRAIN FOR PROPER RUNOFF.
3. MANUALLY PRIME FILL TRAP BEFORE START–UP TO FORM INITIAL DRAIN SEAL.
4. SUPPORT LENGTHY DRAIN LINES TO PREVENT SAG AND CONDENSATE OVERFLOW.



(a) THIS DIMENSION IN INCHES MUST BE GREATER THAN THE MAXIMUM FAN SUCTION STATIC PRESSURE IN INCHES WC (WITH DIRTY FILTERS, COILS, AND MAXIMUM AIR FLOW).

(b) THIS DIMENSION IN INCHES MUST BE GREATER THAN 1/2 OF THE SAME MAXIMUM FAN SUCTION STATIC PRESSURE IN INCHES WC.

(c) 1" WATER SEAL.

13 DRAW THROUGH UNIT CONDENSATE TRAP
SCALE: N.T.S. — H03–10

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MECHANICAL DETAILS

COMMONWEALTH OF VIRGINIA
KENNETH M. SCHRAM
Lic. No. 023977
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12/10/2020

M-501

AIR HANDLING UNIT SCHEDULE (DX WITH ELECTRIC HEAT)

UNIT NO.	LOCATION	TOTAL CFM	MIN O.A. CFM	FAN DATA: CAPACITY CONTROL RANGE	CAPACITY CONTROL TYPE	STATIC PRESS(IN.WG) EXTERNAL	TOTAL (W/DIRTY FILTERS)	OUTLET VELOC (FPM)	WHEEL DIA (IN.)	WHEEL TYPE	RPM	BHP	MOTOR HP	DX COIL: FACE VELOC. (FPM)	COOLING MODE TOTAL COOL. MBH	SENS. COOL. MBH	EAT DB(°F)	EAT WB(°F)	LAT DB(°F)	LAT WB(°F)	HEATING MODE TOTAL HEAT. MBH	EAT DB(°F)	EAT LAT DB(°F)
BCU-1	ATTIC	1,200	375	CV	ECM	1.5	2.84	-	10	DIRECT	1,858	1.02	(2x) 3/4	-	57.6	38.4	81.7	67.5	53	51	80.6	52.5	105
BCU-2	ATTIC	1,300	375	CV	ECM	1.5	2.94	-	10	DIRECT	1,883	1.12	(2x) 3/4	-	60.7	40.7	81.7	67.5	53	51	85.0	53.8	104
BCU-3	ATTIC	1,500	495	CV	ECM	1.5	3.14	-	10	DIRECT	1,934	1.35	(2x) 3/4	-	63.7	42.8	81.7	67.5	55	54	73.2	52.5	97
BCU-4	ATTIC	1,300	375	CV	ECM	1.5	2.94	-	10	DIRECT	1,883	1.12	(2x) 3/4	-	60.7	40.7	81.7	67.5	53	51	85.0	53.8	104
BCU-5	ATTIC	1,200	375	CV	ECM	1.5	2.84	-	10	DIRECT	1,858	1.02	(2x) 3/4	-	57.6	38.4	81.7	67.5	53	51	80.6	52.5	105

UNIT NO.	ELECTRIC HEATING COIL: TYPE	TOTAL MBH	ELECTRIC DATA KW	V	Ø	HZ	FACE VELOC (FPM)	AIR TEMP (°F) EAT DB(°F)	LAT DB(°F)	PD (IN.WG)	CONTROL TYPE	FILTERS PRE (#) HxW	PRE DEPTH	PRE MERV RATING	FINAL (#) HxW	FINAL DEPTH	FINAL MERV RATING	INLET/ OUTLET SOUND POWER BY OCTAVE BAND HERTZ	63	125	250	500	1000	2000	4000	8000	ELECTRIC SERVICE V	Ø	HZ	SCCR	MANUFACTURER MODEL NUMBER (AS STANDARD)	REMARKS
BCU-1	SCR	27.6	8.1	208	1	60	-	52.5	71	-	SCR 0-10V	(2) 16x20	2"	8	(2) 16x20	2"	13	INLET	84	80	74	70	70	64	60	53	208	1	60	5 kA	DAIKIN - BCAD	1, 2, 3, 4
																		OUTLET	96	89	84	80	80	79	77	74						
BCU-2	SCR	27.6	8.1	480	3	60	-	53.8	72	-	SCR 0-10V	(2) 16x20	2"	8	(2) 16x20	2"	13	INLET	84	80	74	71	70	64	60	53	208	1	60	5 kA	DAIKIN - BCAD	1, 2, 3, 4
																		OUTLET	97	90	84	81	80	80	77	74						
BCU-3	SCR	27.6	8.1	480	3	60	-	52.5	70	-	SCR 0-10V	(2) 16x20	2"	8	(2) 16x20	2"	13	INLET	85	81	75	71	71	65	61	54	208	1	60	5 kA	DAIKIN - BCAD	1, 2, 3, 4
																		OUTLET	97	90	85	81	81	80	78	75						
BCU-4	SCR	27.6	8.1	480	3	60	-	53.8	72	-	SCR 0-10V	(2) 16x20	2"	8	(2) 16x20	2"	13	INLET	84	80	74	71	70	64	60	53	208	1	60	5 kA	DAIKIN - BCAD	1, 2, 3, 4
																		OUTLET	97	90	84	81	80	80	77	74						
BCU-5	SCR	27.6	8.1	208	1	60	-	52.5	71	-	SCR 0-10V	(2) 16x20	2"	8	(2) 16x20	2"	13	INLET	84	80	74	70	70	64	60	53	208	1	60	5 kA	DAIKIN - BCAD	1, 2, 3, 4
																		OUTLET	96	89	84	80	80	79	77	74						

NOTES:

1. VRF DX COILS TO BE FIELD INSTALLED BY INSTALLING CONTRACTOR
2. VRF EXPANSION VALVE TO BE FIELD MOUNTED AND BRAZED BY INSTALLING CONTRACTOR
3. VRF EXPANSION VALVE PCB REQUIRES SEPARATE 208V-1PH POWER SUPPLY . SHALL BE FIELD MOUNTED BY INSTALLING CONTRACTOR
4. PROVIDE WITH UNIT MOUNTED DISCONNECT

FAN SCHEDULE

UNIT NO.	SERVICE	LOCATION	FAN DATA: AIR FLOW RATE (CFM)	OUTLET VELOCITY (FPM)	E.S.P. (IN. W.G.)	FAN SPEED (RPM)	WHEEL DATA: DIA. (IN)	TYPE	MOTOR DATA: MOTOR SPEED (RPM)	CONTROL TYPE	BHP	RATED HP	ELECTRICAL (V/Ø/HZ)	INLET/ OUTLET SOUND POWER BY OCTAVE BAND HERTZ	63	125	250	500	1000	2000	4000	8000	LwA	dBA	MANUFACTURER MODEL NUMBER (AS STANDARD)	REMARKS
F-4	OUTSIDE AIR	ATTIC	1,995	–	1.5	2,224	13.5	INLINE	1725	BELT	1.12	1.5	208/3/60	INLET	80	81	83	81	73	70	70	64	81	70	COOK SQN	1,2,3,4,5
														OUTLET	83	85	82	77	73	73	72	66	81	70		
F-5	RETURN AIR	ATTIC	3,500	–	1.5	1,671	16.5	INLINE	1725	BELT	1.97	3	208/3/60	INLET	78	75	89	82	74	73	69	63	84	72	COOK SQN	1,2,3,4,5
														OUTLET	80	83	80	77	77	74	70	64	81	70		

