

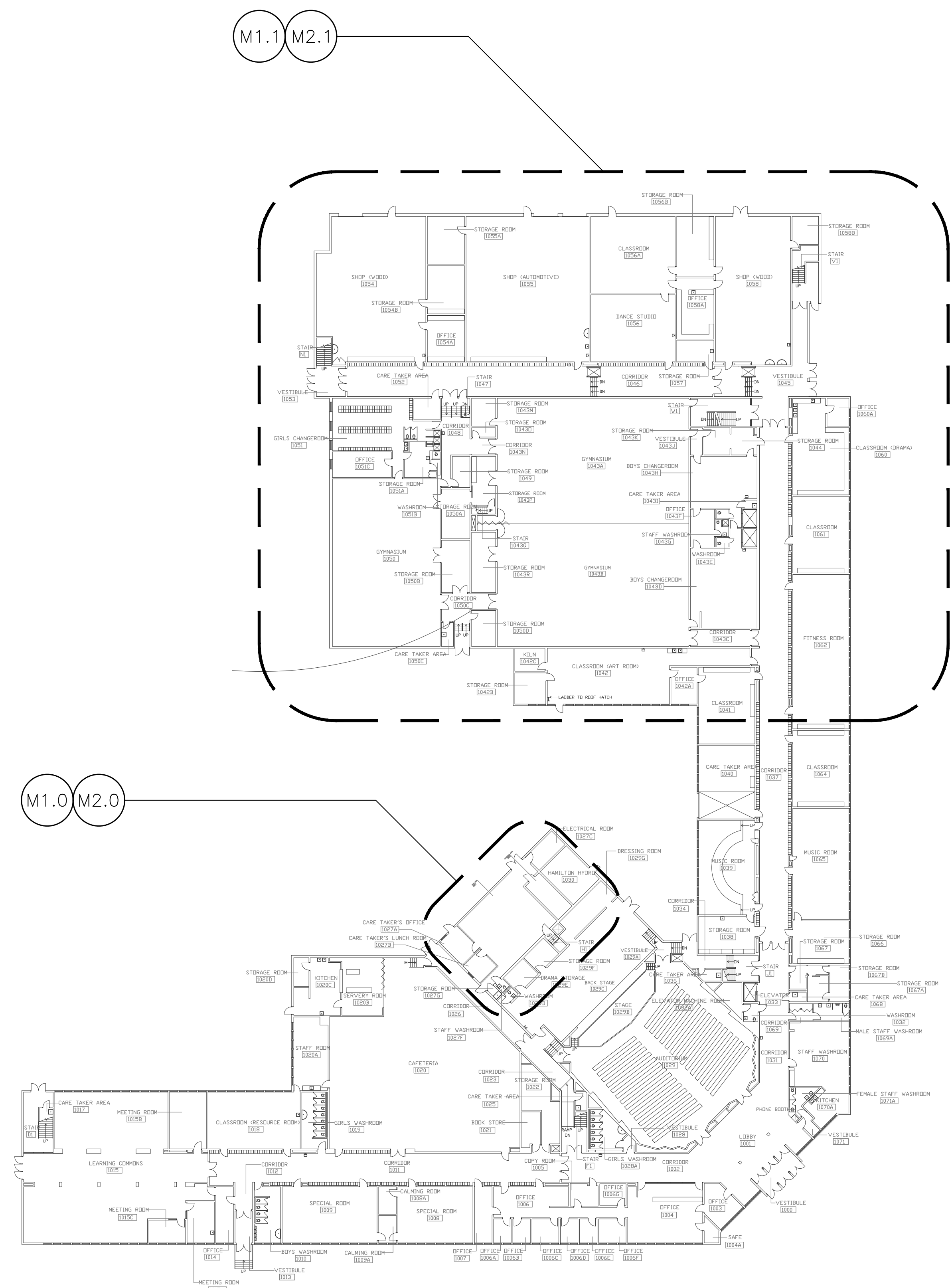
PIPING LEGEND	
	HOT WATER SUPPLY (HWS)
	HOT WATER RETURN (HWR)
	EQUIPMENT DRAIN LINE
	GAS
	SUCTION LINE
	LIQUID LINE
	BOTTOM TAKE-OFF
	TOP TAKE-OFF
	ELBOW UP
	ELBOW DOWN
	VALVE - SEE SPECIFICATIONS
	UNION CONNECTION
	FLANGED CONNECTION
	PLUG CAP
	LOW WATER CUT OFF
	THERMOMETER
	PRESSURE GAUGE
	PUMP AND DESIGNATION
	AIR VENT
	AUTOMATIC AIR VENT
	PETES PLUG
	FLOW SWITCH
	THERMOSTAT w/GUARD
	ABOVE FINISHED FLOOR
	CIRCUIT BALANCING VALVE
	GALLONS PER MINUTE
	REQ'D REQUIRED
	THERMOSTATIC CONTROL VALVE
	TYP. TYPICAL
	BACK FLOW PREVENTOR
	CUBIC FEET HOUR

VALVE LEGEND	
	VALVE - SEE SPEC
	CHECK VALVE
	STRAINER
	PRESSURE REDUCING VALVE
	CONTROL VALVE
	2-WAY CONTROL VALVE
	3-WAY CONTROL VALVE
	RELIEF VALVE
	PLUG VALVE
	SOLENOID VALVE
	NORMALLY CLOSED VALVE
	PET COCK
	CIRCUIT BALANCE VALVE

VENTILATION LEGEND	
	SOUND INSULATION
	FLEXIBLE CONNECTION
	DUCT OFFSET
	DUCT OFFSET (SINGLE LINE)
	TURNING VANES
	BALANCING DAMPER
	FIRE DAMPER
	SPLITTER DAMPER
	BACKDRAFT DAMPER
	OPPOSED BLADE DAMPER
	MOTORIZED DAMPER
	SUPPLY DUCT SECTION
	RETURN DUCT SECTION
	SUPPLY DIFFUSER
	LINEAR DIFFUSER
	EXHAUST GRILLE
	DIFFUSER DESIGNATION AND CFM
	GRILLE DESIGNATION AND CFM
	FLEXIBLE ROUND DUCT
	CAPPED END DUCT
	DUCT REDUCER/ENLARGER
	TRANSITION TO ROUND
	THERMOSTAT
	ACCESS DOOR
	ABOVE FINISHED FLOOR
	CUBIC FEET PER MINUTE
	CIRCUIT BALANCING VALVE

CONTROL LEGEND	
	THERMOSTAT
	TEMPERATURE SENSOR
	PRESSURE SENSOR
	HUMIDITY SENSOR
	FLOW SWITCH
	SOLENOID VALVE
	PRESSURE DIFFERENTIAL SWITCH
	MOTORIZED DAMPER
	PRESSURE GAUGE
	TEMPERATURE GAUGE
	2-WAY CONTROL VALVE
	3-WAY CONTROL VALVE
	HEATING COIL
	COOLING COIL
	OUTSIDE AIR
	RETURN AIR
	SUPPLY AIR
	EXHAUST AIR
	NORMALLY OPEN
	NORMALLY CLOSED
	TEMPERATURE CONTROL VALVE

DRAWING LIST	
DWG No.	DRAWING TITLE
MO.0	MECHANICAL LEGEND AND DRAWING LIST
MO.1	MECHANICAL KEY PLAN
MO.2	MECHANICAL SPECIFICATIONS
MO.3	MECHANICAL SPECIFICATIONS
MO.4	MECHANICAL SPECIFICATIONS
MO.5	MECHANICAL SPECIFICATIONS
MO.6	MECHANICAL SPECIFICATIONS
MO.7	MECHANICAL SPECIFICATIONS
MO.8	MECHANICAL SPECIFICATIONS
MO.9	MECHANICAL SPECIFICATIONS
MO.10	MECHANICAL SPECIFICATIONS
MO.11	MECHANICAL SPECIFICATIONS
M1.0	DEMOLITION BOILER ROOM GROUND FLOOR PLAN
M1.1	DEMOLITION HVAC GROUND FLOOR PLAN
M1.2	DEMOLITION HVAC SECOND FLOOR PLAN
M1.3	DEMOLITION HVAC ROOF PLAN
M2.0	PROPOSED BOILER ROOM GROUND FLOOR PLAN
M2.1	PROPOSED HVAC GROUND FLOOR PLAN
M2.2	PROPOSED HVAC SECOND FLOOR PLAN
M2.3	PROPOSED HVAC ROOF PLAN
M3.0	MECHANICAL DETAILS & SCHEDULES
M3.1	MECHANICAL DETAILS & SCHEDULES
M3.2	MECHANICAL DETAILS & SCHEDULES
M4.0	CONTROL SCHEMATICS
M4.1	CONTROL SCHEMATICS
M4.2	CONTROL SCHEMATICS
M4.3	CONTROL SCHEMATICS
ME1.0	MECHANICAL & ELECTRICAL SCHEDULES
ME1.1	MECHANICAL & ELECTRICAL SCHEDULES



GROUND FLOOR – OVERALL PLAN
SCALE - 1/32" = 1'-0"

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THE CONTRACTOR MUST FIELD VERIFY ALL DIMENSIONS AND MUST CORRELATE & CORRELATE ALL DETAILS WITHIN THE FULL DRAWING PACKAGE BEING RESPONSIBLE FOR SAME THROUGHOUT CONSTRUCTION, REPORTING ANY DISCREPANCIES TO THE ARCHITECT PRIOR TO COMMENCING THE RELEVANT WORK.
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1. ISSUED FOR REVIEW 22.09.23
2. ISSUED FOR REVIEW 10.10.23
3. ISSUED FOR PERMIT 14.11.23
4. ISSUED FOR TENDER 14.02.24

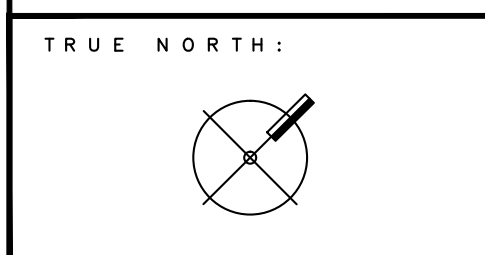
PROJECT:
HVAC Renovations
Glendale Secondary School
145 Rainbow Dr,
Hamilton, ON
For the HWDSB

SCALE:

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DRAWING TITLE:
Mechanical Legend, Key Plan & Drawing List

SCALE:
AS NOTED
DRAWN:
C.M. / J.L.
DATE:
SEPTEMBER 2023

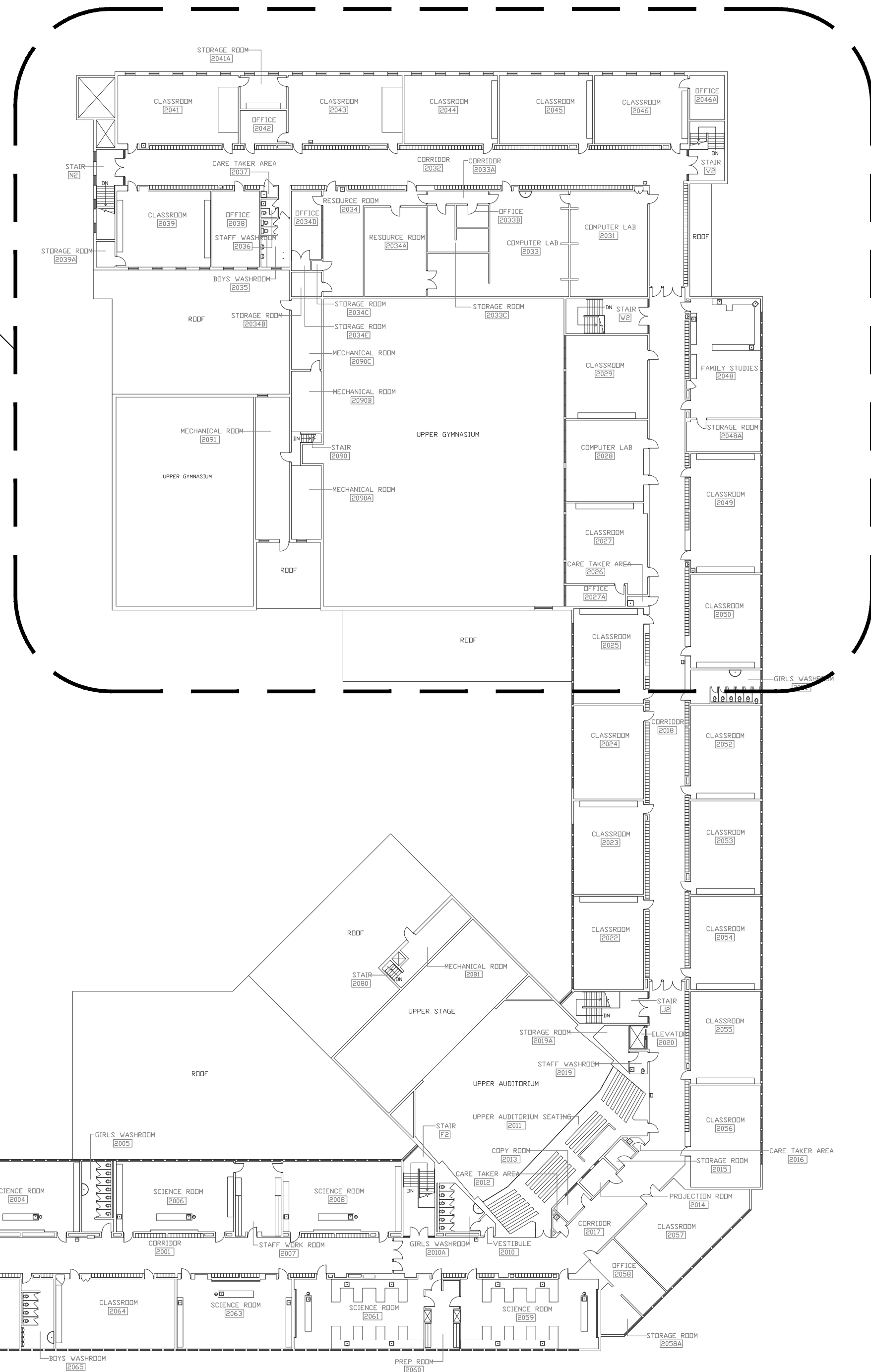
PROJECT #:
ALL-23010629-A0

DRAWING #:
MO.0

DRAWING NOTES

- 1 EXISTING GAS METER ON BUILDING EXTERIOR. CONTRACTOR IS TO COORDINATE WITH THE UTILITY AND OWNER FOR ALL SERVICE INTERRUPTIONS.
- 2 RISE AND OFFSET GAS PIPE AS REQUIRED TO ACCOMMODATE EXISTING ROOF PARAPET STRUCTURE.
- 3 SUPPORT NATURAL GAS PIPING AS PER MECHANICAL DETAILS AND AS OUTLINED IN THE MECHANICAL SPECIFICATIONS
- 4 FIELD ROUTE NATURAL GAS PIPE ON ROOF AS REQUIRED. PAINT GAS PIPE WITH TWO (2) COATS OF YELLOW PAINT AS OUTLINED IN THE MECHANICAL SPECIFICATIONS.
- 5 PROVIDE EXPANSION LOOP IN NATURAL GAS PIPE RUN.
- 6 DROP GAS PIPE EXPOSED TIGHT ALONGSIDE OF WALL. GAS PIPE TO BE PAINTED WITH TWO (2) COATS OF YELLOW PAINT.

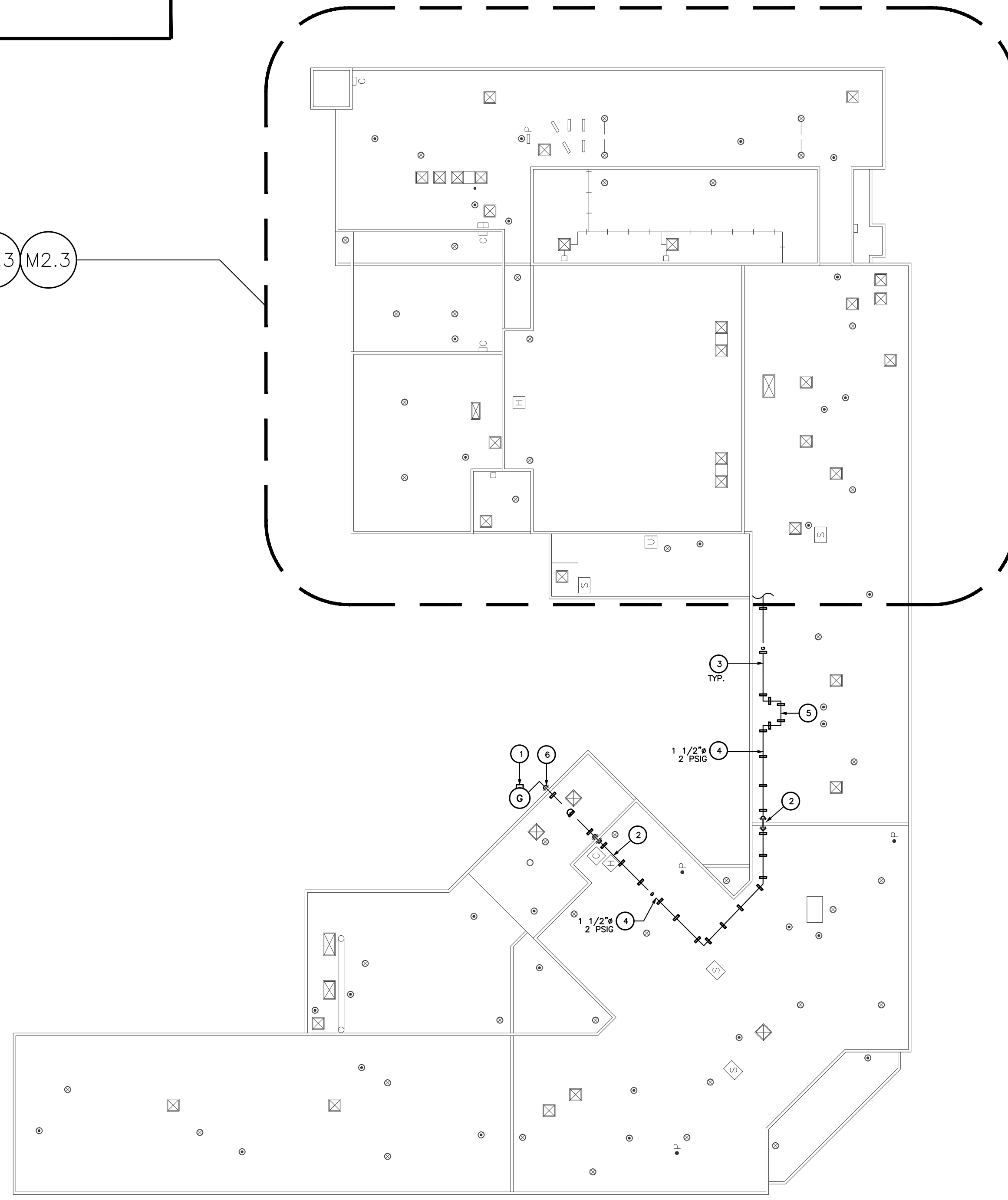
M1.2 M2.2



SECOND FLOOR – OVERALL PLAN

SCALE- 1/32" = 1'-0"

M1.3 M2.3



ROOF LEVEL – OVERALL PLAN

SCALE- 1/32" = 1'-0"

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SEAL:

EXP Services Inc.

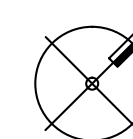
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- INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY

TRUE NORTH:



DRAWING TITLE:
Mechanical
Key Plan

SCALE:
AS NOTED

DRAWN:
C.M. / J.L.

DATE:
SEPTEMBER 2023

PROJECT #:
ALL-23010629-A0

DRAWING #:
MO.1

MECHANICAL SPECIFICATIONS – GENERAL

1. GENERAL
- 1.1 GENERAL REQUIREMENTS
- A. READ AND CONFORM TO:
- 1 THE CONTRACT CDOC 2, STIPULATED PRICE CONTRACT AS AMENDED.
 - 2 DIVISION 1 REQUIREMENTS AND DOCUMENTS REFERRED TO THEREIN.
- B. THE SPECIFICATIONS ARE INTEGRAL WITH THE DRAWINGS WHICH ACCOMPANY THEM. NEITHER IS TO BE USED ALONE. ANY ITEM OR SUBJECT OMITTED FROM ONE BUT IMPLIED IN THE OTHER IS FULLY AND PROPERLY REQUIRED.
- C. WHEREVER DIFFERENCES OCCUR IN THE TENDER DOCUMENTS, THE MOST ONERIOUS CONDITION GOVERNS. BASE THE BID ON THE COSTLIEST ARRANGEMENT.
- D. CONFORM TO THE LATEST EDITION OF ONTARIO BUILDING CODE (CSA STANDARDS), ONTARIO FIRE CODE, LOCAL & DISTRICT BYLAWS, REGULATIONS, & PUBLISHED ENGINEERING STANDARDS.
- E. NOTIFY CONSULTANT UPON DISCOVERY OF CONDITIONS WHICH ADVERSELY AFFECT WORK OF THIS DIVISION. NO ALLOWANCE WILL BE MADE AFTER LETTING OF CONTRACT FOR ANY EXPENSES INCURRED THROUGH FAILURE TO DO SO.
- F. REBID AND PAY FOR PERMITS AND INSPECTIONS BY AUTHORITIES HAVING JURISDICTION, REQUIRED IN THE UNDERTAKING OF THIS DIVISION. MAKE MODIFICATIONS REQUIRED BY AUTHORITIES.
- G. ALL TRADESMEN EMPLOYED ON THE PROJECT SHALL HOLD VALID TRADE CERTIFICATES/LICENSES AND SHALL MAKE A COPY AVAILABLE FOR REVIEW BY THE CONSULTANT AND/OR OWNER WHEN REQUESTED.

- 1.2 SCOPE OF WORK
- A. PRODUCTS AND METHODS MENTIONED OR SHOWN IN THE CONTRACT DOCUMENTS COMPLETE WITH INCIDENTALS NECESSARY FOR A COMPLETE OPERATING INSTALLATION. PROVIDE ALL TOOLS, EQUIPMENT AND SERVICES REQUIRED TO DO THE WORK.
- B. SITE EXAMINE EXISTING CONDITIONS WHICH MAY AFFECT WORK OF THIS DIVISION. EXAMINE ALL CONTRACT DOCUMENTS IN CONJUNCTION WITH SITE EXAMINATION TO ENSURE THAT WORK OF THIS DIVISION MAY BE SATISFACTORILY COMPLETED.
- C. DISCONNECTION AND REMOVAL OF VARIOUS MECHANICAL EQUIPMENT.
- D. DISCONNECTION AND MAKING SAFE OF VARIOUS MECHANICAL SYSTEMS AND EQUIPMENT IN AREAS TO BE DEMOLISHED AND/OR RENOVATED.
- E. ISOLATE AND DRAIN (OR PIPE FREEZE IF DRAINING IS NOT FEASIBLE) SYSTEMS AS REQUIRED TO EFFECT DEMOLITION, RENOVATIONS, MODIFICATIONS AND/OR REPAIRS, DISCONNECT, CAP AND MAKE SAFE ALL MECHANICAL SERVICES TO THE BUILDING INCLUDING, BUT NOT LIMITED TO: SANITARY SEWER(S), STORM SEWER(S), WATER SERVICE
- F. ON COMPLETION OF RENOVATIONS, MODIFICATIONS AND/OR REPAIRS, TEST ENTIRE SYSTEM AS IF NEW. REPORT REPAIRS OR REPLACEMENTS REQUIRED OF EXISTING EQUIPMENT, PIPING, FITTINGS OR DEVICES THAT ARE NOT INCLUDED IN CONTRACT TO CONSULTANT AND OWNER FOR INSTRUCTION. FLUSH, CLEAN AND REFILL RENOVATED SYSTEMS AS SPECIFIED FOR NEW.
- G. CUTTING AND PATCHING OF NEW OR EXISTING WORK.
- H. IDENTIFICATION OF EQUIPMENT, PIPING, VALVES AND CONTROLLERS.
- I. PERFORM START-UP AND COMPLETELY COMMISSION ALL EQUIPMENT AND SYSTEMS INSTALLED AND/OR MODIFIED UNDER THIS CONTRACT. COMMISSIONING WORK SHALL BE COMPLETED TO THE SATISFACTION OF THE CONSULTANT PRIOR TO ACCEPTANCE OF THE WORK OR ANY PART THEREOF.
- J. APPLY FOR & OBTAIN ALL PERMITS INCLUDING BUILDING PERMITS, & TSSA APPLICATIONS, LICENSES, OR CERTIFICATES NECESSARY FOR THE PERFORMANCE OF THE WORK. COORDINATE ALL WORK WITH BUILDING OFFICIALS & AUTHORITIES HAVING JURISDICTION.
- K. TAKE SUCH MEASURES AND INCLUDE IN BID PRICE FOR THE PROPER PROTECTION OF THE EXISTING BUILDING AND ITS FINISHES AT ALL TIMES DURING ALTERATIONS AND CONSTRUCTION OF THE NEW ADDITION. COORDINATE THIS PROTECTIVE WORK WITH ALL TRADES.
- L. VERIFY THE CORRECT OPERATION OF EACH EQUIPMENT ITEM PROVIDED AND/OR ALTERED AND EACH SYSTEM IN TOTAL AND OBTAIN THE OWNER'S APPROVAL PRIOR TO STARTING AND/OR RETURNING TO OPERATION.
- M. REPLACE CONSTRUCTION AND CARBON FILTERS ON ALL NEW AIR HANDLING UNITS, UNIT VENTILATORS AND ENERGY RECOVERY UNITS WITH NEW PRIOR TO PROJECT TURNOVER.
- N. SUPERVISE AND PROVIDE TRAINING OF NEW EQUIPMENT TO OWNERS MAINTENANCE STAFF.
- O. INSTALL AND COMMISSION ALL EQUIPMENT THAT HAS BEEN PRE-ORDERED BY OWNER. REFER TO ARCHITECTURAL SPECIFICATIONS 01030 FOR FULL DETAILS. SUPPLY AND INSTALL NEW EQUIPMENT WHERE INDICATED (BOILERS, PUMPS, HYDRONIC SPECIALTIES ETC.)
- P. SUPPLY AND INSTALL ROOF CURBS FOR RTU-1 AND RTU-2
- Q. CONTRACTOR TO REFERENCE HVAC CONSTRUCTION FILTERS WITH NEW AT PROJECT TURNOVER. PROVIDE ADDITIONAL TWO (2) SETS OF SPARE FILTERS FOR ALL NEW EQUIPMENT.

- 1.3 SUBMITTALS
- A. SHOP DRAWINGS: PREPARE AND SUBMIT TWO (2) COPIES OF SHOP DRAWINGS OF ALL EQUIPMENT ITEMS TO THE CONSULTANT FOR REVIEW. THE CONSULTANT WILL RETURN ONE COPY, MARKED WITH COMMENTS AND HIS REVIEW STAMP AS HE DEEMS APPROPRIATE.
- 1 CLEARLY INDICATE MANUFACTURER'S AND SUPPLIER'S NAMES, MODEL NUMBERS, DETAILS OF CONSTRUCTION, ACCURATE DIMENSIONS, CAPACITIES AND PERFORMANCE. PRIOR TO SUBMISSION CHECK AND CERTIFY AS CORRECT. SHOP DRAWINGS AND DATA SHEETS DO NOT ORDER EQUIPMENT UNTIL A COPY OF THE SHOP DRAWINGS, REVIEWED BY CONSULTANT, HAS BEEN RETURNED TO CONTRACTOR.
 - 2 THE CONSULTANT WILL NOT REVIEW SHOP DRAWINGS THAT FAIL TO BEAR THE CONTRACTOR'S STAMP OF APPROVAL OR CERTIFICATION.
- B. REQUESTS FOR SHUT-DOWN: OBTAIN PERMISSION FOR SYSTEMS SHUT-DOWN AND/OR SERVICE INTERRUPTION FROM THE OWNER PRIOR TO DISRUPTION OF ANY SYSTEM OR SERVICE IN USE BY THE OWNER. EMPLOY THE OWNER'S STANDARD FORM OF REQUEST WHERE AVAILABLE.
- C. WARRANTY: PROVIDE WRITTEN GUARANTEE FOR ALL NEW EQUIPMENT & WORKMANSHIP FOR ONE (1) YEAR FROM DATE OF SUBSTANTIAL COMPLETION. FIVE (5) YEARS FOR COMPRESSOR & HEAT EXCHANGER. DEFECTIVE PARTS REPAIRED OR REPLACED WITHOUT CHARGE.

- 2 COMMON WORK RESULTS
- 2.1 PIPING SPECIALTIES
- A. CAST BRASS, PRESSURE, COPPER TO COPPER UNIONS SHALL BE USED WITH SEAMLESS COPPER TUBING SMALLER THAN 3" (75 MM).
- B. CAST BRASS FLANGES SHALL BE USED WITH SEAMLESS COPPER TUBING, TYPE L FOR TUBING 3" (75 MM) AND LARGER.
- 2.2 FIRE STOPPING COMPOUNDS
- A. APPROVED MANUFACTURER: 3M PRODUCTS INDICATED.
- B. OTHER ACCEPTABLE MANUFACTURERS OFFERING EQUIVALENT PRODUCTS: DOW CORNING, JOHN MANVILLE, HILTI FIRESTOP SYSTEMS.
- C. FIRE RATED SEALANTS: INTUMESCENT MATERIAL, SYNTHETIC ELASTOMERS, CAPABLE OF EXPANDING UP TO 8 TO 10 TIMES WHEN EXPOSED TO TEMPERATURES OF 250°F (121°C) OR HIGHER. ULC LISTED AND LABELLED.
- 2.3 NAMEPLATES
- A. PROVIDE LAMINATED PLASTIC PLATES WITH BLACK FACE AND WHITE CENTRE OF MINIMUM SIZE 3-1/2" x 1-1/2" x 3/32" (90 x 40 x 2 MM) NOMINAL THICKNESS, ENGRAVED WITH 1/4" (6 MM) HIGH LETTERING. USE 1" (25 MM) LETTERING FOR MAJOR EQUIPMENT.
- B. FASTEN NAMEPLATES SECURELY IN CONSPICUOUS PLACE, WHERE NAMEPLATES CANNOT BE MOUNTED ON COOL SURFACE, PROVIDE STANDOFFS.
- C. IDENTIFY EQUIPMENT TYPE AND NUMBER AND SERVICE OF AREAS OR ZONE OF BUILDING SERVED.
- D. FOR EACH ITEM OF EQUIPMENT WHICH MAY BE STARTED AUTOMATICALLY OR REMOTELY, ADD A RED LAMACOID PLATE, 2-1/2" X 9" (65 X 230 MM), READING: "WARNING. THIS EQUIPMENT IS AUTOMATICALLY CONTROLLED AND MAY START AT ANY TIME."
- 2.4 ACCESS DOORS
- A. STANDARD UNIVERSAL FLUSH
- 1 MATERIAL: UPT TO 16" X 16" (400X400) 16 GAUGE MOUNTING FRAME, OVER 16" X 16" (400X400) 14 GAUGE DOOR, 16 GAUGE MOUNTING FRAME.
 - 2 HINGE: CONTINUOUS, CONCEALED.
 - 3 LATCH: STAINLESS STEEL SCREWDRIVER OPERATED CAM LATCH
 - 4 FINISH: STEEL: 5-STAGE IRON PHOSPHATE PREPARATION WITH PRIME COAT

MECHANICAL SPECIFICATIONS – GENERAL

- OF WHITE, ALKYD BAKING ENAMEL OR STAINLESS STEEL TYPE 304, NO. 4 SATIN POLISH.
- .5 MANUFACTURERS: ACUDOR ACORN, CEB, MIFAB, CENDRES CONTOUR
- B. RECESSED ACCESS DOOR
- 1 MATERIAL: STEEL OR STAINLESS STEEL, 22 GAUGE DOOR, 22 GAUGE MOUNTING FRAME. DOOR -RECESSED 5/8"
 - 2 HINGE: CONTINUOUS, CONCEALED.
 - 3 LATCH: STAINLESS STEEL SCREWDRIVER OPERATED CAM LATCH
 - 4 FINISH: SATIN COAT STEEL.
- 5 MANUFACTURERS: ACUDOR ACORN, CEB, MIFAB, CENDRES CONTOUR
- C. FIRE RATED
- 1 ACCESS DOORS IN FIRE SEPARATIONS OR FIRE RATED ASSEMBLIES: ULC LABELLED. REFER TO ARCHITECTURAL DRAWINGS FOR RATINGS OF FIRE SEPARATIONS AND ASSEMBLIES: MINIMUM 12 GAUGE.
 - 2 HINGE: CONTINUOUS, CONCEALED.
 - 3 LATCH: STAINLESS STEEL SCREWDRIVER OPERATED CAM LATCH
 - 4 FINISH: STEEL: 5-STAGE IRON PHOSPHATE PREPARATION WITH PRIME COAT OF WHITE, ALKYD BAKING ENAMEL OR STAINLESS STEEL TYPE 304, NO. 4 SATIN POLISH.
 - 5 MANUFACTURERS: ACUDOR ACORN, CEB, MIFAB, CENDRES CONTOUR

3 SUPPORTS & ANCHORS

- 3.1 ACCESSORIES
- A. HANGER RODS: GALVANIZED, CARBON STEEL CONTINUOUS THREADED.
- B. INSERTS: MALLEABLE IRON CASE OF GALVANIZED STEEL SHELL AND EXPANDER PLUG FOR THREADED CONNECTION WITH LATERAL ADJUSTMENT. TOP SLOT FOR REINFORCING RODS. LUGS FOR ATTACHING TO FORMS; SIZE INSERTS TO SUIT THREADED HANGER ROD.

3.2 EQUIPMENT ROOF CURBS

- A. FABRICATION: WELDED 0.05" (1.2 MM) GALVANIZED STEEL SHELL AND BASE, MITRED 3" (75 MM) CANT, VARIABLE STEP TO MATCH ROOF INSULATION, FACTORY INSTALLED WOOD NAILER.

3.3 PIPE HANGER SPACING

PIPE SIZE (IN)	ROD DIAMETER (IN)	SUPPORT SPACING (FT)	STEEL PIPE
1/2	3/8	7	
3/4	3/8	7	
1	3/8	7	
1-1/4	3/8	7	
1-1/2	3/8	9	
2	3/8	10	

3.4 FUEL GAS PIPE HANGER SPACING

PIPE SIZE (IN)	SUPPORT SPACING (FT)
1/2	6
3/4 - 1	8
1-1/4 - 2-1/2	10
3 - 4	15
5 - 8	20
10 OR LARGER	25
ALL VERTICAL TUBING (ALL SIZES)	EVERY FLOOR
	6

3.5 DUCT HANGER SPACING

DUCT SIZES (LARGEST SIDE) SPACING	ANGLE SIZE	ROD SIZE
UP TO 30" DIAMETER 10 FT	1" X 1" X 1/8"	1/4"
31" TO 42" DIAMETER 10 FT	1-1/2" X 1-1/2" X 1/8"	1/4"
43" TO 60" DIAMETER 10 FT	1-1/2" X 1-1/2" X 1/8"	3/8"
61" TO 84" DIAMETER 8 FT	2" X 2" 1/8"	3/8"

HVAC SPECIFICATIONS

1 HVAC HYDRONIC PIPING

- 1.1 HYDRONIC PIPING – GENERAL:
- A. KEEP OPEN ENDS OF PIPE FREE FROM SCALE AND DIRT. PROTECT OPEN ENDS WITH TEMPORARY PLUGS OR CAPS. AFTER COMPLETION, FITT, CLEAN, AND TREAT SYSTEMS.
- B. PROVIDE NON-CONDUCTING DIELECTRIC CONNECTIONS WHENEVER JOINING DISSIMILAR METALS IN OPEN SYSTEMS.
- C. PPIPE COAT EXPOSED STEEL HANGERS AND SUPPORTS. HANGERS AND SUPPORTS LOCATED IN CRAWL SPACES, PIPE SHAFTS, AND SUSPENDED CEILING SPACES ARE NOT CONSIDERED EXPOSED.
- D. AIR VENTS SHALL BE SELECTED TO SUIT THE SYSTEM OPERATING PRESSURES AND SHALL BE AUTOMATIC AND COMPLETE WITH ISOLATING VALVES.
- E. PIPE ALL DISCHARGE FROM TEMPERATURE & PRESSURE SAFETY RELIEF VALVES TO A POINT OF SAFE DISCHARGE DIRECTLY INTO A FLOOR DRAIN, HUB DRAIN OR SAFE OUTDOOR LOCATION.
- F. AUTOMATIC FEED VALVES: PROVIDE AUTOMATIC FEED VALVE ON THE COLD WATER MAKE-UP LINE TO EACH NEW HOT WATER HEATING SYSTEM.
- G. TEST LIQUID HEAT TRANSFER PIPING HYDROSTATICALLY AT NOT LESS THAN 150% OF OPERATING PRESSURE OR NOT LESS THAN 125 PSI (860 KPA) WHICHEVER IS THE GREATER. TEST PERIOD SHALL BE NOT LESS THAN SIX (6) HOURS DURATION DURING WHICH THE EACH JOINT SHALL BE INSPECTED, GIVEN A SHARP TAP WITH A HAMMER AND CHECKED FOR LEAKS.

1.2 VALVES – GENERAL

- A. CONFORM TO REQUIREMENTS OF ANSI, ASTM, ASME, AND APPLICABLE MSS STANDARDS.
- B. MANUFACTURER'S NAME AND PRESSURE RATING CLEARLY MARKED ON BODY TO MSS-SP-25.
- C. VALID CRN (CANADIAN REGISTRATION NUMBER) REQUIRED FOR EACH VALVE.
- D. MATERIALS:
- 1 BRONZE: ASTM B62 OR B61 AS APPLICABLE
 - 2 BRASS: ASTM B283 C3770
 - 3 CAST IRON: ASTM A126 CLASS B
- E. END CONNECTIONS:
- 1 THREADED ENDS: ANSI B1.20.1
 - 2 FLANGED ENDS: ANSI B16.1 (CLASS 125), ANSI B16.5
 - 3 FACE-TO-FACE DIMENSIONS: ANSI B16.10
- F. DESIGN AND TESTING:
- 1 BRONZE GATE & CHECK VALVES: MSS-SP-80
 - 2 BALL VALVES: MSS-SP-110
 - 3 CAST IRON GATE VALVES: MSS-SP-70
 - 4 CAST IRON GLOBE VALVES: MSS-SP-85
 - 5 CAST IRON CHECK: MSS-SP-71
 - 6 BUTTERFLY VALVES: MSS-SP-67
- G. ACCEPTABLE MANUFACTURERS: KITZ, CRANE, JENKINS, CONBRACO, NIBCO

1.3 HYDRONIC SYSTEMS TO 150 PSIG ABOVE GROUND

- A. NOMINAL OPERATING PRESSURE 125 PSIG
- B. DESIGN PRESSURE 150 PSIG
- C. TEST PRESSURE 225 PSIG
- D. DESIGN TEMPERATURE 350°F
- E. CORROSION ALLOWANCE 0.0625 IN.
- F. STEEL PIPE ASTM A53 GR.B ERW OR ASTM A106 GR.B SMLS, SCH 4
- G. JOINTS, 2" AND SMALLER SCREWED
- H. SCREWED FITTINGS 150 LB. MALLEABLE IRON
- I. UNIONS CL-150, ASTM A-47 MALLEABLE IRON, ASTM A-153 GALVANIZED, ANSI B2.1 THREADS.
- J. JOINTS 2-1/2" AND LARGER WELDED WITH FLANGES AT CONNECTIONS TO EQUIPMENT
- K. BUTT WELD FITTINGS ASTM A234 GR. WFB
- L. FLANGES ASTM A105, CLASS 150, RAISED FACE, WELD NECK OR SLIP ON
- M. BOLTS ASTM A307 C.S. BOLTS, SQ. HEAD; ASTM A563 NUTS, HEX HEAD
- N. GASKETS 1/16" (1.6 MM) THICK PREFORMED NON-ASBESTOS GRAPHITE FIBRE.
- O. COPPER TUBING 2" AND SMALLER ASTM B88, TYPE L, HARD DRAWN.