NOTES:

1. VFD RATED MOTOR - MEETS NEMA MG-1 STANDARD
2. PROVIDE UNIT WITH VFD (BY MECHANICAL CONTRACTOR). VFD SHALL BE 6-PULSE WITH INTEGRAL DISCONNECT, SIMILAR TO ABB-ACH580
3. MOTOR COVER
4. PROVIDE WITH SHAFT GROUNDING RING
5. SPARE SET OF BELTS

DIFFUSER, GRILLE & REGISTER SCHEDULE

TAG	SERVICE	FACE SIZE (INCHES)	NECK SIZE (INCHES)	SELECTION RANGE (CFM)	MAX PRESSURE DROP (IN W.C.) AT MAX AIRFLOW	MAXIMUM NC AT MAX AIRFLOW	MOUNTING	ACCESSORIES	MANUFACTURER MODEL NO. (AS STANDARD)	REMARKS AND NOTES
A1	SUPPLY	REFER TO PLANS	REFER TO PLANS	0–1,000	0.1	20	SURFACE	–	TITUS 8F	3, AND 4
B1	RETURN	REFER TO PLANS	REFER TO PLANS	0–1000	0.1	20	SURFACE	–	TITUS 350RL	2, 3, AND 4
C1	SUPPLY	30x6	28x4	0–350	0.1	25	SURFACE	OBD	TITUS 300RL	1, 2, 3, AND 4
C2	SUPPLY	36x8	34x6	350–600	0.07	25	SURFACE	OBD	TITUS 300RL	1, 2, 3, AND 4
C3	SUPPLY	26x10	24x8	350–600	0.08	25	SURFACE	OBD	TITUS 300RL	1, 2, 3, AND 4

NOTES:

1. PROVIDE 45° DEFLECTION
2. FRONT BLADES PARALLEL WITH BOTTOM OF DUCT.
3. COORDINATE GRILLE FINISH WITH OWNER.
4. ALL RUN-OUTS TO DIFFUSERS ARE FULL NECK SIZE UNLESS OTHERWISE NOTED.

BRANCH SELECTOR SCHEDULE

TAG	SERVICE	ELECTRICAL (V/Ø/HZ)	MIN CIRCUIT AMPS (MCA)	MAX OVER CURRENT PROTECTION (MOP)	DIMENSIONS (WxHxD INCH)	MANUFACTURER MODEL NUMBER	REMARKS AND NOTES
BS–1	ACCU–1 BCU–5	208/1/60	0.1	15.0	13.3x8.1x12.8	DAIKIN–BSQ60TVJ	1, 2
BS–2	ACCU–1 BCU–1,2,3,4	208/1/60	0.8	15.0	22.8x11.7x18.9	DAIKIN–BS8Q54TVJ	1, 2

NOTES:

1. NO DRAIN PIPING NEEDED
2. STANDARD LIMITED WARRANTY: 10-YEAR WARRANTY ON ALL PARTS

HEAT RECOVERY AIR-COOLED CONDENSING UNIT

TAG	LOCATION	NOMINAL TONNAGE	COOLING CAPACITY MBH	COOLING CAPACITY AMBIENT DESIGN DB(°F)	HEATING CAPACITY MBH	HEATING CAPACITY AMBIENT DESIGN DB(°F)	REFRIGERANT TYPE	REFRIGERANT FACTORY CHARGE (LBS)	REFRIGERANT ADDITIONAL CHARGE (LBS)	EFFICIENCY (NON DUCTED) EER	IEER	COP47	COP17	SCHE	ELECTRICAL (PER MODULE) MODULE	(V/Ø/HZ)	MCA	MOP	RLA	MANUFACTURER MODEL NUMBER (AS STANDARD)	REMARKS
ACCU-1	REFER TO PLANS	28	315.5	95.0	266.5	17.3	R410a	51.6	41.9	9.9	20	3.53	2.12	23.30	ACCU-1A	208/3/60	61.9	70	49	DAIKIN REYQ336XATJA	1,2,3,4,5,6
															ACCU-1B	208/3/60	61.9	70	49		

NOTES:

1. UNIT IS COMPRISED OF TWO SUB MODULES, ACCU-1A AND ACCU-1B. LISTED PERFORMANCE IS FOR THE TOTAL UNIT.
2. LOW AMBIENT CONTROL
3. COMPRESSOR SHORT-CYCLE PROTECTION
4. REFRIGERANT PIPING SHALL BE SIZED PER MANUFACTURER'S RECOMMENDATIONS AND FIELD VERIFICATION OF PIPE LENGTHS
5. PROVIDE CENTRAL CONTROLLER WITH BACNET INTERFACE
6. MOUNT ON 18" STANDS IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATIONS.
7. PROVIDE WITH UNIT MOUNTED DISCONNECT SWITCH