- P. JOINTS: SOLDER, LEAD FREE, ASTM B32, 95-5 TIN-ANTIMONY, OR TIN AND SILVER, WITH MELTING RANGE 220°C TO 280°C.
- Q. FITTINGS: ASME B16.18, CAST BRASS, OR ASME B16.22, SOLDER WROUGHT COPPER
- R. DIELECTRIC UNIONS: WATER IMPERVIOUS ISOLATION BARRIER.
- S. VALVES, 2" AND SMALLER: ASTM A105
- 1 GATE VALVES (ISOLATING) 200 PSIG NON-SHOCK WOG, ASTM B62 BRONZE BODY, SOLID WEDGE DISC, RISING STEM, BRONZE TRIM, THREADED ENDS, KITZ #25
 - 2 GLOBE VALVES (THROTTLING) 300 PSIG NON-SHOCK WOG, ASTM B62 BRONZE BODY, COMPOSITION (TEFLON) DISC, RISING STEM, BRONZE TRIM, THREADED ENDS, KITZ #29
 - 3 CHECK VALVES (BACKFLOW) 300 PSIG NON-SHOCK WOG, ASTM B62 BRONZE BODY, Y-PATTERN HORIZONTAL, SWING TYPE DISC, THREADED ENDS, KITZ #29
 - 4 BALL VALVES (DRAIN) 600 PSIG NON-SHOCK WOG, FORGED BRASS, 2-PIECE, CHROME BALL AND STEM, FULL PORT, BLOW-OUT PROOF PIPE SEATS & STEM, LEVER HANDLE, THREADED ENDS, KITZ #68AC.
- T. VALVES, 2-1/2" AND LARGER: ASTM A216
- 1 GATE VALVES (ISOLATING) 200 PSIG NON-SHOCK WOG, ASTM A126 CLASS B CAST IRON BODY, BOLTED BONNET, BRONZE MOUNTED, SOLID WEDGE DISC, OS&Y, NON-ASBESTOS PACKING, FLANGED ENDS, KITZ #72.
 - 2 GLOBE VALVES (THROTTLING) 200 PSIG NON-SHOCK WOG, ASTM A126 CLASS B CAST IRON BODY, BOLTED BONNET, BRONZE MOUNTED, BEVELLED WEDGE DISC, OS&Y, NON-ASBESTOS PACKING, FLANGED ENDS, KITZ #76.
 - 3 CHECK (BACKFLOW) 200 PSIG NON-SHOCK WOG, ASTM 126 CLASS B CAST IRON BODY, BOLTED COVER, BRONZE MOUNTED, SWING TYPE DISC, FLANGED ENDS, KITZ #78

- U. PROVIDE STEM EXTENSIONS FOR INSULATED PIPING.
- V. PROVIDE GEAR OPERATOR AND CHAIN ON VALVES INSTALLED ABOVE 10FT AFF.
- W. STRAINERS, 2" AND SMALLER CLASS 250, 400 PSIG WOG, CAST IRON BODY, Y-PATTERN, SCREWED CAP AND ENDS, A167 304 STAINLESS STEEL SCREEN WITH 1/32" PERFORATIONS, MUELLER STEAM 752.
- X. STRAINERS, 2-1/2" AND LARGER CLASS 250 PSIG NON-SHOCK WOG, CAST IRON, Y-PATTERN, BOLTED FLANGE COVER, BLOW-OUT PLUG, A167 304 STAINLESS STEEL SCREEN WITH 1/32" PERFORATIONS, FLANGED ENDS, MUELLER STEAM 752.

1.4 EQUIPMENT DRAINS AND OVERFLOWS

- A. COPPER TUBING: ASTM B88, TYPE M AND DW, HARD DRAWN.
1. FITTINGS: ASME B16.18, CAST BRASS, OR ASME B16.22 SOLDER WROUGHT COPPER.
2. JOINTS: SOLDER, LEAD FREE, ASTM B32, 95-5 TIN-ANTIMONY, OR TIN AND SILVER, WITH MELTING RANGE 442°F TO 536°F (220°C TO 280°C).

1.5 CIRCUIT BALANCING VALVES

- A. CIRCUIT BALANCING VALVES; 2" (50 MM) AND SMALLER)
- 1 SCREWED CONNECTION, GLOBE STYLE DESIGN, NONFERROUS, PRESSURE DIE-CAST, NONPOROUS AMETAL COPPER ALLOY. EACH VALVE SHALL BE SUCH THAT WHEN INSTALLED IN ANY DIRECTION, IT WILL NOT AFFECT FLOW MEASUREMENT.
 - 2 VALVES SHALL PROVIDE THE FOLLOWING FUNCTIONS:
 - 1 PRECISION FLOW MEASUREMENT.
 - 2 PRECISION FLOW BALANCING.
 - 3 POSITIVE SHUT OFF WITH NO DRIP SEAT AND TEFLON DISC.
 - 4 DRAIN CONNECTION WITH PROTECTIVE CAP.
 - 3 VALVES SHALL HAVE FOUR 360° ADJUSTMENT TURNS OF HANDWHEEL FOR MAXIMUM VERNIER-TYPE SETTING WITH "HIDDEN MEMORY" FEATURE TO PROGRAM THE VALVE WITH PRECISION TAMPER-PROOF BALANCING SETTING.
 - 4 VALVES SHALL BE SHIPPED IN A 4.5 R FACTOR POLYURETHANE CONTAINER THAT SHALL BE USED AS INSULATION FOR VALVE IN INSTALLED.
 - 5 PROVIDE VALVES SUITABLE FOR MAXIMUM WORKING PRESSURE OF 250 PSI (1720 KPA) AND MAXIMUM OPERATING TEMPERATURE OF 250°F (121°C).

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- .6 ACCEPTABLE PRODUCTS: S.A. ARMSTRONG CRV I INDICATED OR TOUR & ANDERSON STA-0 OR NEWMAN HATTERSELY.
- B. CIRCUIT BALANCING VALVES 2 1/2" (65 MM) AND LARGER
- 1 FLANGED, LINE SIZE CONNECTION, GLOBE STYLE DESIGN, NONFERROUS, PRESSURE DIE-CAST, NONPOROUS AMETAL COPPER ALLOY.
 - 2 VALVES, SHALL PROVIDE THE FOLLOWING FUNCTIONS:
 - 1 PRECISION FLOW MEASUREMENT.
 - 2 PRECISION FLOW BALANCING.
 - 3 POSITIVE SHUT OFF WITH NO DRIP SEAT AND TEFLON DISC.
 - 3 VALVES SHALL HAVE TWELVE 360° ADJUSTMENT TURNS OF HANDWHEEL FOR MAXIMUM VERNIER-TYPE SETTING WITH "HIDDEN MEMORY" FEATURE TO PROGRAM THE VALVE WITH PRECISION TAMPER-PROOF BALANCING SETTING.
 - 4 VALVES SHALL BE SUITABLE FOR MAXIMUM WORKING PRESSURE OF 250 PSI (1720 KPA) AND MAXIMUM OPERATING TEMPERATURE OF 250°F (121°C).
 - 5 ACCEPTABLE PRODUCTS: S.A. ARMSTRONG CBV II INDICATED OR TOUR & ANDERSON STA-F OR NEWMAN HATTERSELY.

2 HVAC DUCT INSULATION

- 2.1 GLASS FIBRE, FLEXIBLE
- A. MANUFACTURER: CERTAINTIED SOFT TOUCH AND WIDE WRAP
- B. OTHER ACCEPTABLE MANUFACTURERS: JOHNS MANVILLE MICROLITE.
- C. INSULATION: ASTM C553; ASTM C1290, CAN 51.11-92, ASTM C1136, NFPA 90A, ASTM E84, ASTM E136.
- 1 'KSF' VALUE : ASTM C518, 0.039 AT 24 °C (0.27 @ 75.2 ° F)
 - 2 MAXIMUM SERVICE TEMPERATURE: 121 °C (250 ° F)
 - 3 MAXIMUM MOISTURE ABSORPTION: ASTM C1104; <5% BY WEIGHT.
 - 4 MAXIMUM FLAME SPREAD INDEX: 25
 - 5 MAXIMUM SMOKE DEV INDEX: 50
- D. VAPOUR BARRIER JACKET:
- 1 KRAFT PAPER WITH GLASS FIBRE YARN AND BONDED TO ALUMINIZED FILM, (FSK)
 - 2 KRAFT PAPER REINFORCED WITH GLASS FIBRE YARN AND BONDED TO WHITE METALIZED POLYPROPYLENE
 - 3 MOISTURE VAPOUR TRANSMISSION: ASTM E96; 0.02 PERM.
 - 4 SECURE WITH PRESSURE SENSITIVE TAPE.
- E. VAPOUR BARRIER TAPE:
- 1 KRAFT PAPER REINFORCED WITH GLASS FIBRE YARN AND BONDED TO ALUMINIZED FILM, WITH PRESSURE SENSITIVE RUBBER BASED ADHESIVE.
 - 2 FLOOR VAPOUR BARRIER MASTIC:
 - 1 VINYL EMULSION TYPE ACRYLIC OR MASTIC, COMPATIBLE WITH INSULATION, BLACK COLOUR.
 - 2 G. TIE WIRE: ANNEALED STEEL, 1/16" (1.5 MM).
- 2.2 GLASS FIBRE, RIGID
- A. MANUFACTURER: CERTAINTIED CERTAPRO BOARD.
- B. OTHER ACCEPTABLE MANUFACTURERS: JOHNS MANVILLE 800 SERIES SPIN-GLASS
- C. INSULATION: ASTM C612; RIGID, NONCOMBUSTIBLE BLANKET.
- 1 'KSF' VALUE : ASTM C518, 0.25 BTU-in/Hr-Sq.Ft-F AT 75 F
 - 2 MAXIMUM SERVICE TEMPERATURE: 250 °F (121 °C).
 - 3 MAXIMUM MOISTURE ABSORPTION: ASTM C1104; <5% BY WEIGHT.
- D. VAPOUR BARRIER JACKET:
- 1 KRAFT PAPER WITH GLASS FIBRE YARN AND BONDED TO ALUMINIZED FILM.
 - 2 MOISTURE VAPOUR TRANSMISSION: ASTM E96; 0.04 PERM.
 - 3 SECURE WITH PRESSURE SENSITIVE TAPE.

2.3 ALUMINUM JACKETING (APPLY TO OUTDOOR DUCTWORK)

- MANUFACTURER: JOHNS MANVILLE ALUMINUM ROLL AND SHEET
- COMPLIANCE: ASTM C1729, ASTM E84
- FINISH: SMOOTH PLAIN MILL FINISH
- EMITTANCE: ASTM C1371
- MAXIMUM FLAME SPREAD INDEX: 0
- MAXIMUM SMOKE DEVELOPMENT INDEX: 5

2.4 DUCT INSULATION

- A. INSULATE NEW OR ALTERED DUCTWORK AND RE-INSULATE EXISTING DUCTWORK WHERE INSULATION HAS BEEN REMOVED OR DAMAGED AS FOLLOWS:
- SERVICE INSULATION TYPE THICKNESS
- AIR SUPPLY – RECTANGULAR RIGID 1"
- UNION WITH GALVANIZED OR PLATED STEEL FLEXIBLE 1"
- EXHAUST WITHIN 6' OF OUTSIDE – RECTANGULAR RIGID 3"
- EXHAUST WITHIN 6' OF OUTSIDE – ROUND FLEXIBLE 3"
- EXHAUST AIR PLENUMS RIGID 3"
- DUCTWORK OUTDOORS (SUPPLY & RETURN) RIGID 3"
- B. INLINE DUCT SILENCERS SHALL BE INSULATED IN THE SAME MANNER AS DUCTWORK.

3. HVAC PIPING INSULATION

- 3.1 GLASS FIBRE
- A. APPROVED MANUFACTURERS: JOHNSMANVILLE MICRO-LOK
- B. OTHER ACCEPTABLE MANUFACTURERS OFFERING EQUIVALENT PRODUCTS: OWENS CORING FIBERGLASS, CERTAINTIED CRIMPWRAP.
- C. INSULATION: ASTM C547; ASTM C411, ASTM C356 ASTM E84, ASTM D774, NFPA 259.
- 1 'KSF' VALUE: 0.23 BTU-in/Hr-Sq.Ft.F AT 75°F, 0.33 W/m-c AT 24 °C.
 - 2 MINIMUM SERVICE TEMPERATURE: 0° F (-18°C).
 - 3 MAXIMUM SERVICE TEMPERATURE: 850° F (454°C).
 - 4 MAXIMUM MOISTURE ABSORPTION: <5% BY WEIGHT.
- D. VAPOUR BARRIER JACKET
- 1 ASTM C136 TYPE 1, WHITE KRAFT PAPER REINFORCED WITH GLASS FIBRE YARN AND BONDED TO ALUMINIZED FILM.
 - 2 MOISTURE VAPOUR TRANSMISSION: ASTM E96; 0.02 PERM.
 - 3 SECURE WITH SELF SEALING LONGITUDINAL LAPS AND BUTT STRIPS.
 - 4 SECURE WITH OUTWARD CLINCH EXPANDING STAPLES AND VAPOUR BARRIER MASTIC
- E. TIE WIRE: 1.3 MM STAINLESS STEEL WITH TWISTED ENDS ON MAXIMUM 12" (300 MM) CENTRES
- F. VAPOUR BARRIER LAP ADHESIVE
- 1 COMPATIBLE WITH INSULATION.
- G. INSULATING CEMENT/MASTIC
- 1 ASTM C195; HYDRAULIC SETTING ON MINERAL WOOL, VOC CONTENT NOT TO EXCEED 80 G/L.

3.2 JACKETS

- A. PVC PLASTIC
- 1 JACKET: ONE PIECE MOULDED TYPE FITTING COVERS AND SHEET MATERIAL. ASTM E84, ASTM D1784, UL1802-M88.
 - 2 MAXIMUM SERVICE TEMPERATURE: 151°F (66°C).
 - 3 FINISH: GLOSS.
 - 4 MAXIMUM FLAME SPREAD: ASTM E84; 25 OR LESS.
 - 5 MAXIMUM SMOKE DEVELOPED: ASTM E84; 50 OR LESS.
 - 6 THICKNESS: 20 MIL (0.4 MM) MINIMUM. 30 MIL (0.8 MM) MINIMUM FOR OUTDOOR USE.
 - 7 COLOUR: STANDARD OFF-WHITE
 - 8 COVERING ADHESIVE MASTIC
 - 1 COMPATIBLE WITH INSULATION, MAXIMUM VOC CONTENT OF 50 G/L.
 - 9 APPROVED MANUFACTURER: CEEL-CO 300 SERIES, ZESTON PVC

HVAC SPECIFICATIONS

- 3.3 PIPE INSULATION
- A. INSULATE NEW OR ALTERED PIPING WITH RIGID PIPE INSULATION AND RE-INSULATE EXISTING PIPING WHERE INSULATION HAS BEEN REMOVED OR DAMAGED AS FOLLOWS:
- RIGID PIPE INSULATION
- | SERVICE | OPERATING TEMP. (°F) | PIPE Ø IN. | INSUL THK. IN. |
|------------------------------|----------------------|-------------------|----------------|
| HYDRONIC HEATING (HOT WATER) | 141 TO 200 | 1-1/4 AND SMALLER | 1-1/2" |
| | | 1-1/2" & LARGER | 2" |

4 HYDRONIC SPECIALTIES

- 4.1 AIR VENTS
- A. MANUAL TYPE: SHORT VERTICAL SECTIONS OF 2" (50 MM) DIAMETER PIPE TO FORM AIR CHAMBER, WITH 3 MM BRASS NEEDLE VALVE AT TOP OF CHAMBER
- B. FLOAT TYPE:
- 1 MANUFACTURERS: ARMSTRONG, AMTROL, TACO
 - 2 BRASS OR SEMI-STEEL BODY, COPPER, POLYPROPYLENE, OR SOLID NON-METALLIC FLOAT, STAINLESS STEEL VALVE AND VALVE SEAT; SUITABLE FOR SYSTEM OPERATING TEMPERATURE AND PRESSURE; WITH ISOLATING VALVE.

4.2 STRAINERS

- A. SIZE 2" (50 MM) AND UNDER:
- 1 MANUFACTURERS: SARCO BS, CRANE, ARMSTRONG, COLTON
 - 2 SCREWED BRASS OR IRON BODY FOR 175 PSI (1200 KPA) WORKING PRESSURE, Y PATTERN WITH 0.8 MM STAINLESS STEEL PERFORATED SCREEN.
- C. SIZE 2-1/2" TO 4" (65 MM TO 100 MM):
- 1 FLANGED IRON BODY FOR 175 PSI (1200 KPA) WORKING PRESSURE, Y PATTERN WITH 1.2 MM STAINLESS STEEL PERFORATED SCREEN.
- D. SIZE 6" (150 MM) AND LARGER:
- 1 FLANGED IRON BODY FOR 175 PSI (1200 KPA) WORKING PRESSURE, BASKET PATTERN WITH 3.2 MM STAINLESS STEEL PERFORATED SCREEN.

4.3 RELIEF VALVES

- A. MANUFACTURERS: SARCO, WATTS, BELL & GOSSETT, CONBRAC
- B. BRONZE BODY, TEFLON SEAT, STAINLESS STEEL STEM AND SPRINGS, AUTOMATIC, DIRECT PRESSURE ACTUATED, CAPACITIES ASME CERTIFIED AND LABELLED

5 REFRIGERATION PIPING & SPECIALTIES

5.1 PIPING

- A. COPPER TUBING: ASTM B280, TYPE ACR HARD DRAWN OR ANNEALED.
- 1 FITTINGS: ASME B16.22 WROUGHT COPPER.
 - 2 JOINTS: BRAZE, AWS A5.8 BCUP SILVER/PHOSPHORUS/COPPER ALLOY WITH MELTING RANGE 640 TO 805 DEGREES C.
- B. COPPER TUBING TO 22 MM OD: ASTM B88, TYPE K, ANNEALED.
- 1 FITTINGS: ASME B16.26 CAST COPPER.
 - 2 JOINTS: FLARED.
- C. PIPE SUPPORTS AND ANCHORS:
- 1 CONFORM TO ASME B31.5.
 - 2 HANGERS FOR PIPE SIZES 13 TO 38 MM: MALLEABLE IRON ADJUSTABLE SWIVEL SPLIT RING.
 - 3 HANGERS FOR PIPE SIZES 50 MM AND OVER: CARBON STEEL, ADJUSTABLE, CLEVIS.
 - 4 MULTIPLE OR TRAPEZIE HANGERS: STEEL CHANNELS WITH WELDED SPACERS AND HANGER RODS.
 - 5 WALL SUPPORT FOR PIPE SIZES TO 75 MM: CAST IRON HOOK.
 - 6 WALL SUPPORT FOR PIPE SIZES 100 MM AND OVER: WELDED STEEL BRACKET AND WROUGHT STEEL CLAMP.
 - 7 VERTICAL SUPPORT: STEEL RISER CLAMP.
 - 8 FLOOR SUPPORT: CAST IRON ADJUSTABLE PIPE SADDLE, LOCK NUT, NIPPLE, FLOOR FLANGE, AND CONCRETE PIER OR STEEL SUPPORT.
 - 9 COPPER PIPE SUPPORT: CARBON STEEL RING, ADJUSTABLE, COPPER PLATED.
 - 10 HANGER RODS: MILD STEEL THREADED BOTH ENDS, THREADED ONE END, OR CONTINUOUS THREADED.
 - 11 INSERTS: MALLEABLE IRON CASE OF GALVANIZED STEEL SHELL AND EXPANDER PLUG FOR THREADED CONNECTION WITH LATERAL ADJUSTMENT, TOP SLOT FOR REINFORCING RODS, LUGS FOR ATTACHING TO FORMS; SIZE INSERTS TO SUIT THREADED HANGER RODS.

5.2 REFRIGERANT INSULATION: CLOSED-CELL ELASTOMERIC

- A. MANUFACTURER:

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FOR MAXIMUM WORKING PRESSURE TO SUIT APPLICATION.

- 5.7 CHECK VALVES
A. GLOBE TYPE:
.1 CAST BRONZE OR FORGED BRASS BODY, FORGED BRASS CAP WITH NEOPRENE SEAL, BRASS GUIDE AND DISC HOLDER, PHOSPHOR-BRONZE OR STAINLESS STEEL SPRING, TEFLON SEAT DISC; FOR MAXIMUM WORKING PRESSURE OF 2930 KPA AND MAXIMUM TEMPERATURE OF 149 DEGREES C.

- B. STRAIGHT THROUGH TYPE:
.1 BRASS BODY AND DISC, PHOSPHOR-BRONZE OR STAINLESS STEEL SPRING, NEOPRENE SEAT; FOR MAXIMUM WORKING PRESSURE OF 3450 KPA AND MAXIMUM TEMPERATURE OF 93 DEGREES C.

- 5.8 PRESSURE REGULATORS
A. BRASS BODY, STAINLESS STEEL DIAPHRAGM, DIRECT ACTING, ADJUSTABLE OVER 0 TO 550 KPA RANGE; FOR MAXIMUM WORKING PRESSURE OF 3100 KPA.

- 5.9 PRESSURE RELIEF VALVES
A. STRAIGHT THROUGH OR ANGLE TYPE: BRASS BODY AND DISC, NEOPRENE SEAT, FACTORY SEALED AND STAMPED WITH ASME UV AND NATIONAL BOARD CERTIFICATION NB; FOR STANDARD 1620 KPA SETTING; SELECTED TO ASHRAE 15.

- 5.10 FILTER-DRIERS
A. REPLACEABLE CARTRIDGE ANGLE TYPE:
.1 SHELL: ARI 710, UL LISTED, BRASS, REMOVABLE CAP, FOR MAXIMUM WORKING PRESSURE OF 2410 KPA.

- .2 FILTER CARTRIDGE: PLEATED MEDIA WITH INTEGRAL END RINGS, STAINLESS STEEL SUPPORT.
.3 FILTER DRYER CARTRIDGE: PLEATED MEDIA WITH SOLID CORE SIEVE WITH ACTIVATED ALUMINA.
.4 WAX REMOVAL CARTRIDGE: MOULDED BONDED CORE OF ACTIVATED CHARCOAL WITH INTEGRAL GASKETS.

- B. PERMANENT STRAIGHT THROUGH TYPE:
.1 ARI 710, UL LISTED, STEEL SHELL WITH MOULDED DESICCANT FILTER CORE, FOR MAXIMUM WORKING PRESSURE OF 2410 KPA.

- 5.11 SOLENOID VALVES
A. VALVE: ARI 760, PILOT OPERATED, COPPER OR BRASS OR STEEL BODY AND INTERNAL PARTS, SYNTHETIC SEAT, STAINLESS STEEL STEM AND PLUNGER ASSEMBLY, INTEGRAL STRAINER, WITH FLARED, SOLDER, OR THREADED ENDS; FOR MAXIMUM WORKING PRESSURE OF 3450 KPA. STEM TO PERMIT MANUAL OPERATION IN CASE OF COIL FAILURE.

- B. COIL ASSEMBLY: UL 429, UL LISTED, REPLACEABLE WITH MOULDED ELECTROMAGNETIC COIL, MOISTURE AND FUNGUS PROOF, WITH SURGE PROTECTOR AND COLOUR CODED LEAD WIRES, INTEGRAL JUNCTION BOX WITH PILOT LIGHT.
C. ELECTRICAL CHARACTERISTICS: 120 VOLTS, SINGLE PHASE, 60 HZ.

- 5.12 EXPANSION VALVES
A. ANGLE OR STRAIGHT THROUGH TYPE: ARI 750; DESIGN SUITABLE FOR REFRIGERANT, BRASS BODY, INTERNAL OR EXTERNAL EQUALIZER, BLEED HOLE, CAPILLARY TUBE AND REMOTE SENSING BULB AND REMOTE BULB WELL.
B. SELECTION: EVALUATE REFRIGERANT PRESSURE DROP THROUGH SYSTEM TO DETERMINE AVAILABLE PRESSURE DROP ACROSS VALVE. SELECT VALVE FOR MAXIMUM LOAD AT DESIGN OPERATING PRESSURE AND MINIMUM 6 DEGREES C SUPERHEAT. SELECT TO AVOID BEING UNDERDESIGNED AT FULL LOAD AND EXCESSIVELY OVERSIZED AT PART LOAD.

- 5.13 RECEIVERS
A. INTERNAL DIAMETER 150 MM AND SMALLER:
.1 ARI 495, UL LISTED, STEEL, BRAZED; 2760 KPA MAXIMUM PRESSURE RATING, WITH TAPPINGS FOR INLET, OUTLET, AND PRESSURE RELIEF VALVE.
.2 INTERNAL DIAMETER OVER 150 MM:
.1 ARI 495, WELDED STEEL, TESTED AND STAMPED TO ASME SEC 8D; 2760 KPA WITH TAPPINGS FOR LIQUID INLET AND OUTLET VALVES, PRESSURE RELIEF VALVE, AND MAGNETIC LIQUID LEVEL INDICATOR.

- 5.14 FLEXIBLE CONNECTORS
A. CORRUGATED STAINLESS STEEL HOSE WITH SINGLE LAYER OF STAINLESS STEEL EXTERIOR BRAIDING, MINIMUM 230 MM LONG WITH COPPER TUBE ENDS; FOR MAXIMUM WORKING PRESSURE 3450 KPA.

6 HVAC DUCTWORK

6.1 HVAC DUCTWORK - GENERAL:

- A. INSTALL AND SEAL DUCTS TO SMACNA HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE.
B. SUPPORT ALL DUCTWORK FROM STRUCTURAL MEMBERS. WHERE STRUCTURAL BEARINGS DO NOT EXIST, SUSPEND STRAPPING OR HANGERS FROM STEEL CHANNELS OR ANGLES. PROVIDE SUPPLEMENTARY STRUCTURAL MEMBERS.
C. DO NOT BREAK CONTINUITY OF INSULATION VAPOUR BARRIER BY HANGERS OR RODS.
D. DUCT SIZES ARE INSIDE CLEAR DIMENSIONS. FOR LINED DUCTS, MAINTAIN SIZES INSIDE LINING.
E. PROVIDE OPENINGS IN DUCT WORK WHERE REQUIRED TO ACCOMMODATE THERMOMETERS AND CONTROLLERS. PROVIDE PILOT TUBE OPENINGS WHERE REQUIRED FOR TESTING OF SYSTEMS, COMPLETE WITH METAL CAN WITH SPRING DEVICE OR AGAINST AIR LEAK PLUS GASKETS. PROVIDE PILOT TUBE OPENINGS ARE PROVIDED IN INSULATED DUCTWORK, INSTALL INSULATION MATERIAL INSIDE A METAL RING.
F. BALANCING DAMPERS SHALL BE INSTALLED ON BRANCHES AS PER LOCATIONS SHOWN ON THE DRAWINGS AND AS PER THE REQUIREMENTS OF NEBB AND ABC LISTING/MEASURING STANDARDS.
G. PROVIDE DRAIN IN EVERY FRESH AIR INTAKE AND EXHAUST PLENUM.
H. DUCTWORK SHALL BE LEAK TESTED IN ACCORDANCE WITH THE SMACNA "HVAC AIR DUCT LEAKAGE TEST MANUAL," THE MAXIMUM PERMITTED DUCT LEAKAGE SHALL BE DETERMINED BY MULTIPLYING THE LEAKAGE FACTOR FROM PARAGRAPH 2.4 ABOVE BY THE SURFACE AREA OF THE DUCTWORK IN THE TEST ZONE.

6.2 MATERIALS

- A. RIGID HVAC DUCTS, CASINGS AND FITTINGS:
.1 ASTM A653 GALVANIZED STEEL SHEET, LOCK FORM QUALITY, G90 ZINC COATING (0.90 OZ/F2) TO ASTM A90. SHEETS FREE OF FITS, BUSTERS, SLIVERS, AND UNGALVANIZED SPOTS.

6.3 DUCT SEALING

- SEAL DUCTWORK IN ACCORDANCE WITH SMACNA SEALING REQUIREMENT AS FOLLOWS:

- A. SEAL CLASS A: ALL TRANSVERSE JOINTS, LONGITUDINAL SEAMS AND DUCT WALL PENETRATIONS
B. SEAL CLASS B: ALL TRANSVERSE JOINTS AND LONGITUDINAL SEAMS
C. SEAL CLASS C: ALL TRANSVERSE JOINTS

6.4 DUCTWORK FABRICATION

- A. ALL DUCTWORK SHALL BE CONSTRUCTED TO WITHSTAND 1-1/2 TIMES FAN PRESSURE AT SHUT-OFF AND 2" (500 PA) MINIMUM.
B. FABRICATE AND SUPPORT TO SMACNA HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE, AND AS INDICATED. PROVIDE DUCT MATERIAL, DYNAMICS, REINFORCING, AND SEALING FOR OPERATING PRESSURES INDICATED IN ACCORDANCE WITH RECOMMENDATIONS OF ASHRAE AND SMACNA.
C. JOINTS AND REINFORCEMENTS:
.1 TO SMACNA AND ASHRAE
.2 MAY BE MADE WITH THE DUCTMATE SYSTEM OR NEXUS SYSTEM. SYSTEM COMPONENTS SHALL BE MADE OF STANDARD CATALOGUE MANUFACTURE AS SUPPLIED BY DUCTMATE INDUSTRIES, INC. OR NEXUS INC.
D. CONSTRUCT TEES, BENDS, AND ELBOWS WITH RADIUS OF NOT LESS THAN 1-1/2 TIMES WIDTH OF DUCT ON CENTRELINE. WHERE NOT POSSIBLE AND WHERE RECTANGULAR ELBOWS ARE USED, PROVIDE AIR FLOW TURNING VANES. WHERE ACoustICAL LINING IS INDICATED, PROVIDE TURNING VANES OF PERFORATED METAL WITH GLASS FIBRE INSULATION.
E. INCREASE DUCT SIZES GRADUALLY, NOT EXCEEDING 15 DEGREES DIVERGENCE WHEREVER POSSIBLE; MAXIMUM 30 DEGREES DIVERGENCE UPSTREAM OF EQUIPMENT AND 45 DEGREES CONVERGENCE DOWNSTEAM.
F. FABRICATE CONTINUOUSLY WELDED ROUND AND OVAL DUCT FITTINGS TWO GAUGES HEAVIER THAN DUCT GAUGES INDICATED IN SMACNA STANDARD. JOINTS: MINIMUM 80 MM CEMENTED SLIP JOINT, BRAZED OR ELECTRIC

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- G. WELDED. PRIME COAT WELDED JOINTS.
G. PROVIDE STANDARD 45-DEGREE LATERAL WYE TAKEOFFS. ALTERNATIVE 90-DEGREE CONICAL TEE CONNECTIONS MAY BE USED ONLY WHERE SPECIFICALLY INDICATED.

6.5 FLEXIBLE DUCTWORK

- A. MANUFACTURER: THERMAFLEX M-KC
B. FLEXIBLE DUCTWORK CONFORMING TO UNDERWRITERS LABORATORIES LISTED AS CLASS 1 AIR DUCT UL STANDARD 181 AND CUL S110 WITH NO LIMITATIONS TO 14 FEET RUNS.
C. CONFORMS TO NFPA 90A AND 90B.
D. HEAVY WOVEN AND COATED FIBERGLASS CLOTH CORE.
E. GREENGUARD CERTIFIED.
F. FIBERGLASS INSULATING BLANKET AND LOW PERMEABILITY OUTER VAPOUR BARRIER OF FIBERGLASS REINFORCED METALLIZED FILM LAMINATE.
G. 20/50 FLAME/SMOKE SPREAD RATING.
H. 0.05 PERM VAPOUR TRANSMISSION RATING

7 DUCT ACCESSORIES

7.1 AIR TURNING DEVICES / EXTRACTORS

- A. TURNING VANES IN RECTANGULAR DUCT ELBOWS SHALL BE DOUBLE WALLED, MULTI-BLADE VANES WITH BLADES ALIGNED IN SHORT DIMENSION; STEEL CONSTRUCTION; WITH INDIVIDUALLY ADJUSTABLE BLADES, MOUNTING STRAPS, ACCEPTABLE PRODUCTS: DURO-DYNE "DURO VANE RAIL", HART & COOLEY "DUCTURON", DYN-AIR OR TUTTLE AND BALY.
B. VOLUME EXTRACTORS: GANG OPERATED CURVED BLADES, ADJUSTABLE FROM FULL OPEN TO FULL CLOSED POSITIONS. UNITS SHALL BE FACTORY ASSEMBLED, FABRICATED FROM 14 GA. AND 22 GA. (2 AND 9 MM) STEEL WITH BLADES ON 1" (25 MM) CENTRES, AND NO. 2 OR NO. 3 OPERATORS TO SUIT APPLICATION.
C. ACCEPTABLE MANUFACTURERS: EH PRICE MODEL AE1 INDICATED. KRUEGER MODEL EX-8, DURO-DYNE, DYN-AIR.

7.2 BACKDRAFT DAMPERS

- A. GRAVITY BACKDRAFT DAMPERS, SIZE 18" X 18" (450 X 450 MM) OR SMALLER, PROVIDED WITH AIR MOVING EQUIPMENT; AIR MOVING EQUIPMENT MANUFACTURERS STANDARD CONSTRUCTION.
B. MULTI-BLADE, PARALLEL ACTION GRAVITY BALANCED BACKDRAFT DAMPERS: 1/16" (1.5 MM) THICK GALVANIZED STEEL, OR, WITH CENTRE PIVOTED BLADES OF MAXIMUM 6" (150 MM) WIDTH, WITH FELT OR FLEXIBLE VINYL SEALED EDGES, LINKED TOGETHER IN RATTLE-FREE MANNER WITH 90 DEGREE STEEP, STEEL BALL BEARINGS, AND PLATED STEEL PIVOT PIN; ADJUSTMENT DEVICE TO PERMIT SETTING FOR VARYING DIFFERENTIAL STATIC PRESSURE.
C. ACCEPTABLE MANUFACTURERS: EH PRICE.

7.3 VOLUME CONTROL DAMPERS

- A. FABRICATE TO SMACNA HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE, AND AS INDICATED.
B. SPLITTER DAMPERS:
.1 MATERIAL: SAME GAUGE AND DUCT TO 24" (600 MM) SIZE IN EITHER DIRECTION, AND TWO GAUGES HEAVIER FOR SIZES OVER 24" (600 MM).
.2 BLADE: FABRICATE OF SINGLE THICKNESS SHEET METAL TO STREAMLINE SHAPE, SECURED WITH CONTINUOUS HINGE OR ROD.
.3 OPERATOR: MINIMUM 24" (600 MM) DIAMETER ROD IN SELF ALIGNING, UNIVERSAL JOINT ACTION, FLANGED BUSHING WITH SET SCREW.
C. SINGLE LEAF DAMPERS: FABRICATED FROM MINIMUM 20 GAUGE (1.0 MM) GALVANIZED STEEL, SUITABLY REINFORCED TO PREVENT VIBRATION AND FITTED WITHIN DICATING REGULATOR. DURO-DYNE, LAWSON & TAYLOR, DYN-AIR.
D. MULTI-BLADE OPPOSED ACTION DAMPERS: FABRICATED FROM 16 GAUGE (1.6 MM) GALVANIZED STEEL, MOUNTED IN SEPARATE CHANNEL FORMED, REINFORCED TOPREVENT VIBRATION, AND FITTED WITH OPPOSED ACTION LINKAGE HARDWARE. DURO-DYNE "OPAX" BLADE KIT, LAWSON & TAYLOR, DYN-AIR.
E. END BEARINGS: EXCEPT IN ROUND DUCTWORK 12" (300 MM) AND SMALLER, PROVIDE END BEARINGS. ON MULTIPLE BLADE DAMPERS, PROVIDE OIL-IMPREGNATED NYLON OR SINTERED BRONZE BEARINGS.
F. QUADRANTS:
.1 PROVIDE LOCKING, INDICATING QUADRANT REGULATORS ON SINGLE AND MULTI-BLADE DAMPERS.
.2 ON INSULATED DUCTS MOUNT QUADRANT REGULATORS ON STAND-OFF MOUNTING BRACKETS, BASES, OR ADAPTERS.
.3 WHERE ROD LENGTHS EXCEED 30" (750 MM) PROVIDE REGULATOR AT BOTH ENDS.

7.4 FIRE DAMPERS

- A. MANUFACTURERS: PRICE, RUSKIN, NAILOR
B. FIRE DAMPERS SHALL BE UL LISTED, LABELLED, OR WARNOCK-HERSEY LABEL, MEET ALL REQUIREMENTS OF NFPA 90A, AND CONSTRUCTED AND TESTED IN CONFORMANCE WITH:
.1 CAN4-S92-M82, "STANDARD FOR FIRE DAMPERS", WHEN USED IN A FIRE SEPARATION OF NOT MORE THAN 2 HOURS, AND WHICH IS NOT A FIREWALL.
.2 CAN4-S104-M80, "STANDARD METHOD FOR FIRE TESTS OF DOOR ASSEMBLIES", WHEN USED IN A FIRE SEPARATION OF MORE THAN 2 HOURS, OR USED IN A FIREWALL.
.3 CAN4-S92.2-M84, "FIRE TEST OF CEILING FIRESTOP FLAP CURTAINS", WHEN USED IN A CEILING FIRE SEPARATION.
C. FIRE DAMPERS SHALL BE GALVANIZED STEEL, CHANNEL FRAME CERTAIN TYPE GALVANIZED STEEL INTERLOCKING BLADES, MINIMUM 22 GAUGE (0.9 MM) GALVANIZED STEEL ENCLOSURE, AND 160F (71C) FUSIBLE LINK STANDARD.
D. FIRE DAMPERS FOR HORIZONTAL INSTALLATION IN VERTICAL DUCTWORK SHALL BE OPERATED BY A STAINLESS STEEL CLOSURE SPRING AND LATCH.
E. FIRE DAMPER CONFIGURATION SHALL BE LOW RESISTANCE TYPE B WITH BLADES LOCATED OUTSIDE OF THE AIR STREAM FOR RECTANGULAR DUCTWORK, AND TYPE C FOR ROUND OR OVAL DUCTWORK.
F. CEILING FIRE DAMPERS SHALL BE UL LABELLED, FOR FIRE RATED MEMBRANE TYPE CEILINGS, GALVANIZED STEEL CONSTRUCTION WITH HEAT RETARDANT BLANKET (NON-ASBESTOS) WITH STANDARD 160F (71C) FUSIBLE LINK.
G. THERMAL BLANKET SHALL BE UL LABELLED, FOR FIRE RATED MEMBRANE TYPE CEILINGS, TO COMPLETELY ENSHROUD CEILING PENETRATION.
H. FIRE DAMPERS IN STAINLESS STEEL DUCTWORK SHALL BE OF ALL STAINLESS STEEL CONSTRUCTION.

7.5 FIRE DAMPERS (DYNAMIC)

- A. DYNAMIC FIRE DAMPERS TESTED, CONSTRUCTED AND LABELLED IN ACCORDANCE WITH THE LATEST EDITION OF UL STANDARD 555. DAMPERS SHALL HAVE A FIRE RATING OF 1-1/2 HOURS OR 3 HOURS AND SHALL MEET THE REQUIREMENTS OF THE LATEST EDITION OF NFPA90A.
B. EACH DAMPER SHALL INCLUDE A 165F (74C) FUSIBLE LINK AND SHALL BE LABELLED FOR USE IN DYNAMIC SYSTEMS. THE DAMPER SHALL BE RATED FOR DYNAMIC CLOSURE AT 2000FPM (10.16M/S) AND 4 INCHES W.G. (1 KPA) STATIC PRESSURE AND SHALL BE RATED TO CLOSE WITH AIRFLOW IN EITHER DIRECTION.
C. EACH DYNAMIC FIRE DAMPER SHALL INCLUDE A STEEL SLEEVE AND MOUNTING ANGLES FURNISHED BY THE DAMPER MANUFACTURER TO ENSURE APPROPRIATE INSTALLATION. SUBMITTALS INFORMATION SHALL INCLUDE THE FIRE PROTECTION RATING, MAXIMUM VELOCITY/PRESSURE RATINGS AND THE MANUFACTURER'S UL INSTALLATION INSTRUCTIONS. THE DAMPERS SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S UL INSTALLATION INSTRUCTIONS.
D. ACCEPTABLE PRODUCT: RUSKIN DIB02/DIB023, NCA, VENTEX, PRICE, CONTROLLED AIR.

7.6 DUCT ACCESS DOORS

- A. FABRICATE TO SMACNA HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE, AND AS INDICATED.
B. FABRICATION: RIGID AND CLOSE-FITTING OF GALVANIZED STEEL WITH SEALING GASKETS AND QUICK FASTENING LOCKING DEVICES. FOR INSULATED DUCT WORK, INSTALL MINIMUM 1" (25 MM) THICK INSULATION WITH SHEET METAL COVER.

HVAC SPECIFICATIONS

- COVER.
.1 LESS THAN 12" (300 MM) SQUARE: SECURE WITH SASH LOCKS.
.2 UP TO 18" (450 MM) SQUARE: PROVIDE TWO HINGES AND TWO SASH LOCKS.
.3 UP TO 24" X 48" (600 X 1200 MM): THREE HINGES AND TWO COMPRESSION LATCHES WITH OUTSIDE AND INSIDE HANDLES.

- .4 LARGER SIZES: PROVIDE AN ADDITIONAL HINGE.
C. ACCESS DOORS WITH SHEET METAL SCREW FASTENERS ARE NOT ACCEPTABLE.
D. ACCEPTABLE MANUFACTURER: ACUDOOR, DURO-DYNE, DYN-AIR, NAILOR, KRUEGER

7.7 DUCT TEST HOLES

- A. PROVIDE TEST PORTS TO SUIT INTENDED APPLICATION, (IE. INSULATED/UNINSULATED CUT, ROUND/RECTANGULAR DUCT).
B. TEMPORARY TEST HOLES: CUT OR DRILL IN DUCTS AS REQUIRED. CAP WITH NEAT PATCHES, NEOPRENE PLUGS, THREADED PLUGS, OR THREADED OR TWIST-ON METAL CAPS.
C. PERMANENT TEST HOLES: FACTORY FABRICATED, AIR TIGHT FLANGED FITTINGS WITH SCREW CAP. PROVIDE EXTENDED NECK FITTINGS TO CLEAR INSULATION.
D. ACCEPTABLE MANUFACTURERS: AIR POWER CO..

7.8 FLEXIBLE DUCT CONNECTIONS

- A. FABRICATE TO SMACNA HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE, AND AS INDICATED.
.1 MIL-C-20696B PARA. 4.4.3, 4.4.4 (OIL AND HYDRO CARBON RESISTANCE)
.2 UL CERTIFIED NFA 701 TESTS FOR FLAME PROPROGATION OF FABRICS AND FILM.
.3 10/120 ASTM E84 FLAME/SMOKE RATING.
.4 -40F TO 250F CONTINUOUS TEMPERATURE RANGE.
.5 WHITE WOVEN FIBERGLASS COLOUR
.6 GALVANIZED STEEL CONFORMING TO ASTM-A-525 G 60 OR BETTER
B. ACCEPTABLE MANUFACTURERS: DURO-DYNE, DFDDC.

7.9 HANGERS AND SUPPORTS

- A. FABRICATE STRAP HANGERS TO SAME MATERIAL AS DUCT. HANGER CONFIGURATION TO SMACNA DETAILS. 20" (500 MM) IS MAXIMUM DUCT SIZE TO BE SUPPORTED BY STRAP HANGER.
B. ROD AND ANGLE HANGERS: GALVANIZED STEEL TO SMACNA DETAILS.
C. HANGER ATTACHMENTS: MANUFACTURED CONCRETE INSERTS, EXPANSION SHIELDS AND BOLTED STEEL CLAMPS. DO NOT WELD RODS TO STEEL DECKS OR USE POWDER ACTUATED FASTENERS.

7.10 ACOUSTICAL LINING

- MANUFACTURER: ARMACELL AP ARMAXFLA SX
COMPLIANCE: ASTM C54, ASTM E84, UL-C-5102, NFPA 90A, ASTM C1534, ASTM D1038
THICKNESS: 25mm (1") THICK
THERMAL CONDUCTIVITY: 0.245 BTU-in/Hr-Sq-Ft-F AT 75 F (0.0353 W/mK AT 24 C)
PERMEABILITY: 0.05 PERM-IN
MAXIMUM FLAME SPREAD INDEX: 25
MAXIMUM SMOKE DEVELOPMENT INDEX: 50
WATER ABSORPTION: 0.2% BY VOLUME
MAXIMUM SERVICE TEMPERATURE: 180 F (82 C)
MINIMUM SERVICE TEMPERATURE: -30 F (34 C)
EROSION RESISTANCE: ASTM C1071.

7.11 DUCT SEALANT

- A. GENERAL: LOW VOC, WATER BASED SEALANT, NON-TOXIC, NON-COMBUSTIBLE, NON-FLAMMABLE, AND TESTED IN ACCORDANCE WITH CAN4/ULC-5102. FLAME SPREAD SHALL NOT EXCEED 25 AND SMOKE DEVELOPED SHALL NOT EXCEED 50.
B. ACCEPTABLE PRODUCTS: MULTI-PURPOSE DUCT SEALANT AS MANUFACTURED BY TRANS CONTINENTAL EQUIPMENT, DURO DYNE SWB DUCT SEALER, IRON GRIP 601 AS SUPPLIED BY ALPHA SHEET METAL CO., OR UNI-GRIP DUCT SEALER FROM UNITED MCGILL CORPORATION.

8 TESTING, ADJUSTING, BALANCING

8.1 PREPARATION

- A. TESTING ADJUSTING, AND BALANCING SHALL BE PERFORMED BY AN AAEC OR NBC CERTIFIED AGENCY.
B. PROVIDE A FINAL TESTING AND BALANCING REPORT TO ENGINEER FOR REVIEW PRIOR TO PROJECT CLOSURE.
C. PROVIDE INSTRUMENTS REQUIRED FOR TESTING, ADJUSTING, AND BALANCING OPERATIONS. MAKE INSTRUMENTS AVAILABLE TO CONSULTANT TO FACILITATE SPOT CHECKS DURING TESTING.
D. PROVIDE ADDITIONAL BALANCING DEVICES AS REQUIRED.

8.2 INSTALLATION TOLERANCES

- A. AIR HANDLING SYSTEMS: ADJUST TO WITHIN PLUS OR MINUS 5 PERCENT OF DESIGN FOR SUPPLY SYSTEMS AND PLUS OR MINUS 5 PERCENT OF DESIGN FOR RETURN AND EXHAUST SYSTEMS.
B. AIR OUTLETS AND INLETS: ADJUST TOTAL TO WITHIN PLUS 5 PERCENT AND MINUS 5 PERCENT OF DESIGN TO SPACE. ADJUST OUTLETS AND INLETS TO WITHIN PLUS OR MINUS 5 PERCENT OF DESIGN.
C. HYDRONIC SYSTEMS: ADJUST TO WITHIN PLUS OR MINUS 10 PERCENT OF DESIGN.
D. ROOM PRESSURIZATION: ADJUST TO WITHIN PLUS 20 PERCENT AND MINUS 0 PERCENT OF DESIGN FOR ROOMS UNDER POSITIVE PRESSURE AND WITHIN PLUS 0 PERCENT AND MINUS 20 PERCENT OF DESIGN FOR ROOMS UNDER NEGATIVE PRESSURE.

8.3 ADJUSTING

- A. ENSURE RECORDED DATA REPRESENTS ACTUAL MEASURED OR OBSERVED CONDITIONS.
B. PERMANENTLY MARK SETTINGS OF VALVES, DAMPERS, AND OTHER ADJUSTMENT DEVICES ALLOWING SETTINGS TO BE RESTORED. SET AND LOCK MEMORY STOPS.
C. AFTER ADJUSTMENT, TAKE MEASUREMENTS TO VERIFY BALANCE HAS NOT BEEN DISRUPTED OR THAT SUCH DISRUPTION HAS BEEN RECTIFIED.
D. LEAVE SYSTEMS IN PROPER WORKING ORDER, REPLACING BELT GUARDS, CLOSING ACCESS DOORS, CLOSING DOORS TO ELECTRICAL SWITCH BOXES, AND RESTORING THERMOSTATS TO SPECIFIED SETTINGS.
E. AT FINAL INSPECTION, RECHECK RANDOM SELECTIONS OF DATA RECORDED IN REPORT. RECHECK POINTS OR AREAS AS SELECTED AND WITNESSED BY THE CHECKER.
F. CHECK AND ADJUST SYSTEMS APPROXIMATELY SIX MONTHS AFTER FINAL ACCEPTANCE AND SUBMIT REPORT.

8.4 AIR SYSTEM PROCEDURE

- A. ADJUST AIR HANDLING AND DISTRIBUTION SYSTEMS TO PROVIDE REQUIRED OR DESIGN SUPPLY, RETURN, AND EXHAUST AIR QUANTITIES AT SITE ALIQUOT.
B. MAKE AIR QUANTITY MEASUREMENTS IN DUCTS BY PILOT TUBE TRAVERSE OF ENTIRE CROSS-SECTIONAL AREA OF DUCT.
C. MEASURE AIR QUANTITIES AT AIR INLETS AND OUTLETS.
D. ADJUST DISTRIBUTION SYSTEM TO OBTAIN UNIFORM SPACE TEMPERATURES FREE FROM OBJECTIONABLE DRAFTS AND NOISE.
E. USE BRANCH VOLUME CONTROL DAMPERS AND SPLITTERS TO REGULATE AIR QUANTITIES. DEVICES AT AIR OUTLETS MAY BE USED ONLY TO THE EXTENT THAT ADJUSTMENTS DO NOT CREATE OBJECTIONABLE AIR MOTION OR SOUND LEVELS.
F. VARY TOTAL SYSTEM AIR QUANTITIES BY ADJUSTMENT OF FAN SPEEDS, ADJUST AIRFLOW TO DESIGN QUANTITIES. PROVIDE DRIVE CHANGES AS REQUIRED. MAKE ALLOWANCES FOR LOADINGS OF FILTERS TO 50% OF MANUFACTURER'S RECOMMENDATIONS FOR FINAL PRESSURE AT FANS WITH FIXED SPEED DRIVES AND TO 100% OF MANUFACTURERS' RECOMMENDATIONS FOR FINAL PRESSURE AT FANS WITH VARIABLE SPEED DRIVES.
G. PROVIDE SYSTEM SCHEMATIC WITH REQUIRED AND ACTUAL AIR QUANTITIES RECORDED AT EACH OUTLET OR INLET.
H. MEASURE STATIC AIR PRESSURE CONDITIONS ON AIR SUPPLY UNITS, INCLUDING FILTER AND COIL PRESSURE DROPS, AND TOTAL PRESSURE ACROSS THE FAN.
I. ADJUST OUTSIDE AIR AUTOMATIC DAMPERS, OUTSIDE AIR, RETURN AIR, AND

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- EXHAUST DAMPERS FOR DESIGN CONDITIONS.
J. EXHAUST TEMPERATURE CONDITIONS ACROSS OUTSIDE AIR, RETURN AIR, AND EXHAUST DAMPERS TO CHECK LEAKAGE.
K. WHERE MODULATING DAMPERS ARE PROVIDED, TAKE MEASUREMENTS AND BALANCE AT EXTREME CONDITIONS. BALANCE VARIABLE VOLUME SYSTEMS AT MAXIMUM AIR FLOW RATE, FULL COOLING, AND AT MINIMUM AIR FLOW RATE, FULL HEATING.
L. MEASURE BUILDING STATIC PRESSURE AND ADJUST SUPPLY, RETURN, AND EXHAUST AIR SYSTEMS TO PROVIDE REQUIRED RELATIONSHIP BETWEEN EACH TO MAINTAIN APPROXIMATELY 0.05 IN.W.G. (10.5 PA) POSITIVE STATIC PRESSURE NEAR THE BUILDING ENTRIES.

8.5 WATER SYSTEM PROCEDURE

- A. ADJUST WATER SYSTEMS TO PROVIDE REQUIRED OR DESIGN QUANTITIES.
B. USE CALIBRATED VENTURI TUBES, ORIFICES, OR OTHER METERED FITTINGS AND PRESSURE GAUGES TO DETERMINE FLOW RATES FOR SYSTEM BALANCE. WHERE FLOW METERING DEVICES ARE NOT INSTALLED, BASE FLOW BALANCE ON TEMPERATURE DIFFERENCE ACROSS VARIOUS HEAT TRANSFER ELEMENTS IN THE SYSTEM.
C. ADJUST SYSTEMS TO PROVIDE SPECIFIED PRESSURE DROPS AND FLOWS THROUGH HEAT TRANSFER ELEMENTS PRIOR TO THERMAL TESTING. PERFORM BALANCING BY MEASUREMENT OF TEMPERATURE DIFFERENTIAL IN CONJUNCTION WITH AIR BALANCING.
D. EFFECT SYSTEM BALANCE WITH AUTOMATIC CONTROL VALVES FULLY OPEN TO HEAT TRANSFER ELEMENTS.
E. EFFECT ADJUSTMENT OF WATER DISTRIBUTION SYSTEMS BY MEANS OF BALANCING COCKS, VALVES, AND FITTINGS. DO NOT USE SERVICE OR SHUT-OFF VALVES FOR BALANCING UNLESS INDEXED FOR BALANCE POINT.
F. WHERE AVAILABLE PUMP CAPACITY IS LESS THAN TOTAL FLOW REQUIREMENTS OR INDIVIDUAL SYSTEM PARTS, FULL FLOW IN ONE PART MAY BE SIMULATED BY TEMPORARY RESTRICTION OF FLOW TO OTHER PARTS.

9 HVAC EQUIPMENT

9.1 PACKAGED ROOFTOP AIR CONDITIONING UNITS (RTU-2, AHU-9, AHU-12)

- A. SUMMARY
.1 THE CONTRACTOR SHALL INSTALL PACKAGE ROOFTOP UNIT(S) AS SHOWN AND SCHEDULED ON THE CONTRACT DOCUMENTS. THE UNIT(S) SHALL BE INSTALLED IN ACCORDANCE WITH THIS SPECIFICATION AND PERFORM AT THE SPECIFIED CONDITIONS AS SCHEDULED.
.2 THE PACKAGED ROOFTOP UNITS ARE PRE-ORDERED BY OWNER. REFER TO ARCHITECTURAL SPECIFICATIONS 01030 FOR FULL DETAILS.
B. GENERAL UNIT DESCRIPTION
.1 PACKAGED ROOFTOP UNITS COOLING, HEATING CAPACITIES, AND EFFICIENCIES ARE AHRF CERTIFIED WITHIN SCOPE OF AHRF STANDARD 210-240 FOR 6 TO 25 TONS AND ANSI/ZE 1.47 AND 10 CFR PART 431 PERTAINING TO COMMERCIAL WARM AIR FURNACES (ALL GAS HEATING UNITS).
.2 ROOFTOP UNIT SHALL BE FACTORY ASSEMBLED, INTERNALLY WHEED, FULLY CHARGED WITH R-410A, AND 100 PERCENT RUN TESTED TO CHECK COOLING OPERAN, FAN AMB AND FLOW CONTROL AND CONTROL SEQUENCE BEFORE LEAVING THE FACTORY.
.3 ALL UNITS, 3-25T SHALL HAVE FIELD CONVERTIBLE AIRFLOW.
.4 INTERNAL WIRING MUST BE COLORED AND NUMBERED FOR SIMPLIFIED IDENTIFICATION.

- C. UNIT CASING
.1 CABINET: GALVANIZED STEEL WITH BAKED ENAMEL FINISH.
.2 ROOFTOP UNIT CASING SHALL BE ZINC COATED, HEAVY GAUGE, STEEL. CASING PANELS ARE WEATHER RESISTANT PRE-PAINTED METAL WITH GALVANIZED SUBSTRATE AND MEET ASTM B117, 672 HOUR SALT SPRAY TEST.
.3 CABINET TOP COVER SHALL BE ONE PIECE CONSTRUCTION OR WHERE SEAMS EXITS, IT SHALL BE DOUBLE-HEMMED AND GASKET-SEALED.
.4 UNIT SHALL INCLUDE A REMOVABLE SINGLE SIDE MAINTENANCE ACCESS PANELS. LIFTING HANDLES IN MAINTENANCE ACCESS PANELS CAN BE REMOVED AND REINSTALLED BY REMOVING FASTENERS WHILE PROVIDING A WATER AND AIR TIGHT SEAL.

- .5 UNITS' BASE PAN SHALL HAVE A RAISED 1 1/8 INCH HIGH LIP AROUND THE SUPPLY AND RETURN AIRWAYS AND FORMED TO PROVIDE A WEATHER TIGHT SEAL.
.6 EXPOSED VERTICAL PANELS AND TOP COVERS IN THE INDOOR AIR SECTION ARE INSULATED WITH A CLEANABLE FOIL-FACED, FIRE-RETARDANT PERMANENT, ODORLESS GLASS FIBER MATERIAL.
.7 BASE PAN SHALL HAVE NO PENETRATIONS WITHIN THE PERIMETER OF THE CURB OTHER THAN THE RAISED 1 INCH HIGH DOWNFLOW SUPPLY/RETURN OPENINGS TO PROVIDE AN ADDED WATER INTEGRITY PRECAUTION, IF THE CONDENSATE DRAIN BACKS UP.
.8 BASE OF THE UNIT IS INSULATED WITH 1/8 INCH, FOIL-FACED, CLOSED-CELL INSULATION.
.9 PROVIDE OPENINGS EITHER ON SIDE OF UNIT OR THROUGH THE BASE FOR POWER, CONTROL, CONDENSATE, AND GAS CONNECTIONS.
.10 UNIT BASE SHALL CONTAIN PROVISIONS FOR FORKLIFT AND/OR CRANE LIFTING ON THREE SIDES OF UNIT.

D. AIR FILTERS

- .1 MERV13 FILTERS
E. FANS AND MOTORS
.1 SUPPLY FAN SHALL BE A DIRECT DRIVE PLENUM FAN WITH BACKWARD-CURVED FAN WHEEL WITH AN EXTERNAL ROTOR DIRECT DRIVE VARIABLE SPEED MOTOR.
.2 SUPPLY FAN SPEED ADJUSTMENTS CAN BE MADE USING THE CONTROL USER INTERFACE OR MOBILE APP.
.3 PROVIDE FAN FLAM INDICATION. THE INDICATION WILL BE REGISTERED AT THE ON-BOARD USER INTERFACE, MOBILE SERVICE APP., OR BUILDING MANAGEMENT SYSTEM.

- .4 VARIABLE SPEED DIRECT DRIVE MOTORS ARE PREMIUM EFFICIENCY - 6 TO 25 TONS.
.5 MOTORS ARE THERMALLY PROTECTED.
.6 OUTDOOR FANS SHALL BE DIRECT DRIVE, STATICALLY AND DYNAMICALLY BALANCED, DRAW THROUGH IN THE VERTICAL DISCHARGE POSITION. OUTDOOR MOTORS SHALL BE 3 PHASE.
.7 PROVIDE SHAFTS CONSTRUCTED OF SOLID HOT ROLLED STEEL, GROUND AND POLISHED, WITH KEY-WAY, AND PROTECTIVELY COATED WITH LUBRICATING OIL.

F. GAS FIRED HEATING SECTION

- .1 THE HEATING SECTION SHALL HAVE A PROGRESSIVE TUBULAR HEAT EXCHANGER WITH CORROSION-RESISTANT ALUMINIZED STEEL TUBES AND BURNERS AS STANDARD ON ALL MODELS.
.2 ON INITIAL CALL FOR HEAT, THE COMBUSTION BLOWER SHALL PURGE THE HEAT EXCHANGER FOR 20 SECONDS BEFORE IGNITION.
.3 COMPLETELY ASSEMBLED AND FACTORY INSTALLED HEATING SYSTEM SHALL BE INTEGRAL TO UNIT, UL OR CSA APPROVED SPECIFICALLY FOR OUTDOOR APPLICATIONS FOR USE DOWNSTREAM FROM REFRIGERANT COOLING COILS. THREADED CONNECTION WITH PLUG OR CAP PROVIDED.
.4 HEATING SECTION SHALL BE FACTORY RUN TESTED PRIOR TO SHIPMENT.
.5 INDUCED DRAFT COMBUSTION BLOWER SHALL BE USED TO PULL THE COMBUSTION PRODUCTS THROUGH THE FIRING TUBES. SYSTEM SHALL USE DIRECT SPARK IGNITION (DSI).
.6 AFTER THREE UNSUCCESSFUL IGNITION ATTEMPTS, ENTIRE HEATING SYSTEM SHALL BE LOCKED OUT UNTIL MANUALLY RESET AT THE THERMOSTAT/ZONE SENSOR.
.7 INDUCED DRAFT BLOWER TO PULL THE GAS MIXTURE THROUGH THE BURNER TUBES.
.8 COMPACT CABINET FEATURES A TUBULAR HEAT EXCHANGER IN LOW, MEDIUM, AND HIGH HEAT CAPACITIES. CORROSION-RESISTANT ALUMINIZED STEEL TUBES WITH BURNERS ARE STANDARD ON ALL MODELS.
.9 LIMIT CONTROLS: HIGH TEMPERATURE LIMIT CONTROLS WILL SHUT OFF GAS FLOW IN THE EVENT OF EXCESSIVE TEMPERATURES RESULTING FROM RESTRICTED INDOOR AIRFLOW OR LOSS OF INDOOR AIRFLOW.

G. EVAPORATOR COIL

- .1 COOLING ONLY, GAS HEAT, AND ELECTRIC HEAT EVAPORATORS SHALL ALUMINUM MICROCHANNEL THAT PROVIDE OPTIMAL HEAT TRANSFER PERFORMANCE DUE TO FLAT, STREAMLINED TUBES WITH SMALL PORTS, AND METALLURGICAL TUBE-TO-FIN BOND.
.2 PROVIDE A REMOVABLE, REVERSIBLE CLEANABLE DOUBLE SLOPED DRAIN PAN FOR BASE OF EVAPORATOR COIL CONSTRUCTED OF PVC.
H. CONDENSER SECTION
.1 PROVIDE VERTICAL DISCHARGE, DIRECT DRIVE FANS WITH ALUMINUM BLADES. FANS SHALL BE STATICALLY BALANCED. MOTORS SHALL BE PERMANENTLY LUBRICATED, WITH INTEGRAL THERMAL OVERLOAD PROTECTION IN A WEATHER TIGHT CASING.

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- .2 COOLING ONLY, GAS HEAT, AND ELECTRIC HEAT CONDENSERS SHALL BE MICROCHANNEL.
.3 PROVIDE TOOL-LESS FACTORY INSTALLED CORROSION RESISTANT LOUVERED HALL/WALKWAY GUARDS TO PROTECT CONDENSER COILS FROM HALL OR PHYSICAL DAMAGE.

I. REFRIGERATION SYSTEM

- .1 ALL UNITS HAVE DIRECT-DRIVE, HERMETIC, SCROLL TYPE COMPRESSORS WITH CENTRIFUGAL TYPE OIL PUMPS. SUCTION GAS-COOLED MOTOR WITH VOLTAGE UTILIZATION RANGE OF PLUS OR MINUS 10 PERCENT OF UNIT NAMEPLATE VOLTAGE. INTERNAL OVERLOADS STANDARD WITH SCROLL COMPRESSORS; CRANKCASE HEATERS ARE STANDARD ON ALL COMPRESSORS.
.2 COMPRESSORS SHALL HAVE THERMOSTATIC TEMPERATURE MOTOR WINDING CONTROL FOR PROTECTION AGAINST EXCESSIVE TEMPERATURES CAUSED BY OVER/UNDER VOLTAGE OPERATION OR LOSS OF CHARGE. ALSO PROVIDE HIGH AND LOW PRESSURE SWITCHES.
.3 THERMAL EXPANSION VALVES ARE STANDARD FOR ALL MODELS.
.4 ALL UNITS HAVE DUAL COMPRESSORS.
.5 UNITS SHALL HAVE COOLING CAPABILITIES DOWN TO 0 DEGREE F AS STANDARD. FOR FIELD-INSTALLED LOW AMBIENT ACCESSORY, THE MANUFACTURER SHALL PROVIDE A FACTORY-AUTHORIZED SERVICE TECHNICIAN THROUGHOUT CONSTRUCTION.

- .6 THREE STAGES OF COOLING AVAILABLE ON 6 TO 17.5 TONS UNITS AND FOUR STAGES OF COOLING AVAILABLE ON 20 AND 25 TON UNITS.
.7 PROVIDE RTU-2 WITH A MODULATING HOT GAS REHEAT (HGRH) COMPONENT WHICH SHALL CONSIST OF THE FOLLOWING REFRIGERATION OPTIONS: A HOT GAS REHEAT COIL, A COOLING MODULATING VALVE, A REHEAT MODULATING VALVE, A REHEAT CHECK VALVE, A REHEAT PUMP OUT SOLENOID, AND ADDITIONAL INTERCONNECTING TUBING.
J. EXHAUST/RETURN SECTION

- .1 PROVIDE, A FACTORY SUPPLIED FIELD INSTALLED POWER EXHAUST ASSEMBLY TO PREVENT THE BAROMETRIC RELIEF DAMPER IN THE ECONOMIZER IN RELIEVING BUILDING PRESSURIZATION.
.2 BAROMETRIC RELIEF SHALL PROVIDE A PRESSURE OPERATED DAMPER THAT SHALL BE GRAVITY CLOSING.
.3 BAROMETRIC RELIEF SHALL PROHIBIT ENTRANCE OF OUTSIDE AIR DURING THE EQUIPMENT "OFF" CYCLE.
.4 PROVIDE SPRING RETURN MOTOR FOR OUTSIDE AIR DAMPER CLOSURE DURING UNIT SHUT DOWN OR POWER INTERRUPTION.

- .5 PROVIDE MICROPROCESSOR UNIT-MOUNTED CONTROL WHICH WHEN USED WITH AN ELECTRONIC ZONE CO

HVAC SPECIFICATIONS

- A. HEAT EXCHANGER
 1. PROVIDE HEATCO INC. INDIRECT GAS-FIRED DUCT FURNACE MODULE LISTED BY INTERTEK TESTING LABORATORY (NRTL) AS A NATIONALLY RECOGNIZED TESTING LABORATORY (NRTL) AS A RECOGNIZED COMPONENT, TO THE CURRENT EDITION OF ANSI Z83.8 / CSA 2.6 STANDARD FOR GAS-FIRED DUCT FURNACES FOR INSTALLATION ON THE POSITIVE PRESSURE SIDE OF THE CIRCULATING AIR FLOW ONLY. DUCT FURNACE MODULE SHALL PROVIDE A MINIMUM COMBUSTION EFFICIENCY OF 80%.
 2. THE HEAT EXCHANGER CONSIST OF A PRIMARY DRUM AND SECONDARY TUBES ENTIRELY MADE OF 304 STAINLESS STEEL, REQUIRING NO THERMAL TREATMENT TO PREVENT THE CRACKING OF WELDED JOINTS, HEAT EXCHANGER IS GUARANTEED FOR 10 YEARS PRO-RATED ON PARTS.
- B. BURNER ASSEMBLY
 1. THE BURNER WILL BE OF A FORCED DRAFT TYPE, FACTORY-INSTALLED ON THE HEAT EXCHANGER WITH ALL GAS PIPING AND CONTROL WIRING REQUIRED FOR THE PROPER OPERATION OF THE UNIT.
 2. THE GAS PIPING WILL BE EQUIPPED WITH AN ELECTRONIC SPARK IGNITER, MANUAL SHUT-OFF VALVE, PRESSURE REGULATOR, AUTOMATIC SHUT-OFF VALVES AND MANUAL COCK.
 3. SIEMENS TYPE OF THE BURNER WILL INCLUDE A PRESSURE REGULATOR, A MANUAL IGNITION COCK, TEST PORTS, A MODULATING GAS VALVE AND THE PROPER SAFETY SHUT-OFF VALVES DEPENDING ON SIZE OF THE UNIT AND IF THE UNIT IS BUILT FOR CANADA OR THE U.S.
 4. THE BURNER AND GAS PIPING ASSEMBLY WILL HAVE A MODULATING TURNDOWN RATIO OF AT LEAST 10:1 ON ALL MODELS.
- C. FANS
 1. THE FAN SECTION WILL BE DESIGNED ACCORDING TO THE AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA) STANDARDS. THE FAN AND MOTOR WILL BE INSTALLED ON A FORMED STEEL STRUCTURE AND REST ON ANTI-VIBRATION ISOLATORS. A HINGED ACCESS DOOR WILL PROVIDE ACCESS FOR MAINTENANCE OF THE FAN, MOTOR, BEARINGS, BELTS AND PULLEYS. THE FAN WILL BE A FC/DWI TWIN FANS ON COMMON SHAFT FROM COMEFRI. THE MOTOR WILL BE TOTALLY ENCLOSED FAN-COOLED (TEFC) AND PREMIUM EFFICIENCY FOR HIGHER EFFICIENCY. THE FAN/MOTOR ASSEMBLY WILL BE INSTALLED ON A UNITARY BASE.
- D. FILTERS
 1. THE FILTERS SHALL BE PLATED LARGE SURFACE DISPOSABLE TYPE, 2-INCH THICK MERV 13, CLASS 2, UL RATED. THESE WILL BE INSTALLED IN THE FRESH FLOW.
 2. FILTERS WILL BE MOUNTED INSIDE THE UNIT IN GALVANIZED STEEL SLIDING FRAMES, AND ACCESSIBLE THROUGH A HINGED ACCESS DOOR. RUBBER GASKETS WILL BE PROVIDED WHERE REQUIRED TO ENSURE TIGHTNESS BETWEEN FILTERS AND ACCESS DOOR, TO AVOID AIR BY-PASS AND MINIMIZE FILTRATION.
- E. DAMPERS
 1. THE DAMPERS WILL BE OPPOSED BLADES STANDARD LOW LEAKAGE, ALUMINIUM EXTRUDED, AIRFOIL BASKET BLADES, ACTUATORS TO BE SPRING RETURN, OPEN/CLOSED FROM PACKAGED.
- F. DX COOLING
 1. UNITS ARE TO BE EQUIPPED WITH PACKAGED DX COOLING, CAPACITY TO BE AS SPECIFIED ON THE EQUIPMENT SCHEDULE. UNITS DX COILS WILL BE PRE-PIPED TO A UNIT MOUNTED CONDENSING UNIT THAT WILL BE COMPOSED OF A COMPRESSOR RACK WITH STAGING AS PER THE EQUIPMENT SCHEDULE.
- G. HOODS
 1. THE INTAKE HOODS WILL BE MOUNTED ON UNIT END, AND EQUIPPED WITH 27-MAN HINCH STEEL BIRD SCREEN. HELL RAIN GUINETS.
 2. HOOD AIR VELOCITY SHALL NOT EXCEED 500 FPM.
 3. HOODS SHALL BE CONSTRUCTED OF THE SAME MATERIALS AS THE UNIT'S EXTERIOR WITH A MINIMUM ZOGA G-90 GALVANIZED STEEL CONSTRUCTION. IT SHALL ALSO BE POLISHED TO A HINGED ACCESS DOOR, RUBBER GASKETS WILL BE PROVIDED WHERE REQUIRED TO ENSURE TIGHTNESS ESTHETICAL FINISHES (PAINTED OR GALVANIZED).
- H. BURNER CONTROLS
 1. SIEMENS FLAME SAFETY CONTROLLER;
 2. DDC DISTECH CONTROLLER BACNET / EC SMART VUE W/ ROOM SENSOR;
 3. BACNET BTL COMPATIBLE AS WELL FOR CAS SYSTEM;
- I. ELECTRICITY & CONTROLS
 1. SUPPLY UNITS AS PER UNIT SCHEDULE.
 2. TERMINAL BLOCK FOR POWER CONNECTION
 3. TEMPERATURE CONTROL
 4. SAFEGUARD WITH INDICATING LIGHTS AND SCREEN
 5. AIR CONTROL LIMIT
- J. CERTIFICATION
 1. ALL FAN UNITS SHALL BE CULFAS APPROVED AND CERTIFIED ACCORDING TO STANDARDS ANSI Z83.8/CSA 2.6 ET 221.47/CSA 2.3.
 2. ALL TBI UNITS SHALL BE CSA APPROVED AND CERTIFIED ACCORDING TO STANDARDS CAN/CSA 2.2 AND UL 795.
- K. STARTUP & FACTORY ACCEPTANCE
 1. EACH UNIT SHALL BE FIRE TESTED AND PRE-ADJUSTED AT FACTORY PRIOR TO SHIPMENT, ON SITE START-UP SHALL BE PERFORMED BY A QUALIFIED TECHNICIAN WITH APPROPRIATE CREDENTIALS FOR GAS EQUIPMENT AND AUTHORIZED BY THE MANUFACTURER.
- L. EXECUTION
 1. CONTRACTOR SHALL VERIFY THAT ROOF IS READY TO RECEIVE WATER AND OPENING DIMENSIONS ARE CORRECT.
 2. CONTRACTOR SHALL VERIFY THAT PROPER POWER SUPPLY IS AVAILABLE.
 3. CONTRACTOR SHALL INSTALL IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.
 4. MOUNT UNITS ON FACTORY-BUILT ROOF MOUNTING FRAME PROVIDING WATERIGHT ENCLOSURE TO PROTECT DUCTWORK AND UTILITY SERVICES. INSTALL ROOF MOUNTING CURB LEVEL.
- M. AIR HANDLER (RTU-1)
 1. AIR HANDLING UNITS SHALL BE BUILT TO THE LEVEL OF QUALITY AS HEREIN SPECIFIED AND TO THE DESCRIPTION OF THE AIR HANDLING UNIT SCHEDULE.
 2. UNLESS STATED OTHERWISE, AIR-HANDLING UNITS ARE TO BE SHIPPED TO THE JOB IN ONE PIECE, FACTORY ASSEMBLED, MODULAR UNITS ASSEMBLED TO ACHIEVE A CLOSE APPROXIMATION TO THE INTENT OF THIS SPECIFICATION WILL NOT BE CONSIDERED EQUAL. ALL EQUIPMENT SHALL BE MANUFACTURED AND FACTORY ASSEMBLED AND FACTORY CERTIFIED BY AN APPROVED TESTING AGENCY SUCH AS ETL, UL, OR CSA FOR THE DESTINATION.
 3. ALL ELECTRICAL CIRCUITS SHALL UNDERGO A DIELECTRIC STRENGTH TEST AND SHALL BE FACTORY TESTED AND CHECKED AS TO PROPER FUNCTION.
 4. THE AIR HANDLING UNITS AND MAJOR COMPONENTS SHALL BE PRODUCTS OF MANUFACTURERS REGULARLY CHECKED FOR QUALITY AND RELIABILITY. EQUIPMENT AND WITH A MINIMUM OF FIFTY (50) CONTINUOUS YEARS OF PROVEN PRODUCTION EXPERIENCE.
 5. AIR HANDLING UNITS SHALL BE INSTALLED BY THE CONTRACTOR AS SHOWN AND SCHEDULED ON THE DRAWINGS. AIR HANDLING UNITS ARE TO BE PRE-PURCHASED BY OWNER. REFER TO ARCHITECTURAL SPECIFICATIONS 01030 FOR FULL DETAILS.
 6. RTU-1 ROOF CURB SHALL BE FURNISHED AND INSTALLED BY CONTRACTOR.
- N. UNIT CONSTRUCTION
 1. UNIT CASING SHALL BE OF MINIMUM 19 GA (1.3 MM) SATIN COAT GALVANIZED SHEET METAL. SURFACES ON INDOOR AND OUTDOOR UNITS SHALL BE CLEANED WITH A DECREASING SOLVENT TO REMOVE OIL AND METAL OXIDES. OUTDOOR UNITS SHALL BE PRIMED WITH A TWO-PART ACID BASED ETCHING PRIMER. ALL UNPROTECTED METAL AND WELDS SHALL BE FACTORY COATED.
 2. ALL EXPOSED SURFACES SHALL HAVE A FINISH COAT OF ENAMEL TO ALL EXPOSED SURFACES WITH AN ASTM B117-11 SALT SPRAY RATING OF 500 HRS.
 3. ALL WALLS, ROOFS, AND FLOORS SHALL BE OF FORMED CONSTRUCTION WITH AT LEAST TWO BREAKS AT EACH JOINT. JOINTS SHALL BE SECURED BY SHEET METAL SCREWS OR POP RIVETS. WALL AND FLOOR JOINTS SHALL BE BROKEN IN AND ON ALL OUTDOOR UNITS ROOF JOINTS BROKEN OUT (EXPOSED) FOR RIGIDITY. ALL JOINTS SHALL BE CAULKED WITH A WATER RESISTANT SEALANT.
 4. PROVIDED A 22 GA (.85 MM) SOLID METAL LINER OVER INSULATED AREAS.
 5. UNITS SHALL BE PROVIDED WITH ACCESS DOORS TO THE FOLLOWING COMPONENTS: FANS, MOTORS, FILTERS, DAMPERS AND OPERATORS, ACCESS PLenums, HUMIDIFIERS/MET. CELLS, ELECTRICAL CONTROL PANELS AND BURNER/COMPRESSOR COMPARTMENTS. ACCESS DOORS SHALL BE AS LARGE AS PRACTICAL FOR EASY ACCESS. SCREWED WALL PANEL ACCESS DOORS SHALL NOT BE ACCEPTABLE FOR THE ABOVE LISTED COMPONENTS.
 6. UNITS SHALL BE PROVIDED WITH HINGED ACCESS DOORS WITH E-PROFILE GASKET, FULLY LINED, AND A MINIMUM OF TWO LEVER HANDLES.
 7. ALL UNITS SHALL BE INTERNALLY INSULATED WITH 2" (51 MM) THICK, 1 1/2" LB / FT³ (24 KG/M³) DENSITY COATED INSULATION. THE COATED INSULATION SHALL BE SECURED TO METAL PANELS WITH A FIRE RETARDANT ADHESIVE AND WELDED STEEL PINS AT 18" (450 MM) O/C. ALL LONGITUDINAL INSULATION JOINTS AND BUTT ENDS SHALL BE COVERED BY SHEET METAL OVERLAP COATED INSULATION. THE COATED INSULATION OF EXPOSED EDGES, DRAIN PANS AND ALL FLOOR AREAS SHALL BE INSULATED ON THE UNDERSIDE.
 8. COOLING COIL DRAIN PANS SHALL BE FABRICATED OF 304 STAINLESS STEEL AND ARE AN INTEGRAL PART OF THE FLOOR PANELING, A MINIMUM OF 2" (51 MM) DEEP WITH WELDED CORNERS. DRAIN PANS SHALL EXTEND A MINIMUM OF 6" (152 MM) DOWNSTREAM OF COIL FACE AND BE PROVIDED WITH 1" (25.4 MM) 5.5 M.P.T. DRAIN CONNECTION. ALL COOLING COIL DRAIN PANS SHALL HAVE A FAST PAN AND BE SLOPED AND PITCHED SUCH THAT THERE IS NO STANDING WATER. INTERMEDIATE DRAIN PANS SHALL BE PROVIDED WHERE REQUIRED FOR EFFECTIVE MOISTURE REMOVAL.