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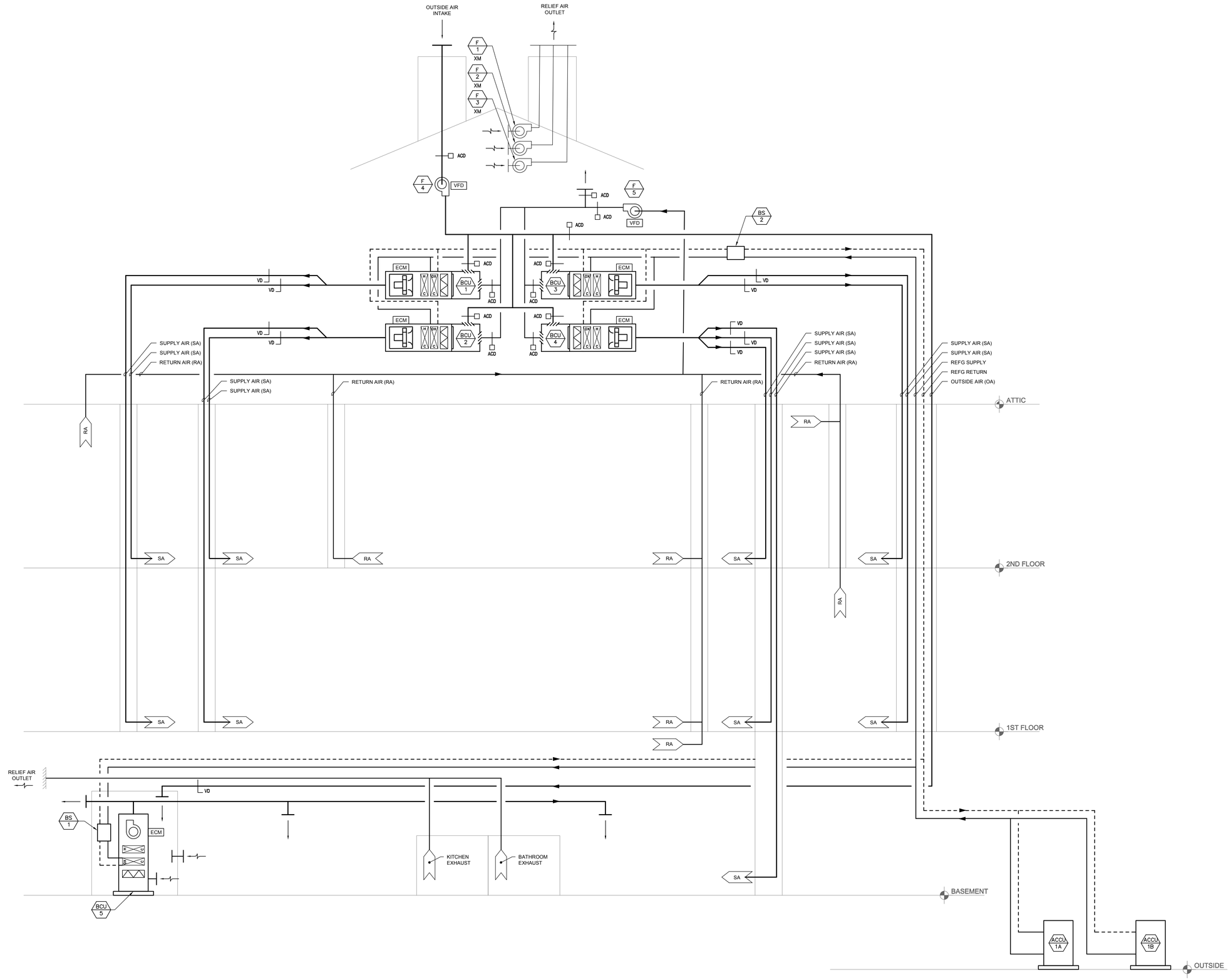
MECHANICAL SCHEDULES

COMMONWEALTH OF VIRGINIA
KENNETH M. SCHRAM
Lic. No. 023977
PROFESSIONAL ENGINEER
Date: 12/10/2020

M-601



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MECHANICAL
RISER DIAGRAM

COMMONWEALTH OF VIRGINIA
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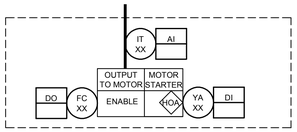
12/10/2020

M-701

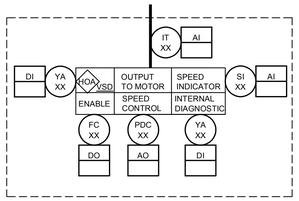
TYPICAL VARIABLE FREQUENCY CONTROLLER AND MOTOR STARTER CONTROL POINTS

MOTOR STARTER



MS — SYMBOL USED TO REPRESENT MOTOR STARTER

VARIABLE FREQUENCY CONTROLLER



VFC — SYMBOL USED TO REPRESENT VARIABLE FREQUENCY CONTROLLER

VIRTUAL POINTS:

VARIABLE FREQUENCY CONTROLLER MANUFACTURER COMMUNICATION CHIP/CARD MAY BE USED IN LIEU OF INDIVIDUAL POINTS INDICATED AND SHALL COMMUNICATE THE FOLLOWING INTEGRATED POINTS TO THE DDC SYSTEM:

a. SPEED INDICATION
b. AUTO/OUT OF AUTO INDICATION
c. FAULT/FAULT CODE
d. MOTOR CURRENT
e. DRIVE TEMPERATURE
f. DC BUS VOLTAGE
g. POWER DEMAND (KW)

NOTES ON VARIABLE FREQUENCY CONTROLLER

THE HAND-OFF-AUTOMATIC SWITCH ON THE VFC SHALL PROVIDE FOR THE FOLLOWING BASIS OF CONTROL:

a. HAND POSITION: THE DDC SYSTEM SHALL HAVE NO CONTROL OVER THE MOTOR SPEED NOR SHALL IT BE ABLE TO START OR STOP THE MOTOR (EXCEPT FOR SAFETY PURPOSES WHERE THE MOTOR SHALL SHUT DOWN). THE MOTOR SHALL RUN UNDER SPEED CONTROL FROM THE HAND POTENTIOMETER ON THE VFC. ALL SAFETIES CONTROLLING THE SHUTDOWN SHALL BE OPERATIONAL (i.e. SMOKE DETECTORS, PRESSURE SWITCHES, ETC). TEMPERATURE AND HUMIDITY CONTROL SHALL BE AVAILABLE THROUGH THE DDC SYSTEM.

b. OFF POSITION: THE MOTOR SHALL BE OFF. THE DDC SYSTEM SHALL NOT CONTROL THE MOTOR. ALL OTHER CONTROL POINTS SHALL BE IN THEIR FAIL-SAFE POSITION.

c. AUTOMATIC POSITION: THE MOTOR SHALL BE CONTROLLED BY THE DDC SYSTEM.

ALL ELECTRICAL DISCONNECTS ON EQUIPMENT SERVED BY VARIABLE FREQUENCY CONTROLLER SHALL HAVE A SWITCH IN THE ELECTRICAL DISCONNECT WHICH REPORTS DISCONNECT POSITION. THIS SWITCH SHALL BE IN THE PERMISSIVE CIRCUIT OF THE VARIABLE FREQUENCY CONTROLLER.

SENSOR LEGEND

REFER TO PLANS FOR SPACE TEMPERATURE, HUMIDITY, PRESSURE AND CARBON DIOXIDE SENSORS/TRANSMITTERS INDICATED BY THE FOLLOWING SYMBOLS:

TEMPERATURE SENSOR/TRANSMITTER = (T)

HUMIDITY SENSOR/TRANSMITTER = (H)

PRESSURE SENSOR/TRANSMITTER = (P)

EQUIPMENT ALARM CABLE LOCATION = (1 CABLE WITH 8 CONDUCTORS) (A)

CARBON DIOXIDE SENSOR = (C)

AIRFLOW DIRECTION INDICATOR = (ADI)

ALARM STROBE/HORN =

HVAC DDC SYSTEM GENERAL REQUIREMENTS

1. THE DESIGN INTENT IS FOR THE DIRECT DIGITAL CONTROLS (DDC) SYSTEM TO MONITOR PRESSURES, TEMPERATURES AND FLOWS AND TO CONTROL THE VARIOUS COMPONENTS OF THE HVAC SYSTEM INCLUDING BUT NOT LIMITED TO CHILLERS, VALVES, VARIABLE FREQUENCY CONTROLLERS (VFCS), AIR HANDLING UNITS (AHUS), PUMPS, ETC.... MONITORED DATA WILL BE USED TO ENERGIZE OR DE-ENERGIZE EQUIPMENT IN ACCORDANCE WITH THE SEQUENCES OUTLINED.