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10. OUTDOOR UNITS SHALL BE WEATHERPROOFED AND EQUIPPED FOR INSTALLATION OUTDOORS. UNITS SHALL BE FABRICATED TO PREVENT THE INFILTRATION OF RAIN AND SNOW. A NATIONALLY RECOGNIZED TESTING LABORATORY (NRTL) AS A RECOGNIZED COMPONENT, TO THE CURRENT EDITION OF ANSI Z83.8 / CSA 2.6 STANDARD FOR GAS-FIRED DUCT FURNACES FOR INSTALLATION ON THE POSITIVE PRESSURE SIDE OF THE CIRCULATING AIR FLOW ONLY. DUCT FURNACE MODULE SHALL PROVIDE A MINIMUM COMBUSTION EFFICIENCY OF 80%.
11. THE HEAT EXCHANGER CONSIST OF A PRIMARY DRUM AND SECONDARY TUBES ENTIRELY MADE OF 304 STAINLESS STEEL, REQUIRING NO THERMAL TREATMENT TO PREVENT THE CRACKING OF WELDED JOINTS, HEAT EXCHANGER IS GUARANTEED FOR 10 YEARS PRO-RATED ON PARTS.
12. THE BURNER WILL BE OF A FORCED DRAFT TYPE, FACTORY-INSTALLED ON THE HEAT EXCHANGER WITH ALL GAS PIPING AND CONTROL WIRING REQUIRED FOR THE PROPER OPERATION OF THE UNIT.
13. THE GAS PIPING WILL BE EQUIPPED WITH AN ELECTRONIC SPARK IGNITER, MANUAL SHUT-OFF VALVE, PRESSURE REGULATOR, AUTOMATIC SHUT-OFF VALVES AND MANUAL COCK.
14. SIEMENS TYPE OF THE BURNER WILL INCLUDE A PRESSURE REGULATOR, A MANUAL IGNITION COCK, TEST PORTS, A MODULATING GAS VALVE AND THE PROPER SAFETY SHUT-OFF VALVES DEPENDING ON SIZE OF THE UNIT AND IF THE UNIT IS BUILT FOR CANADA OR THE U.S.
15. THE BURNER AND GAS PIPING ASSEMBLY WILL HAVE A MODULATING TURNDOWN RATIO OF AT LEAST 10:1 ON ALL MODELS.
16. CENTRIFUGAL FANS SHALL BE RATED IN ACCORDANCE WITH AMCA STANDARD TEST CODE - BULLETIN 210. FAN MANUFACTURER SHALL BE A MEMBER OF AMCA. ALL FANS AND MOTOR SHALL BE BALANCED DYNAMICALLY BALANCED DURING FACTORY TEST. FAN SHAFTS SHALL BE SELECTED FOR STABLE OPERATION AT LEAST 20% BELOW THE FIRST CRITICAL RPM. FAN SHAFTS SHALL BE PROVIDED WITH A RUST INHIBITING COATING.
17. BACKWARD INCLINED FANS WITH AIRFOIL OR FLAT BLADE DESIGN SHALL BE EQUIPPED WITH GREASABLE SELF-ALIGNING BALL OR ROLLER TYPE PILLW BLOCK BEARINGS.
18. FANS SHALL BE BELT DRIVEN PLENUM TYPE CONFIGURATION WHERE NOTED IN SCHEDULES. THRUST RESTRAINT ISOLATORS SHALL BE PROVIDED IN PARALLEL TO THE SHAFT CENTERLINE WHEN REQUIRED TO MINIMIZE AXIAL MOVEMENT AND BENDING MOVEMENTS OF THE BLOWER ASSEMBLY(S). DRIVE SIDE BEARINGS ON PLENUM FANS SHALL BE ADAPTER STYLE TO ENSURE EVEN CLAMPING OF THE BEARING SLEEVE TO THE SHAFT.
19. PROVIDE INLET SCREEN & OPEN WIRE MESH PROTECTIVE DISCHARGE SCREEN.
20. FAN MOTOR SHEAVES SHALL BE ADJUSTABLE WITH MOTORS 7 1/2 HP (5.6 KW) AND SMALLER. ON FANS WITH LARGER MOTORS, FIXED DRIVES SHALL BE PROVIDED. ALL DRIVES SHALL BE PROVIDED WITH AN OVERCURRENT COATING. THE AIR BALANCER SHALL PROVIDE FOR DRIVE CHANGES (IF REQUIRED) DURING THE AIR BALANCE PROCEDURE.
21. PROVIDE FULL SECTION RETURN AIR FAN(S) AS SCHEDULED. THE USE OF POWER EXHAUST FAN FELLER TYPE ARRANGEMENTS WILL NOT BE CONSIDERED.
22. FAN AND MOTOR SHEAVES SHALL BE FACTORY INSTALLED, FAN BALANCED, AND TESTED PRIOR TO SHIPMENT.
23. VARIABLE FREQUENCY DRIVES
 1. A PULSE WIDTH MODULATED (PWM) INVERTER DESIGNED FOR USE WITH BOTH ASYNCHRONOUS AND PERMANENT MAGNET MOTORS SHALL BE PROVIDED.
 2. IEEE 519-2014 IS AN ELECTRICAL SYSTEM STANDARD FOR HARMONIC MITIGATION AND NOT INTENDED TO BE APPLIED TO AN INDIVIDUAL PIECE OF EQUIPMENT. DRIVES ARE ALLOWED TO EXCEED THE LIMITS OF HARMONICS; THUS, VERIFICATION OF SYSTEM IEEE 519-2014 COMPLIANCE IS BEYOND THE MANUFACTURER'S SCOPE. THE EOR (ENGINEER OF RECORD) IS RESPONSIBLE FOR CONDUCTING AN ELECTRICAL SYSTEM STUDY AND VERIFYING THAT THE SCHEDULED LOADS SPECIFIED PROPER HARMONIC MITIGATION FOR THE DRIVES.
 3. DRIVES SHALL BE UL LABELED AS A COMPLETE ASSEMBLY.
 4. THE BASE DRIVE SHALL BE 48V/60HZ. DRIVES SHALL BE MUST TOLERATE VOLTAGE SAGS TO 50% FOR UP TO 0.2 SECONDS, SAGS TO 70% FOR UP TO 0.5 SECONDS, AND SAGS TO 80% FOR UP TO ONE SECOND.
 5. THE DRIVE SHALL PROVIDE FULL RATED OUTPUT FROM A LINE OF +10% TO -15% OF NOMINAL VOLTAGE. THE DRIVE SHALL CONTINUE TO OPERATE WITHOUT FAULTING FROM A LINE OF +25% TO -35% OF NOMINAL VOLTAGE.
 6. MULTIPLE HOME VIEW SCREENS SHALL BE CAPABLE OF DISPLAYING UP TO 21 POINTS OF INFORMATION.
 7. THE CONTROL PANEL SHALL DISPLAY THE FOLLOWING ITEMS ON A SINGLE SCREEN: OUTPUT FREQUENCY, OUTPUT CURRENT, REFERENCE SIGNAL, DRIVE NAME, TIME, AND OPERATING MODE (HAND VS AUTO, RUN VS STOP). BI-COLOR (RED/GREEN) STATUS LED SHALL BE INCLUDED. DRIVE (EQUIPMENT) NAME SHALL BE CUSTOMIZABLE.
 8. THERE SHALL BE A BUILT-IN TIME CLOCK. THE CLOCK SHALL HAVE A BATTERY BACKUP WITH 10 YEARS MINIMUM LIFE SPAN. DAYLIGHT SAVINGS TIME SHALL BE SELECTABLE.
 9. THE DRIVE SHALL AUTOMATICALLY BACKUP PARAMETERS TO ITS CONTROL PANEL. IN ADDITION TO THE AUTOMATIC BACKUP, THE DRIVE SHALL ALLOW TWO ADDITIONAL PARAMETERS TO BE STORED. BACKUP FILES SHALL INCLUDE A TIME AND DATE STAMP. IN THE EVENT OF A DRIVE FAILURE, THE CONTROL PANEL OF THE ORIGINAL DRIVE CAN BE INSTALLED. THE ORIGINAL REPLACEMENT DRIVE AND PARAMETERS FROM THE CONTROL PANEL CAN BE DOWNLOADED INTO THE REPLACEMENT DRIVE.
 10. THE CONTROL PANEL SHALL BE REMOVABLE CAPABLE OF REMOTE MOUNTING.
 11. THE CONTROL PANEL SHALL HAVE THE ABILITY TO STORE SCREEN SHOTS WHICH ARE DOWNLOADABLE VIA USB.
 12. ALL DRIVES SHALL HAVE THE FOLLOWING HARDWARE FEATURES/CHARACTERISTICS AS STANDARD:
 1. TWO (2) PROGRAMMABLE ANALOG INPUTS SHALL ACCEPT CURRENT OR VOLTAGE SIGNALS. CURRENT OR VOLTAGE SELECTION CONFIGURED VIA THE VFD CONTROL PANEL. DRIVES THAT REQUIRE ACCESS TO INTERNAL COMPONENTS TO PERFORM THESE FUNCTIONS ARE NOT ACCEPTABLE.
 2. TWO (2) PROGRAMMABLE ANALOG OUTPUTS. AT LEAST ONE OF THE ANALOG OUTPUTS SHALL BE ADJUSTABLE FOR CURRENT OR VOLTAGE SIGNAL CONFIGURED VIA THE VFD CONTROL PANEL. DRIVES THAT REQUIRE ACCESS TO INTERNAL COMPONENTS TO PERFORM THESE FUNCTIONS ARE NOT ACCEPTABLE.
 3. SIX (6) PROGRAMMABLE DIGITAL INPUTS. ALL DIGITAL INPUTS SHALL BE PROGRAMMABLE TO SUPPORT BOTH ACTIVE HIGH AND ACTIVE LOW LOGIC AND SHALL INCLUDE ADJUSTABLE ON/OFF TIME DELAYS. THE DIGITAL INPUT SHALL BE CAPABLE OF ACCEPTING BOTH 24 VDC AND 24 VAC.
 4. THREE (3) PROGRAMMABLE FORM-C RELAY OUTPUTS. THE RELAY OUTPUTS SHALL INCLUDE PROGRAMMABLE TIME DELAYS. THE RELAYS SHALL BE RATED FOR A CONTINUOUS CURRENT RATING OF 2 AMPS AND MAXIMUM SWITCHING VOLTAGE OF 250 VAC / 30 VDC. OPEN COLLECTOR AND FORM-A RELAYS ARE NOT ACCEPTABLE. DRIVES THAT HAVE LESS THAN (3) FORM-C RELAY OUTPUTS SHALL PROVIDE AN OPTION CARD TO PROVIDE ADDITIONAL RELAY OUTPUTS.
 5. DRIVE TERMINALS SHALL BE COLOR CODED FOR EASY IDENTIFICATION OF FUNCTION.
 6. THE DRIVE SHALL INCLUDE AN ISOLATED VSD PORT FOR INTERFACE BETWEEN THE DRIVE AND A LAPTOP. A NON-ISOLATED VSD PORT IS NOT ACCEPTABLE.
 7. AN AUXILIARY POWER SUPPLY RATED AT 24 VDC, 250 MA SHALL BE INCLUDED.
 8. AT A MINIMUM, THE DRIVES SHALL HAVE INTERNAL IMPEDANCE EQUIVALENT TO 5% TO REDUCE THE HARMONICS TO THE POWER LINE. 5% IMPEDANCE MAY BE FROM DUAL (POSITIVE AND NEGATIVE DC LINK) CHOKES OR AC LINE REACTOR. DRIVES WITH ONLY ONE DC LINK CHOKES SHALL ADD AN AC LINE CHOKES INTEGRAL TO THE DRIVE ENCLOSURE.
 9. THE DRIVE SHALL HAVE COOLING FANS THAT ARE DESIGNED FOR FIELD REPLACEMENT. THE PRIMARY COOLING FAN SHALL OPERATE ONLY WHEN REQUIRED AND BE VARIABLE SPEED FOR INCREASED LONGEVITY AND LOWER NOISE LEVELS. DRIVES WHOSE PRIMARY COOLING FANS ARE NOT VARIABLE SPEED SHALL INCLUDE A SPARE COOLING FAN.
 10. THE OVERLOAD RATING OF THE DRIVE SHALL BE 110% OF ITS NOMINAL DUTY CURRENT RATING FOR ONE HOUR EVERY 10 MINUTES, 130% OVERLOAD FOR 2 SECONDS EVERY MINUTE. THE MINIMUM CURRENT RATING SHALL MEET OR EXCEED THE VALUES IN THE NEC/UL TABLE 430.250 FOR 4-POLE MOTORS.
 11. THE INPUT CURRENT RATING OF THE DRIVE SHALL NOT BE GREATER THAN THE OUTPUT CURRENT RATING.
 12. CIRCUIT BOARDS SHALL BE COATED PER IEC 60721-3-3.
 13. CHEMICAL GASES CLASS 352 AND OPERATING CLASS 352.
 14. EARTH (GROUND) FAULT DETECTION SHALL FUNCTION IN BOTH MODULATING (RUNNING) AND NON-MODULATING MODES.
 15. COORDINATED AC TRANSIENT SURGE PROTECTION SYSTEM CONSISTING OF 4 MOV'S (PHASE TO-GROUND, PHASE TO-PHASE AND PHASE-TO-GROUND), A CAPACITOR CLAMP, AND INTERNAL CHOKES. THE MOV'S SHALL COMPLY WITH UL 1449 4TH/ EDITION. DRIVES THAT DO NOT INCLUDE COORDINATED AC TRANSIENT SURGE PROTECTION SHALL INCLUDE AN EXTERNAL TVSS/SPD (TRANSIENT VOLTAGE SURGE SUPPRESSOR/SURGE PROTECTION DEVICE).
 16. THE DRIVE SHALL INCLUDE A ROBUST DC BUS TO PROVIDE SHORT TERM POWER TO MOTOR DRIVES THROUGH THE DC BUS DOULE TO DRIVE KVIA RATIO SHALL BE 4.5 J/KVA OR HIGHER. AN INERTIA-BASED RIDE THROUGH FUNCTION SHOULD HELP MAINTAIN THE DC BUS RATED POWER LOSS EVENTS. DRIVES WITH CONTROL POWER RIDE THROUGH ONLY ARE NOT ACCEPTABLE.
 17. ALL DRIVES SHALL HAVE THE FOLLOWING SOFTWARE FEATURES AS STANDARD:
 1. A FAULT LOGGER THAT STORES THE LAST 16 FAULTS IN NON-VOLATILE MEMORY. THE MOST RECENT 5 FAULTS SAVE AT LEAST 9 DATA POINTS INCLUDING: A STATIC PRESSURE TIME/DATE, FREQUENCY, DC BUS VOLTAGE, MOTOR CURRENT, DI

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18. STATUS, TEMPERATURE, AND STATUS WORDS. THE DATE AND TIME OF EACH FAULT AND FAULT RESET ATTEMPT SHALL BE STORED IN DRIVERS MEMORY. THE LOGGER SHALL BE A NATIONALLY RECOGNIZED TESTING LABORATORY (NRTL) AS A RECOGNIZED COMPONENT, TO THE CURRENT EDITION OF ANSI Z83.8 / CSA 2.6 STANDARD FOR GAS-FIRED DUCT FURNACES FOR INSTALLATION ON THE POSITIVE PRESSURE SIDE OF THE CIRCULATING AIR FLOW ONLY. DUCT FURNACE MODULE SHALL PROVIDE A MINIMUM COMBUSTION EFFICIENCY OF 80%.
19. THE HEAT EXCHANGER CONSIST OF A PRIMARY DRUM AND SECONDARY TUBES ENTIRELY MADE OF 304 STAINLESS STEEL, REQUIRING NO THERMAL TREATMENT TO PREVENT THE CRACKING OF WELDED JOINTS, HEAT EXCHANGER IS GUARANTEED FOR 10 YEARS PRO-RATED ON PARTS.
20. THE BURNER WILL BE OF A FORCED DRAFT TYPE, FACTORY-INSTALLED ON THE HEAT EXCHANGER WITH ALL GAS PIPING AND CONTROL WIRING REQUIRED FOR THE PROPER OPERATION OF THE UNIT.
21. THE GAS PIPING WILL BE EQUIPPED WITH AN ELECTRONIC SPARK IGNITER, MANUAL SHUT-OFF VALVE, PRESSURE REGULATOR, AUTOMATIC SHUT-OFF VALVES AND MANUAL COCK.
22. SIEMENS TYPE OF THE BURNER WILL INCLUDE A PRESSURE REGULATOR, A MANUAL IGNITION COCK, TEST PORTS, A MODULATING GAS VALVE AND THE PROPER SAFETY SHUT-OFF VALVES DEPENDING ON SIZE OF THE UNIT AND IF THE UNIT IS BUILT FOR CANADA OR THE U.S.
23. THE BURNER AND GAS PIPING ASSEMBLY WILL HAVE A MODULATING TURNDOWN RATIO OF AT LEAST 10:1 ON ALL MODELS.
24. CENTRIFUGAL FANS SHALL BE RATED IN ACCORDANCE WITH AMCA STANDARD TEST CODE - BULLETIN 210. FAN MANUFACTURER SHALL BE A MEMBER OF AMCA. ALL FANS AND MOTOR SHALL BE BALANCED DYNAMICALLY BALANCED DURING FACTORY TEST. FAN SHAFTS SHALL BE SELECTED FOR STABLE OPERATION AT LEAST 20% BELOW THE FIRST CRITICAL RPM. FAN SHAFTS SHALL BE PROVIDED WITH A RUST INHIBITING COATING.
25. BACKWARD INCLINED FANS WITH AIRFOIL OR FLAT BLADE DESIGN SHALL BE EQUIPPED WITH GREASABLE SELF-ALIGNING BALL OR ROLLER TYPE PILLW BLOCK BEARINGS.
26. FANS SHALL BE BELT DRIVEN PLENUM TYPE CONFIGURATION WHERE NOTED IN SCHEDULES. THRUST RESTRAINT ISOLATORS SHALL BE PROVIDED IN PARALLEL TO THE SHAFT CENTERLINE WHEN REQUIRED TO MINIMIZE AXIAL MOVEMENT AND BENDING MOVEMENTS OF THE BLOWER ASSEMBLY(S). DRIVE SIDE BEARINGS ON PLENUM FANS SHALL BE ADAPTER STYLE TO ENSURE EVEN CLAMPING OF THE BEARING SLEEVE TO THE SHAFT.
27. PROVIDE INLET SCREEN & OPEN WIRE MESH PROTECTIVE DISCHARGE SCREEN.
28. FAN MOTOR SHEAVES SHALL BE ADJUSTABLE WITH MOTORS 7 1/2 HP (5.6 KW) AND SMALLER. ON FANS WITH LARGER MOTORS, FIXED DRIVES SHALL BE PROVIDED. ALL DRIVES SHALL BE PROVIDED WITH AN OVERCURRENT COATING. THE AIR BALANCER SHALL PROVIDE FOR DRIVE CHANGES (IF REQUIRED) DURING THE AIR BALANCE PROCEDURE.
29. PROVIDE FULL SECTION RETURN AIR FAN(S) AS SCHEDULED. THE USE OF POWER EXHAUST FAN FELLER TYPE ARRANGEMENTS WILL NOT BE CONSIDERED.
30. FAN AND MOTOR SHEAVES SHALL BE FACTORY INSTALLED, FAN BALANCED, AND TESTED PRIOR TO SHIPMENT.
31. VARIABLE FREQUENCY DRIVES
 1. A PULSE WIDTH MODULATED (PWM) INVERTER DESIGNED FOR USE WITH BOTH ASYNCHRONOUS AND PERMANENT MAGNET MOTORS SHALL BE PROVIDED.
 2. IEEE 519-2014 IS AN ELECTRICAL SYSTEM STANDARD FOR HARMONIC MITIGATION AND NOT INTENDED TO BE APPLIED TO AN INDIVIDUAL PIECE OF EQUIPMENT. DRIVES ARE ALLOWED TO EXCEED THE LIMITS OF HARMONICS; THUS, VERIFICATION OF SYSTEM IEEE 519-2014 COMPLIANCE IS BEYOND THE MANUFACTURER'S SCOPE. THE EOR (ENGINEER OF RECORD) IS RESPONSIBLE FOR CONDUCTING AN ELECTRICAL SYSTEM STUDY AND VERIFYING THAT THE SCHEDULED LOADS SPECIFIED PROPER HARMONIC MITIGATION FOR THE DRIVES.
 3. DRIVES SHALL BE UL LABELED AS A COMPLETE ASSEMBLY.
 4. THE BASE DRIVE SHALL BE 48V/60HZ. DRIVES SHALL BE MUST TOLERATE VOLTAGE SAGS TO 50% FOR UP TO 0.2 SECONDS, SAGS TO 70% FOR UP TO 0.5 SECONDS, AND SAGS TO 80% FOR UP TO ONE SECOND.
 5. THE DRIVE SHALL PROVIDE FULL RATED OUTPUT FROM A LINE OF +10% TO -15% OF NOMINAL VOLTAGE. THE DRIVE SHALL CONTINUE TO OPERATE WITHOUT FAULTING FROM A LINE OF +25% TO -35% OF NOMINAL VOLTAGE.
 6. MULTIPLE HOME VIEW SCREENS SHALL BE CAPABLE OF DISPLAYING UP TO 21 POINTS OF INFORMATION.
 7. THE CONTROL PANEL SHALL DISPLAY THE FOLLOWING ITEMS ON A SINGLE SCREEN: OUTPUT FREQUENCY, OUTPUT CURRENT, REFERENCE SIGNAL, DRIVE NAME, TIME, AND OPERATING MODE (HAND VS AUTO, RUN VS STOP). BI-COLOR (RED/GREEN) STATUS LED SHALL BE INCLUDED. DRIVE (EQUIPMENT) NAME SHALL BE CUSTOMIZABLE.
 8. THERE SHALL BE A BUILT-IN TIME CLOCK. THE CLOCK SHALL HAVE A BATTERY BACKUP WITH 10 YEARS MINIMUM LIFE SPAN. DAYLIGHT SAVINGS TIME SHALL BE SELECTABLE.
 9. THE DRIVE SHALL AUTOMATICALLY BACKUP PARAMETERS TO ITS CONTROL PANEL. IN ADDITION TO THE AUTOMATIC BACKUP, THE DRIVE SHALL ALLOW TWO ADDITIONAL PARAMETERS TO BE STORED. BACKUP FILES SHALL INCLUDE A TIME AND DATE STAMP. IN THE EVENT OF A DRIVE FAILURE, THE CONTROL PANEL OF THE ORIGINAL DRIVE CAN BE INSTALLED. THE ORIGINAL REPLACEMENT DRIVE AND PARAMETERS FROM THE CONTROL PANEL CAN BE DOWNLOADED INTO THE REPLACEMENT DRIVE.
 10. THE CONTROL PANEL SHALL BE REMOVABLE CAPABLE OF REMOTE MOUNTING.
 11. THE CONTROL PANEL SHALL HAVE THE ABILITY TO STORE SCREEN SHOTS WHICH ARE DOWNLOADABLE VIA USB.
 12. ALL DRIVES SHALL HAVE THE FOLLOWING HARDWARE FEATURES/CHARACTERISTICS AS STANDARD:
 1. TWO (2) PROGRAMMABLE ANALOG INPUTS SHALL ACCEPT CURRENT OR VOLTAGE SIGNALS. CURRENT OR VOLTAGE SELECTION CONFIGURED VIA THE VFD CONTROL PANEL. DRIVES THAT REQUIRE ACCESS TO INTERNAL COMPONENTS TO PERFORM THESE FUNCTIONS ARE NOT ACCEPTABLE.
 2. TWO (2) PROGRAMMABLE ANALOG OUTPUTS. AT LEAST ONE OF THE ANALOG OUTPUTS SHALL BE ADJUSTABLE FOR CURRENT OR VOLTAGE SIGNAL CONFIGURED VIA THE VFD CONTROL PANEL. DRIVES THAT REQUIRE ACCESS TO INTERNAL COMPONENTS TO PERFORM THESE FUNCTIONS ARE NOT ACCEPTABLE.
 3. SIX (6) PROGRAMMABLE DIGITAL INPUTS. ALL DIGITAL INPUTS SHALL BE PROGRAMMABLE TO SUPPORT BOTH ACTIVE HIGH AND ACTIVE LOW LOGIC AND SHALL INCLUDE ADJUSTABLE ON/OFF TIME DELAYS. THE DIGITAL INPUT SHALL BE CAPABLE OF ACCEPTING BOTH 24 VDC AND 24 VAC.
 4. THREE (3) PROGRAMMABLE FORM-C RELAY OUTPUTS. THE RELAY OUTPUTS SHALL INCLUDE PROGRAMMABLE TIME DELAYS. THE RELAYS SHALL BE RATED FOR A CONTINUOUS CURRENT RATING OF 2 AMPS AND MAXIMUM SWITCHING VOLTAGE OF 250 VAC / 30 VDC. OPEN COLLECTOR AND FORM-A RELAYS ARE NOT ACCEPTABLE. DRIVES THAT HAVE LESS THAN (3) FORM-C RELAY OUTPUTS SHALL PROVIDE AN OPTION CARD TO PROVIDE ADDITIONAL RELAY OUTPUTS.
 5. DRIVE TERMINALS SHALL BE COLOR CODED FOR EASY IDENTIFICATION OF FUNCTION.
 6. THE DRIVE SHALL INCLUDE AN ISOLATED VSD PORT FOR INTERFACE BETWEEN THE DRIVE AND A LAPTOP. A NON-ISOLATED VSD PORT IS NOT ACCEPTABLE.
 7. AN AUXILIARY POWER SUPPLY RATED AT 24 VDC, 250 MA SHALL BE INCLUDED.
 8. AT A MINIMUM, THE DRIVES SHALL HAVE INTERNAL IMPEDANCE EQUIVALENT TO 5% TO REDUCE THE HARMONICS TO THE POWER LINE. 5% IMPEDANCE MAY BE FROM DUAL (POSITIVE AND NEGATIVE DC LINK) CHOKES OR AC LINE REACTOR. DRIVES WITH ONLY ONE DC LINK CHOKES SHALL ADD AN AC LINE CHOKES INTEGRAL TO THE DRIVE ENCLOSURE.
 9. THE DRIVE SHALL HAVE COOLING FANS THAT ARE DESIGNED FOR FIELD REPLACEMENT. THE PRIMARY COOLING FAN SHALL OPERATE ONLY WHEN REQUIRED AND BE VARIABLE SPEED FOR INCREASED LONGEVITY AND LOWER NOISE LEVELS. DRIVES WHOSE PRIMARY COOLING FANS ARE NOT VARIABLE SPEED SHALL INCLUDE A SPARE COOLING FAN.
 10. THE OVERLOAD RATING OF THE DRIVE SHALL BE 110% OF ITS NOMINAL DUTY CURRENT RATING FOR ONE HOUR EVERY 10 MINUTES, 130% OVERLOAD FOR 2 SECONDS EVERY MINUTE. THE MINIMUM CURRENT RATING SHALL MEET OR EXCEED THE VALUES IN THE NEC/UL TABLE 430.250 FOR 4-POLE MOTORS.
 11. THE INPUT CURRENT RATING OF THE DRIVE SHALL NOT BE GREATER THAN THE OUTPUT CURRENT RATING.
 12. CIRCUIT BOARDS SHALL BE COATED PER IEC 60721-3-3.
 13. CHEMICAL GASES CLASS 352 AND OPERATING CLASS 352.
 14. EARTH (GROUND) FAULT DETECTION SHALL FUNCTION IN BOTH MODULATING (RUNNING) AND NON-MODULATING MODES.
 15. COORDINATED AC TRANSIENT SURGE PROTECTION SYSTEM CONSISTING OF 4 MOV'S (PHASE TO-GROUND, PHASE TO-PHASE AND PHASE-TO-GROUND), A CAPACITOR CLAMP, AND INTERNAL CHOKES. THE MOV'S SHALL COMPLY WITH UL 1449 4TH/ EDITION. DRIVES THAT DO NOT INCLUDE COORDINATED AC TRANSIENT SURGE PROTECTION SHALL INCLUDE AN EXTERNAL TVSS/SPD (TRANSIENT VOLTAGE SURGE SUPPRESSOR/SURGE PROTECTION DEVICE).
 16. THE DRIVE SHALL INCLUDE A ROBUST DC BUS TO PROVIDE SHORT TERM POWER TO MOTOR DRIVES THROUGH THE DC BUS DOULE TO DRIVE KVIA RATIO SHALL BE 4.5 J/KVA OR HIGHER. AN INERTIA-BASED RIDE THROUGH FUNCTION SHOULD HELP MAINTAIN THE DC BUS RATED POWER LOSS EVENTS. DRIVES WITH CONTROL POWER RIDE THROUGH ONLY ARE NOT ACCEPTABLE.
 17. ALL DRIVES SHALL HAVE THE FOLLOWING SOFTWARE FEATURES AS STANDARD:
 1. A FAULT LOGGER THAT STORES THE LAST 16 FAULTS IN NON-VOLATILE MEMORY. THE MOST RECENT 5 FAULTS SAVE AT LEAST 9 DATA POINTS INCLUDING: A STATIC PRESSURE TIME/DATE, FREQUENCY, DC BUS VOLTAGE, MOTOR CURRENT, DI

HVAC SPECIFICATIONS

32. STATUS, TEMPERATURE, AND STATUS WORDS. THE DATE AND TIME OF EACH FAULT AND FAULT RESET ATTEMPT SHALL BE STORED IN DRIVERS MEMORY. THE LOGGER SHALL BE A NATIONALLY RECOGNIZED TESTING LABORATORY (NRTL) AS A RECOGNIZED COMPONENT, TO THE CURRENT EDITION OF ANSI Z83.8 / CSA 2.6 STANDARD FOR GAS-FIRED DUCT FURNACES FOR INSTALLATION ON THE POSITIVE PRESSURE SIDE OF THE CIRCULATING AIR FLOW ONLY. DUCT FURNACE MODULE SHALL PROVIDE A MINIMUM COMBUSTION EFFICIENCY OF 80%.
33. THE HEAT EXCHANGER CONSIST OF A PRIMARY DRUM AND SECONDARY TUBES ENTIRELY MADE OF 304 STAINLESS STEEL, REQUIRING NO THERMAL TREATMENT TO PREVENT THE CRACKING OF WELDED JOINTS, HEAT EXCHANGER IS GUARANTEED FOR 10 YEARS PRO-RATED ON PARTS.
34. THE BURNER WILL BE OF A FORCED DRAFT TYPE, FACTORY-INSTALLED ON THE HEAT EXCHANGER WITH ALL GAS PIPING AND CONTROL WIRING REQUIRED FOR THE PROPER OPERATION OF THE UNIT.
35. THE GAS PIPING WILL BE EQUIPPED WITH AN ELECTRONIC SPARK IGNITER, MANUAL SHUT-OFF VALVE, PRESSURE REGULATOR, AUTOMATIC SHUT-OFF VALVES AND MANUAL COCK.
36. SIEMENS TYPE OF THE BURNER WILL INCLUDE A PRESSURE REGULATOR, A MANUAL IGNITION COCK, TEST PORTS, A MODULATING GAS VALVE AND THE PROPER SAFETY SHUT-OFF VALVES DEPENDING ON SIZE OF THE UNIT AND IF THE UNIT IS BUILT FOR CANADA OR THE U.S.
37. THE BURNER AND GAS PIPING ASSEMBLY WILL HAVE A MODULATING TURNDOWN RATIO OF AT LEAST 10:1 ON ALL MODELS.
38. CENTRIFUGAL FANS SHALL BE RATED IN ACCORDANCE WITH AMCA STANDARD TEST CODE - BULLETIN 210. FAN MANUFACTURER SHALL BE A MEMBER OF AMCA. ALL FANS AND MOTOR SHALL BE BALANCED DYNAMICALLY BALANCED DURING FACTORY TEST. FAN SHAFTS SHALL BE SELECTED FOR STABLE OPERATION AT LEAST 20% BELOW THE FIRST CRITICAL RPM. FAN SHAFTS SHALL BE PROVIDED WITH A RUST INHIBITING COATING.
39. BACKWARD INCLINED FANS WITH AIRFOIL OR FLAT BLADE DESIGN SHALL BE EQUIPPED WITH GREASABLE SELF-ALIGNING BALL OR ROLLER TYPE PILLW BLOCK BEARINGS.
40. FANS SHALL BE BELT DRIVEN PLENUM TYPE CONFIGURATION WHERE NOTED IN SCHEDULES. THRUST RESTRAINT ISOLATORS SHALL BE PROVIDED IN PARALLEL TO THE SHAFT CENTERLINE WHEN REQUIRED TO MINIMIZE AXIAL MOVEMENT AND BENDING MOVEMENTS OF THE BLOWER ASSEMBLY(S). DRIVE SIDE BEARINGS ON PLENUM FANS SHALL BE ADAPTER STYLE TO ENSURE EVEN CLAMPING OF THE BEARING SLEEVE TO THE SHAFT.
41. PROVIDE INLET SCREEN & OPEN WIRE MESH PROTECTIVE DISCHARGE SCREEN.
42. FAN MOTOR SHEAVES SHALL BE ADJUSTABLE WITH MOTORS 7 1/2 HP (5.6 KW) AND SMALLER. ON FANS WITH LARGER MOTORS, FIXED DRIVES SHALL BE PROVIDED. ALL DRIVES SHALL BE PROVIDED WITH AN OVERCURRENT COATING. THE AIR BALANCER SHALL PROVIDE FOR DRIVE CHANGES (IF REQUIRED) DURING THE AIR BALANCE PROCEDURE.
43. PROVIDE FULL SECTION RETURN AIR FAN(S) AS SCHEDULED. THE USE OF POWER EXHAUST FAN FELLER TYPE ARRANGEMENTS WILL NOT BE CONSIDERED.
44. FAN AND MOTOR SHEAVES SHALL BE FACTORY INSTALLED, FAN BALANCED, AND TESTED PRIOR TO SHIPMENT.
45. VARIABLE FREQUENCY DRIVES
 1. A PULSE WIDTH MODULATED (PWM) INVERTER DESIGNED FOR USE WITH BOTH ASYNCHRONOUS AND PERMANENT MAGNET MOTORS SHALL BE PROVIDED.
 2. IEEE 519-2014 IS AN ELECTRICAL SYSTEM STANDARD FOR HARMONIC MITIGATION AND NOT INTENDED TO BE APPLIED TO AN INDIVIDUAL PIECE OF EQUIPMENT. DRIVES ARE ALLOWED TO EXCEED THE LIMITS OF HARMONICS; THUS, VERIFICATION OF SYSTEM IEEE 519-2014 COMPLIANCE IS BEYOND THE MANUFACTURER'S SCOPE. THE EOR (ENGINEER OF RECORD) IS RESPONSIBLE FOR CONDUCTING AN ELECTRICAL SYSTEM STUDY AND VERIFYING THAT THE SCHEDULED LOADS SPECIFIED PROPER HARMONIC MITIGATION FOR THE DRIVES.
 3. DRIVES SHALL BE UL LABELED AS A COMPLETE ASSEMBLY.
 4. THE BASE DRIVE SHALL BE 48V/60HZ. DRIVES SHALL BE MUST TOLERATE VOLTAGE SAGS TO 50% FOR UP TO 0.2 SECONDS, SAGS TO 70% FOR UP TO 0.5 SECONDS, AND SAGS TO 80% FOR UP TO ONE SECOND.
 5. THE DRIVE SHALL PROVIDE FULL RATED OUTPUT FROM A LINE OF +10% TO -15% OF NOMINAL VOLTAGE. THE DRIVE SHALL CONTINUE TO OPERATE WITHOUT FAULTING FROM A LINE OF +25% TO -35% OF NOMINAL VOLTAGE.
 6. MULTIPLE HOME VIEW SCREENS SHALL BE CAPABLE OF DISPLAYING UP TO 21 POINTS OF INFORMATION.
 7. THE CONTROL PANEL SHALL DISPLAY THE FOLLOWING ITEMS ON A SINGLE SCREEN: OUTPUT FREQUENCY, OUTPUT CURRENT, REFERENCE SIGNAL, DRIVE NAME, TIME, AND OPERATING MODE (HAND VS AUTO, RUN VS STOP). BI-COLOR (RED/GREEN) STATUS LED SHALL BE INCLUDED. DRIVE (EQUIPMENT) NAME SHALL BE CUSTOMIZABLE.
 8. THERE SHALL BE A BUILT-IN TIME CLOCK. THE CLOCK SHALL HAVE A BATTERY BACKUP WITH 10 YEARS MINIMUM LIFE SPAN. DAYLIGHT SAVINGS TIME SHALL BE SELECTABLE.
 9. THE DRIVE SHALL AUTOMATICALLY BACKUP PARAMETERS TO ITS CONTROL PANEL. IN ADDITION TO THE AUTOMATIC BACKUP, THE DRIVE SHALL ALLOW TWO ADDITIONAL PARAMETERS TO BE STORED. BACKUP FILES SHALL INCLUDE A TIME AND DATE STAMP. IN THE EVENT OF A DRIVE FAILURE, THE CONTROL PANEL OF THE ORIGINAL DRIVE CAN BE INSTALLED. THE ORIGINAL REPLACEMENT DRIVE AND PARAMETERS FROM THE CONTROL PANEL CAN BE DOWNLOADED INTO THE REPLACEMENT DRIVE.
 10. THE CONTROL PANEL SHALL BE REMOVABLE CAPABLE OF REMOTE MOUNTING.
 11. THE CONTROL PANEL SHALL HAVE THE ABILITY TO STORE SCREEN SHOTS WHICH ARE DOWNLOADABLE VIA USB.
 12. ALL DRIVES SHALL HAVE THE FOLLOWING HARDWARE FEATURES/CHARACTERISTICS AS STANDARD:
 1. TWO (2) PROGRAMMABLE ANALOG INPUTS SHALL ACCEPT CURRENT OR VOLTAGE SIGNALS. CURRENT OR VOLTAGE SELECTION CONFIGURED VIA THE VFD CONTROL PANEL. DRIVES THAT REQUIRE ACCESS TO INTERNAL COMPONENTS TO PERFORM THESE FUNCTIONS ARE NOT ACCEPTABLE.
 2. TWO (2) PROGRAMMABLE ANALOG OUTPUTS. AT LEAST ONE OF THE ANALOG OUTPUTS SHALL BE ADJUSTABLE FOR CURRENT OR VOLTAGE SIGNAL CONFIGURED VIA THE VFD CONTROL PANEL. DRIVES THAT REQUIRE ACCESS TO INTERNAL COMPONENTS TO PERFORM THESE FUNCTIONS ARE NOT ACCEPTABLE.
 3. SIX (6) PROGRAMMABLE DIGITAL INPUTS. ALL DIGITAL INPUTS SHALL BE PROGRAMMABLE TO SUPPORT BOTH ACTIVE HIGH AND ACTIVE LOW LOGIC AND SHALL INCLUDE ADJUSTABLE ON/OFF TIME DELAYS. THE DIGITAL INPUT SHALL BE CAPABLE OF ACCEPTING BOTH 24 VDC AND 24 VAC.
 4. THREE (3) PROGRAMMABLE FORM-C RELAY OUTPUTS. THE RELAY OUTPUTS SHALL INCLUDE PROGRAMMABLE TIME DELAYS. THE RELAYS SHALL BE RATED FOR A CONTINUOUS CURRENT RATING OF 2 AMPS AND MAXIMUM SWITCHING VOLTAGE OF 250 VAC / 30 VDC. OPEN COLLECTOR AND FORM-A RELAYS ARE NOT ACCEPTABLE. DRIVES THAT HAVE LESS THAN (3) FORM-C RELAY OUTPUTS SHALL PROVIDE AN OPTION CARD TO PROVIDE ADDITIONAL RELAY OUTPUTS.
 5. DRIVE TERMINALS SHALL BE COLOR CODED FOR EASY IDENTIFICATION OF FUNCTION.
 6. THE DRIVE SHALL INCLUDE AN ISOLATED VSD PORT FOR INTERFACE BETWEEN THE DRIVE AND A LAPTOP. A NON-ISOLATED VSD PORT IS NOT ACCEPTABLE.
 7. AN AUXILIARY POWER SUPPLY RATED AT 24 VDC, 250 MA SHALL BE INCLUDED.
 8. AT A MINIMUM, THE DRIVES SHALL HAVE INTERNAL IMPEDANCE EQUIVALENT TO 5% TO REDUCE THE HARMONICS TO THE POWER LINE. 5% IMPEDANCE MAY BE FROM DUAL (POSITIVE AND NEGATIVE DC LINK) CHOKES OR AC LINE REACTOR. DRIVES WITH ONLY ONE DC LINK CHOKES SHALL ADD AN AC LINE CHOKES INTEGRAL TO THE DRIVE ENCLOSURE.
 9. THE DRIVE SHALL HAVE COOLING FANS THAT ARE DESIGNED FOR FIELD REPLACEMENT. THE PRIMARY COOLING FAN SHALL OPERATE ONLY WHEN REQUIRED AND BE VARIABLE SPEED FOR INCREASED LONGEVITY AND LOWER NOISE LEVELS. DRIVES WHOSE PRIMARY COOLING FANS ARE NOT VARIABLE SPEED SHALL INCLUDE A SPARE COOLING FAN.
 10. THE OVERLOAD RATING OF THE DRIVE SHALL BE 110% OF ITS NOMINAL DUTY CURRENT RATING FOR ONE HOUR EVERY 10 MINUTES, 130% OVERLOAD FOR 2 SECONDS EVERY MINUTE. THE MINIMUM CURRENT RATING SHALL MEET OR EXCEED THE VALUES IN THE NEC/UL TABLE 430.250 FOR 4-POLE MOTORS.
 11. THE INPUT CURRENT RATING OF THE DRIVE SHALL NOT BE GREATER THAN THE OUTPUT CURRENT RATING.
 12. CIRCUIT BOARDS SHALL BE COATED PER IEC 60721-3-3.
 13. CHEMICAL GASES CLASS 352 AND OPERATING CLASS 352.
 14. EARTH (GROUND) FAULT DETECTION SHALL FUNCTION IN BOTH MODULATING (RUNNING) AND NON-MODULATING MODES.
 15. COORDINATED AC TRANSIENT SURGE PROTECTION SYSTEM CONSISTING OF 4 MOV'S (PHASE TO-GROUND, PHASE TO-PHASE AND PHASE-TO-GROUND), A CAPACITOR CLAMP, AND INTERNAL CHOKES. THE MOV'S SHALL COMPLY WITH UL 1449 4TH/ EDITION. DRIVES THAT DO NOT INCLUDE COORDINATED AC TRANSIENT SURGE PROTECTION SHALL INCLUDE AN EXTERNAL TVSS/SPD (TRANSIENT VOLTAGE SURGE SUPPRESSOR/SURGE PROTECTION DEVICE).
 16. THE DRIVE SHALL INCLUDE A ROBUST DC BUS TO PROVIDE SHORT TERM POWER TO MOTOR DRIVES THROUGH THE DC BUS DOULE TO DRIVE KVIA RATIO SHALL BE 4.5 J/KVA OR HIGHER. AN INERTIA-BASED RIDE THROUGH FUNCTION SHOULD HELP MAINTAIN THE DC BUS RATED POWER LOSS EVENTS. DRIVES WITH CONTROL POWER RIDE THROUGH ONLY ARE NOT ACCEPTABLE.
 17. ALL DRIVES SHALL HAVE THE FOLLOWING SOFTWARE FEATURES AS STANDARD:
 1. A FAULT LOGGER THAT STORES THE LAST 16 FAULTS IN NON-VOLATILE MEMORY. THE MOST RECENT 5 FAULTS SAVE AT LEAST 9 DATA POINTS INCLUDING: A STATIC PRESSURE TIME/DATE, FREQUENCY, DC BUS VOLTAGE, MOTOR CURRENT, DI

HVAC SPECIFICATIONS

46. STATUS, TEMPERATURE, AND STATUS WORDS. THE DATE AND TIME OF EACH FAULT AND FAULT RESET ATTEMPT SHALL BE STORED IN DRIVERS MEMORY. THE LOGGER SHALL BE A NATIONALLY RECOGNIZED TESTING LABORATORY (NRTL) AS A RECOGNIZED COMPONENT, TO THE CURRENT EDITION OF ANSI Z83.8 / CSA 2.6 STANDARD FOR GAS-FIRED DUCT FURNACES FOR INSTALLATION ON THE POSITIVE PRESSURE SIDE OF THE CIRCULATING AIR FLOW ONLY. DUCT FURNACE MODULE SHALL PROVIDE A MINIMUM COMBUSTION EFFICIENCY OF 80%.
47. THE HEAT EXCHANGER CONSIST OF A PRIMARY DRUM AND SECONDARY TUBES ENTIRELY MADE OF 304 STAINLESS STEEL, REQUIRING NO THERMAL TREATMENT TO PREVENT THE CRACKING OF WELDED JOINTS, HEAT EXCHANGER IS GUARANTEED FOR 10 YEARS PRO-RATED ON PARTS.
48. THE BURNER WILL BE OF A FORCED DRAFT TYPE, FACTORY-INSTALLED ON THE HEAT EXCHANGER WITH ALL GAS PIPING AND CONTROL WIRING REQUIRED FOR THE PROPER OPERATION OF THE UNIT.
49. THE GAS PIPING WILL BE EQUIPPED WITH AN ELECTRONIC SPARK IGNITER, MANUAL SHUT-OFF VALVE, PRESSURE REGULATOR, AUTOMATIC SHUT-OFF VALVES AND MANUAL COCK.