2. SEQUENCES OUTLINED (UNLESS OTHERWISE SPECIFIED) SHALL BE PERFORMED BY NETWORK CONTROLLERS, PROGRAMMABLE APPLICATION CONTROLLERS AND APPLICATION SPECIFIC CONTROLLERS CONNECTED TO A CENTRAL DDC SYSTEM. SYSTEM ARCHITECTURE SHALL BE BASED ON A PEER-TO-PEER DISTRIBUTED CONTROL SYSTEM NETWORK. SYSTEM SHALL INTEGRATE OPEN COMMUNICATION PROTOCOL CONTROLLERS. ALL CONTROLLERS SHALL BE CAPABLE OF INDEPENDENT OPERATION REGARDLESS OF THE STATUS OF THE DDC SYSTEM WORKSTATION.

3. ALL HVAC EQUIPMENT SHALL BE STARTED/ENABLED AND STOPPED/DISABLED THROUGH THE DDC SYSTEM.

4. AFTER INITIAL STARTUP DDC SYSTEM SHALL AUTOMATICALLY CONTROL OPERATING MODE FOR ALL EQUIPMENT VIA PROGRAMMABLE SCHEDULES INDICATED IN INDIVIDUAL ZONE OR EQUIPMENT SEQUENCES.

5. DDC SYSTEM CONTRACTOR SHALL BE FULLY RESPONSIBLE TO PROVIDE EQUIPMENT AND PROGRAMMING NEEDED TO PERFORM ALL SEQUENCES. WHERE PACKAGED EQUIPMENT IS USED, DDC SYSTEM CONTRACTOR SHALL COORDINATE WITH THE PACKAGED EQUIPMENT CONTROL PANEL FEATURES. DDC SYSTEM CONTRACTOR MAY USE PACKAGED EQUIPMENT CONTROLLER FUNCTIONS WHERE AVAILABLE TO PERFORM SEQUENCES SUBJECT TO FULL COMPLIANCE WITH ALL SEQUENCES AND ALARM MONITORING INDICATED ON THE DRAWINGS. COMMUNICATIONS INTERFACE INCLUDING SOFTWARE BETWEEN THE DDC SYSTEM AND EACH EQUIPMENT MANUFACTURER SUPPLIED CONTROL PANEL SHALL BE PROVIDED BY THE DDC SYSTEM CONTRACTOR. DDC SYSTEM SHALL BE CAPABLE OF READING AND DISPLAYING ALL DATA (INPUT AND OUTPUT) USED BY THE EQUIPMENT MANUFACTURER CONTROL PANEL. SOFTWARE INTERFACE SHALL BE THROUGH LONMARK OR BACNET COMPLIANT OPEN PROTOCOL. PACKAGED EQUIPMENT MIGHT INCLUDE BUT IS NOT LIMITED TO:
   a. CHILLERS
   b. BOILERS
   c. VRF SYSTEMS
   d. DX SPLIT SYSTEMS
   e. PACKAGED AIR HANDLING UNITS

6. ADDRESS IDENTIFIERS FOR ALL POINTS AND VARIABLES SHALL BE COORDINATED WITH EXISTING CONTROLS AND SHALL BE APPROVED BY THE FACILTY OWNER.

7. ABILITY TO REVIEW ALL MEASURED DATA, CONTROL SETPOINTS AND FUNCTIONS SHALL BE PROVIDED AT DDC SYSTEM WORKSTATION AND ON LAPTOP SERVICE TOOL.

8. DDC SYSTEM CONTRACTOR SHALL PROVIDE ALL POWER WIRING AND CONNECTIONS REQUIRED TO OPERATE THE DDC SYSTEM AND ALL CONTROL COMPONENTS AND SHALL COMPLY WITH REQUIREMENTS OF DIVISION 26 SECTIONS. ELECTRICAL CIRCUITS FOR ALL CONTROLS SHALL BE DEDICATED ONLY TO THE DDC SYSTEM AND COMPONENTS. ALL WIRING FROM AND INCLUDING DEDICATED CIRCUIT BREAKERS TO THE POINT OF USE SHALL BE PROVIDED BY THIS SECTION.
   a. WHERE REQUIRED BY SPECIFICATIONS OR OTHERWISE, CONTROL SYSTEM INCLUDING HEAD END WORKSTATION SHALL BE PROVIDED WITH STANDBY POWER TO PERFORM SEQUENCES OUTLINED.
   b. CONTROL PANELS, WORK STATIONS AND HOST COMPUTERS SHALL BE WIRED TO STANDBY POWER WHEN OPERATION OF EQUIPMENT BEING CONTROLLED IS CONNECTED TO STANDBY POWER.
   c. DDC SYSTEM SHALL MONITOR GENERATOR SWITCHGEAR TO OBTAIN STATUS OF NORMAL (STREET) POWER. INPUT SHALL BE PROVIDED INDEPENDENTLY TO AT LEAST TWO NETWORK CONTROLLERS.

9. SAFETIES SHALL BE HARDWIRED TO THE CONTROLLED DEVICE UNLESS NOTED OTHERWISE.

10. INDICATED VALUES OF ALL PARAMETERS IN THE SEQUENCES (TEMPERATURES, PRESSURES, FLOW RATES, PERCENTAGES, LIMITS, DEADBANDS, ETC.) ARE NOMINAL VALUES ONLY AND SHALL BE MANUALLY ADJUSTABLE FROM THE DDC SYSTEM. SETPOINTS AND STATUS SHALL BE ADJUSTABLE GLOBALLY AS WELL AS ON AN INDIVIDUAL COMPONENT BASIS. ALL SETPOINTS, DELAYS AND OTHER PARAMETERS SHALL BE ADJUSTABLE BY THE OPERATOR THROUGH THE DDC SYSTEM WORKSTATION AND THROUGH LAPTOP SERVICE TOOL CONNECTED TO CONTROLLERS WITHOUT ANY HARDWARE OR SOFTWARE REVISIONS.

11. PROVIDE ADEQUATE DAMPING OF ALL MODULATING CONTROL LOOPS TO PREVENT HUNTING. ALL CONTROL LOOPS SHALL BE TUNED TO PROVIDE FOR STABLE OPERATION OF THE CONTROL DEVICE. LOOP TUNING MAY BE REQUIRED MULTIPLE TIMES TO STABILIZE MULTIPLE CONTROL SCENARIOS.

12. ALL EQUIPMENT CONTROLLED BY THE DDC SYSTEM SHALL BE CAPABLE OF MANUAL OPERATION THROUGH HAND-OFF-AUTOMATIC (HOA) SWITCHES LOCATED IN THE MOTOR STARTERS OR VARIABLE FREQUENCY CONTROLLERS. DDC SYSTEM SHALL INCLUDE OPTION TO MANUALLY OVERRIDE EACH AUTOMATED SEQUENCE VIA INPUT TO THE DDC SYSTEM.