HVAC SPECIFICATIONS

WITHOUT THE BENEFIT OF PACKAGED EQUIPMENT. WHEEL MATERIAL WILL NOT EXCEED A FLAME SPREAD RATING OF 0 AND A SMOKE DEVELOPED RATING OF 40 WHEN TESTED IN ACCORDANCE WITH UL 723 (2016) ASTM E84.

HVAC SPECIFICATIONS

SHALL BE CAULKED WITH A WATER RESISTANT SEALANT. THE ROOF JOINTS SHALL BE TURNED UP 2" (51 MM) WITH THREE BREAK INTERLOCKING DESIGN AND THE ROOF WELLS OF EACH EVENT'S START AND COMPLETION POINTS SHALL BE STORED IN THE EVENT LOGGER.

HVAC SPECIFICATIONS

BUT NOT LIMITED TO: WARNING MESSAGES, CHECKSUM MISMATCH, RUN PERMISSIVE OPEN, START INTERLOCK OPEN, AND AUTOMATIC RESET OF A FAULT. THE DATE AND TIME OF EACH EVENT'S START AND COMPLETION POINTS SHALL BE STORED IN THE EVENT LOGGER.

HVAC SPECIFICATIONS

ISOLATORS SHALL BE BOLTED TO STEEL CHANNEL WELDED TO UNIT FLOOR THAT IS WELDED TO THE STRUCTURAL FRAME OF THE UNIT. USE OF SEPARATE BRIMTEES ARE NOT ACCEPTABLE. FANS SHALL BE ATTACHED TO THE DISCHARGE PANEL BY A POLYVINYL CHLORIDE COATED POLYESTER WOVEN FABRIC WITH A SEALED DOUBLE LOCKING FABRIC TO METAL CORRECT TO THE APPLICATION.

HVAC SPECIFICATIONS

RELAY IN UNIT CIRCUITRY. FACTORY INSTALLED AND WIRED NON-FUSED DISCONNECT SWITCH IN NEMA TYPE 'A' ENCLOSURE. THE DATE AND TIME OF EACH EVENT'S START AND COMPLETION POINTS SHALL BE STORED IN THE EVENT LOGGER.

THESE DRAWINGS ARE NOT TO BE SCALED. ALL DRAWINGS, THE DESIGN, AND THE DETAILS THEREON REMAIN THE PROPERTY OF THE CONSULTANT AND ARE NOT TO BE ALTERED, RE-USED OR REPRODUCED WITHOUT THE CONSULTANT'S EXPRESS WRITTEN CONSENT.

THE CONTRACTOR MUST FIELD VERIFY ALL DIMENSIONS AND MUST CORRECT & CORRELATE ALL DETAILS WITH THE FULL DRAWING PACKAGE BEING RESPONSIBLE FOR SAME THROUGHOUT CONSTRUCTION REPORTING ANY DISCREPANCIES TO THE ARCHITECT PRIOR TO COMMENCING THE RELEVANT WORK.

PROJECT: HVAC Renovations. Glendale Secondary School. 145 Rainbow Dr, Hamilton, ON. For the HWDSB.

SCALE:

EXP Services Inc. 1,905.525.6069 / f: 905.528.7310. 1266 South Service Road, Suite C1-1, Stoney Creek, ON L5E 5S9, Canada. www.exp.com



BUILDINGS • EARTH & ENVIRONMENT • ENERGY INDUSTRIAL INFRASTRUCTURE • SUSTAINABILITY

TRUE NORTH:

DRAWING TITLE: Mechanical Specifications

SCALE: AS NOTED. C.M. / J.L. DATE: SEPTEMBER 2023

PROJECT #: ALL-23010629-A0

DRAWING #: MO.5

HVAC SPECIFICATIONS

- E. RETURN GRILLES
1. THE UNIT SHALL BE SUPPLIED WITH PUNCHED COLOR STANDARD PUNCHED RETURN GRILL...
F. MIXED AIR FILTERS
1. EACH UNIT SHALL BE EQUIPPED WITH TWO 2" PLEATED DISPOSABLE FILTERS (MERV 13)...
G. HEATING - HOT WATER COIL
1. THE UNIT SHALL BE SUPPLIED WITH A HOT WATER COIL CONSTRUCTED OF SEAMLESS DRAWN COPPER TUBES...

HVAC SPECIFICATIONS

- 1. THE MANUFACTURER SHALL SUPPLY A LIMITED 14-MONTH WARRANTY ON ALL PARTS AND A THREE-YEAR WARRANTY ON THE DAMPER ACTUATOR FROM THE DATE OF SHIPPING...
S. CONTROLS
1. UNIT VENTILATOR SHALL HAVE DCO READY CONTROLS (CONTROLLER BY OTHERS)
2. A DIRECT DIGITAL CONTROLLER SHALL BE SUPPLIED AND INSTALLED BY THE CONTRACTOR...

HVAC SPECIFICATIONS

- 7. EACH BOILER MUST BE EQUIPPED WITH DIRECT SPARK IGNITION. MAIN FLAME MUST BE MONITORED AND CONTROLLED BY A FLAME ROD (IONIZATION PROBE) (CERTIFICATION) SYSTEM.
5. BOILER SAFETY AND TRIM DEVICES
1. THE BOILER MANUFACTURER MUST FURNISH AND TEST THE FOLLOWING SAFETY DEVICES:
1. SAFETY RELIEF VALVE MUST BE PROVIDED IN COMPLIANCE WITH THE ASME CODE...

HVAC SPECIFICATIONS

- 6. BOILER SAFETY/TRIM DEVICES. THE CONTRACTOR MUST INSTALL ANY ELECTRICAL DEVICES FURNISHED FROM THE BOILER MANUFACTURER...
7. THE CONTRACTOR MUST INSTALL CONTROL WIRING TO FIELD MOUNTED ELECTRICAL DEVICES IN ACCORDANCE WITH THE REQUIREMENTS OF NFPA 70.
3. HYDRONIC PIPING
1. EACH BOILER MUST BE PROVIDED WITH ALL NECESSARY INLET (SUPPLY) AND OUTLET (RETURN) CONNECTIONS...
11. HVAC PUMPS
1.1) VARIABLE SPEED PACKAGED PUMP SYSTEM (P-1, P-2, P-3, P-4, P-5, P-6)
A. GENERAL
1. FURNISH AND INSTALL A PRE-FABRICATED AND TESTED VARIABLE SPEED PACKAGED PUMPING SYSTEM...

HVAC SPECIFICATIONS

- 4. IMPELLER WEAR RINGS: 304 STAINLESS STEEL
5. SHAFT JOURNALS AND CHAMBER BEARINGS: SILICON CARBIDE
6. O-RINGS: EPDM
SHAFT COUPLINGS FOR MOTOR FLANGE SIZES 1840 AND SMALLER SHALL BE MADE OF CAST IRON...
4. THE SHAFT SEAL SHALL BE A BALANCED O-RING CARTRIDGE TYPE WITH THE FOLLOWING FEATURES:
1. COLLAR, DRIVERS, SPRING: 316 STAINLESS STEEL
2. SHAFT SLEEVE, GLAND PLUG: 316 STAINLESS STEEL
3. STATIONARY RING: SILICON CARBIDE
4. ROTATING RING-SILICON CARBIDE
5. O-RINGS: EPDM
THE SILICON CARBIDE SHALL BE IMBEDDED WITH GRAPHITE.
5. SHAFT SEAL REPLACEMENT SHALL BE POSSIBLE WITHOUT REMOVAL OF ANY PUMP COMPONENTS OTHER THAN THE COUPLING GUARD, SHAFT COUPLING AND MOTOR...
5. LARGE IN-LINE VERTICAL MULTI-STAGE PUMPS (NOMINAL FLOW FROM 130 TO 500 GALLONS PER MINUTE) SHALL HAVE THE FOLLOWING FEATURES:
1. THE PUMP IMPELLERS SHALL BE SECURED DIRECTLY TO THE SMOOTH PUMP SHAFT BY MEANS OF A SPLINED COUPLER AND NUT DESIGN.
2. THE SUCTION/DISCHARGE BASE SHALL HAVE ANSI CLASS 125 OR CLASS 250 FLANGE CONNECTIONS IN 12-1/2" RING (ROTATING FLANGE) DESIGN AS INDICATED IN THE DRAWINGS OR PUMP SCHEDULE.
3. PUMP CONSTRUCTION.
1. SUCTION/DISCHARGE BASE, PUMP HEAD DUCTILE IRON (ASTM 65-45-12)
2. SHAFT COUPLINGS, FLANGE RINGS: DUCTILE IRON (ASTM 65-45-12)
3. IMPELLER: 431 STAINLESS STEEL
4. MOTOR CAST IRON (ASTM CLASS 30)
5. IMPELLERS, DIFFUSER CHAMBERS, OUTER SLEEVE: 304 STAINLESS STEEL
6. IMPELLER WEAR RINGS: 304 STAINLESS STEEL
7. INTERMEDIATE BEARING JOURNALS: SILICON CARBIDE
8. INTERMEDIATE CHAMBER BEARINGS: LEADLESS TIN BRONZE
9. CHAMBER BUSHINGS: GRAPHITE FILLED PIPE
10. O-RINGS: EPDM
4. THE SHAFT SEAL SHALL BE A BALANCED O-RING CARTRIDGE TYPE WITH THE FOLLOWING FEATURES:
1. COLLAR, DRIVERS, SPRING: 316 STAINLESS STEEL
2. SHAFT SLEEVE, GLAND PLUG: 316 STAINLESS STEEL
3. STATIONARY RING: SILICON CARBIDE
4. ROTATING RING: SILICON CARBIDE
5. O-RINGS: EPDM
THE SILICON CARBIDE SHALL BE IMBEDDED WITH GRAPHITE.
5. EACH MOTOR SHALL HAVE A VARIABLE FREQUENCY DRIVE SHIPPED LOOSE WITH THE VFD SHALL BE OF THE PULSE WIDTH MODULATION DESIGN USING CURRENT IGBT (INSULATED GATE BIPOLE TRANSISTOR) TECHNOLOGY.
3. THE VFD SHALL CONVERT INCOMING FIXED FREQUENCY THREE-PHASE AC POWER INTO A VARIABLE FREQUENCY AND VOLTAGE FOR CONTROLLING THE SPEED OF THE MOTOR...
C. VARIABLE FREQUENCY DRIVE MOTORS
1. EACH MOTOR SHALL HAVE A VARIABLE FREQUENCY DRIVE SHIPPED LOOSE WITH THE VFD SHALL BE OF THE PULSE WIDTH MODULATION DESIGN...
4. THE VFD SHALL UTILIZE AN ENERGY OPTIMIZATION ALGORITHM TO MINIMIZE ENERGY CONSUMPTION...
5. THE VFD SHALL AUTOMATICALLY REVERSE THE SWITCHING FREQUENCY AND/OR THE OUTPUT VOLTAGE AND FREQUENCY TO THE MOTOR DURING PERIODS OF SUSTAINED AMBIENT TEMPERATURES THAT ARE HIGHER THAN THE NORMAL OPERATING RANGE...
6. AN INTERNAL RFI FILTER SHALL BE STANDARD IN THE VFD.
7. THE VFD SHALL HAVE A MINIMUM OF TWO SKIP FREQUENCY BANDS WHICH CAN BE FIELD ADJUSTABLE.
8. THE VFD SHALL HAVE INTERNAL SOLID-STATE OVERLOAD PROTECTION DESIGNED TO SHUT DOWN WITH THE RATING OF 125% TO 150% OF CURRENT.
9. THE INTEGRATED VFD MOTOR SHALL INCLUDE PROTECTION AGAINST INPUT TRANSIENTS, PHASE IMBALANCE, LOSS OF AC LINE PHASE, OVER-VOLTAGE, UNDER-VOLTAGE, VFD OVER-TEMPERATURE, AND MOTOR OVER-TEMPERATURE...
10. THE VFD MOTOR SHALL HAVE, AS A MINIMUM, THE FOLLOWING INPUTS:
1. SPEED REFERENCE SIGNAL: 0-10 VDC, 4-20MA
2. DIGITAL REMOTE ON/OFF
3. FAULT SIGNAL RELAY (NC OR NO)
4. FIELDBUS COMMUNICATION PORT (RS485)
11. THE MOTOR SHALL BE TOTALLY ENCLOSED FAN COOLED (TEFC) WITH A STANDARD NEMA C-FACE, CLASS F INSULATION WITH A TEMPERATURE RISE NO HIGHER THAN CLASS B.
12. THE COOLING DESIGN OF THE MOTOR AND VFD SHALL BE SUCH THAT A CLASS B MOTOR TEMPERATURE RISE IS NOT EXCEEDED AT FULL RATED LOAD AND SPEED AT A MINIMUM SWITCHING FREQUENCY OF 9.0 KHZ.
13. MOTOR DRIVE END BEARINGS SHALL BE ADEQUATELY SIZED SO THAT THE MINIMUM L10 BEARING LIFE IS 17,500 HOURS AT THE MINIMUM ALLOWABLE CONTINUOUS IN-WR RATE...
14. THE MOTOR SHALL BE SWITCHED TO THE 'OFF' POSITION BUT WITH ELECTRICITY SUPPLY STILL CONNECTED...
18. THE CONTROLLER SHALL BE CAPABLE OF CHANGING THE NUMBER OF PUMPS OPERATING AT ANY GIVEN TIME...
19. THE CONTROLLER SHALL BE CAPABLE OF DISPLAYING INSTANTANEOUS POWER CONSUMPTION (KW) OR (KILOWATTS) AND CUMULATIVE ENERGY CONSUMPTION (KILOWATT-HOURS).
20. THE CONTROLLER SHALL BE CAPABLE OF DISPLAYING INSTANTANEOUS SPECIFIC ENERGY USE (KW/GPM), (OPTIONAL FLOW METER MUST BE CONNECTED).
21. THE ACTUAL PUMP PERFORMANCE CURVES (5TH ORDER POLYNOMIAL) SHALL BE LOADED (SOFTWARE) INTO THE PUMP SYSTEM CONTROLLER. PUMP CURVE DATA SHALL BE USED FOR THE FOLLOWING:
1. DISPLAY AND DATA LOGGING OF CALCULATED FLOW RATE (NOT REQUIRING FLOW MEASUREMENT)
2. PROPORTIONAL PRESSURE CONTROL
3. PUMP OUTSIDE OF RATED PROTECTION
4. PUMP CASCADE CONTROL BASED ON PUMP EFFICIENCY
22. THE CONTROLLER SHALL BE CAPABLE OF DISPLAYING AN ESTIMATED FLOW-RATE ON THE DEFAULT STATUS SCREEN.
23. THE CONTROLLER SHALL HAVE PROPORTIONAL PRESSURE CONTROL TO COMPENSATE FOR PIPE FRICTION LOSS BY DECREASING PRESSURE SET-POINT AT HIGH FLOW-RATES AND INCREASING PRESSURE SET-POINT AT HIGH FLOW - RATES BY USING ACTUAL FLOW RATE OR CALCULATED FLOW RATE. PROPORTIONAL PRESSURE CONTROL THAT USES PUMP SPEED OR POWER CONSUMPTION ONLY SHALL NOT BE CONSIDERED EQUAL TO

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THE CONTRACTOR MUST FIELD VERIFY ALL DIMENSIONS AND MUST CORRECT & CORRELATE ALL DETAILS WITH THE FULL DRAWING PACKAGE BEING RESPONSIBLE FOR SAME THROUGHOUT CONSTRUCTION REPORTING ANY DISCREPANCIES TO THE ARCHITECT PRIOR TO COMMENCING THE RELEVANT WORK.

ALL DRAWINGS, DETAILS & SPECIFICATIONS REPRESENTED IN THE DRAWINGS ARE TO BE USED FOR CONSTRUCTION ONLY WHEN ISSUED BY THE ARCHITECT AND NOTED ACCORDINGLY IN THE 'ISSUE/REVISIONS' BOX HEREON.

- 1. ISSUED FOR REVIEW 22.09.23
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PROJECT: HVAC Renovations

Glendale Secondary School

145 Rainbow Dr, Hamilton, ON For the HWDSB

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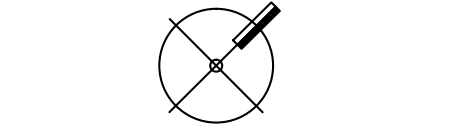
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TRUE NORTH:



DRAWING TITLE: Mechanical Specifications

SCALE: AS NOTED

DRAWN: C.M. / J.L.

DATE: SEPTEMBER 2023

PROJECT #: ALL-23010629-A0

DRAWING #: MO.6

HVAC SPECIFICATIONS

- PROPORTIONAL PRESSURE CONTROL THAT USES ACTUAL OR CALCULATED FLOW RATE.
24. THE CONTROLLER SHALL HAVE THE ABILITY TO COMMUNICATE COMMON FIELD-BUS PROTOCOLS, (BACNET, MODBUS, PROFIBUS, AND LON), VIA OPTIONAL COMMUNICATION EXPANSION CARD INSTALLED INSIDE CONTROLLER.
25. THE CONTROLLER SHALL HAVE ETHERNET CONNECTION WITH A BUILT IN SERVER ALLOWING FOR CONNECTION TO A NETWORK WITH READ/WRITE ACCESS TO CONTROLLER VIA WEB BROWSER AND INTERNET.
26. THE CONTROLLER SHALL HAVE A PROGRAMMABLE SERVICE CONTACT FIELD THAT CAN BE POPULATED WITH SERVICE CONTACT INFORMATION INCLUDING: CONTACT NAME, ADDRESS, PHONE NUMBER(S) AND WEBSITE.
- A. SYSTEM CONSTRUCTION
1. SUCTION AND DISCHARGE MANIFOLD CONSTRUCTION SHALL BE IN WAY THAT ENSURES MINIMAL PRESSURE DROPS, MINIMIZE POTENTIAL FOR CORROSION, AND PREVENTS BACTERIA GROWTH AT INTERSECTION OF PIPING INTO THE MANIFOLD. MANIFOLD CONSTRUCTION THAT INCLUDES SHARP EDGE TRANSITIONS OR INTERCONNECTING PIPING PROTRUDING INTO MANIFOLD IS NOT ACCEPTABLE. MANIFOLD CONSTRUCTION SHALL BE SUCH THAT WATER STAGNATION CAN NOT EXIST IN MANIFOLD DURING OPERATION TO PREVENT BACTERIA GROWTH INSIDE MANIFOLD.
2. THE SUCTION AND DISCHARGE MANIFOLD'S MATERIAL SHALL BE 316 STAINLESS STEEL. MANIFOLD CONNECTION SIZES SHALL BE AS FOLLOWS:
- 3 INCH AND SMALLER: MALE NPT THREADED
 - 4 INCH THROUGH 8 INCH: ANSI CLASS 150
 - ROTATING FLANGES 10 INCH AND LARGER: ANSI CLASS 150 FLANGES
3. PUMP ISOLATION VALVES SHALL BE PROVIDED ON THE SUCTION AND DISCHARGE OF EACH PUMP. ISOLATION VALVE SIZES 2 INCH AND SMALLER SHALL BE NICKEL PLATED BRASS FULL PORT BALL VALVES. ISOLATION VALVE SIZES 3 INCH AND LARGER SHALL BE A FULL LUG STYLE BUTTERFLY VALVE. THE VALVE DISK SHALL BE OF STAINLESS STEEL. THE VALVE SEAT MATERIAL SHALL BE EPDM AND THE BODY SHALL BE CAST IRON, COATED INTERNALLY AND EXTERNALLY WITH FUSION-BONDED EPOXY.
4. A SPRING-LOADED NON-SLAM TYPE CHECK VALVE SHALL BE INSTALLED ON THE DISCHARGE OF EACH PUMP. THE VALVE SHALL BE A WAFER STYLE TYPE FITTED BETWEEN TWO FLANGES. THE HEAD LOSS THROUGH THE CHECK VALVE SHALL NOT EXCEED 5 PSI AT THE PUMP DESIGN CAPACITY. CHECK VALVES 1-1/2" AND SMALLER SHALL HAVE A POM COMPOSITE BODY AND POPPET, A STAINLESS STEEL SPRING WITH EPDM OR NBR SEATS. CHECK VALVES 2" AND LARGER SHALL HAVE A BODY MATERIAL OF STAINLESS STEEL OR EPOXY COATED IRON (FUSION BONDED) WITH AN EPDM OR NBR RESILIENT SEAT. SPRING MATERIAL SHALL BE STAINLESS STEEL. DISK SHALL BE OF STAINLESS STEEL OR LEADLESS BRONZE.
5. FOR SYSTEMS THAT REQUIRE A DIAPHRAGM TANK, A CONNECTION OF NO SMALLER THAN 1/2" SHALL BE PROVIDED ON THE DISCHARGE MANIFOLD.
6. A PRESSURE TRANSDUCER SHALL BE FACTORY INSTALLED ON THE DISCHARGE MANIFOLD (OR FIELD INSTALLED AS SPECIFIED ON PLANS). SYSTEMS WITH POSITIVE INLET GAUGE PRESSURE SHALL HAVE A FACTORY INSTALLED PRESSURE TRANSDUCER ON THE SUCTION MANIFOLD FOR WATER SHORTAGE PROTECTION. PRESSURE TRANSDUCERS SHALL BE MADE OF 316 STAINLESS STEEL. TRANSDUCER ACCURACY SHALL BE +/- 1.0% FULL SCALE WITH HYSTERESIS AND REPEATABILITY OF NO GREATER THAN 0.1% FULL SCALE. THE OUTPUT SIGNAL SHALL BE 4-20 MA WITH A SUPPLY VOLTAGE RANGE OF 9-32 VDC.
7. A BOURDON TUBE PRESSURE GAUGE, 2.5 INCH DIAMETER, SHALL BE PLACED ON THE SUCTION AND DISCHARGE MANIFOLDS. THE GAUGE SHALL BE LIQUID FILLED AND HAVE COPPER ALLOY INTERNAL PARTS IN A STAINLESS STEEL CASE. GAUGE ACCURACY SHALL BE 2/1/2 %. THE GAUGE SHALL BE CAPABLE OF A PRESSURE OF 30% ABOVE ITS MAXIMUM SPAN WITHOUT REQUIRING RECALIBRATION.
8. SYSTEMS WITH A FLOODED SUCTION INLET OR SUCTION LIFT CONFIGURATION SHALL HAVE A FACTORY INSTALLED WATER SHORTAGE PROTECTION DEVICE ON THE SUCTION MANIFOLD.
9. THE BASE FRAME SHALL BE CONSTRUCTED OF CORROSION RESISTANT 304 STAINLESS STEEL. RUBBER VIBRATION DAMPERS SHALL BE FITTED BETWEEN EACH PUMPS AND BASEFRAME TO MINIMIZE VIBRATION.
10. DEPENDING ON THE SYSTEM SIZE AND CONFIGURATION, THE CONTROL PANEL SHALL BE MOUNTED IN ONE OF THE FOLLOWING WAYS:
- ON A 304 STAINLESS STEEL FABRICATED CONTROL CABINET STAND ATTACHED TO THE SYSTEM SKID, ON A 304 STAINLESS STEEL FABRICATED SKID, SEPARATE FROM THE MAIN SYSTEM SKID ON ITS OWN BASE (FLOOR MOUNTED WITH PLINTH)
- H. TESTING
1. THE ENTIRE PUMP STATION SHALL BE FACTORY TESTED FOR FUNCTIONALITY. FUNCTIONALITY TESTING SHALL INCLUDE THE FOLLOWING PARAMETERS: DRY RUN PROTECTION, MINIMUM PRESSURE AND MAXIMUM PRESSURE ALARMS (WHERE APPLICABLE), SETPOINT OPERATION, AND MOTOR ROTATION.
2. THE SYSTEM SHALL UNDERGO A FACTORY HYDROSTATIC TEST AT THE END OF THE PRODUCTION CYCLE. THE SYSTEM SHALL BE FILLED WITH WATER AND PRESSURIZED TO 1.5 TIMES THE NAMEPLATE MAXIMUM PRESSURE. SYSTEMS WITH 150# FLANGE CONNECTIONS SHALL BE TESTED AT 350 PSIG, AND SYSTEMS WITH 300# FLANGE CONNECTIONS SHALL BE TESTED AT 450 PSIG. THE PRESSURE SHALL BE MAINTAINED FOR A MINIMUM OF 15 MINUTES WITH NO LEAKAGE (SLIGHT LEAKAGE AROUND PUMP(S) MECHANICAL SEAL IS ACCEPTABLE) PRIOR TO SHIPMENT.
- I. WARRANTY
1. THE WARRANTY PERIOD SHALL BE A NON-PRORATED PERIOD OF 24 MONTHS FROM DATE OF INSTALLATION, NOT TO EXCEED 30 MONTHS FROM DATE OF MANUFACTURE.
- 11.2 CLOSE COUPLED IN-LINE PUMP (P-9, P-10, P-11)
- A. GENERAL
1. FURNISH AND INSTALL CLOSE COUPLED IN-LINE PUMPS AS PER PLANS AND PUMP SCHEDULE.
2. THE PUMP AND ELECTRIC MOTOR SHALL BE FACTORY ASSEMBLED AT THE PUMP MANUFACTURER'S FACILITY. THE PUMP MANUFACTURER SHALL HAVE COMPLETE UNIT RESPONSIBILITY.
- B. PUMPS
1. THE PUMPS SHALL BE CLOSE COUPLED, SINGLE STAGE, IN-LINE DESIGN, CAST IRON BRONZE FITTED CONSTRUCTION.
2. THE PUMPS SHALL HAVE THE FOLLOWING FEATURES:
- ALL PUMPS SHALL BE OF THE BACK PULL-OUT DESIGN SO THAT THE ROTATING ELEMENT CAN BE REMOVED FROM THE CASING WITHOUT DISCONNECTING THE SUCTION OR DISCHARGE PIPING. THE CASING MATERIAL SHALL BE CLOSE-GRAINED CAST IRON ASTM A48 - CLASS 30 WITH A MINIMUM TENSILE STRENGTH OF 30,000 P.S.I. PUMPS LARGER THAN 12.2" IMPELLER SHALL HAVE CASING MATERIAL OF DUCTILE IRON ASTM A536- CLASS 65 WITH A MINIMUM TENSILE STRENGTH OF 65,000 P.S.I. VOLUTE SHALL HAVE INTEGRALLY CAST SUCTION AND DISCHARGE CONNECTIONS, GAUGE PORTS AT NOZZLES, AND VENT AND DRAIN PORTS. PUMPS SUCTION AND DISCHARGE SHALL BE OF SAME SIZE. PUMPS WITH 3" AND ABOVE SUCTION/DISCHARGE SIZES SHALL HAVE DOUBLE VOLUTE. CASING AND SHALL HAVE SUCTION SPLITTER TO REDUCE PRE-ROTATION AND IMPROVE EFFICIENCY. CASINGS SHALL BE DESIGNED FOR SCHEDULED WORKING PRESSURE AND CAN WITHSTAND HYDROSTATIC TEST AT 150% OF THE MAXIMUM WORKING PRESSURE UNDER WHICH THE PUMP COULD OPERATE AT DESIGN SPEED.
 - PUMPS SHALL BE FITTED WITH BRONZE RENEWABLE CASE WEAR RINGS.
 - SUCTION AND DISCHARGE FLANGES SHALL BE DRILLED TO ANSI CLASS 125# STANDARDS AND BE MACHINED FLAT FACE.
 - THE MOTOR SHAFT SHALL BE OF COLD ROLLED STEEL AISI 1024 WITH BRONZE SLEEVES COVERING THE WETTED AREA OF THE SHAFT. MOTORS WITH 56J FRAME SHALL HAVE A MOTOR SHAFT OF STAINLESS STEEL AISI 416.
 - THE PUMP MANUFACTURER SHALL RECOMMEND THE PROPER MECHANICAL SEAL BASED ON THE PRESSURE, TEMPERATURE AND LIQUID OUTLINED ON THE EQUIPMENT SCHEDULE. MECHANICAL SEALS, AT A MINIMUM, SHALL HAVE CERAMIC STATIONARY SEATS, CARBON ROTATING RINGS, BUNA ELASTOMERS AND STAINLESS STEEL HARDWARE. APPLICATION OF A MECHANICAL SEAL SHALL BE INTERNALLY FLUSHED TYPE, WITHOUT REQUIRING EXTERNAL FLUSHING LINES. SEALS SHALL BE CAPABLE OF BEING INSPECTED AND EASILY REPLACED WITHOUT REMOVING THE PIPING OR VOLUTE.
 - RECIRCULATION LINE OF NYLON TUBING WITH BRASS FITTING SHALL BE PROVIDED TO VENT THE MECHANICAL SEAL.
 - IMPELLER SHALL BE OF THE ENCLOSED FRANCIS VANE TYPE, SINGLE SUCTION DESIGN, MADE OF SILICON BRONZE, ASTM B584 C87600, BOTH HYDRAULICALLY AND DYNAMICALLY BALANCED TO ISO 1940-1:2003 BALANCE GRADE G6.3 AND KEYS TO THE SHAFT. THE IMPELLER SHALL BE TRIMMED TO MEET THE SPECIFIC HYDRAULIC REQUIREMENTS.
 - PUMP CONSTRUCTION. THE STANDARD MATERIAL OF CONSTRUCTION FOR THE PUMP SHALL BE AS BELOW. SPECIAL MATERIAL SHALL BE AVAILABLE AS OPTION TO SUIT THE LIQUID PUMPED.
- VOLUTE: CAST IRON ASTM A48 - CLASS 30 OR DUCTILE IRON ASTM A536-

HVAC SPECIFICATIONS

- CLASS 65
- CASE WEAR RING: TIN BRONZE ASTM B584-90500
 - IMPELLER: SILICON BRONZE ASTM B584 C87600
 - SHAFT: COLD ROLL STEEL AISI 1024 OR STAINLESS STEEL AISI 416
 - SHAFT SLEEVE: BRONZE #1932 C89835
 - MECHANICAL SEALS: CARBON - CERAMIC WITH BUNA ELASTOMERS AND STAINLESS STEEL HARDWARE
 - RECIRCULATION LINE: NYLON TUBING WITH BRASS FITTINGS
1. PUMP ROTATION SHALL BE CLOCKWISE AS VIEWED FROM THE MOTOR END.
2. OPTIONAL SUPPORTS: PUMP SHALL BE MOUNTED ON A HEAVY DUTY CAST IRON SUPPORT STAND OR ON STEEL FLANGE SUPPORTS FOR FLOOR MOUNTING.
3. PUMP SHALL BE OF A MAINTAINABLE DESIGN FOR EASE OF MAINTENANCE AND SHOULD USE MACHINE FIT PARTS THAT ARE EASILY DISASSEMBLED.
4. EACH PUMP SHALL BE PAINTED WITH ONE COAT OF HIGH QUALITY FACTORY APPROVED PAINT AND NAME-PLATED BEFORE SHIPMENT FROM THE FACTORY.
5. WHERE NOTED ON SCHEDULE THE PUMP SHALL ALSO BE NSF-50 OR NSF-61 CERTIFIED.
6. PUMPS SHALL BE MANUFACTURED AND ASSEMBLED IN AN ISO-9001 CERTIFIED FACILITY.
- B. MOTORS
1. MOTORS SHALL MEET SCHEDULED HORSEPOWER, SPEED, VOLTAGE, AND ENCLOSURE DESIGN. PUMP AND MOTORS SHALL BE FACTORY ASSEMBLED.
2. MOTORS SHALL BE SUITABLY SIZED PER ISO5199 AND SHALL MEET NEMA SPECIFICATIONS AND CONFORM TO THE STANDARDS OUTLINED IN EISA 2007
- C. INSTALLATION
1. THE PUMP SHALL BE INSTALLED PER MANUFACTURER'S RECOMMENDATIONS AND ACCORDING TO THE STANDARDS OF THE HYDRAULICS INSTITUTE.
- D. TESTING
1. WHERE NOTED ON SCHEDULE, PUMPING EQUIPMENT MAY REQUIRE ONE OR MORE OF THE FOLLOWING: CERTIFIED PERFORMANCE TEST
HYDRO STATIC TEST NPSH TEST
ANY OTHER FACTORY TEST AS NOTED IN THE PUMP SCHEDULE
THE TESTING SHALL BE IN ACCORDANCE WITH HYDRAULIC INSTITUTE LEVEL B OR THE LATEST HI STANDARD AS NOTED IN THE PUMP SCHEDULE.

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PROJECT:
HVAC Renovations

Glendale
Secondary
School

145 Rainbow Dr,
Hamilton, ON
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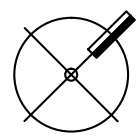
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DRAWING TITLE:
Mechanical
Specifications

SCALE:

AS NOTED

DRAWN:

C.M. / J.L.

DATE:

SEPTEMBER 2023

PROJECT #:

ALL-23010629-A0

DRAWING #:

MO.7

CONTROLS & INSTRUMENTATION SPEC.