13. PROVIDE MENU DRIVEN CAPABILITY TO OVERRIDE AUTOMATED START/STOP OR OPERATING MODES FOR EACH PIECE OF EQUIPMENT (INCLUDING PUMPS, AIR HANDLING UNITS, VV BOXES, ETC.) AT CONTROLLERS. IF A SEQUENCE IS DISABLED BY MANUAL INPUT AND THE DDC SYSTEM ATTEMPTS AN AUTOMATED CHANGE IN OPERATING MODE, AN ALARM SHALL BE INITIATED AT THE DDC SYSTEM STATING THAT THE SYSTEM WAS UNABLE TO CHANGE THE MODE DUE TO USER INPUT. WHERE APPLICABLE A MANUAL INPUT COMMAND WILL THEN BE REQUIRED FROM THE USER INSTRUCTING THE DDC SYSTEM TO START THE NEXT SEQUENTIAL PIECE OF EQUIPMENT.

14. ALL SAFETIES AND ALARMS SHALL REMAIN ACTIVE WHEN OPERATING IN MANUAL OVERRIDE MODES.

15. WHEN A UNIT IS OFF-LINE VIA THE BAS START/STOP, THE H-O-A SWITCH, THE SERVICE DISCONNECT, OR ANY OF THE SAFETIES, COMPONENTS SHALL GO TO THEIR FAIL-SAFE POSITIONS. UNLESS INDICATED OTHERWISE IN THE SEQUENCES, THE FAIL-SAFE POSITIONS ARE: ALL THE DAMPERS SHALL BE CLOSED. THE VARIABLE FREQUENCY CONTROLLERS SHALL BE OFF. THE CHILLED WATER TEMPERATURE CONTROL VALVE SHALL BE CLOSED. THE HOT WATER TEMPERATURE CONTROL VALVE SHALL BE OPEN.

16. IN THE EVENT OF A POWER OUTAGE OR UNPLANNED LOSS OF CONTROLS OR UNPLANNED EQUIPMENT SHUTDOWN, EQUIPMENT SHALL GO TO IT'S FAIL SAFE SETTINGS. IF EQUIPMENT IS DEACTIVATED DUE TO NORMAL OCCUPANCY CYCLE OR OCCUPANCY CONTROLS, FAIL SAFE SETTINGS ARE NOT REQUIRED UNLESS SEQUENCE SPECIFIES OTHERWISE.

17. WHENEVER AN ALARM IS INITIATED, THE DDC SYSTEM SHALL RETAIN IN MEMORY THE READING AND SETPOINT OF EACH ASSOCIATED DEVICE TO HELP THE OPERATOR IN ISOLATING THE CAUSE OF THE ALARM.

18. DDC SYSTEM SHALL HAVE THE ABILITY TO TEMPORARILY DISABLE ALARMS RELATED TO A PIECE OF EQUIPMENT TAKEN OFFLINE FOR MAINTENANCE.

19. IF ANY CONTROLLER OR EQUIPMENT MANUFACTURER'S CONTROL PANEL LOSES COMMUNICATION WITH THE DDC SYSTEM NETWORK, AN ALARM SHALL BE INITIATED AT THE DDC SYSTEM INDICATING THE LOCATION OF THE FAULT.

20. ALL CONTROL SYSTEM SENSORS SHALL HAVE HIGH AND LOW LIMIT SOFTWARE ALARMS TO INDICATE FAULTS. ALL ALARMS SHALL INITIATE AUDIBLE AND VISUAL ALARM AT THE DDC SYSTEM WORKSTATION AND AT THE WORKSTATION ALARM PRINTER. ALARM SHALL INDICATE TIME, DATE, SPECIFIC CONTROL POINT AND NATURE OF THE ALARM.

21. COORDINATE ALL SENSOR INSTALLATION LOCATIONS AND SUBMIT PROPOSED POSITIONS ON APPLICABLE PIPING AND DUCTWORK COORDINATION SUBMITTALS. COORDINATE AND ENSURE MANUFACTURER RECOMMENDED UPSTREAM AND DOWNSTREAM PIPE OR DUCT DIAMETERS ARE PROVIDED. SPECIAL ATTENTION IN THIS REGARD IS REQUIRED FOR FLOW MEASURING DEVICES.

22. WHERE CURRENT TRANSMITTERS ARE USED TO DETERMINE FAN OR EQUIPMENT STATUS, A BELT-OFF TEST SHALL BE PERFORMED TO DETERMINE CURRENT LOW POINT TO VERIFY STATUS.

23. ALL WALL MOUNTED TEMPERATURE OR HUMIDITY TRANSMITTERS SHALL HAVE ALL PENETRATIONS SEALED.

24. ALL CONTROL DEVICES SHALL BE INSTALLED IN SUCH A WAY TO BE ACCESSIBLE FOR MAINTENANCE AND REPAIR.

25. ALL COMMON INFORMATION (E.G. OUTSIDE AIR TEMPERATURE AND HUMIDITY) SHALL BE MEASURED IN AT LEAST (2) LOCATIONS AND COMMUNICATED TO INDEPENDENT NETWORK LEVEL CONTROLLERS.

26. SMOKE DETECTORS SHALL BE FURNISHED AND WIRED TO THE FIRE ALARM SYSTEM BY DIVISION 28. DIVISION 23 SHALL MOUNT THE DETECTORS IN DUCTWORK, WHERE REQUIRED BY CODE AND DIVISION 23, DIVISION 23 SHALL WIRE THE DETECTORS TO THE DDC SYSTEM AND FAN STARTERS FOR SHUTDOWN.

27. SMOKE DAMPERS SHALL BE UL555S LISTED. FIRE DAMPERS SHALL BE UL555 LISTED. PROVIDE FIRE DAMPERS, SMOKE DAMPERS AND FIRE/SMOKE DAMPERS AND ASSOCIATED ACCESS PANELS IN COMPLIANCE WITH APPLICABLE BUILDING AND MECHANICAL CODES AND NFPA 90A. ACCESS DOOR DIMENSIONS SHALL MEET REQUIREMENTS OF NFPA 90A AND NFPA 80.

28. AS A MINIMUM, ONE PROGRAMMABLE APPLICATION CONTROLLER SHALL BE PROVIDED FOR EACH AIR HANDLING UNIT.

DDC SYSTEM INSTRUMENT LEGEND

	FIRST LETTER(S)		SUCCEEDING LETTERS		
	PROCESS OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER FLAME		USERS CHOICE(*)	USERS CHOICE(*)	USERS CHOICE(*)
C	USERS CHOICE(*)			CONTROL	
D	DEWPOINT	DIFFERENTIAL		DAMPER	
E	VOLTAGE		SENSOR (PRIMARY ELEMENT)		
F	FLOW OR FUME HOOD FACE VELOCITY	RATIO			
G	GAS		GLASS	GATE	
H	HAND (MANUAL)				HIGH
I	CURRENT		INDICATE		
J	POWER	SCAN			
K	TIME OR SCHEDULE	RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW
M	MOISTURE	MOMENTARY			
N	USERS CHOICE(*)		USERS CHOICE(*)	USERS CHOICE(*)	USERS CHOICE(*)
O	USERS CHOICE(*)		ORIFICE, RESTRICTION		
P	PRESSURE (OR VACUUM)		POINT (TEST CONNECTION)		
Q	QUANTITY OR EVENT(*)	INTEGRATE	INTEGRATE		
R	RADIATION		RECORD OR PRINT		
S	SPEED OR FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE(*)		MULTIFUNCTION(*)	MULTIFUNCTION(*)	MULTIFUNCTION(*)
V	VIBRATION, MECH ANALYSIS			VALVE	
W	WEIGHT OR FORCE		WELL		
X	SMOKE		UNCLASSIFIED(*)	TRANSFORMER	UNCLASSIFIED(*)
Y	EVENT (STATUS)			RELAY OR COMPUTE(*)	
Z	POSITION, DIMENSION			DRIVER, ACTUATOR OR UNCLASSIFIED FINAL CONTROL ELEMENT	