1. GENERAL
- A. THE WORK SHALL INCLUDE DESIGN, SUPPLY, INSTALLATION, AND COMMISSIONING A COMPLETE MICROPROCESSOR BASED AUTOMATIC CONTROL SYSTEM TO ACHIEVE THE PERFORMANCE SPECIFIED IN THE FOLLOWING CLAUSES.
- B. FOR EXISTING SITES VISIT THE PREMISES PRIOR TO TENDER TO BECOME FAMILIAR WITH FIELD CONDITIONS AND EXISTING EQUIPMENT.
- C. THE CONTROL SYSTEM SHALL BE INSTALLED BY THE CONTROL SUBCONTRACTOR BUT AS AN INTEGRAL PART OF THE MECHANICAL SUB-CONTRACT. THE SYSTEM SHALL BE INSTALLED BY CERTIFIED ELECTRICIANS REGULARLY EMPLOYED BY THE CONTROL SUB-CONTRACTOR.
- D. THE CONTROLS CONTRACTOR WILL SPECIFICALLY READ ALL MECHANICAL AND ELECTRICAL DRAWINGS, SPECIFICATIONS, AND APPENDIX AND DETERMINE THE CONTROLS WORK PROVIDED BY THE MECHANICAL CONTRACTOR, HIS SUBCONTRACTORS, AND THE ELECTRICAL CONTRACTOR. THE CONTROLS CONTRACTOR IS EXPECTED TO HAVE THE EXPERTISE TO COORDINATE THE WORK OF OTHER CONTRACTORS AND TO MAKE A COMPLETELY COORDINATED BUILDING AUTOMATION CONTROL SYSTEM (BAS) FOR THE MECHANICAL SYSTEMS. THE CONTROLS SPECIFICATIONS ARE SPECIFICALLY WRITTEN TO COORDINATE THE MECHANICAL AND ELECTRICAL SYSTEMS, WHERE OTHERS ARE SPECIFICALLY SPECIFIED TO ALLOW FOR CONTROLS WORK. THEN THE BAS CONTRACTOR WILL NOT ALLOW FOR THAT WORK. THIS CLAUSE IS NOT INTENDED TO MAKE THE CONTROLS CONTRACTOR RESPONSIBLE FOR WORK NOT SPECIFIED, BUT TO MAKE THE BAS CONTRACTOR RESPONSIBLE FOR EXAMINING THE SPECIFICATIONS FOR CONTRADICTIONS AND OVERLAP.
- E. THE BAS CONTRACTOR SHALL PROVIDE THE NECESSARY ENGINEERING, INSTALLATION, SUPERVISION, COMMISSIONING AND PROGRAMMING FOR A COMPLETE AND FULLY OPERATIONAL SYSTEM. THE CONTRACTOR WILL PROVIDE AS MANY TRIPS TO THE JOB SITE FOR INSTALLATION, SUPERVISION, AND COMMISSIONING AS ARE NECESSARY TO COMPLETE THE PROJECT TO THE SATISFACTION OF THE CONSULTANT AND/OR BUILDING PROJECT SUPERVISOR.
- F. THE SYSTEM SHALL CONSIST OF ALL OPERATOR INTERFACES, MICROPROCESSOR-BASED CONTROLLERS, SENSORS, WELLS, AUTOMATIC CONTROL VALVES, CONTROL DAMPERS, TRANSDUCERS, AND RELAYS, AUTOMATIC CONTROL VALVES, AND DAMPER ACTUATORS.
2. SCOPE OF WORK
- A. THIS PROJECT SCOPE SHALL INCLUDE, BUT NOT BE LIMITED TO, THE FOLLOWING WORK:
- B. PREPARATION OF CONTROL SHOP DRAWINGS FOR REVIEW AND APPROVAL. SEE SUBMITTALS. SUPPLY AND INSTALL A NETWORK OF DIRECT DIGITAL CONTROL (DDC) PANELS AND FIELD DEVICES. SEE HARDWARE, SOFTWARE AND FIELD DEVICES
1. SUPPLY AND INSTALL CUSTOMIZED GRAPHICS SOFTWARE TO BUILDING STANDARDS, SYSTEM SOFTWARE, AND THIRD PARTY SOFTWARE AS SPECIFIED. SEE SOFTWARE
 2. INSTALL, WIRE AND LABEL ALL DDC CONTROL SYSTEM COMPONENTS. SEE INSTALLATION.
 3. CALIBRATE AND COMMISSION THE INSTALLED CONTROL SYSTEM. SEE COMMISSIONING.
 4. PROVIDE MAINTENANCE MANUALS AND AS-BUILT DRAWINGS. SEE AS-BUILT DOCUMENTATION
 5. PROVIDE CUSTOMIZED TRAINING FOR BUILDING OPERATIONS, MAINTENANCE AND TECHNICAL STAFF. SEE TRAINING
 6. PROVIDE A ONE-YEAR ON SITE PARTS AND LABOUR WARRANTY ON ALL COMPONENTS. SEE WARRANTY.
3. BASE BUILDING BAS VENDOR
- 3.1 BIDS FOR THE BAS CONTROL UNIT ONLY BE ACCEPTED FROM AUTHORIZED VENDORS/INSTALLERS OF THE FOLLOWING MANUFACTURERS:
- CONVERGENT TECHNOLOGIES
4. SYSTEM PERFORMANCE
- A. PERFORMANCE STANDARDS – THE BAS SYSTEM SHALL CONFORM TO THE FOLLOWING:
1. GRAPHIC DISPLAY: THE SYSTEM SHALL DISPLAY A GRAPHIC WITH A MINIMUM OF 20 DYNAMIC POINTS. ALL CURRENT DATA SHALL BE DISPLAYED WITHIN 10 SECONDS OF THE OPERATOR'S REQUEST.
 2. GRAPHIC REFRESH: THE SYSTEM SHALL UPDATE ALL DYNAMIC POINTS WITH CURRENT DATA WITHIN 10 SECONDS.
 3. OBJECT COMMAND: THE MAXIMUM TIME BETWEEN THE COMMAND OF A BINARY OBJECT BY THE OPERATOR AND THE REACTION BY THE DEVICE SHALL BE 5 SECONDS. ANALOG OBJECTS SHALL START TO ADJUST WITHIN 5 SECONDS.
 4. OBJECT SCAN: ALL CHANGES OF STATE AND CHANGE OF ANALOG VALUES SHALL BE TRANSMITTED OVER THE HIGH-SPEED NETWORK SUCH THAT ANY DATA USED OR DISPLAYED AT A CONTROLLER OR WORKSTATION WILL BE CURRENT WITHIN THE PRIOR 10 SECONDS.
 5. ALARM RESPONSE TIME: THE MAXIMUM TIME FROM WHEN AN OBJECT GOES INTO ALARM TO WHEN IT IS ANNUNCIATED AT THE WORKSTATION SHALL NOT EXCEED 10 SECONDS.
 6. PROGRAM EXECUTION FREQUENCY: CUSTOM AND STANDARD APPLICATIONS SHALL BE CAPABLE OF RUNNING AS OFTEN AS ONCE EVERY 5 SECONDS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SELECTING EXECUTION TIMES CONSISTENT WITH THE MECHANICAL PROCESS UNDER CONTROL.
 7. PROGRAMMABLE CONTROLLERS SHALL BE ABLE TO EXECUTE DDC PID CONTROL LOOPS AT A SELECTABLE FREQUENCY FROM AT LEAST ONCE EVERY 5 SECONDS. THE CONTROLLER SHALL SCAN AND UPDATE THE PROCESS VALUE AND OUTPUT GENERATED BY THIS CALCULATION AT THIS SAME FREQUENCY.
 8. MULTIPLE ALARM ANNUNCIATIONS: ALL WORKSTATIONS ON THE NETWORK SHALL RECEIVE ALARMS WITHIN 5 SECONDS OF EACH OTHER.
5. SUBMITTAL REQUIREMENTS
- A. SUBMITTAL INFORMATION SHALL BE PROVIDED TO THE ENGINEER OR OWNER ELECTRONICALLY PRIOR TO COMMENCING THE PROJECT.
- B. QUANTITIES OF ITEMS SUBMITTED SHALL BE REVIEWED BY THE ENGINEER AND OWNER. SUCH REVIEW SHALL NOT RELIEVE THE BAS MANUFACTURER OF FURNISHING QUANTITIES REQUIRED BASED UPON CONTRACT DOCUMENTS.
- C. PROVIDE THE ENGINEER AND OWNER, ANY ADDITIONAL INFORMATION OR DATA WHICH IS DEEMED NECESSARY TO DETERMINE COMPLIANCE WITH THE SPECIFICATIONS OR WHICH IS DEEMED VALUABLE IN DOCUMENTING AND UNDERSTANDING THE SYSTEM TO BE INSTALLED.
- D. SUBMIT THE FOLLOWING WITHIN 90 DAYS OF CONTRACT AWARD:
1. A COMPLETE BILL OF MATERIALS OF EQUIPMENT TO BE USED INDICATING QUANTITIES, MANUFACTURERS AND MODEL NUMBERS.
- E. PROVIDE ALL MANUFACTURERS' TECHNICAL CUT SHEETS FOR MAJOR SYSTEM COMPONENTS. WHEN TECHNICAL CUT SHEETS APPLY TO A PRODUCT SERIES RATHER THAN A SPECIFIC MODEL, THE POINTS LIST FOR THAT PRODUCT SHALL BE HIGHLIGHTED OR CLEARLY INDICATED BY OTHER MEANS. INCLUDE:
1. BUILDING CONTROLLERS
 2. CUSTOM APPLICATION CONTROLLERS
 3. APPLICATION SPECIFIC CONTROLLERS
 4. OPERATOR WORKSTATIONS
 5. PORTABLE OPERATOR TERMINALS
 6. AUXILIARY CONTROL DEVICES
- F. PROVIDE PROPOSED BUILDING AUTOMATION SYSTEM ARCHITECTURAL DIAGRAM DEPICTING VARIOUS CONTROLLER TYPES, WORKSTATIONS, DEVICE LOCATIONS, ADDRESSES, AND COMMUNICATION CABLE REQUIREMENTS
- G. PROVIDE DETAILED TERMINATION DRAWINGS SHOWING ALL REQUIRED FIELD AND FACTORY TERMINATIONS, AS WELL AS TERMINAL TIE-INS TO DDC CONTROLS PROVIDED BY MECHANICAL EQUIPMENT MANUFACTURERS. TERMINAL NUMBERS SHALL BE CLEARLY LABELED.
- H. PROVIDE POINTS LIST SHOWING ALL SYSTEM OBJECTS AND THE PROPOSED ENGLISH LANGUAGE OBJECT NAMES.
- I. PROVIDE A SEQUENCE OF OPERATION FOR EACH CONTROLLED MECHANICAL SYSTEM AND TERMINAL END DEVICES.
- J. PROVIDE A BACNET PROTOCOL IMPLEMENTATION CONFORMANCE STATEMENT (PICS) FOR EACH BACNET SYSTEM LEVEL DEVICE (I.E. BUILDING CONTROLLER & OPERATOR WORKSTATIONS) TYPE. THIS DEFINES THE POINTS LIST FOR PROPER COORDINATION OF INTEROPERABILITY WITH OTHER BUILDING SYSTEMS IF APPLICABLE FOR THIS PROJECT.
6. WARRANTY REQUIREMENTS
- A. WARRANTY ALL WORK AS FOLLOWS:
1. BAS SYSTEM LABOR AND MATERIALS SHALL BE WARRANTED FREE FROM

CONTROLS & INSTRUMENTATION SPEC.

- DEFECTS FOR A PERIOD OF TWELVE (12) MONTHS AFTER FINAL COMPLETION ACCEPTANCE BY THE OWNER. BAS FAILURES DURING THE WARRANTY PERIOD SHALL BE ADJUSTED, REPAIRED, OR REPLACED AT NO CHARGE TO THE OWNER. THE BAS MANUFACTURER SHALL RESPOND TO THE OWNER'S REQUEST FOR WARRANTY SERVICE WITHIN 24 HOURS OF THE INITIATED CALL AND WILL OCCUR DURING NORMAL BUSINESS HOURS (8AM-5PM).
2. THE BAS MANUFACTURER SHALL PROVIDE A TOTAL OF (16) HOURS OF ON-SITE PREVENTATIVE MAINTENANCE DURING WARRANTY PERIOD. EIGHT (8) HOURS AT SIX (6) MONTHS, AND EIGHT (8) HOURS AT TEN (10) MONTHS AFTER SUBSTANTIAL COMPLETION OF ON-SITE PREVENTATIVE MAINTENANCE INTO THE WARRANTY PERIOD.
 3. AT THE END OF THE FINAL START-UP/TESTING, IF EQUIPMENT AND SYSTEMS ARE OPERATING SATISFACTORILY TO THE CUSTOMER, THE CUSTOMER SHALL SIGN CERTIFYING THAT THE BAS IS OPERATIONAL AND HAS BEEN TESTED AND ACCEPTED IN ACCORDANCE WITH THE TERMS OF THIS SPECIFICATION. THE DATE OF CUSTOMER ACCEPTANCE SHALL BE THE START OF THE WARRANTY PERIOD.
 4. OPERATOR WORKSTATION SOFTWARE, PROJECT SPECIFIC SOFTWARE, GRAPHICS, DATABASE, AND FIRMWARE UPDATES SHALL BE PROVIDED TO THE CUSTOMER AT NO CHARGE DURING THE WARRANTY PERIOD. WRITTEN AUTHORIZATION BY THE CUSTOMER MUST BE GRANTED PRIOR TO THE INSTALLATION OF THESE UPDATES.
 5. THE BAS MANUFACTURER SHALL PROVIDE A WEB-ACCESSIBLE USERS NETWORK FOR THE PROPOSED SYSTEM AND GIVE THE OWNER FREE ACCESS TO QUESTION/ANSWER FORUM, USER TIPS, UPGRADES, AND TRAINING SCHEDULES FOR A ONE YEAR PERIOD OF TIME CORRELATING WITH THE WARRANTY PERIOD.
- B. THE PROJECT'S CONTROLS CONTRACTOR SHALL PROVIDE AND MAINTAIN SECURE REMOTE ACCESS TO THE FACILITIES BUILDING AUTOMATION SYSTEM (BAS) OR OTHER BUILDING SYSTEMS UNTIL UP TO 1 YEAR AFTER SUBSTANTIAL COMPLETION. PRIOR TO TRANSITION FROM WARRANTY, THE BUILDING OWNER WILL PROVIDE AND MAINTAIN THE SECURED REMOTE ACCESS.
7. DATA MONITORING, STORING, & COLLECTION STANDARDS
- A. THE SYSTEM SHALL RECORD AND STORE INTERVAL DATA, 24 HOURS/DAY, 7 DAYS/WEEK, 365 DAYS/YEAR.
- B. DATA TO BE COLLECTED FOR REAL-TIME CONTINUOUS MONITORING AND COLLECTION OF WHOLE-BUILDING ENERGY METERS AND SUB-METERS IF THE METERS HAVE BEEN INSTALLED AS PART OF THE WARRANTED PROJECT.
- C. DATA TO BE COLLECTED FROM BUILDING AUTOMATION AND CONTROL SYSTEMS SUB-METERS AND SENSORS DATA FOR EQUIPMENT STATUS, SET POINTS, AND OPERATIONAL POINTS.
- D. DATA SHALL BE STORED IN A CLASS 5 SECURE HOSTING LOCATION PROTECTED BY ISO 5001-COMPLIANT FIREWALL AND INTRUSION DETECTION SYSTEMS WITH SUPPORT FOR MAJOR NETWORK SECURITY PROTOCOLS SUCH AS HTTPS AND SFTP TO SECURELY ACCESS AND STORE DATA.
- E. DASHBOARD WEB INTERFACE: THE DASHBOARD INTERFACE SHALL ALLOW DISPLAY OF ENERGY AND BUILDING SYSTEM DATA IN WIDGETS, CHARTS AND TRACKING APPLICATIONS, AND BE AVAILABLE WITHOUT REQUIRING USERS TO UTILIZE EXTERNAL, THIRD PARTY TOOLS.
1. THE DASHBOARD WEB INTERFACE SHALL BE ACCESSIBLE VIA A WEB BROWSER WITHOUT REQUIRING ANY "PLUG-INS" (I.E. JAVA RUNTIME ENVIRONMENT (JRE), ADOBE FLASH).
 2. THE INTERFACE SHALL SUPPORT COMMON INTERNET WEB BROWSERS AT A MINIMUM INCLUDING: INTERNET EXPLORER 10.0+, FIREFOX 4.0+, CHROME 10.0+, OPERA, SAFARI
 3. THE INTERFACE SHALL SUPPORT THE FOLLOWING MOBILE WEB BROWSERS AT A MINIMUM: IOS (IPAD/IPHONE) V9.1+, ANDROID (TABLET) V4.3+, ANDROID (PHONE) V2.3+.
 4. DASHBOARDS SHALL BE CUSTOMIZABLE FOR EACH INDIVIDUAL OR GROUP OF USERS THE TO MODIFY PERSONAL DASHBOARDS AT ANY TIME USING A LIBRARY OF WIDGETS SPECIFIC TO THE PROJECT SITE OR DRAWING ON A VENDOR-PROVIDED LIBRARY OF ENERGY WIDGETS WITH EMBEDDED LOGIC FOR COMMON ENERGY CALCULATIONS.
 5. DASHBOARDS SHOULD BE CAPABLE OF TRACKING & DISPLAYING SUMMARY METRICS AND STATUS OF ENERGY AND EMISSIONS GOALS AT VARIOUS LEVELS: FLOOR/AREA, BUILDING, CAMPUS, PORTFOLIO.
- F. EACH USER SHALL BE REQUIRED TO LOGIN TO THE SYSTEM WITH A USER NAME AND PASSWORD IN ORDER TO VIEW, EDIT, ADD, OR DELETE DATA
- G. USER PROFILES SHALL RESTRICT THE USER TO ONLY THE OBJECTS, APPLICATIONS, AND SYSTEM FUNCTIONS AS ASSIGNED BY THE SYSTEM ADMINISTRATOR.
- H. EACH USER SHALL BE ALLOWED TO CHANGE THEIR USER PASSWORD.
- I. THE SYSTEM ADMINISTRATOR SHALL BE ABLE TO MANAGE THE SECURITY FOR ALL OTHER USERS
- J. THE SYSTEM SHALL INCLUDE PRE-DEFINED "ROLES" THAT ALLOW A SYSTEM ADMINISTRATOR TO QUICKLY ASSIGN PERMISSIONS TO A USER.
- K. BEMS DASHBOARD SHALL INCLUDE AN OBJECT-BASED WIDGET BUILDER FOR THE CREATION OF CUSTOM WIDGETS, AS WELL AS A LIBRARY OF OFF-THE-SHELF ENERGY WIDGETS TO UTILIZE:
1. USERS SHALL MODIFY PERSONAL DASHBOARDS AT ANY TIME USING A LIBRARY OF WIDGETS SPECIFIC TO THE PROJECT SITE OR DRAWING ON A VENDOR-PROVIDED LIBRARY OF ENERGY WIDGETS WITH EMBEDDED LOGIC FOR COMMON ENERGY CALCULATIONS.
 2. USERS ARE ALLOWED TO PICK AND CHOOSE WHICH WIDGETS ARE DISPLAYED, AND WHERE THEY ARE LOCATED.
- L. 7.12 SHALL PROVIDE AN OBJECT-BASED WIDGET BUILDER FOR THE CREATION OF CUSTOM WIDGETS INCLUDING:
1. TARGET A SPECIFIC BUILDING OR SYSTEM/EQUIPMENT
 2. CONFIGURE TIME PERIODS, PARAMETER VALUES (MAXIMUM/MINIMUM), UNITS OF MEASURE
 3. SELECT DISPLAY COLORS
 4. PREVIEW WIDGETS USING TARGET OBJECT
8. COMMUNICATION
- A. CONNECTIVITY / REMOTE ACCESS / NETWORK SECURITY
- B. PROVIDE THE INTEGRATION DEVICE (GATEWAY) TO COLLECT THE REQUIRED MONITORING POINTS FROM THE FACILITIES BAS. INTERFACE BETWEEN THE CLOUD STORAGE AND BAS SHALL BE VIA BACNET/IP.
- C. PROVIDE AND MAINTAIN SECURE REMOTE ACCESS TO THE FACILITIES BUILDING AUTOMATION SYSTEM (BAS) OR OTHER BUILDING SYSTEMS. USERS ACCESSING SERVICE SHALL NOT HAVE ACCESS TO THE BUILDING OWNERS NETWORK. SECURE REMOTE ACCESS TO THE BAS SHALL NOT REQUIRE ANY INBOUND PORTS ON A FIREWALL TO BE "EXPOSED" OR "FORWARDED".
- D. THE DASHBOARD WEB INTERFACE SHALL BE ACCESSIBLE VIA A WEB BROWSER WITHOUT REQUIRING ANY "PLUG-INS" (I.E. JAVA RUNTIME ENVIRONMENT (JRE), ADOBE FLASH).
- E. THE INTERFACE SHALL SUPPORT COMMON INTERNET WEB BROWSERS AT A MINIMUM INCLUDING: INTERNET EXPLORER 10.0+, FIREFOX 4.0+, CHROME 10.0+, OPERA, SAFARI
- F. THE INTERFACE SHALL SUPPORT THE FOLLOWING MOBILE WEB BROWSERS AT A MINIMUM: IOS (IPAD/IPHONE) V9.1+, ANDROID (TABLET) V4.3+, ANDROID (PHONE) V2.3+
- G. DASHBOARDS SHALL BE CUSTOMIZABLE FOR EACH INDIVIDUAL OR GROUP OF USERS TO MODIFY PERSONAL DASHBOARDS AT ANY TIME USING A LIBRARY OF WIDGETS SPECIFIC TO THE PROJECT SITE.
- H. DASHBOARDS SHOULD BE CAPABLE OF TRACKING & DISPLAYING SUMMARY METRICS AND STATUS OF ENERGY AND EMISSIONS GOALS AT VARIOUS LEVELS: FLOOR/AREA, BUILDING, CAMPUS, PORTFOLIO.
- I. DASHBOARD WIDGET BUILDER/LIBRARY:
1. DASHBOARD SHALL INCLUDE AN OBJECT-BASED WIDGET BUILDER FOR THE CREATION OF CUSTOM WIDGETS, AS WELL AS A LIBRARY OF OFF-THE-SHELF ENERGY WIDGETS TO UTILIZE.
 1. USER SHALL MODIFY PERSONAL DASHBOARDS AT ANY TIME USING A LIBRARY OF WIDGETS SPECIFIC TO THE PROJECT SITE OR DRAWING ON A VENDOR-PROVIDED LIBRARY OF ENERGY WIDGETS WITH EMBEDDED LOGIC FOR COMMON ENERGY CALCULATIONS.
 2. USERS ARE ALLOWED TO PICK AND CHOOSE WHICH WIDGETS ARE DISPLAYED, AND WHERE THEY ARE LOCATED.
2. SHALL PROVIDE AN OBJECT-BASED WIDGET BUILDER FOR THE CREATION OF CUSTOM WIDGETS INCLUDING:
1. TARGET A SPECIFIC BUILDING OR SYSTEM/EQUIPMENT
 2. CONFIGURE TIME PERIODS, PARAMETER VALUES (MAXIMUM/MINIMUM), UNITS OF MEASURE
 3. SELECT DISPLAY COLORS
 4. PREVIEW WIDGETS USING TARGET OBJECT.
- J. ACTIVE MONITORING SERVICE
1. REMOTE MONITORING FACILITY AND STAFFING:
 1. THIS SPECIFICATION REQUIRES THAT, FOR 1 YEAR, XYZ WILL HAVE 24/7/365 MONITORING OF UP TO 60 OF THEIR MOST CRITICAL ALARMS

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- DEVICES – SECTION 15.247 & SUBPART E
- G. EACH SYSTEM CONTROLLER SHALL PERFORM COMMUNICATIONS TO A NETWORK OF CUSTOM/APPLICATION AND APPLICATION SPECIFIC CONTROLLERS USING BACNET/MSTP (RS485) AS DEFINED BY THE BACNET STANDARD.
- ANALYTICS AND CONTINUING COMMISSIONING ARE BECOMING STANDARD IN AUTOMATION. DATA IS TRANSFERRED TO THE CLOUD FOR LONG TERM TRENDS, EASY TO INTERPRET GRAPHICS AND DASHBOARDS, AND TO BE ANALYZED TO CREATE ACTIONABLE RECOMMENDATIONS FOR AUTOMATION SYSTEM IMPROVEMENT.
9. INTELLIGENT SERVICES ANALYTICS
- A. ACCEPTABLE BUILDING ENERGY MANAGEMENT SYSTEM (BEMS) PROVIDERS:
1. SIEMENS AUTOMATION
- B. SYSTEM DESCRIPTION:
1. A BUILDING ANALYTIC SERVICE IS A CLOUD-BASED MONITORING TOOL ESTABLISHING THE BUILDING OPERATION BASELINE, ASSIST IN IDENTIFY ENERGY-SAVING OPPORTUNITIES AND IMPROVE BUILDING PERFORMANCE.
- C. BUILDING ANALYTIC SERVICE COMPONENT REQUIREMENTS AND TERM OF SERVICES:
1. THE SERVICE SHALL PROVIDE ENERGY METER DATA COLLECTION AND STORAGE INCLUDING ADVANCED ENERGY ANALYTICS FOR ENERGY CONSUMPTION AND COSTS WITH DISPLAY AND REPORTING VIA DASHBOARD/WIDGET TECHNOLOGIES.
 2. THE SERVICE SHALL PROVIDE DATA COLLECTION AND STORAGE FOR BUILDING SYSTEMS AND EQUIPMENT, ANALYTICS AND PROFESSIONAL ANALYSIS, INCLUDING AT A MINIMUM: GENERAL FACILITY PERFORMANCE METRICS, AUTOMATED FAR INSTALLATION, SUPERVISION, AND DIAGNOSIS AND SYSTEM/EQUIPMENT ANALYTICS WITH DISPLAY AND REPORTING VIA DASHBOARD/WIDGET TECHNOLOGIES.
 3. THE SERVICE SHALL BE PROVIDED FOR A 2-YEAR TERM FROM SUBSTANTIAL COMPLETION.
- D. CONNECTIVITY / REMOTE ACCESS / NETWORK SECURITY
1. PROVIDE THE INTEGRATION DEVICE (GATEWAY) TO COLLECT THE REQUIRED MONITORING POINTS FROM THE FACILITIES BAS. INTERFACE BETWEEN THE CLOUD STORAGE AND BAS SHALL BE VIA BACNET/IP.
 2. PROVIDE AND MAINTAIN SECURE REMOTE ACCESS TO THE FACILITIES BUILDING AUTOMATION SYSTEM (BAS) OR OTHER BUILDING SYSTEMS. USERS ACCESSING SERVICE SHALL NOT HAVE ACCESS TO THE BUILDING OWNERS NETWORK. SECURE REMOTE ACCESS TO THE BAS SHALL NOT REQUIRE ADDITIONAL SOFTWARE TO BE INSTALLED ON THE CLIENT DEVICE (I.E. VPN CLIENT).
 3. SECURE REMOTE ACCESS TO THE BAS SHALL NOT REQUIRE ANY INBOUND PORTS ON A FIREWALL TO BE "EXPOSED" OR "FORWARDED".
 3. SECURE REMOTE ACCESS TO THE BAS SHALL BE AVAILABLE ANYWHERE, ANYTIME, USING A COMPATIBLE CLIENT DEVICE (PC/TABLET/PHONE)
- E. DATA MONITORING & COLLECTION STANDARDS
1. THE SYSTEM SHALL RECORD AND STORE INTERVAL DATA, 24 HOURS/DAY, 7 DAYS/WEEK, 365 DAYS/YEAR. DATA TO BE COLLECTED FOR REAL-TIME CONTINUOUS MONITORING AND COLLECTION OF WHOLE-BUILDING ENERGY METERS AND SUB-METERS
 2. DATA TO BE COLLECTED FROM BUILDING AUTOMATION AND CONTROL SYSTEMS SUB-METERS AND SENSORS DATA FOR EQUIPMENT STATUS, SET POINTS, AND OPERATIONAL POINTS.
- F. BUILDING ANALYTICS & ANALYSIS:
1. PROVIDER SHALL BE PERFORM AUTOMATED BENCHMARKS OF FACILITY PERFORMANCE INCLUDING COMPARISONS AGAINST HOW THE BUILDING SHOULD OPERATE NORMALLY. PROVIDER SHALL DELIVER QUARTERLY COMPARISON OF BUILDING MONTH-TO-MONTH TRENDS TO KEY PERFORMANCE INDICATORS (KPI'S) AUTOMATED TESTS FOR BUILDING SCHEDULES, SYSTEMS AND EQUIPMENT SHALL PROVIDE EVIDENCE OF THE ONSET OF A PROBLEM AND PROVIDE GRAPHICAL DATA THAT DEMONSTRATES A RESOLUTION TO THE PROBLEM. KPI'S SHALL INCLUDE THE FOLLOWING:
 1. PERCENT TIME IN NORMAL OPERATIONS OF HVAC EQUIPMENT, SYSTEMS AND FACILITY
 2. ADVISORY DETAILS FOR HVAC EQUIPMENT AND SYSTEMS WITH INDICATORS FOR NORMAL OPERATION, WARNING, CRITICAL FAILURE.
 3. THE BUILDING PERFORMANCE SERVICE SHALL AUTOMATICALLY PROVIDE A FULL RANGE OF BUILDING-SPECIFIC FDD ANALYTICS FOR THE SYSTEM IN THE FOLLOWING AREAS:
 1. HEATING SYSTEMS/EQUIPMENT
 2. DEDICATED OUTDOOR AIR SYSTEMS/EQUIPMENT
 3. TERMINAL EQUIPMENT.
 2. PROFESSIONAL ANALYSIS: PROVIDER SHALL HAVE TRAINED PERSONNEL WITH RELEVANT PROFESSIONAL CREDENTIALS IN HVAC SYSTEMS, ENERGY MANAGEMENT AND BUILDING OPTIMIZATION METHODOLOGIES TO PREPARE PROFESSIONAL ASSESSMENT REPORTS INCLUDING:
 1. IDENTIFY BUILDING SYSTEM PERFORMANCE TRENDS AND DEVIATIONS FROM NORMAL OPERATION
 2. PREPARE ACTIONABLE RECOMMENDATIONS TO OPTIMIZE HVAC SYSTEM PERFORMANCE
 3. PREPARE RECOMMENDATIONS FOR OPERATIONAL ADJUSTMENTS
 4. PREPARE RISK ANALYSIS OF EMERGENCY MAINTENANCE OR FAILURE
 5. DEVELOP ENERGY CONSERVATION MEASURES (ECMS) WITH ENERGY SAVINGS OR PERFORMANCE IMPROVEMENT ESTIMATES
 3. PERFORMANCE ANALYTICS AND REPORTS ARE TO BE DEVELOPED AND REVIEWED WITH BUILDING OWNER DURING SCHEDULED PERFORMANCE REVIEW MEETINGS.
 1. PROVIDER WILL INCLUDE A MINIMUM OF [2] PERFORMANCE ANALYSIS FAULT DETECTION REPORTS ANNUALLY.
 2. PROVIDER SHALL SCHEDULE [2] PERFORMANCE REVIEW MEETINGS ANNUALLY WITH OWNER OR OWNERS DESIGNATED REPRESENTATIVE TO REVIEW PERFORMANCE REPORTS.
 3. PROVIDER SHALL PROVIDE A MINIMUM OF [2] ECM / PERFORMANCE IMPROVEMENT OPPORTUNITIES AT EACH REVIEW MEETING.
- G. DASHBOARD WEB INTERFACE: THE DASHBOARD INTERFACE SHALL ALLOW DISPLAY OF ENERGY AND BUILDING SYSTEM DATA IN WIDGETS, CHARTS AND TRACKING APPLICATIONS, AND BE AVAILABLE WITHOUT REQUIRING USERS TO UTILIZE EXTERNAL, THIRD PARTY TOOLS.
1. THE DASHBOARD WEB INTERFACE SHALL BE ACCESSIBLE VIA A WEB BROWSER WITHOUT REQUIRING ANY "PLUG-INS" (I.E. JAVA RUNTIME ENVIRONMENT (JRE), ADOBE FLASH).
 2. THE INTERFACE SHALL SUPPORT COMMON INTERNET WEB BROWSERS AT A MINIMUM INCLUDING: INTERNET EXPLORER 10.0+, FIREFOX 4.0+, CHROME 10.0+, OPERA, SAFARI
 3. THE INTERFACE SHALL SUPPORT THE FOLLOWING MOBILE WEB BROWSERS AT A MINIMUM: IOS (IPAD/IPHONE) V9.1+, ANDROID (TABLET) V4.3+, ANDROID (PHONE) V2.3+
 4. DASHBOARDS SHALL BE CUSTOMIZABLE FOR EACH INDIVIDUAL OR GROUP OF USERS TO MODIFY PERSONAL DASHBOARDS AT ANY TIME USING A LIBRARY OF WIDGETS SPECIFIC TO THE PROJECT SITE.
 5. DASHBOARDS SHOULD BE CAPABLE OF TRACKING & DISPLAYING SUMMARY METRICS AND STATUS OF ENERGY AND EMISSIONS GOALS AT VARIOUS LEVELS: FLOOR/AREA, BUILDING, CAMPUS, PORTFOLIO.
- H. DASHBOARD WIDGET BUILDER/LIBRARY:
1. DASHBOARD SHALL INCLUDE AN OBJECT-BASED WIDGET BUILDER FOR THE CREATION OF CUSTOM WIDGETS, AS WELL AS A LIBRARY OF OFF-THE-SHELF ENERGY WIDGETS TO UTILIZE.
 1. USER SHALL MODIFY PERSONAL DASHBOARDS AT ANY TIME USING A LIBRARY OF WIDGETS SPECIFIC TO THE PROJECT SITE OR DRAWING ON A VENDOR-PROVIDED LIBRARY OF ENERGY WIDGETS WITH EMBEDDED LOGIC FOR COMMON ENERGY CALCULATIONS.
 2. USERS ARE ALLOWED TO PICK AND CHOOSE WHICH WIDGETS ARE DISPLAYED, AND WHERE THEY ARE LOCATED.
2. SHALL PROVIDE AN OBJECT-BASED WIDGET BUILDER FOR THE CREATION OF CUSTOM WIDGETS INCLUDING:
1. TARGET A SPECIFIC BUILDING OR SYSTEM/EQUIPMENT
 2. CONFIGURE TIME PERIODS, PARAMETER VALUES (MAXIMUM/MINIMUM), UNITS OF MEASURE
 3. SELECT DISPLAY COLORS
 4. PREVIEW WIDGETS USING TARGET OBJECT.
- I. ACTIVE MONITORING SERVICE
1. REMOTE MONITORING FACILITY AND STAFFING:
 1. THIS SPECIFICATION REQUIRES THAT, FOR 1 YEAR, XYZ WILL HAVE 24/7/365 MONITORING OF UP TO 60 OF THEIR MOST CRITICAL ALARMS

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- FROM A DEDICATED REMOTE FACILITY STAFFED WITH HVAC TECHNICAL SPECIALISTS.
2. THE ORIGINAL EQUIPMENT MANUFACTURER (OEM) MONITORING CENTER MUST HAVE FULL REDUNDANCY IN SYSTEMS AT THE DATA CENTER LEVEL TO FULLY SUPPORT A 24/7/365 OPERATION. THIS INCLUDES, BUT IS NOT LIMITED TO, THE FOLLOWING SYSTEMS: ELECTRICAL, PHONE, DATABASE, AND SUPPORT.
 3. THE CENTER MUST HAVE A STAFF OF CONTROLS SPECIALISTS WHO HAVE FIELD EXPERTISE IN HVAC APPLIED SYSTEMS OPERATIONS.
 4. FACILITY CONTROLS SPECIALISTS MUST BE FACTORY TRAINED AND CERTIFIED IN BUILDING AUTOMATION SYSTEMS (BAS)
 5. IN THE EVENT OF AN OUTAGE AT THE PRIMARY REMOTE CENTER, A REDUNDANT SITE MUST BE IN PLACE TO PROVIDE ADDITIONAL BACKUP AND SUPPORT.
 6. IT WILL BE THE RESPONSIBILITY OF THE BUILDING OWNER TO PROVIDE THE CONNECTIVITY MEDIUM REQUIRED FOR REMOTE MONITORING TO THE DDC CONTRACTOR, AS WELL AS THE ANNUAL COSTS OF MAINTAINING THAT MEDIUM (FOR EXAMPLE, PHONE LINE, INTERNET, ET CETERA). THE REMOTE CONNECTION IS CONTINGENT ON RECEIVING PERMISSION FOR REMOTE ACCESS FROM PROPERTY OWNER.
- J. ACTIVE MONITORING RESPONSE REQUIREMENTS
1. UPON RECEIPT OF AN ALARM THROUGH AN OWNER-PROVIDED CONNECTIVITY MEDIUM (SUCH AS A PHONE LINE OR INTERNET ACCESS), AN HVAC SPECIALIST FROM THE MONITORING FACILITY WILL DIAGNOSE THE ISSUE AND TROUBLESHOOT FROM HIS/HER INTERFACE TO THE SYSTEM IN AN ATTEMPT TO CORRECT THE PROBLEM WITHOUT INITIATING ANY ON-SITE REMEDIATION. THIS WILL PREVENT XYZ FROM PLACING ANY SERVICE CALLS THAT MAY INHIBIT OR DELAY NECESSARY.
 2. IF CORRECTING THE ALARM REMOTELY IS NOT POSSIBLE, THE MONITORING FACILITY MUST INTELLIGENTLY DISPATCH A SERVICE TECHNICIAN WITH INFORMATION ABOUT THE ISSUE AND PROVIDE RECOMMENDATIONS TO COMPLETE THE PROBLEM IN THE FIELD.
 3. USE TELEPHONE SUPPORT TO DISPATCH A SERVICE TECHNICIAN, AS DICTATED BY XYZ, TO ENSURE THAT ONLY THE MOST APPROPRIATE OWNER CONTACTS, TECHNICIANS, AND FIELD SUPPORT PERSONNEL ARE ALWAYS INVOLVED. THIS HELPS FOR SMARTER AND MORE EFFICIENT SERVICE THAT ENSURES ACCURATE CALLS IN CASES WHERE THIS TYPE OF MAINTENANCE IS REQUIRED.
 4. TO GUARANTEE CONTINUAL MONITORING, COMMUNICATION BETWEEN THE REMOTE MONITORING FACILITY AND THE XYZ BUILDING CONTROL SYSTEM MUST BE TESTED AND PROVEN EACH QUARTER. DAMAGE CAUSED BY MISSED ALARMS, DUE TO LOST CONNECTIVITY IN BETWEEN TESTS, WILL NOT BE THE LIABILITY OF THE DDC CONTRACTOR. IT IS REQUIRED TO DELIVER TO XYZ EACH QUARTER, A RECORD OF THIS SUCCESSFUL TEST, AS WELL AS A RECORD OF EACH AUTOMATED CRITICAL ALARM RECORDED (AND THE ACTIONS ASSOCIATED ACTIONS IT).
 5. THE REMOTE FACILITY MUST COMPILE AND STORE A HISTORY OF ALL CRITICAL ALARMS, WITH THIS DATA BEING THE OWNED PROPERTY OF THE REMOTE MONITORING SERVICE PROVIDER, FOR FURTHER REDUNDANCY AND PROTECTION FROM FAILURES, DURING START-UP AND COMMISSIONING OF THE ALARM REPAIR. THIS LOGS AN ALARM TO DEMONSTRATE REMOTE CAPABILITY PRIOR TO ACCEPTANCE.
10. OPERATOR INTERFACE
- A. FURNISH [1] PC BASED OPERATOR WEB INTERFACE AS SHOWN ON THE SYSTEM DRAWINGS. EACH OF THESE BUILDING OPERATOR WEB INTERFACES SHALL BE ABLE TO ACCESS ALL INFORMATION IN THE SYSTEM. THE BUILDING OPERATOR WEB INTERFACE SHALL RESIDE ON THE BUILDING WIDE NETWORK, WHICH IS SAME HIGH-SPEED IP COMMUNICATIONS NETWORK AS THE SYSTEM CONTROLLERS. THE BUILDING WIDE NETWORK WILL BE PROVIDED BY THE OWNER AND SUPPORTS THE INTERNET PROTOCOL (IP).
- B. EACH OPERATOR INTERFACE PC SHALL INCLUDE THE FOLLOWING: (3) YEARS OF SOFTWARE SERVICE UPDATES, TREND DATA STORAGE, BACKUPS, PREFERRED CONNECTIVITY FOR BACKUPS IS THROUGH THE CLOUD. IF CLOUD IS NOT AVAILABLE PROVIDE AN ONSITE SERVER WITH 2 TB OF SECURE STORAGE.
- C. SERVICE TOOL
1. LAPTOP
- D. MINIMUM HARDWARE
1. INTEL CORE I5 OR BETTER
 - 8 GB RAM
 - 500 GB HARD DRIVE SPACE
- E. INTERNET BROWSER COMPATIBILITY OUTLINED IN THE FOLLOWING SECTIONS.
1. THE OPERATOR WEB INTERFACE SHALL BE ACCESSIBLE VIA A WEB BROWSER WITHOUT REQUIRING ANY "PLUG-INS" (I.E. JAVA RUNTIME ENVIRONMENT (JRE), ADOBE FLASH).
 2. THE OPERATOR WEB INTERFACE SHALL SUPPORT THE FOLLOWING INTERNET WEB BROWSERS:
 1. INTERNET EXPLORER 11.0+
 2. FIREFOX 47.0+
 3. CHROME 75.0+
 4. EDGE 13.0+
- F. THE OPERATOR WEB INTERFACE SHALL SUPPORT THE FOLLOWING MOBILE WEB BROWSERS:
1. IOS (IPAD/IPHONE) V9.1+
 2. ANDROID (TABLET) V4.3+
 3. ANDROID (PHONE) V2.3+
- G. BUILDING OPERATOR WEB INTERFACE
1. THE BUILDING OPERATOR WEB INTERFACE SHALL BE ACCESSIBLE VIA A WEB BROWSER WITHOUT REQUIRING ANY "PLUG-INS" (I.E. JAVA RUNTIME ENVIRONMENT (JRE), ADOBE FLASH)
- H. SYSTEM SECURITY
1. EACH OPERATOR SHALL BE REQUIRED TO LOGIN TO THE SYSTEM WITH A USER NAME AND PASSWORD IN ORDER TO VIEW, EDIT, ADD, OR DELETE DATA
 2. USER PROFILES SHALL RESTRICT THE USER TO ONLY THE OBJECTS, APPLICATIONS, AND SYSTEM FUNCTIONS AS ASSIGNED BY THE SYSTEM ADMINISTRATOR.
 3. EACH OPERATOR SHALL BE ALLOWED TO CHANGE THEIR USER PASSWORD.
 4. THE SYSTEM ADMINISTRATOR SHALL BE ABLE TO MANAGE THE SECURITY FOR ALL OTHER USERS.
 5. THE SYSTEM SHALL INCLUDE PRE-DEFINED "ROLES" THAT ALLOW A SYSTEM ADMINISTRATOR TO QUICKLY ASSIGN PERMISSIONS TO A USER.
 6. USER LOGON/LOGOFF ATTEMPTS SHALL BE RECORDED.
 7. THE SYSTEM SHALL PROTECT ITSELF FROM UNAUTHORIZED ACCESS BY AUTOMATICALLY LOGGING OFF FOLLOWING THE LAST KEYSTROKE. THE DELAY TIME SHALL BE USER DEFINABLE.
 8. ALL SYSTEM SECURITY DATA SHALL BE STORED IN AN ENCRYPTED FORMAT.
- I. ON-LINE HELP AND TRAINING
1. PROVIDE A CONTEXT SENSITIVE, ONLINE HELP SYSTEM TO ASSIST THE OPERATOR IN OPERATION AND CONFIGURATION OF THE SYSTEM.
 2. ON-LINE HELP SHALL INCLUDE A LIBRARY OF FILTER FUNCTIONALITIES AND SHALL PROVIDE THE RELEVANT DATA FOR EACH PARTICULAR SCREEN.
- J. SYSTEM DIAGNOSTICS
1. THE SYSTEM SHALL AUTOMATICALLY MONITOR THE OPERATION OF ALL NETWORK CONNECTIONS, BUILDING MANAGEMENT PANELS, AND CONTROLLERS.
 2. THE FAILURE OF ANY DEVICE SHALL BE ANNUNCIATED TO THE OPERATORS.
- K. EQUIPMENT & APPLICATION PAGES
1. THE BUILDING OPERATOR WEB INTERFACE SHALL INCLUDE STANDARD PAGES FOR ALL EQUIPMENT AND APPLICATIONS. THESE PAGES SHALL ALLOW AN OPERATOR TO OBTAIN INFORMATION RELEVANT TO THE OPERATION OF THE EQUIPMENT AND/OR APPLICATION, INCLUDING:
 1. ALARMS RELEVANT TO THE EQUIPMENT OR APPLICATION WITHOUT REQUIRING A USER TO NAVIGATE TO AN ALARM PAGE AND PERFORM A FILTER.
 2. HISTORICAL DATA (AS DEFINED IN DATA LOG SECTION BELOW) FOR THE EQUIPMENT OR APPLICATION WITHOUT REQUIRING A USER TO NAVIGATE TO A DATA LOG PAGE AND PERFORM A FILTER.
- L. SYSTEM GRAPHICS. BUILDING OPERATOR WEB INTERFACE SHALL BE GRAPHICALLY BASED AND SHALL INCLUDE AT LEAST ONE GRAPHIC PER PIECE OF EQUIPMENT OR OCCUPIED ZONE. GRAPHICS FOR EACH CHILLED WATER AND HOT WATER SYSTEM, AND GRAPHICS THAT SUMMARIZE CONDITIONS ON EACH FLOOR OF EACH BUILDING INCLUDED IN THIS CONTRACT. INDICATE THERMAL COMFORT ON FLOOR PLAN SUMMARY GRAPHICS USING COLORS TO REPRESENT ZONE TEMPERATURE RELATIVE TO ZONE SET POINTS.
1. FUNCTIONALITY. GRAPHICS SHALL ALLOW OPERATOR TO MONITOR SYSTEM STATUS, TO VIEW A SUMMARY OF THE MOST IMPORTANT DATA FOR EACH CONTROLLED ZONE OR PIECE OF EQUIPMENT, TO USE POINT AND-CLICK NAVIGATION BETWEEN ZONES OR EQUIPMENT, AND TO EDIT SET POINTS AND OTHER SPECIFIED PARAMETERS.
 2. GRAPHIC IMAGERY – GRAPHICS SHALL USE 3D IMAGES FOR ALL STANDARD

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- AND CUSTOM GRAPHICS. THE ONLY ALLOWABLE EXCEPTIONS WILL BE PHOTO IMAGES, MAPS, SCHEMATIC DRAWINGS, AND SELECTED FLOOR PLANS.
3. ALARM INDICATION. INDICATE AREAS OR EQUIPMENT IN AN ALARM CONDITION USING COLOR OR OTHER VISUAL INDICATOR.
- M. CUSTOM GRAPHICS
1. THE OPERATOR INTERFACE SHALL BE CAPABLE OF DISPLAYING CUSTOM GRAPHICS IN ORDER TO CONVEY THE STATUS OF THE FACILITY TO ITS OPERATORS.
 2. GRAPHICAL NAVIGATION. THE BUILDING OPERATOR WEB INTERFACE SHALL PROVIDE DYNAMIC COLOR GRAPHICS OF BUILDING AREAS, SYSTEMS AND EQUIPMENT.
 3. GRAPHICAL DATA VISUALIZATION. THE BUILDING OPERATOR WEB INTERFACE SHALL SUPPORT DYNAMIC POINTS INCLUDING ANALOG AND BINARY VALUES, DYNAMIC TEXT, STATIC TEXT, AND ANIMATION FILES.
- N. MANUAL CONTROL AND OVERRIDE
1. POINT CONTROL. PROVIDE A METHOD FOR A USER TO VIEW, OVERRIDE, AND EDIT IF APPLICABLE, THE STATUS OF ANY OBJECT AND PROPERTY IN THE SYSTEM. THE POINT STATUS SHALL BE AVAILABLE BY MENU, ON GRAPHICS OR THROUGH CUSTOM PROGRAMS.
 3. OVERRIDE OWNERS. THE SYSTEM SHALL CONVEY TO THE USER THE OWNER OF EACH OVERRIDE FOR ALL PRIORITIES THAT AN OVERRIDE EXISTS.
 4. PROVIDE A SPECIFIC ICON TO SHOW TIMED OVERRIDE OR OPERATOR OVERRIDE WHEN A POINT, UNIT CONTROLLER OR APPLICATION HAS BEEN OVERRIDDEN MANUALLY.
- O. SCHEDULING. A USER SHALL BE ABLE TO PERFORM THE FOLLOWING TASKS UTILIZING THE BUILDING OPERATOR WEB INTERFACE:
1. CREATE A NEW SCHEDULE, DEFINING THE DEFAULT VALUES, EVENTS AND MEMBERSHIP.
 2. CREATE EXCEPTIONS TO A SCHEDULE FOR ANY GIVEN DAY.
 3. APPLY AN EXCEPTION THAT SPANS A SINGLE DAY OR MULTIPLE DAYS.
 4. VIEW A SCHEDULE BY DAY, WEEK AND MONTH.
 5. EXCEPTION SCHEDULES AND HOLIDAYS SHALL BE SHOWN CLEARLY ON THE CALENDAR.
 6. MODIFY THE SCHEDULE EVENTS, MEMBERS AND EXCEPTIONS.
- P. DATA LOGS
1. DATA LOGS DEFINITION.
 1. THE BUILDING OPERATOR WEB INTERFACE SHALL ALLOW A USER WITH THE APPROPRIATE SECURITY PERMISSIONS TO DEFINE A DATA LOG FOR ANY DATA IN THE SYSTEM.
 2. THE BUILDING OPERATOR WEB INTERFACE SHALL ALLOW A USER TO DEFINE ANY DATA LOG OPTIONS AS DESCRIBED IN THE APPLICATION AND CONTROL, SOFTWARE SECTION.
 2. DATA LOG VIEWERS.
 1. THE BUILDING OPERATOR WEB INTERFACE SHALL ALLOW DATA LOG DATA TO BE VIEWED AND PRINTED.
 2. THE BUILDING OPERATOR WEB INTERFACE SHALL ALLOW A USER TO VIEW DATA LOG DATA IN A TEXT-BASED FORMAT (TIME - STAMP/VALUE).
 3. THE OPERATOR SHALL BE ABLE TO VIEW THE DATA COLLECTED BY A DATA LOG IN A GRAPHICAL CHART IN THE BUILDING OPERATOR WEB INTERFACE.
 4. DATA LOG VIEWING CAPABILITIES SHALL INCLUDE THE ABILITY TO SHOW A MINIMUM OF 5 POINTS ON A CHART.
 5. EACH DATA POINT DATA LINE SHALL BE DISPLAYED AS A UNIQUE COLOR.
 6. THE OPERATOR SHALL BE ABLE TO SPECIFY THE DURATION OF HISTORICAL DATA TO VIEW BY SCROLLING AND ZOOMING.
 7. THE SYSTEM SHALL PROVIDE A GRAPHICAL TRACE DISPLAY OF THE ASSOCIATED TIME STAMP AND VALUE FOR ANY SELECTED POINT ALONG THE X-AXIS.
 3. EXPORT DATA LOGS.
 1. THE BUILDING OPERATOR WEB INTERFACE SHALL ALLOW A USER TO EXPORT DATA LOG DATA IN CSV OR PDF FORMAT FOR USE BY OTHER INDUSTRY STANDARD WORD PROCESSING AND SPREADSHEET PACKAGES.
- Q. ALARM/EVENT NOTIFICATION
1. AN OPERATOR SHALL BE NOTIFIED OF NEW ALARMS/EVENTS AS THEY OCCUR WHILE NAVIGATING THROUGH ANY PART OF THE SYSTEM VIA AN ALARM ICON.
 2. ALARM/EVENT LOG. THE OPERATOR SHALL BE ABLE TO VIEW ALL LOGGED SYSTEM ALARMS/EVENTS FROM ANY BUILDING OPERATOR WEB INTERFACE.
 3. THE OPERATOR SHALL BE ABLE TO SORT AND FILTER ALARMS FROM EVENTS. ALARMS SHALL BE SORTED IN A MINIMUM OF 4 CATEGORIES BASED ON SEVERITY.
 4. ALARM/EVENT MESSAGES SHALL USE FULL LANGUAGE, EASILY RECOGNIZED DESCRIPTORS.
 5. AN OPERATOR WITH THE PROPER SECURITY LEVEL MAY ACKNOWLEDGE AND CLEAR ALARMS/EVENTS.
 6. ALL ALARMS/EVENTS THAT HAVE NOT BEEN CLEARED BY THE OPERATOR SHALL BE STORED BY THE BUILDING CONTROLLER.
 7. THE ALARM/EVENT LOG SHALL INCLUDE A COMMENT FIELD FOR EACH ALARM/EVENT THAT ALLOWS A USER TO ADD SPECIFIC COMMENTS ASSOCIATED WITH ANY ALARM.
 8. ALARM PROCESSING.
 1. THE OPERATOR SHALL BE ABLE TO CONFIGURE ANY OBJECT IN THE SYSTEM TO GENERATE AN ALARM WHEN TRANSITIONING IN AND OUT OF A NORMAL STATE.
 2. THE OPERATOR SHALL BE ABLE TO CONFIGURE THE ALARM LIMITS, WARNING LIMITS, STATES, AND REACTIONS FOR EACH OBJECT IN THE SYSTEM.
- R. REPORTS AND LOGS.
1. THE BUILDING OPERATOR WEB INTERFACE SHALL PROVIDE A REPORTING PACKAGE THAT ALLOWS THE OPERATOR TO SELECT REPORTS.
 2. THE BUILDING OPERATOR WEB INTERFACE SHALL PROVIDE THE ABILITY TO SCHEDULE REPORTS TO RUN AT SPECIFIED INTERVALS OF TIME.
 3. THE BUILDING OPERATOR WEB INTERFACE SHALL ALLOW A USER TO EXPORT REPORTS AND LOGS FROM THE BUILDING CONTROLLER IN A FORMAT THAT IS READILY ACCESSIBLE BY OTHER STANDARD SOFTWARE APPLICATIONS INCLUDING SPREADSHEETS AND WORD PROCESSING. ACCEPTABLE FORMATS INCLUDE:
 1. CSV, HTML, XML, PDF
 4. REPORTS AND LOGS SHALL BE READILY PRINTED TO THE SYSTEM PRINTER.
 5. PROVIDE A MEANS TO LIST AND ACCESS THE LAST 10 REPORTS VIEWED BY THE USER.
 6. THE FOLLOWING STANDARD REPORTS SHALL BE AVAILABLE WITHOUT REQUIRING A USER TO MANUALLY CONFIGURE THE REPORT:
 1. ALL POINTS IN ALARM REPORT: PROVIDE AN ON-DEMAND REPORT SHOWING ALL CURRENT ALARMS.
 2. ALL POINTS IN OVERRIDE REPORT: PROVIDE AN ON-DEMAND REPORT SHOWING ALL OVERRIDES IN EFFECT.
 3. COMMISSIONING REPORT: PROVIDE A ONE-TIME REPORT THAT LISTS ALL EQUIPMENT WITH THE UNIT CONFIGURATION AND PRESENT OPERATION.
 4. POINTS REPORT: PROVIDE A REPORT THAT LISTS THE CURRENT VALUE OF ALL POINTS

THESE DRAWINGS ARE NOT TO BE SCALED
ALL DRAWINGS, THE DESIGN, AND THE DETAILS THEREON REMAIN THE PROPERTY OF THE CONSULTANT AND ARE NOT TO BE ALTERED, RE-USED OR REPRODUCED WITHOUT THE CONSULTANT'S EXPRESS WRITTEN CONSENT.

THE CONTRACTOR MUST FIELD VERIFY ALL DIMENSIONS AND MUST CONFIRM & CORRELATE ALL DETAILS WITHIN THE FULL DRAWING PACKAGE. BEING RESPONSIBLE FOR SAME THROUGHOUT CONSTRUCTION. REPORTING ANY DISCREPANCIES TO THE ARCHITECT PRIOR TO COMMENCING THE RELEVANT WORK.

ALL DRAWINGS, DETAILS & SPECIFICATIONS REPRESENTED IN THE DRAWINGS ARE TO BE USED FOR CONSTRUCTION ONLY WHEN ISSUED BY THE ARCHITECT AND NOTED ACCORDINGLY IN THE 'ISSUE/REVISIONS BOX HEREON.'

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HVAC Renovations

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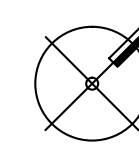
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TRUE NORTH:



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CONTROLS & INSTRUMENTATION SPEC.

13. CONTROLLER SOFTWARE
A. FURNISH THE FOLLOWING APPLICATIONS SOFTWARE FOR BUILDING AND ENERGY MANAGEMENT AND SOFTWARE APPLICATIONS RESIDES AND RUN IN THE SYSTEM CONTROLLERS. EDITING OF APPLICATIONS SHALL OCCUR AT THE BUILDING OPERATOR INTERFACE.
1. SCHEDULING, PROVIDE THE CAPABILITY TO SCHEDULE EACH OBJECT OR GROUP OF OBJECTS IN THE SYSTEM EACH OF THESE SCHEDULES SHALL INCLUDE THE CAPABILITY FOR START, STOP, OPTIMAL START, OPTIMAL STOP, AND NIGHT ECONOMIZER ACTIONS. EACH SCHEDULE MAY CONSIST OF UP TO [10] EVENTS. WHEN A GROUP OF OBJECTS ARE SCHEDULED TOGETHER, PROVIDE THE CAPABILITY TO DEFINE DELAYS AND DELAYS FOR EACH MEMBER. EACH SCHEDULE SHALL CONSIST OF THE FOLLOWING:
1. WEEKLY SCHEDULE:
PROVIDE SEPARATE SCHEDULES FOR EACH DAY OF THE WEEK.
2. EXCEPTION SCHEDULES:
PROVIDE THE ABILITY FOR THE OPERATOR TO DESIGNATE ANY DAY OF THE YEAR AS AN EXCEPTION SCHEDULE. THIS EXCEPTION SCHEDULE SHALL OVERRIDE THE STANDARD SCHEDULE FOR THAT DAY. EXCEPTION SCHEDULES MAY BE DEFINED UP TO A YEAR IN ADVANCE. ONCE AN EXCEPTION SCHEDULE IS EXERCISED IT WILL BE DISCARDED AND REPLACED BY THE STANDARD SCHEDULE FOR THAT DAY OF THE WEEK.
3. HOLIDAY SCHEDULES:
PROVIDE THE CAPABILITY FOR THE OPERATOR TO DEFINE UP TO 99 SPECIAL OR HOLIDAY SCHEDULES. THESE SCHEDULES MAY BE PLACED ON THE SCHEDULING CALENDAR AND WILL BE REPEATED EACH YEAR. THE OPERATOR SHALL BE ABLE TO DEFINE THE LENGTH OF EACH HOLIDAY PERIOD.
4. OPTIMAL START:
THE SCHEDULING APPLICATION OUTLINED ABOVE SHALL SUPPORT AN OPTIMAL START ALGORITHM. THIS SHALL CALCULATE THE THERMAL CHARACTERISTICS OF A ZONE AND START THE EQUIPMENT PRIOR TO OCCUPANCY TO ACHIEVE THE DESIRED SPACE TEMPERATURE AT THE SPECIFIED OCCUPANCY TIME. THE ALGORITHM SHALL CALCULATE SEPARATE SETS OF HEATING AND COOLING RATES FOR ZONES THAT HAVE BEEN UNOCCUPIED FOR LESS THAN AND GREATER THAN 24 HOURS. PROVIDE THE ABILITY TO DEFINE AN EARLY START LIMIT IN MINUTES TO PREVENT THE SYSTEM FROM STARTING BEFORE AN OPERATOR DETERMINED TIME LIMIT.
2. TREND LOG APPLICATION
1. TREND LOG DATA SHALL BE SAMPLED AND STORED ON THE SYSTEM CONTROLLER PANEL AND SHALL CAPABLE OF BEING ARCHIVED TO A BACNET WORKSTATION FOR LONGER TERM STORAGE.
2. TREND LOGS SHALL INCLUDE INTERVAL, START-TIME, AND STOP-TIME.
3. TREND LOG INTERVALS SHALL BE CONFIGURABLE AS FREQUENTLY AS 1 MINUTE AND AS INFREQUENTLY AS 1 YEAR.
3. TREND LOGS
1. THE SYSTEM CONTROLLER SHALL CREATE TREND LOGS FOR DEFINED KEY PERFORMANCE INDICATORS FOR EACH CONTROLLED HVAC DEVICE AND HVAC APPLICATION.
2. THE TREND LOGS SHALL MONITOR THESE PARAMETERS FOR A MINIMUM OF 7 DAYS AT 15 MINUTE INTERVALS. THE AUTOMATIC TREND LOGS SHALL BE USER ADJUSTABLE.
4. ALARM/EVENT LOG
1. ANY OBJECT IN THE SYSTEM SHALL BE CONFIGURABLE TO GENERATE AN ALARM WHEN TRANSITIONING IN AND OUT OF A NORMAL OR FAULT STATE.
2. ANY OBJECT IN THE SYSTEM SHALL ALLOW THE ALARM LIMITS, WARNING LIMITS, STATES, AND REACTIONS TO BE CONFIGURED FOR EACH OBJECT IN THE SYSTEM.
3. AN ALARM/EVENT SHALL BE CAPABLE OF TRIGGERING ANY OF THE FOLLOWING ACTIONS:
1. ROUTE THE ALARM/EVENT TO ONE OR MORE ALARM LOG
2. THE ALARM MESSAGE SHALL INCLUDE THE NAME OF THE ALARM LOCATION, THE DEVICE THAT GENERATED THE ALARM, AND THE ALARM MESSAGE ITSELF.
3. ROUTE AN E-MAIL MESSAGE TO AN OPERATOR(S)
4. LOG A DATA POINT(S) FOR A PERIOD OF TIME
5. RUN A CUSTOM CONTROL PROGRAM
5. POINT CONTROL USER SHALL HAVE THE OPTION TO SET THE UPDATE INTERVAL, MINIMUM ON/OFF TIME, EVENT NOTIFICATION, CUSTOM PROGRAMMING ON CHANGE OF EVENTS.
6. TIMEED OVERRIDE. A STANDARD APPLICATION SHALL BE UTILIZED TO ENABLE/DISABLE TEMPERATURE CONTROL WHEN A USER SELECTS ON/CANCEL AT THE ZONE SENSOR, BUILDING OPERATOR INTERFACE, OR THE LOCAL OPERATOR DISPLAY. THE AMOUNT OF TIME THAT THE OVERRIDE TAKES PRECEDENCE WILL BE SELECTABLE FROM THE BUILDING OPERATOR INTERFACE.
7. ANTI-SHORT CYCLING ALL BINARY OUTPUT POINTS SHALL BE PROTECTED FROM SHORT CYCLING

CONTROLS & INSTRUMENTATION SPEC.

15. AUXILIARY CONTROL DEVICES
A. BINARY TEMPERATURE DEVICES
1. LOW-VOLTAGE SPACE THERMOSTAT SHALL BE 24 V, BIMETAL-OPERATED, MERCURY-SWITCH TYPE, WITH EITHER ADJUSTABLE OR FIXED ANTICIPATION HEATER, CONCEALED SETPOINT ADJUSTMENT, 1/32 TO 30/32 (55F TO 85F) SETPOINT RANGE, 1" (2F) MAXIMUM DIFFERENTIAL, AND VENTED ABS PLASTIC COVER.
2. LINE-VOLTAGE SPACE THERMOSTAT SHALL BE BIMETAL-ACTUATED, OPEN CONTACT TYPE, OR BELLOWS-ACTUATED, ENCLOSED, SNAP-SWITCH TYPE OR EQUIVALENT SOLID-STATE TYPE, WITH HEAT ANTICIPATOR, UL LISTED FOR ELECTRICAL RATING, CONCEALED SETPOINT ADJUSTMENT, 1/32 TO 30/32 (55F TO 85F) SETPOINT RANGE, 1" (2F) MAXIMUM DIFFERENTIAL, AND VENTED ABS PLASTIC COVER.
3. LOW-LIMIT THERMOSTATS, LOW-LIMIT AIRSTREAM THERMOSTATS SHALL BE UL LISTED, VAPOR PRESSURE TYPE, WITH AN ELEMENT OF 6 M (20 FT) MINIMUM LENGTH. ELEMENT SHALL RESPOND TO THE LOWEST TEMPERATURE SENSIBLE BY ANY 30 CM (1 FT) SECTION. THE LOW-LIMIT THERMOSTAT SHALL BE MANUAL RESET ONLY.
16. COORDINATION
A. SITE
1. WHERE THE MECHANICAL WORK WILL BE INSTALLED IN CLOSE PROXIMITY TO, OR WILL INTERFERE WITH, WORK OF OTHER TRADES, THE CONTRACTOR SHALL ASSIST IN WORKING OUT SPACE CONDITIONS TO MAKE A SATISFACTORY ADJUSTMENT. IF THE CONTRACTOR INSTALLS HIS/HER WORK BEFORE COORDINATING WITH OTHER TRADES, SO AS TO CAUSE ANY INTERFERENCE WITH WORK OF OTHER TRADES, THE CONTRACTOR SHALL MAKE THE NECESSARY CHANGES IN HIS/HER WORK TO CORRECT THE CONDITION WITHOUT EXTRA CHARGE.
2. COORDINATE AND SCHEDULE WORK WITH ALL OTHER WORK IN THE SAME AREA, OR WITH WORK THAT IS DEPENDENT UPON OTHER WORK, TO FACILITATE MUTUAL PROGRESS.
B. TEST AND BALANCE
1. THE CONTRACTOR SHALL FURNISH A SINGLE SET OF ALL TOOLS NECESSARY TO INTERFERE TO THE CONTROL SYSTEM FOR TEST AND BALANCE PURPOSES.
2. THE CONTRACTOR SHALL PROVIDE TRAINING IN THE USE OF THESE TOOLS. THIS TRAINING WILL BE PLANNED FOR A DURATION OF 4 HOURS.
3. IN ADDITION, THE CONTRACTOR SHALL PROVIDE A QUALIFIED TECHNICIAN TO ASSIST IN THE TEST AND BALANCE PROCESS, UNTIL THE FIRST 20 TERMINAL UNITS ARE BALANCED.
4. THE TOOLS USED DURING THE TEST AND BALANCE PROCESS SHALL BE RETURNED TO THE CONTRACTOR AT THE COMPLETION OF THE TESTING AND BALANCING.
C. COORDINATION WITH CONTROLS SPECIFIED IN OTHER SECTIONS OR DIVISIONS, OTHER SECTIONS AND/OR DIVISIONS OF THIS SPECIFICATION INCLUDE CONTROLS AND CONTROL DEVICES THAT ARE TO BE PART OF OR INTERFACED TO THE CONTROL SYSTEM SPECIFIED IN THIS SECTION. THESE CONTROLS SHALL BE INTEGRATED INTO THE SYSTEM AND COORDINATED BY THE CONTRACTOR AS FOLLOWS:
1. ALL COMMUNICATION MEDIA AND EQUIPMENT SHALL BE PROVIDED AS SPECIFIED IN THE COMMUNICATIONS SECTION OF THIS SPECIFICATION
2. EACH SUPPLIER OF A CONTROLS PRODUCT IS RESPONSIBLE FOR THE CONFIGURATION, PROGRAMMING, START-UP, AND TESTING OF THAT PRODUCT TO MEET THE SEQUENCES OF OPERATION DESCRIBED IN THIS SECTION
3. THE CONTRACTOR SHALL COORDINATE AND RESOLVE ANY INCOMPATIBILITY ISSUES THAT ARISE BETWEEN THE CONTROL PRODUCTS PROVIDED UNDER THIS SECTION AND THOSE PROVIDED UNDER OTHER SECTIONS OR DIVISIONS OF THIS SPECIFICATION.
D. PARTS SUPPLIED BY CONTROLS CONTRACTOR MUST BE TURNED OVER TO THE MECHANICAL CONTRACTOR FOR INSTALLATION. PARTS INCLUDE BUT ARE NOT LIMITED TO CONTROL VALVES, DAMPERS, INLINE DEVICES, THERMAL DEVICES, THERMAL WELLS.
17. WIRING
A. BAS INSTALLING CONTRACTOR IS RESPONSIBLE FOR ALL MECHANICAL INTERLOCK WIRING, SENSOR WIRING, AND CONTROL WIRING REQUIRED UNLESS SPECIFIED TO BE FACTORY MOUNTED PER DIVISION 23.
B. ALL CONTROL AND INTERLOCK WIRING SHALL COMPLY WITH THE NATIONAL, LOCAL ELECTRICAL CODES, AND SECTION 26 00 00 OF THESE CONTRACT DOCUMENT SPECIFICATIONS. WHERE THE REQUIREMENTS OF THIS SECTION DIFFER WITH THOSE IN ELECTRICAL SPECIFICATIONS, THE REQUIREMENTS OF THIS SECTION SHALL TAKE PRECEDENCE. THIS WORK INCLUDES INTERLOCK WIRING FOR MECHANICAL EQUIPMENT REQUIRED FOR A COMPLETE INSTALLATION. EQUIPMENT SPECIFIED TO HAVE FACTORY MOUNTED CONTROLLERS AND DEVICE ARE NOT INCLUDE BY THIS DIVISION.
C. ALL CEC CLASS 1 (LINE VOLTAGE) WIRING SHALL BE UL LISTED IN APPROVED RACEWAY ACCORDING TO CEC REQUIREMENTS.
D. WHERE CLASS 2 WIRES ARE IN CONCEALED AND ACCESSIBLE LOCATIONS; INCLUDING CEILING RETURN AIR PLENUMS, APPROVED CABLES OUTSIDE OF ELECTRICAL RACEWAY CAN BE USED PROVIDED THAT THE FOLLOWING CONDITIONS ARE MET:
1. CIRCUITS MEET CEC CLASS 2 (CURRENT_LIMITED) REQUIREMENTS. (LOW-VOLTAGE POWER CIRCUITS SHALL BE SUB_FUSED WHEN REQUIRED TO MEET CLASS 2 CURRENT_LIMIT)
2. ALL CABLES SHALL BE UL LISTED FOR APPLICATION (I.E., CABLES USED IN CEILING PLENUMS SHALL BE UL LISTED SPECIFICALLY FOR THAT PURPOSE).
E. DO NOT INSTALL CLASS 2 WIRING IN CONDUITS CONTAINING CLASS 1 WIRING, BOXES AND PANELS CONTAINING HIGH VOLTAGE MAY NOT BE USED FOR LOW VOLTAGE WIRING EXCEPT FOR THE PURPOSE OF INTERFACING THE TWO VIA CONTROL RELAYS AND TRANSFORMERS.
F. WHERE CLASS 2 WIRING IS RUN EXPOSED, WIRING SHALL BE RUN PARALLEL ALONG A SURFACE OR PERPENDICULAR TO IT, AND BUNDLED, USING APPROVED WIRE TIES AT NO GREATER THAN 3 M (10 FT) INTERVALS. SUCH BUNDLED CABLE SHALL BE FASTENED TO THE STRUCTURE, USING INDUSTRY APPROVED FASTENERS, AT 1.5 M (5 FT) INTERVALS OR MORE OFTEN TO ACHIEVE A NEAT AND WORKMANLIKE RESULT.
G. ALL WIRE-TO-DEVICE CONNECTIONS SHALL BE MADE AT A TERMINAL BLOCKS OR TERMINAL STRIP. ALL WIRE-TO WIRE CONNECTIONS SHALL BE AT A TERMINAL BLOCK, OR WITH A GRIPED CONNECTOR. ALL WIRING WITHIN ENCLOSURES SHALL BE NEATLY BUNDLED AND ANCHORED TO PERMIT ACCESS AND PREVENT RESTRICTION TO DEVICES AND TERMINALS.
H. MAXIMUM ALLOWABLE VOLTAGE FOR CONTROL WIRING SHALL BE 120VAC IF ONLY HIGHER VOLTAGES ARE AVAILABLE FOR USE. THE BAS MANUFACTURER SHALL PROVIDE STEP-DOWN TRANSFORMERS TO ACHIEVE THE DESIRED CONTROL VOLTAGES.
I. ALL CONTROL WIRING SHALL BE INSTALLED AS CONTINUOUS LENGTHS, WHERE POSSIBLE. ANY REQUIRED SPLICES SHALL BE MADE ONLY WITHIN WIRING APPROVED JUNCTION BOX OR OTHER APPROVED PROTECTIVE DEVICE.
J. INSTALL PLENUM WIRING IN SLEEVES WHERE IT PASSES THROUGH WALLS AND FLOORS. MAINTAIN FIRE RATING AT ALL PENETRATIONS IN ACCORDANCE WITH CONTRACT DOCUMENTS AND NATIONAL AND/OR LOCAL CODES.
K. CONDUIT AND WIRE SIZING SHALL BE DETERMINED BY THE BAS MANUFACTURER IN ORDER TO MAINTAIN MANUFACTURER'S RECOMMENDATION AND MEET NATIONAL AND LOCAL CODES.
L. CONTROL AND STATUS RELAYS ARE TO BE LOCATED IN PRE-FABRICATED ENCLOSURES THAT MEET THE APPLICATION. THESE RELAYS MAY ALSO BE LOCATED WITHIN PACKAGED EQUIPMENT CONTROL PANEL ENCLOSURES AS COORDINATED. THESE RELAYS SHALL NOT BE LOCATED WITHIN CLASS 1 STARTER ENCLOSURES.
M. FOLLOW MANUFACTURER'S INSTALLATION RECOMMENDATIONS FOR ALL COMMUNICATION AND NETWORK BUS CABLING. NETWORK OR COMMUNICATION CABLING SHALL BE RUN SEPARATELY FROM ALL CONTROL POWER WIRING.
N. ADHERE TO ELECTRICAL REQUIREMENTS FOR INSTALLATION OF ELECTRICAL RACEWAYS.
O. BAS MANUFACTURER SHALL TERMINATE ALL CONTROL AND/OR INTERLOCK WIRING AND SHALL MAINTAIN UPDATED (AS-BUILT) WIRING DIAGRAMS WITH TERMINATIONS IDENTIFIED AT THE JOB SITE.
P. FLEXIBLE METAL CONDUITS AND LIQUID-TIGHT FLEXIBLE METAL CONDUITS SHALL NOT EXCEED 3' IN LENGTH AND SHALL BE SUPPORTED AT EACH END. FLEXIBLE METAL CONDUIT LESS THAN 1/2" ELECTRICAL TRADE SIZE SHALL NOT BE USED. IN AREAS EXPOSED TO MOISTURE, INCLUDING CHILLER AND BOILER ROOMS, LIQUID-TIGHT, FLEXIBLE METAL CONDUITS SHALL BE USED.
18. SUPPLY OF CONTROL DEVICES

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A. UNLESS OTHERWISE SPECIFIED, SUPPLY ALL REQUIRED CONTROL DAMPERS, HAND THE DAMPERS TO THE SHEET METAL TRADE AT THE SITE IN THE LOCATION WHERE THEY ARE REQUIRED FOR INSTALLATION AS PART OF THE SHEET METAL WORK. ENSURE THAT EACH DAMPER IS CORRECTLY LOCATED AND MOUNTED.
B. PROVIDE LINKAGE AND OPERATORS FOR THE DAMPERS. WHEREVER POSSIBLE LOCATE DAMPER OPERATORS SO THAT THEY ARE ACCESSIBLE FROM OUTSIDE DUCT, PLENUM, AND EQUIPMENT CASINGS. BRACKET MOUNT OPERATORS ON DUCTS OR PLENUMS CLEAR OF INSULATION WHERE APPLICABLE.
C. WHERE SEQUENCE OPERATION IS INDICATED, OR WHERE MULTIPLE OPERATORS DRIVE A SERIES OF DAMPERS, PROVIDE PILOT POSITIONERS TO COUPLE THEIR ACTION.
D. ENSURE THAT DAMPERS LOCATED IN DUCTWORK OTHER THAN GALVANIZED STEEL ARE CONSTRUCTED OF TYPE 316 STAINLESS STEEL.
E. UNLESS OTHERWISE SPECIFIED, SUPPLY ALL REQUIRED AUTOMATIC CONTROL VALVES. HAND THE VALVES TO THE APPROPRIATE PIPING TRADES AT THE SITE IN THE LOCATIONS THEY ARE REQUIRED FOR INSTALLATION AS PART OF THE PIPING WORK. ENSURE THAT EACH VALVE IS PROPERLY SIZED, LOCATED AND INSTALLED.
F. PROVIDE AN OPERATOR FOR EACH VALVE WITH ON/OFF CONTROL FOR 2 POSITION, 0-10VDC OR 4-20MA FOR MODULATING FOR CONTROL. SPRING RETURN ACTUATORS ARE REQUIRED ON AS DEFINED ON THE DRAWINGS FOR FAIL SAFE OPERATION, OR AS NEEDED TO PROTECT THE EQUIPMENT, SUCH AS NORMAL CLOSED POSITION FOR OUTSIDE AIR DAMPERS.
19. TRAINING
A. PROVIDE MINIMUM OF (4) TRAINING SESSIONS, AND (4) HOURS FOR EACH SESSION, THROUGHOUT THE CONTRACT PERIOD. THE TRAINING WILL BE PROVIDED FOR PERSONNEL DESIGNATED BY THE OWNER.
B. THESE OBJECTIVES WILL BE DIVIDED INTO LOGICAL GROUPINGS; PARTICIPANTS MAY ATTEND ONE OR MORE OF THESE, DEPENDING ON LEVEL OF KNOWLEDGE REQUIRED:
1. DAY-TO-DAY BAS OPERATORS
2. BAS TROUBLESHOOTING & MAINTENANCE
C. THE INSTRUCTOR(S) SHALL BE FACTORY-TRAINED AND EXPERIENCED IN TEACHING THIS TECHNIQUE.
D. TRAINING WILL BEGIN WHEN THE OPERATING AND MAINTENANCE MANUALS HAVE BEEN DELIVERED TO THE OWNER OR REVIEWED BY THE ENGINEER'S REPRESENTATIVE.
E. BUILDING WALK THROUGH AND LOCATION OF CONTROL DEVICES
F. OPERATING PROCEDURES
G. MAINTENANCE PROCEDURES
H. TROUBLE-SHOOTING PROCEDURES
I. SPARE PARTS REQUIRED
J. PREPARE RECORD DOCUMENTS: UPON COMPLETION OF INSTALLATION, SUBMIT AN ELECTRONIC COPY, THE DOCUMENTS SHALL BE SUBMITTED FOR APPROVAL PRIOR TO FINAL COMPLETION AND INCLUDE:
1. PROJECT RECORD DRAWINGS - THESE SHALL BE AS-BUILT VERSIONS OF THE SUBMITTAL SHOP DRAWINGS. ONE SET OF ELECTRONIC MEDIA .PDF DRAWING FILES SHALL BE PROVIDED.
2. TESTING AND COMMISSIONING REPORTS AND CHECKLISTS SIGNED OFF BY TRAINED FACTORY (EQUIPMENT MANUFACTURERS) AND FIELD (BAS) COMMISSIONING PERSONNEL.
20. OPERATING AND MAINTENANCE (O & M) MANUALS
A. THESE SHALL BE AS-BUILT VERSIONS OF THE SUBMITTAL PRODUCT DATA. IN ADDITION TO THE INFORMATION REQUIRED FOR THE SUBMITTALS, OPERATING & MAINTENANCE MANUAL SHALL INCLUDE:
1. 24-HOUR/7-DAY PER WEEK EMERGENCY SERVICE TELEPHONE NUMBERS OF CONTRACTOR SERVICE DEPARTMENT ALONG WITH NAMES, ADDRESS OF SERVICE PERSONNEL RESPONSIBLE FOR SUPPORTING THE ONGOING WARRANTY AND SERVICES OF THE CONTROL SYSTEM.
2. PREVENTATIVE MAINTENANCE AND CALIBRATION PROCEDURES; HARDWARE TROUBLESHOOTING; AND HARDWARE REPAIR AND/OR REPLACEMENT PROCEDURES.
3. ONE SET OF ELECTRONIC MEDIA CONTAINING FILES OF ALL OPERATOR COLOR GRAPHIC SCREENS FOR THE PROJECT.
4. LOCAL SUPPLY STORE SHOULD HAVE A MINIMUM 3 UNIT CONTROLLERS, SYSTEM CONTROLLERS, AND ROOM SENSORS AVAILABLE FOR SAME DAY PURCHASE.
5. DOCUMENTATION, INSTALLATION, AND MAINTENANCE INFORMATION FOR ALL THIRD PARTY HARDWARE/SOFTWARE PRODUCTS PROVIDED INCLUDING PERSONAL COMPUTERS, PRINTERS, HUBS, SENSORS, VALVES, ETC.
6. ORIGINAL ISSUE MEDIA FOR ALL SOFTWARE PROVIDED, INCLUDING OPERATING SYSTEMS, PROGRAMMING LANGUAGE, OPERATOR WORKSTATION SOFTWARE, AND GRAPHICS SOFTWARE.
7. LICENSES, GUARANTEE, AND WARRANTY DOCUMENTS FOR ALL EQUIPMENT AND SYSTEMS.
8. RECOMMENDED PREVENTIVE MAINTENANCE PROCEDURES FOR ALL SYSTEM COMPONENTS INCLUDING A SCHEDULE OF TASKS (INSPECTION, CLEANING, CALIBRATION, ETC.) AND TASK DESCRIPTIONS.
21. SEQUENCE OF OPERATIONS
21.1 ENERGY RECOVERY VENTILATOR (ERV-1)
A. RUN CONDITIONS - CONTINUOUS:
THE UNIT SHALL RUN CONTINUOUSLY.
THE UNIT SHALL SHUT DOWN AND GENERATE AN ALARM UPON RECEIVING SMOKE DETECTOR STATUS.
B. DAMPER OPERATION:
THE OUTSIDE AIR DAMPER SHALL OPEN ANYTIME THE UNIT RUNS AND SHALL CLOSE ANYTIME THE UNIT STOPS. THE SUPPLY FAN SHALL START ONLY AFTER THE DAMPER STATUS HAS PROVEN THE DAMPER IS OPEN. THE OUTSIDE AIR DAMPER SHALL CLOSE 4SEC (ADJ.) AFTER THE SUPPLY FAN STOPS.
THE CORE DAMPER SHALL OPEN ANYTIME THE UNIT RUNS AND SHALL CLOSE ANYTIME THE UNIT STOPS. THE SUPPLY FAN SHALL START ONLY AFTER THE DAMPER STATUS HAS PROVEN THE DAMPER IS OPEN. THE OUTSIDE AIR DAMPER SHALL CLOSE 4SEC (ADJ.) AFTER THE SUPPLY FAN STOPS.
THE EXHAUST AIR DAMPER SHALL OPEN ANYTIME THE UNIT RUNS AND SHALL CLOSE ANYTIME THE UNIT STOPS. THE EXHAUST FAN SHALL START ONLY AFTER THE DAMPER STATUS HAS PROVEN THE DAMPER IS OPEN. THE OUTSIDE AIR DAMPER SHALL CLOSE 4SEC (ADJ.) AFTER THE EXHAUST FAN STOPS.
C. FAN OPERATION:
THE SUPPLY FAN SHALL RUN ANYTIME THE UNIT IS COMMANDED TO RUN. TO PREVENT SHORT CYCLING, THE SUPPLY FAN SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME, UNLESS SHUTDOWN ON SAFETIES.
THE EXHAUST FAN SHALL RUN WHENEVER THE SUPPLY FAN RUNS, UNLESS SHUTDOWN ON SAFETIES.
THE CONTRACTOR SHALL MONITOR THE SUPPLY AIR TEMPERATURE. DURING WINTER CONDITIONS WHEN HEATING IS ENABLED THE CONTROLLER SHALL MAINTAIN A SUPPLY AIR TEMPERATURE SETPOINT OF 72F (ADJ.)
D. GAS HEATING STAGE:
THE CONTROLLER SHALL MEASURE THE SUPPLY AIR TEMPERATURE AND STAGE THE HEATING TO MAINTAIN ITS HEATING SETPOINT. TO PREVENT SHORT CYCLING, THE STAGE SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.
THE HEATING SHALL BE ENABLED WHENEVER:
- OUTSIDE AIR TEMPERATURE IS LESS THAN 65F (ADJ.).
- AND THE SUPPLY AIR TEMPERATURE IS BELOW HEATING SETPOINT.
- AND THE FAN STATUS IS ON.
E. FILTER MONITOR:
THE CONTROLLER SHALL MONITOR THE DIFFERENTIAL PRESSURE ACROSS THE:
- PREFILTER.
- FINAL FILTER.
- RETURN FILTER
- CARBON FILTER