(*) WHEN USED, EXPLANATION IS SHOWN ADJACENT TO INSTRUMENT SYMBOL. SEE ABBREVIATIONS AND LETTER SYMBOLS.
EXAMPLE: PT=PRESSURE TRANSMITTER, HS=HAND SWITCH

GENERAL INSTRUMENT/FUNCTION SYMBOLS

CONTROL DEVICE OR INSTRUMENT TAG

XXX — SYMBOL MODIFIER OR SETPOINT

XX ## — DEVICE OR SENSOR TAG ID

WHEN IDENTICAL, MULTIPLE INSTRUMENTS EXIST WITHIN A LOOP, THEY ARE INDIVIDUALLY, SEQUENTIALLY NUMBERED HERE.

DDC SYSTEM INPUT/OUTPUT IDENTIFIER

XY — X = ANALOG(A) OR DIGITAL(D); Y = OUTPUT(O) OR INPUT(I)

MODIFIER SYMBOLS AND DESCRIPTIONS SHOWN BELOW

OC	OPEN/CLOSE
OO	ON/OFF
SS	START/STOP
AUTO	AUTO
PAL	PRESSURE ALARM LOW LIMIT
PAH	PRESSURE ALARM HIGH LIMIT
TSL	TEMPERATURE ALARM LOW LIMIT
TSH	TEMPERATURE ALARM HIGH LIMIT
MAL	MOISTURE ALARM LOW LIMIT
MAH	MOISTURE ALARM HIGH LIMIT
R	MANUAL RESET

SAMPLE DEVICE TAGS

XS / R — DUCT SMOKE DETECTOR WITH AUXILIARY CONTACTS AND MANUAL RESET

MT — MAH / MAL — HIGH & LOW MOISTURE "OUT OF RANGE" LIMITS FOR FAULTY SENSOR ALARM

XX / XX — PILOT LIGHT

NOTES:

INSTRUMENTATION IDENTIFICATION TAGS SHOWN ON THE ENCLOSED CONTROL DRAWINGS ARE INTENDED TO BE SPECIFIC FOR EACH SEQUENCE. NO ATTEMPT HAS BEEN MADE TO COORDINATE SEQUENTIAL TAGS IN ALL SEQUENCES AS THIS EFFORT WOULD NOT AID IN THE UNDERSTANDING OF THE DESIGN INTENT. THEREFORE THERE MAY BE INSTRUMENTS ON THE CONTROL DRAWINGS WHICH APPEAR TO HAVE THE SAME IDENTIFICATION NUMBER.

PROVIDE AND COORDINATE A COMPLETE LIST OF INSTRUMENTATION, THE ASSOCIATED IDENTIFICATION TAGS AND A CROSS REFERENCE TO BE USED IN THE DDC SYSTEM PROGRAM CODE.

LINETYPE LEGEND

PROCESS LINE

INSTRUMENT LINE

EQUIPMENT SYMBOLS

SYMBOL	DESCRIPTION
	CENTRIFUGAL FAN
	TUBULAR CENTRIFUGAL OR VANEAXIAL FAN
	PLUG FAN
	PROP FAN
C C / H C / RH C / PH C	COIL: CC - COOLING COIL; HC- HEATING COIL; RHC- REHEAT COIL; PHC- PREHEAT COIL
	FILTER
MS	MOTOR STARTER
VFC	VARIABLE FREQUENCY CONTROLLER
ECM	ELECTRONICALLY COMMUTATED MOTOR SPEED CONTROLLER

SYMBOL	DESCRIPTION
	MODULATING ACTUATOR WITHOUT INTEGRAL PILOT POSITIONER
	MODULATING ACTUATOR WITHOUT PILOT POSITIONER - FAILS OPEN
	MODULATING ACTUATOR WITHOUT PILOT POSITIONER - FAILS CLOSED
	TWO POSITION ACTUATOR, FAILS OPEN
	TWO POSITION ACTUATOR, FAILS CLOSED
HOA	HAND-OFF-AUTOMATIC CONTROL STATION REFER TO DIVISION 16 DWGS
	TWO WAY VALVE ASSOCIATED WITH ACTUATOR - SEE DRAWINGS & SPECS FOR VALVE TYPE
	THREE WAY VALVE ASSOCIATED WITH ACTUATOR - SEE DRAWINGS & SPECS FOR VALVE TYPE
	OPPOSED BLADE DAMPER ASSOCIATED WITH ACTUATOR
	PARALLEL BLADE DAMPER ASSOCIATED WITH ACTUATOR

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MECHANICAL CONTROL LEGEND

COMMONWEALTH OF VIRGINIA
KENNETH M. SCHRAM
Lic. No. 023977
PROFESSIONAL ENGINEER
12/10/2020

M-801

GENERAL

1. REQUIREMENTS OF "SEQUENCE OF CONTROLS - GENERAL", "SEQUENCE OF CONTROLS - STANDBY POWER" AND "CONTROL SYSTEM NOTES" ON CONTROL LEGEND DRAWING TO ALL SEQUENCES.
2. THIS CONTROL SEQUENCE APPLIES TO A VARIABLE FLOW REFRIGERANT (VRF)FAN COIL SYSTEM CAPABLE OF SIMULTANEOUS HEATING AND COOLING WITH SUPPLEMENTAL ELECTRIC REHEAT.
3. SEQUENCES SHALL BE PERFORMED BY A LOCAL DDC CONTROLLER.
4. FAN COIL UNITS SHALL BE AVAILABLE FOR OPERATION 24 HOURS PER DAY 7 DAYS A WEEK.
5. FAN COIL UNITS SHALL HAVE START, STOP AND STATUS CONTROL THROUGH THE BAS.
6. VRF MANUFACTURES SHALL PROVIDE STAND ALONE SYSTEM CONTROLS CAPABLE OF CONTROLLING THE AIR-COOLING CONDENSING AND FAN COILS.
7. VRF SYSTEM SHALL RUN CONTINUOUSLY TO MAINTAIN SUMMER SPACE DESIGN CONDITIONS OF 75°F / 50%RH (±5°F AND ±10%RH) . WINTER SPACE CONDITIONS SHALL BE MAINTAINED AT 70°F ± 5°F.
8. ALL WIRING BETWEEN CONDENSING UNITS AND INDOOR UNITS SHALL BE IN ACCORDANCE WITH THE UNIT MANUFACTURER'S INSTALLATION GUIDELINES.
9. ATC CONTRACTOR SHALL COORDINATE WITH VRF MANUFACTURER TO PROVIDE APPROPRIATE OEM MODULE TO COMMUNICATE WITH BAS SYSTEM.

SAFETIES

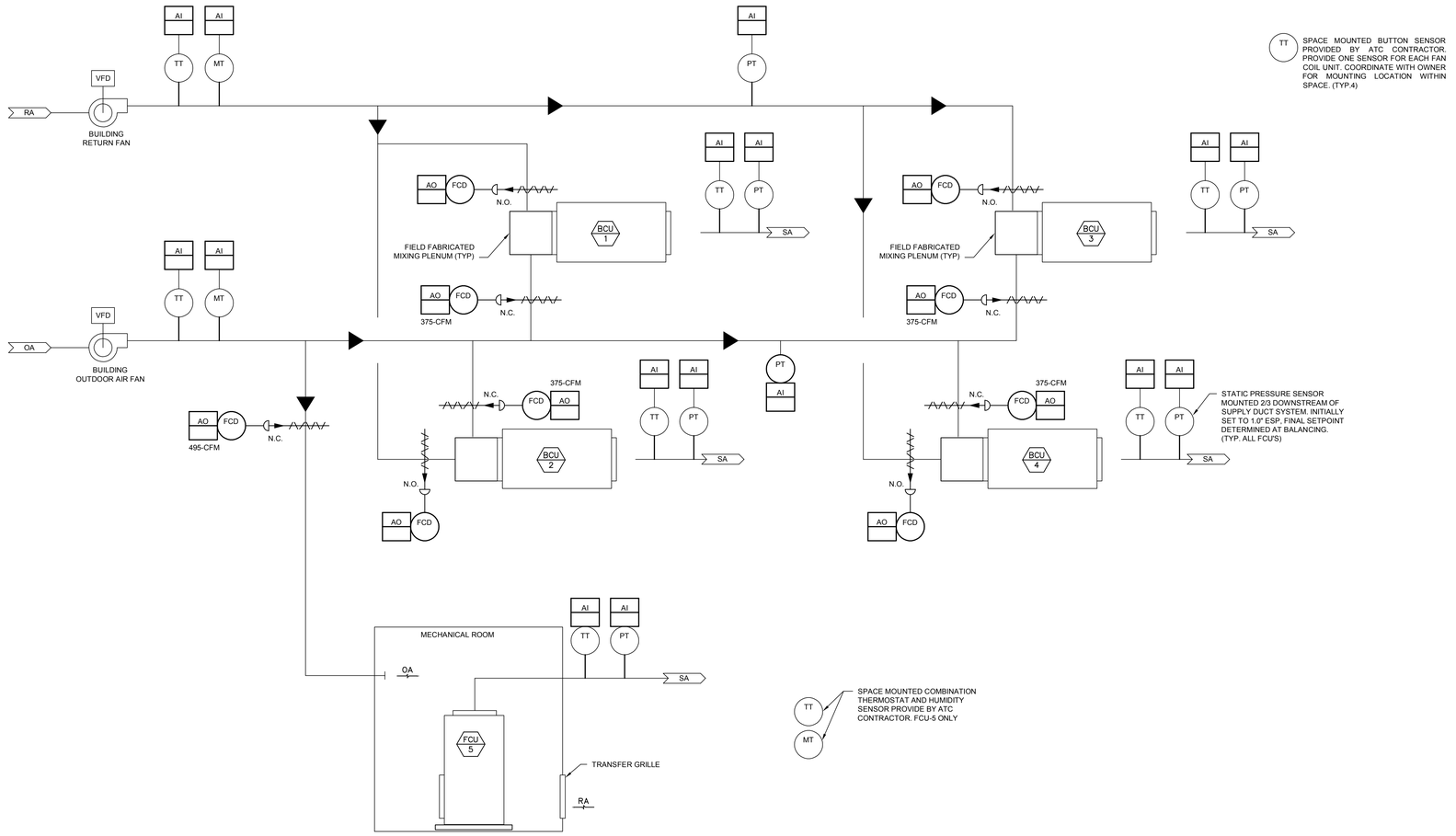
1. THE INDIVIDUAL FAN COIL SHALL SHUTDOWN UPON ANY OF THE FOLLOWING:
   a. SUPPLY FAN FAILS TO START AFTER 30 SECONDS OF BEING ENABLED
   b. SYSTEM RETURN FAN FAILS TO STARTS AFTER 30 SECONDS THE ENTIRE SYSTEM SHALL BE DISABLED.
   c. SYSTEM OUTDOOR AIR FAN FAILS TO START AFTER 30 SECONDS, THE ENTIRE SYSTEM SHALL BE DISABLED.
   d. COOLING COIL FREEZE STAT FALLS BELOW 40°F.
   e. RETURN AIR DAMPERS DOES NOT OPEN, AS VERIFIED BY END SWITCH.
   f. OUTDOOR AIR DAMPER DOES NOT OPEN, AS VERIFIED BY END SWITCH.
2. THE FCU SHALL SHUTDOWN IF MOISTURE IS DETECTED AT THE LEAK DETECTOR IN THE SECONDARY DRAIN PAN.

ALARMS

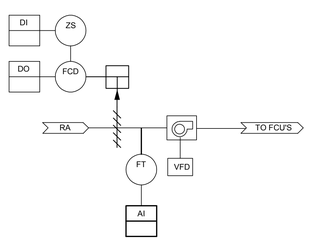
1. THE FOLLOWING SHALL INITIATE SPECIFIC ALARM NOTICES AT THE BAS ONLY WHEN THE UNIT STATUS IS "ON":
   a. FAN NOT OPERATING WHENEVER COMMANDED TO RUN. AFTER A 15 SECOND DELAY THE CONTROL SYSTEM SENSES NO STATUS VIA THE FANS CURRENT TRANSFORMER RELAYS.
   b. FAN AMPERAGE STATUS, AS SENSED BY THE CURRENT TRANSFORMER, VARIES FROM THE INITIAL START-UP INDICATING A LOOSE BELT.
   c. FAN IS SCHEDULED TO BE OFF AFTER A 1 MINUTE DELAY IS INDICATED AS RUNNING VIA THE CURRENT TRANSFORMER RELAY.
   d. MOISTURE IS DETECTED AT THE LEAK DETECTOR IN THE SECONDARY DRAIN PAN
   e. OUTDOOR AIR FAN NOT OPERATING WHENEVER COMMANDED TO RUN.
   f. RETURN AIR FAN NOT OPERATING WHENEVER COMMANDED TO RUN.
   g. WHEN THE VRF SYSTEM IS IN ALARM MODE.

TEMPERATURE CONTROL SEQUENCE

1. SUMMER "OCCUPIED" MODE:
   a. THE FAN COIL UNIT SHALL RUN CONTINUOUSLY TO MAINTAIN SPACE TEMPERATURE AND HUMIDITY SETPOINTS.
   b. THE VRF CONTROLLER SHALL ADJUST THE LEAVING AIR TEMPEATURE, VIA MODULATING THE DX COIL CONTROL VALVE, TO MAINTAIN THE SPACE SETPOINT. THE FCU DISCHARGE AIR TEMPERATURE SHALL MODULATE BETWEEN 55°F AND 65°F.
   c. IF THE RETURN AIR HUMIDITY EXCEEDS 60%, THE DISCHARGE AIR TEMPERATURE ON ALL THE FAN COIL UNITS SHALL RESET TO 55°F. THE ELECTRIC REHEAT COIL SHALL MODULATE TO MAINTAIN SPACE TEMPERATURE SETPOINT.
2. SUMMER "UNOCCUPIED" MODE:
   a. THE FAN COIL UNIT SHALL CYCLE TO MAINTAIN SPACE SETPOINT. WHENEVER THE SPACE TEMPERATURE RISES ABOVE 85°F THE SYSTEM SHALL BE ENABLE AND OPERATE PER "SUMMER OCCUPIED MODE" SEQUENCE.
   b. WHEN THE SPACE TEMPERATURE SETPOINT HAS BEEN SATISFIED THE SYSTEM SHALL RUN FOR A MINIMUM OF 15 MINUTES (ADJ) BEFORE TURNING OFF.
   c. ONCE TURNING OFF, THE SYSTEM SHALL REMAIN OFF FOR A MINIMUM OF 15 MINUTES (ADJ) BEFORE TURNING BACK ON.
3. WINTER "OCCUPIED" MODE:
   a. THE FAN COIL UNIT SHALL RUN CONTINUOUSLY TO MAINTAIN SPACE TEMPERATURE SETPOINT.
   b. THE VRF CONTROLLER SHALL ADJUST THE LEAVING AIR TEMPEATURE, VIA MODULATING THE DX COIL CONTROL VALVE, TO MAINTAIN THE SPACE SETPOINT. THE FCU DISCHARGE AIR TEMPERATURE SHALL MODULATE BETWEEN 60°F AND 70°F.
   c. IF THE SPACE TEMPERATURE CONTINUES TO DROP, THE ELECTRIC REHEAT COIL SHALL BE ENERGIZED AND MODULATE TO MAINTAIN SPACE SET POINT TEMPERATURE.
4. WINTER "UNOCCUPIED" MODE:
   a. THE FAN COIL UNIT SHALL CYCLE TO MAINTAIN SPACE SETPOINT. WHENEVER THE SPACE TEMPERATURE FALLS BELOW 60°F THE SYSTEM SHALL BE ENABLE AND OPERATE PER "WINTER OCCUPIED MODE" SEQUENCE.
   b. WHEN THE SPACE TEMPERATURE SETPOINT HAS BEEN SATISFIED THE SYSTEM SHALL RUN FOR A MINIMUM OF 15 MINUTES (ADJ) BEFORE TURNING OFF.
   c. ONCE TURNING OFF, THE SYSTEM SHALL REMAIN OFF FOR A MINIMUM OF 15 MINUTES (ADJ) BEFORE TURNING BACK ON.



VRF CONTROLS SEQUENCE OF OPERATION

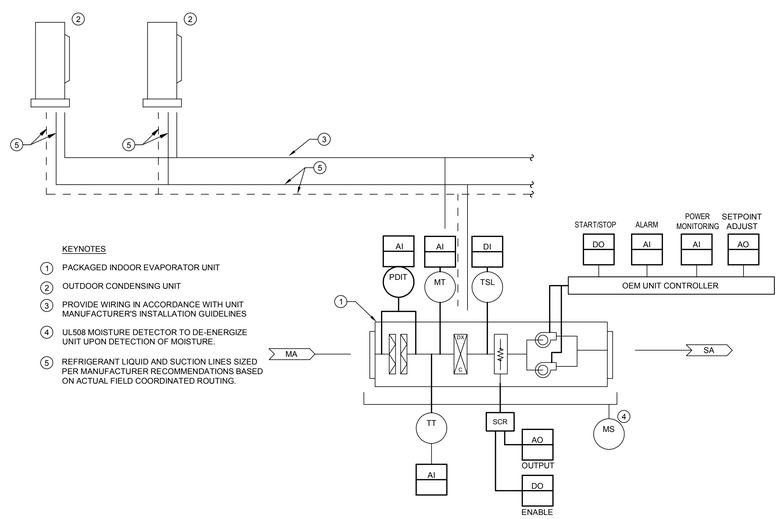


GENERAL:
1. BUILDING RETURN AIR FAN SHALL BE INTERLOCKED TO OPERATE WHENEVER A FAN COIL UNIT IS COMMANDED TO RUN.
2. ISOLATION DAMPER SHALL BE WIRED TO START CIRCUIT.

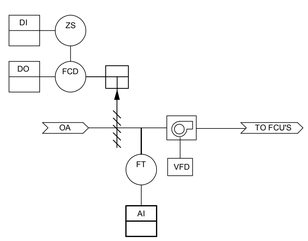
SAFETIES AND ALARMS:
1. IF ANY OF THE FOLLOWING OCCUR, THE FAN SHALL SHUTDOWN AND INITIATE AN ALARM:
   a. FAN IS COMMANDED ON AND DOES NOT START.
   b. ISOLATION DAMPER IS NOT PROVEN OPEN VIA END SWITCHES.

OPERATION:
1. UPON A SIGNAL TO START FROM THE BAS, THE ISOLATION DAMPER SHALL OPEN, ONCE PROVEN OPEN, THE FAN SHALL BE ACTIVATED,
2. THE FAN SHALL RAMP UP TO DESIGN AIRFLOW.

RETURN AIR FAN CONTROLS



TYPICAL FAN COIL CONTROL DIAGRAM



GENERAL:
1. BUILDING OUTDOOR AIR FAN SHALL BE INTERLOCKED TO OPERATE WHENEVER A FAN COIL UNIT IS COMMANDED TO RUN.
2. ISOLATION DAMPER SHALL BE WIRED TO START CIRCUIT.

SAFETIES AND ALARMS:
1. IF ANY OF THE FOLLOWING OCCUR, THE FAN SHALL SHUTDOWN AND INITIATE AN ALARM:
   a. FAN IS COMMANDED ON AND DOES NOT START.
   b. ISOLATION DAMPER IS NOT PROVEN OPEN VIA END SWITCHES.

OPERATION:
1. UPON A SIGNAL TO START FROM THE BAS, THE ISOLATION DAMPER SHALL OPEN, ONCE PROVEN OPEN, THE FAN SHALL BE ACTIVATED,
2. THE FAN SHALL RAMP UP TO DESIGN AIRFLOW.

OUTSIDE AIR FAN CONTROLS

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MECHANICAL
MISC. CONTROLS

COMMONWEALTH OF VIRGINIA
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Date: 12/10/2020

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