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ALARMS SHALL BE PROVIDED AS FOLLOWS:
- OUTSIDE AIR DAMPER FAILURE: COMMANDED OPEN, BUT THE STATUS IS CLOSED.
- OUTSIDE AIR DAMPER IN HAND: COMMANDED CLOSED, BUT THE STATUS IS OPEN.
- CORE DAMPER FAILURE: COMMANDED OPEN, BUT THE STATUS IS CLOSED.
- CORE DAMPER IN HAND: COMMANDED CLOSED, BUT THE STATUS IS OPEN.
- EXHAUST AIR DAMPER FAILURE: COMMANDED OPEN, BUT THE STATUS IS CLOSED.
- EXHAUST AIR DAMPER IN HAND: COMMANDED CLOSED, BUT THE STATUS IS OPEN.
- SUPPLY FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- SUPPLY FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
- SUPPLY FAN RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT (ADJ.).
- EXHAUST FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- EXHAUST FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
- EXHAUST FAN RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT (ADJ.).
- PREFILTER CHANGE REQUIRED: PREFILTER DIFFERENTIAL PRESSURE EXCEEDS A USER DEFINABLE LIMIT (ADJ.).
- FINAL FILTER CHANGE REQUIRED: FINAL FILTER DIFFERENTIAL PRESSURE EXCEEDS A USER DEFINABLE LIMIT (ADJ.).
- CARBON FILTER CHANGE REQUIRED: CARBON FILTER DIFFERENTIAL PRESSURE EXCEEDS A USER DEFINABLE LIMIT (ADJ.).
- RETURN FILTER CHANGE REQUIRED: RETURN FILTER DIFFERENTIAL PRESSURE EXCEEDS A USER DEFINABLE LIMIT (ADJ.).
- HIGH SUPPLY AIR TEMP: IF THE SUPPLY AIR TEMPERATURE IS GREATER THAN 120F (ADJ.).
- LOW SUPPLY AIR TEMP: IF THE SUPPLY AIR TEMPERATURE IS LESS THAN 45F (ADJ.).
21.2 AIRHANDLING UNIT WITH ENTHALPY WHEEL (RTU-1)
A. RUN CONDITIONS:
THE UNIT SHALL RUN ACCORDING TO A USER DEFINABLE TIME SCHEDULE IN THE FOLLOWING MODES:
OCCUPIED MODE: THE UNIT SHALL MAINTAIN
- A 75F (ADJ.) COOLING SETPOINT.
- A 70F (ADJ.) HEATING SETPOINT.
- UNOCCUPIED MODE (NIGHT SETBACK): THE UNIT SHALL MAINTAIN
- A 80F (ADJ.) COOLING SETPOINT.
- A 65F (ADJ.) HEATING SETPOINT.
THE UNIT SHALL SHUT DOWN AND GENERATE AN ALARM UPON RECEIVING A FREEZESTAT STATUS.
B. ZONE OPTIMAL START:
THE UNIT SHALL USE AN OPTIMAL START ALGORITHM FOR MORNING START-UP. THIS ALGORITHM SHALL MINIMIZE THE UNOCCUPIED WARM-UP OR COOL-DOWN PERIOD WHILE STILL ACHIEVING COMFORT CONDITIONS BY THE START OF A SCHEDULED OCCUPATION PERIOD.
C. FAN OPERATION:
THE SUPPLY FAN SHALL RUN ANYTIME THE UNIT IS COMMANDED TO RUN, UNLESS SHUTDOWN ON SAFETIES. TO PREVENT SHORT CYCLING, THE SUPPLY FAN SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.
THE RETURN FAN SHALL RUN WHENEVER THE SUPPLY FAN RUNS, UNLESS SHUTDOWN ON SAFETIES. TO PREVENT SHORT CYCLING, THE RETURN FAN SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.
D. ENTHALPY WHEEL:
THE CONTROLLER SHALL RUN THE ENTHALPY WHEEL FOR ENERGY RECOVERY AS FOLLOWS:
COOLING MODE:
THE ENTHALPY WHEEL SHALL RUN FOR FULL COOL RECOVERY WHENEVER:
- THE OUTSIDE AIR ENTHALPY IS GREATER THAN THE RETURN AIR ENTHALPY.
- AND THE ZONE TEMPERATURE IS ABOVE COOLING SETPOINT.
- AND THE SUPPLY FAN IS ON.
THE ENTHALPY WHEEL SHALL RUN FOR PARTIAL COOL RECOVERY WHENEVER:
- THE OUTSIDE AIR HUMIDITY RATIO IS LESS THAN THE RETURN AIR HUMIDITY RATIO
- AND THE OUTSIDE AIR TEMPERATURE IS GREATER THAN THE RETURN AIR TEMPERATURE
- AND THE ZONE TEMPERATURE IS ABOVE COOLING SETPOINT
- AND THE SUPPLY FAN IS ON.
HEATING MODE:
THE ENTHALPY WHEEL SHALL RUN FOR FULL HEAT RECOVERY WHENEVER:
- OUTSIDE AIR ENTHALPY IS LESS THAN RETURN AIR ENTHALPY
- AND THE OUTSIDE AIR TEMPERATURE IS LESS THAN THE RETURN AIR TEMPERATURE
- AND THE ZONE TEMPERATURE IS BELOW HEATING SETPOINT.
- AND THE SUPPLY FAN IS ON.
PERIODIC SELF-CLEANING:
THE ENTHALPY WHEEL SHALL RUN FOR 10SEC (ADJ.) EVERY 4HR (ADJ.) THE UNIT RUNS.
FROST PROTECTION:
THE ENTHALPY WHEEL FROST PROTECTION CONTROLS SHALL BE SUPPLIED AND OPERATED AS PER THE MANUFACTURERS INSTRUCTIONS.
F. COOLING STAGES:
THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND STAGE THE COOLING TO MAINTAIN ITS COOLING SETPOINT. TO PREVENT SHORT CYCLING, THERE SHALL BE A USER DEFINABLE (ADJ.) DELAY BETWEEN STAGES, AND EACH STAGE SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.
THE COOLING SHALL BE ENABLED WHENEVER:
- OUTSIDE AIR TEMPERATURE IS GREATER THAN 60F (ADJ.).
- AND THE ECONOMIZER (IF PRESENT) IS DISABLED OR FULLY OPEN.
- AND THE ZONE TEMPERATURE IS ABOVE COOLING SETPOINT.
- AND THE SUPPLY FAN STATUS IS ON.
- AND THE HEATING IS NOT ACTIVE.
J. GAS HEATING STAGE:
THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND STAGE THE HEATING TO MAINTAIN ITS HEATING SETPOINT. TO PREVENT SHORT CYCLING, THE STAGE SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.
THE HEATING SHALL BE ENABLED WHENEVER:
- OUTSIDE AIR TEMPERATURE IS LESS THAN 65F (ADJ.).
- AND THE ZONE TEMPERATURE IS BELOW HEATING SETPOINT.
- AND THE SUPPLY FAN STATUS IS ON.
- AND THE COOLING IS NOT ACTIVE.

CONTROLS & INSTRUMENTATION SPEC.

K. ECONOMIZER:
THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND MODULATE THE ECONOMIZER DAMPERS IN SEQUENCE TO MAINTAIN A SETPOINT 2F LESS THAN THE ZONE COOLING SETPOINT. THE OUTSIDE AIR DAMPERS SHALL MAINTAIN A MINIMUM ADJUSTABLE POSITION OF 20% (ADJ.) OPEN WHENEVER OCCUPIED.
THE ECONOMIZER SHALL BE ENABLED WHENEVER:
- OUTSIDE AIR TEMPERATURE IS LESS THAN 65F (ADJ.).
- AND THE OUTSIDE AIR ENTHALPY IS LESS THAN 22BTU/LB (ADJ.).
- AND THE OUTSIDE AIR TEMPERATURE IS LESS THAN THE RETURN AIR TEMPERATURE.
- AND THE OUTSIDE AIR ENTHALPY IS LESS THAN THE RETURN AIR ENTHALPY.
- AND THE SUPPLY FAN STATUS IS ON.
THE ECONOMIZER SHALL CLOSE WHENEVER:
- MIXED AIR TEMPERATURE DROPS FROM 45F TO 40F (ADJ.).
- OR ON LOSS OF SUPPLY FAN STATUS.
- OR FREEZESTAT (IF PRESENT) IS ON.
THE OUTSIDE AND EXHAUST AIR DAMPERS SHALL CLOSE AND THE RETURN AIR DAMPER SHALL OPEN WHEN THE UNIT IS OFF. IF OPTIMAL START UP IS AVAILABLE, THE MIXED AIR DAMPER SHALL OPERATE AS DESCRIBED IN THE OCCUPIED MODE EXCEPT THAT THE OUTSIDE AIR DAMPER SHALL MODULATE TO FULLY CLOSED.
L. CARBON DIOXIDE (CO2) CONTROL:
WHEN IN THE OCCUPIED MODE, THE CONTROLLER SHALL MEASURE THE RETURN AIR CO2 LEVELS AND MODULATE THE OUTSIDE AIR DAMPERS OPEN ON RISING CO2 CONCENTRATIONS, OVERRIDING NORMAL DAMPER OPERATION TO MAINTAIN A CO2 SETPOINT OF 750 PPM (ADJ.).
M. DEHUMIDIFICATION:
THE CONTROLLER SHALL MEASURE THE RETURN AIR HUMIDITY AND OVERRIDE THE COOLING SEQUENCE TO MAINTAIN RETURN AIR HUMIDITY AT OR BELOW 60% RH (ADJ.).
DEHUMIDIFICATION SHALL BE ENABLED WHENEVER:
- THE SUPPLY FAN STATUS IS ON.
- AND ZONE TEMPERATURE IS GREATER THAN THE COOLING SETPOINT.
N. MISCELLANEOUS MONITORING:
THE CONTROLLER SHALL MONITOR THE DIFFERENTIAL PRESSURE ACROSS THE PREFILTER.
THE CONTROLLER SHALL MONITOR THE DIFFERENTIAL PRESSURE ACROSS THE FINAL FILTER.
THE CONTROLLER SHALL MONITOR THE MIXED AIR TEMPERATURE AND USE AS RETURN FOR ECONOMIZER CONTROL.
O. RETURN AIR CARBON DIOXIDE (CO2) CONCENTRATION MONITORING:
THE CONTROLLER SHALL MEASURE THE RETURN AIR CO2 CONCENTRATION.
THE CONTROLLER SHALL MONITOR THE RETURN AIR HUMIDITY AND USE AS REQUIRED FOR ECONOMIZER CONTROL.
THE CONTROLLER SHALL MONITOR THE RETURN AIR TEMPERATURE AND USE AS REQUIRED FOR ECONOMIZER CONTROL.
THE CONTROLLER SHALL MONITOR THE SUPPLY AIR TEMPERATURE.
ALARMS SHALL BE PROVIDED AS FOLLOWS:
- HIGH ZONE TEMP: IF THE ZONE TEMPERATURE IS GREATER THAN THE COOLING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).
- LOW ZONE TEMP: IF THE ZONE TEMPERATURE IS LESS THAN THE HEATING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).
- SUPPLY FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- SUPPLY FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
- SUPPLY FAN RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT (ADJ.).
- RETURN FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- RETURN FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
- RETURN FAN RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT (ADJ.).
- ENTHALPY WHEEL ROTATION FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- ENTHALPY WHEEL IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
- ENTHALPY WHEEL RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT (ADJ.).
- PREFILTER CHANGE REQUIRED: PREFILTER DIFFERENTIAL PRESSURE EXCEEDS A USER DEFINABLE LIMIT (ADJ.).
- FINAL FILTER CHANGE REQUIRED: FINAL FILTER DIFFERENTIAL PRESSURE EXCEEDS A USER DEFINABLE LIMIT (ADJ.).
- HIGH MIXED AIR TEMP: IF THE MIXED AIR TEMPERATURE IS GREATER THAN 90F (ADJ.).
- LOW MIXED AIR TEMP: IF THE MIXED AIR TEMPERATURE IS LESS THAN 45F (ADJ.).
- HIGH RETURN AIR CARBON DIOXIDE CONCENTRATION: IF THE RETURN AIR CO2 CONCENTRATION IS GREATER THAN 1000PPM (ADJ.) WHEN IN THE OCCUPIED MODE.
- HIGH RETURN AIR HUMIDITY: IF THE RETURN AIR HUMIDITY IS GREATER THAN 70% (ADJ.).
- LOW RETURN AIR HUMIDITY: IF THE RETURN AIR HUMIDITY IS LESS THAN 35% (ADJ.).
- HIGH RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS GREATER THAN 90F (ADJ.).
- LOW RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS LESS THAN 45F (ADJ.).
- HIGH SUPPLY AIR TEMP: IF THE SUPPLY AIR TEMPERATURE IS GREATER THAN 120F (ADJ.).
- LOW SUPPLY AIR TEMP: IF THE SUPPLY AIR TEMPERATURE IS LESS THAN 45F (ADJ.).

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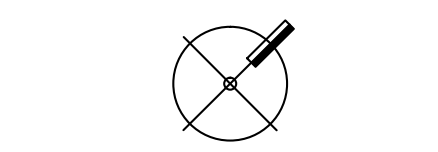
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CONTROLS & INSTRUMENTATION SPEC.

21.3 AIRHANDLING UNIT (RTU)-2
A. RUN CONDITIONS:
THE UNIT SHALL RUN ACCORDING TO A USER DEFINABLE TIME SCHEDULE IN THE FOLLOWING MODES:

- OCCUPIED MODE: THE UNIT SHALL MAINTAIN
- A 75F (ADJ.) COOLING SETPOINT
- A 70F (ADJ.) HEATING SETPOINT.
- UNOCCUPIED MODE (NIGHT SETBACK): THE UNIT SHALL MAINTAIN
- A 80F (ADJ.) COOLING SETPOINT.
- A 65F (ADJ.) HEATING SETPOINT.

THE UNIT SHALL SHUT DOWN AND GENERATE AN ALARM UPON RECEIVING A FREEZESTAT STATUS
B. ZONE OPTIMAL START:
THE UNIT SHALL USE AN OPTIMAL START ALGORITHM FOR MORNING START-UP, THIS ALGORITHM SHALL MINIMIZE THE UNOCCUPIED WARM-UP OR COOL-DOWN PERIOD WHILE STILL ACHIEVING COMFORT CONDITIONS BY THE START OF A SCHEDULED OCCUPIED PERIOD.

A TIMED LOCAL OVERRIDE CONTROL SHALL ALLOW AN OCCUPANT TO OVERRIDE THE SCHEDULE AND PLACE THE UNIT INTO AN OCCUPIED MODE FOR AN ADJUSTABLE PERIOD OF TIME. AT THE EXPIRATION OF THIS TIME, CONTROL OF THE UNIT SHALL AUTOMATICALLY RETURN TO THE SCHEDULE.

C. FAN OPERATION:
THE SUPPLY FAN SHALL RUN ANYTIME THE UNIT IS COMMANDED TO RUN, UNLESS SHUTDOWN ON SAFETIES. TO PREVENT SHORT CYCLING, THE SUPPLY FAN SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.
THE POWER EXHAUST FAN SHALL RUN WHENEVER THE SUPPLY FAN RUNS, UNLESS SHUTDOWN ON SAFETIES. TO PREVENT SHORT CYCLING, THE POWER EXHAUST FAN SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.

D. COOLING STAGES:
THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND STAGE THE COOLING TO MAINTAIN ITS COOLING SETPOINT. TO PREVENT SHORT CYCLING, THERE SHALL BE A USER DEFINABLE (ADJ.) DELAY BETWEEN STAGES, AND EACH STAGE SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.

- THE COOLING SHALL BE ENABLED WHENEVER:
- OUTSIDE AIR TEMPERATURE IS GREATER THAN 60F (ADJ.).
- AND THE ECONOMIZER IS DISABLED OR FULLY OPEN.
- AND THE ZONE TEMPERATURE IS ABOVE COOLING SETPOINT.
- AND THE SUPPLY FAN STATUS IS ON.
- AND THE HEATING IS NOT ACTIVE.

E. GAS HEATING:
THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND MODULATE THE HEATING VALVE TO MAINTAIN ITS HEATING SETPOINT.

- THE HEATING SHALL BE ENABLED WHENEVER:
- OUTSIDE AIR TEMPERATURE IS LESS THAN 65F (ADJ.).
- AND THE ZONE TEMPERATURE IS BELOW HEATING SETPOINT.
- AND THE SUPPLY FAN STATUS IS ON.
- AND THE COOLING IS NOT ACTIVE.

F. ECONOMIZER:
THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND MODULATE THE ECONOMIZER DAMPERS IN SEQUENCE TO MAINTAIN A SETPOINT 2F LESS THAN THE ZONE COOLING SETPOINT. THE OUTSIDE AIR DAMPERS SHALL MAINTAIN A MINIMUM ADJUSTABLE POSITION OF 20% (ADJ.) OPEN WHENEVER OCCUPIED.

- THE ECONOMIZER SHALL BE ENABLED WHENEVER:
- OUTSIDE AIR TEMPERATURE IS LESS THAN 65F (ADJ.).
- AND THE OUTSIDE AIR ENTHALPY IS LESS THAN 22BTU/LB (ADJ.).
- AND THE OUTSIDE AIR TEMPERATURE IS LESS THAN THE RETURN AIR TEMPERATURE.
- AND THE OUTSIDE AIR ENTHALPY IS LESS THAN THE RETURN AIR ENTHALPY.
- AND THE SUPPLY FAN STATUS IS ON.

THE ECONOMIZER SHALL CLOSE WHENEVER:
- MIXED AIR TEMPERATURE DROPS FROM 45F TO 40F (ADJ.).
- OR ON LOSS OF SUPPLY FAN STATUS.
- OR FREEZESTAT IS ON.

THE OUTSIDE AND EXHAUST AIR DAMPERS SHALL CLOSE AND THE RETURN AIR DAMPER SHALL OPEN WHEN THE UNIT IS OFF. IF OPTIMAL START UP IS AVAILABLE, THE MIXED AIR DAMPER SHALL OPERATE AS DESCRIBED IN THE OCCUPIED MODE EXCEPT THAT THE OUTSIDE AIR DAMPER SHALL MODULATE TO FULLY CLOSED.

G. DIOXIDE (CO2) CONTROL:
WHEN IN THE OCCUPIED MODE, THE CONTROLLER SHALL MEASURE THE RETURN AIR CO2 LEVELS AND MODULATE THE OUTSIDE AIR DAMPERS OPEN ON RISING CO2 CONCENTRATIONS, OVERRIDING NORMAL DAMPER OPERATION TO MAINTAIN A CO2 SETPOINT OF 750 PPM (ADJ.).

H. DEHUMIDIFICATION:
THE CONTROLLER SHALL MEASURE THE RETURN AIR HUMIDITY AND OVERRIDE THE COOLING SEQUENCE TO MAINTAIN RETURN AIR HUMIDITY AT OR BELOW 60% RH (ADJ.).

DURING DEHUMIDIFICATION, THE MODULATING CONDENSER REHEAT SHALL MODULATE TO MAINTAIN A SETPOINT 1°F (ADJ.) LESS THAN THE ZONE COOLING SETPOINT.

- DEHUMIDIFICATION SHALL BE ENABLED WHENEVER:
- THE SUPPLY FAN STATUS IS ON.
- AND ZONE TEMPERATURE IS GREATER THAN THE COOLING SETPOINT.

I. MISCELLANEOUS MONITORING:
THE CONTROLLER SHALL MONITOR THE DIFFERENTIAL PRESSURE ACROSS THE PREFILTER.

THE CONTROLLER SHALL MONITOR THE MIXED AIR TEMPERATURE AND USE AS REQUIRED FOR ECONOMIZER CONTROL
THE CONTROLLER SHALL MEASURE THE RETURN AIR CO2 CONCENTRATION.

THE CONTROLLER SHALL MONITOR THE RETURN AIR HUMIDITY AND USE AS REQUIRED FOR ECONOMIZER CONTROL
THE CONTROLLER SHALL MONITOR THE RETURN AIR TEMPERATURE AND USE AS REQUIRED FOR ECONOMIZER CONTROL

THE CONTROLLER SHALL MONITOR THE SUPPLY AIR TEMPERATURE.
ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH ZONE TEMP: IF THE ZONE TEMPERATURE IS GREATER THAN THE COOLING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).
- LOW ZONE TEMP: IF THE ZONE TEMPERATURE IS LESS THAN THE HEATING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).
- SUPPLY FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- SUPPLY FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
- SUPPLY FAN RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT (ADJ.).
- POWER EXHAUST FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- POWER EXHAUST FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
- POWER EXHAUST FAN RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT (ADJ.).
- FILTER CHANGE REQUIRED: PREFILTER DIFFERENTIAL PRESSURE EXCEEDS A USER DEFINABLE LIMIT (ADJ.).

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- HIGH MIXED AIR TEMP: IF THE MIXED AIR TEMPERATURE IS GREATER THAN 90F (ADJ.).
- LOW MIXED AIR TEMP: IF THE MIXED AIR TEMPERATURE IS LESS THAN 45F (ADJ.).
- HIGH RETURN AIR CARBON DIOXIDE CONCENTRATION: IF THE RETURN AIR CO2 CONCENTRATION IS GREATER THAN 1000PPM (ADJ.) WHEN IN THE OCCUPIED MODE.

- HIGH RETURN AIR HUMIDITY: IF THE RETURN AIR HUMIDITY IS GREATER THAN 70% (ADJ.).
- LOW RETURN AIR HUMIDITY: IF THE RETURN AIR HUMIDITY IS LESS THAN 35% (ADJ.).
- HIGH RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS GREATER THAN 90F (ADJ.).
- LOW RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS LESS THAN 45F (ADJ.).

- HIGH SUPPLY AIR TEMP: IF THE SUPPLY AIR TEMPERATURE IS GREATER THAN 120F (ADJ.).
- LOW SUPPLY AIR TEMP: IF THE SUPPLY AIR TEMPERATURE IS LESS THAN 45F (ADJ.).

21.4 UNIT VENTILATOR (UV-1, UV-2)
A. RUN CONDITIONS:

THE UNIT SHALL RUN ACCORDING TO A USER DEFINABLE TIME SCHEDULE. THE UNIT SHALL SHUT DOWN AND GENERATE AN ALARM UPON RECEIVING A FREEZESTAT STATUS.

THE FAN SHALL RUN ANYTIME THE UNIT IS COMMANDED TO RUN UNLESS SHUTDOWN ON SAFETIES.
B. ZONE SETPOINT ADJUST:
THE ZONE TEMPERATURE HEATING AND COOLING SETPOINTS SHALL BE ADJUSTED AT THE BAS GRAPHIC INTERFACE. SETPOINTS SHALL BE AS FOLLOWS:

- COOLING UNOCCUPIED: 28C (ADJ.)
- COOLING OCCUPIED: 24C (ADJ.)
- HEATING UNOCCUPIED: 18C (ADJ.)
- HEATING OCCUPIED: 21C (ADJ.)

C. ZONE OPTIMAL START:
THE UNIT SHALL USE AN OPTIMAL START ALGORITHM FOR MORNING START-UP, THIS ALGORITHM SHALL MINIMIZE THE UNOCCUPIED WARM-UP OR COOL-DOWN PERIOD WHILE STILL ACHIEVING COMFORT CONDITIONS BY THE START OF SCHEDULED OCCUPIED PERIOD.

D. ZONE UNOCCUPIED OVERRIDE:
A TIMED LOCAL OVERRIDE CONTROL SHALL BE ALLOWED AT THE BAS GRAPHIC INTERFACE TO OVERRIDE THE SCHEDULE AND PLACE THE UNIT INTO AN OCCUPIED MODE FOR AN ADJUSTABLE PERIOD OF TIME. AT THE EXPIRATION OF THIS TIME, CONTROL OF THE UNIT SHALL AUTOMATICALLY RETURN TO THE SCHEDULE.

E. COOLING:
THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND STAGE THE COOLING TO MAINTAIN ITS COOLING SETPOINT. TO PREVENT SHORT CYCLING, THERE SHALL BE A USER DEFINABLE (ADJ.) DELAY BETWEEN STAGES, AND EACH STAGE SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.

- THE COOLING SHALL BE ENABLED WHENEVER:
- OUTSIDE AIR TEMPERATURE IS GREATER THAN 60F (ADJ.).
- AND THE ZONE TEMPERATURE IS ABOVE COOLING SETPOINT.
- AND THE FAN IS ON.

F. HEATING COIL VALVE:
THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND ENABLE HEATING TO MAINTAIN HEATING SETPOINT.

WHEN HEATING IS ENABLED THE CONTROLLER SHALL MEASURE THE LEAVING AIR TEMPERATURE AND MODULATE THE HEATING COIL VALVE TO MAINTAIN THE ZONE TEMPERATURE SET POINT.

- THE HEATING SHALL BE ENABLED WHENEVER:
- OUTSIDE AIR TEMPERATURE IS LESS THAN 65F (ADJ.).
- AND THE ZONE TEMPERATURE IS BELOW HEATING SETPOINT.
- AND THE FAN IS ON.

THE HEATING COIL VALVE SHALL OPEN WHENEVER THE FREEZESTAT IS ON.

G. ECONOMIZER:
THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND MODULATE THE MIXED AIR DAMPERS IN SEQUENCE TO MAINTAIN THE ZONE COOLING SETPOINT. THE OUTSIDE AIR DAMPERS SHALL MAINTAIN A MINIMUM ADJUSTABLE POSITION AS VERIFIED BY THE AIR BALANCER OPEN DURING HEATING AND VENTILATION WHENEVER OCCUPIED.

- THE ECONOMIZER SHALL BE ENABLED WHENEVER:
- OUTSIDE AIR TEMPERATURE IS AT LEAST 3F (ADJ.) LESS THAN THE ZONE TEMPERATURE.
- AND THE OUTSIDE AIR TEMPERATURE IS LESS THAN 75F (ADJ.)

THE ECONOMIZER SHALL CLOSE WHENEVER THE FREEZESTAT IS ON.
THE OUTSIDE AIR DAMPERS SHALL CLOSE AND THE RETURN AIR DAMPER SHALL OPEN WHEN THE UNIT IS OFF. DURING OPTIMAL START UP THE MIXED AIR DAMPER SHALL OPERATE AS DESCRIBED IN THE OCCUPIED MODE EXCEPT THAT THE OUTSIDE AIR DAMPER SHALL MODULATE TO FULLY CLOSED.

THE CONTROLLER SHALL MONITOR THE DISCHARGE AIR TEMPERATURE. SHOULD DISCHARGE TEMPERATURE DROP BELOW A USER DEFINABLE TEMPERATURE (ADJ.), THE CONTROLLER SHALL ENABLE THE HEATING, CLOSE THE OUTSIDE DAMPER AND OPEN THE RETURN DAMPER

H. CARBON DIOXIDE (CO2) CONTROL:
WHEN IN THE OCCUPIED MODE, THE CONTROLLER SHALL MEASURE THE ZONE CO2 CONCENTRATION AND OPEN THE OUTSIDE AIR DAMPERS ON RISING CO2 CONCENTRATIONS, OVERRIDING NORMAL DAMPER OPERATION AS CO2 CONCENTRATIONS RISE ABOVE 750PPM (ADJ.).

I. STATUS:
THE CONTROLLER SHALL MONITOR THE DIFFERENTIAL PRESSURE ACROSS THE FILTER. THE CONTROLLER SHALL MONITOR THE DISCHARGE AIR TEMPERATURE. THE CONTROLLER SHALL MONITOR THE FAN STATUS.

THE CONTROLLER SHALL MEASURE THE ZONE CO2 CONCENTRATION.
ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH ZONE TEMP: IF THE ZONE TEMPERATURE IS GREATER THAN THE COOLING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).
- LOW ZONE TEMP: IF THE ZONE TEMPERATURE IS LESS THAN THE HEATING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).
- FILTER CHANGE REQUIRED: FILTER DIFFERENTIAL PRESSURE EXCEEDS A USER DEFINABLE LIMIT (ADJ.).
- HIGH DISCHARGE AIR TEMP: IF THE DISCHARGE AIR TEMPERATURE IS GREATER THAN 120F (ADJ.).
- LOW DISCHARGE AIR TEMP: IF THE DISCHARGE AIR TEMPERATURE IS LESS THAN 40F (ADJ.).
- FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
- FAN RUNTIME EXCEEDED: FAN STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT (ADJ.).
- HIGH ZONE CARBON DIOXIDE CONCENTRATION: IF THE ZONE CO2

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CONCENTRATION IS GREATER THAN 1000PPM (ADJ.) WHEN IN THE OCCUPIED MODE.

21.5 PERIMETER RADIATORS
A. RUN CONDITIONS:
THE UNIT SHALL RUN CONTINUOUSLY AND SHALL MAINTAIN A HEATING SETPOINT OF 70F (ADJ.).

B. HEATING COIL VALVE:
THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND MODULATE THE HEATING COIL VALVE TO MAINTAIN ITS HEATING SETPOINT.

THE HEATING SHALL BE ENABLED WHENEVER:
- OUTSIDE AIR TEMPERATURE IS LESS THAN 65F (ADJ.).
- AND THE ZONE TEMPERATURE IS BELOW HEATING SETPOINT.

ALARMS SHALL BE PROVIDED AS FOLLOWS:
- LOW ZONE TEMP: IF THE ZONE TEMPERATURE IS LESS THAN THE

21.6 BOILER (B-1, B-2, B-3)
A. RUN CONDITIONS:
THE BOILER SYSTEM SHALL BE ENABLED TO RUN WHENEVER OUTSIDE AIR TEMPERATURE IS LESS THAN 65F (ADJ.).

TO PREVENT SHORT CYCLING, THE BOILER SYSTEM SHALL RUN FOR AND BE OFF FOR MINIMUM ADJUSTABLE TIMES (BOTH USER DEFINABLE), UNLESS SHUTDOWN ON SAFETIES OR OUTSIDE AIR CONDITIONS.

EACH BOILER SHALL RUN SUBJECT TO ITS OWN INTERNAL SAFETIES AND CONTROLS. THE BOILER SYSTEM SHALL ALSO RUN FOR FREEZE PROTECTION WHENEVER OUTSIDE AIR TEMPERATURE IS LESS THAN 38F (ADJ.)

B. BOILER SAFETIES:
THE FOLLOWING SAFETIES SHALL BE MONITORED FOR EACH BOILER:

- BOILER ALARM.
- LOW WATER LEVEL.

C. BOILER PRIMARY PUMP:
EACH BOILER PRIMARY HOT WATER PUMP SHALL RUN ANYTIME THE RESPECTIVE BOILER IS CALLED TO RUN AND SHALL HAVE A USER DEFINABLE DELAY (ADJ.) ON STOP.

D. BOILER ENABLE:
EACH BOILER SHALL BE ENABLED WHEN THE BOILER SYSTEM IS COMMANDED ON. THE BOILER SHALL BE ENABLED AFTER PUMP STATUS IS PROVEN ON AND SHALL RUN SUBJECT TO ITS OWN INTERNAL SAFETIES AND CONTROLS.

E. HOT WATER SUPPLY TEMPERATURE SETPOINT RESET:
THE HOT WATER SUPPLY TEMPERATURE SETPOINT SHALL RESET BASED ON OUTSIDE AIR TEMPERATURE. AS OUTSIDE AIR TEMPERATURE RISES FROM 0F (ADJ.) TO 70F (ADJ.) THE HOT WATER SUPPLY TEMPERATURE SETPOINT SHALL RESET DOWNWARDS BY SUBTRACTING FROM 0F (ADJ.) UP TO 20F (ADJ.) FROM THE CURRENT BOILER SETPOINT.

F. PRIMARY HOT WATER TEMPERATURE MONITORING:
THE FOLLOWING TEMPERATURES SHALL BE MONITORED:

- PRIMARY HOT WATER SUPPLY.
- PRIMARY HOT WATER RETURN.

BOILER STAGING:
THE CONTROLLER SHALL DETERMINE THE FACILITY HEATING LOAD AND SHALL STAGE THE BOILERS ON IN SEQUENCE TO MEET RISING HEATING DEMAND AND PRIMARY HOT WATER SUPPLY TEMPERATURE WHERE:

- LOAD (MBTU/H) = [HWS TEMP (DEGREES F) - HWR TEMP (DEGREES F)] X FLOW (GPM) X 0.5
- UNITS SHALL BE CONVERTED AS REQUIRED TO REFLECT ACTUAL SYSTEM OF UNITS USED (METRIC OR ENGLISH)

THE CONTROLLER SHALL DETERMINE THE FACILITY HEATING LOAD FROM:
- HWS FLOW
- HWS TEMPERATURE
- HWR TEMPERATURE

THE LEAD BOILER TRAIN SHALL RUN ANYTIME THE BOILER MANAGER IS ENABLED. ADDITIONAL BOILERS SHALL STAGE ON AS FOLLOWS. TO PREVENT SHORT CYCLING, THERE SHALL BE A USER DEFINABLE (ADJ.) DELAY BETWEEN STAGES, AND EACH STAGE SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.

- SECOND BOILER:
G. STAGE ON: IF HOT WATER SUPPLY TEMPERATURE DROPS BELOW SETPOINT BY 10F (ADJ.)
STAGE OFF IF HOT WATER SUPPLY TEMPERATURE RISES ABOVE SETPOINT BY 20F (ADJ.)
- THIRD BOILER:
H. STAGE ON: IF HOT WATER SUPPLY TEMPERATURE DROPS BELOW SETPOINT BY 10F (ADJ.)
STAGE OFF IF HOT WATER SUPPLY TEMPERATURE RISES ABOVE SETPOINT BY 20F (ADJ.)

THE BOILER STAGING ORDER SHALL BE USER DEFINABLE. THE DESIGNATED LEAD BOILER SHALL ROTATE UPON ONE OF THE FOLLOWING CONDITIONS (USER SELECTABLE):
- MANUALLY THROUGH A SOFTWARE SWITCH
- IF BOILER RUNTIME (ADJ.) IS EXCEEDED

- DAILY
- WEEKLY
- MONTHLY

ALARMS SHALL BE PROVIDED AS FOLLOWS:
- BOILER ALARM (TYP. OF 3).
- LOW WATER LEVEL ALARM.

- BOILER HOT WATER PUMP FAILURE (TYP. OF 3): COMMANDED ON, BUT THE STATUS IS OFF.
- BOILER HOT WATER PUMP RUNNING IN HAND (TYP. OF 3): COMMANDED OFF, BUT THE STATUS IS ON.

- BOILER HOT WATER PUMP RUNTIME EXCEEDED (TYP. OF 3): STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT.
- HIGH PRIMARY HOT WATER SUPPLY TEMP: IF GREATER THAN 200F (ADJ.).
- LOW PRIMARY HOT WATER SUPPLY TEMP: IF LESS THAN 120F (ADJ.).

- BOILER FAILURE (TYP. OF 3): COMMANDED ON, BUT THE STATUS IS OFF.
- BOILER RUNNING IN HAND (TYP. OF 3): COMMANDED OFF, BUT THE STATUS IS ON.
- BOILER RUNTIME EXCEEDED (TYP. OF 3): STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT.

21.7 AIR HANDLING UNIT (AHU-10, AHU-11)
A. RUN CONDITIONS:
THE UNIT SHALL RUN ACCORDING TO A USER DEFINABLE TIME SCHEDULE IN THE FOLLOWING MODES:

- OCCUPIED MODE: THE UNIT SHALL MAINTAIN
- A 75F (ADJ.) COOLING SETPOINT
- A 70F (ADJ.) HEATING SETPOINT.
- UNOCCUPIED MODE (NIGHT SETBACK): THE UNIT SHALL MAINTAIN

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- A 80F (ADJ.) COOLING SETPOINT.
- A 65F (ADJ.) HEATING SETPOINT.

THE UNIT SHALL SHUT DOWN AND GENERATE AN ALARM UPON RECEIVING A FREEZESTAT STATUS
B. ZONE OPTIMAL START:
THE UNIT SHALL USE AN OPTIMAL START ALGORITHM FOR MORNING START-UP, THIS ALGORITHM SHALL MINIMIZE THE UNOCCUPIED WARM-UP OR COOL-DOWN PERIOD WHILE STILL ACHIEVING COMFORT CONDITIONS BY THE START OF A SCHEDULED OCCUPIED PERIOD.

A TIMED LOCAL OVERRIDE CONTROL SHALL ALLOW AN OCCUPANT TO OVERRIDE THE SCHEDULE AND PLACE THE UNIT INTO AN OCCUPIED MODE FOR AN ADJUSTABLE PERIOD OF TIME. AT THE EXPIRATION OF THIS TIME, CONTROL OF THE UNIT SHALL AUTOMATICALLY RETURN TO THE SCHEDULE.

C. FAN OPERATION:
THE SUPPLY FAN SHALL RUN ANYTIME THE UNIT IS COMMANDED TO RUN, UNLESS SHUTDOWN ON SAFETIES. TO PREVENT SHORT CYCLING, THE SUPPLY FAN SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.

D. COOLING STAGES:
THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND STAGE THE COOLING TO MAINTAIN ITS COOLING SETPOINT. TO PREVENT SHORT CYCLING, THERE SHALL BE A USER DEFINABLE (ADJ.) DELAY BETWEEN STAGES, AND EACH STAGE SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.

- THE COOLING SHALL BE ENABLED WHENEVER:
- OUTSIDE AIR TEMPERATURE IS GREATER THAN 60F (ADJ.).
- AND THE ECONOMIZER IS DISABLED OR FULLY OPEN.
- AND THE ZONE TEMPERATURE IS ABOVE COOLING SETPOINT.
- AND THE SUPPLY FAN STATUS IS ON.
- AND THE HEATING IS NOT ACTIVE.

F. GAS HEATING:
THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND MODULATE THE HEATING VALVE TO MAINTAIN ITS HEATING SETPOINT.

THE HEATING SHALL BE ENABLED WHENEVER:
- OUTSIDE AIR TEMPERATURE IS LESS THAN 65F (ADJ.).
- AND THE ZONE TEMPERATURE IS BELOW HEATING SETPOINT.
- AND THE SUPPLY FAN STATUS IS ON.
- AND THE COOLING IS NOT ACTIVE.

G. ECONOMIZER:
THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND MODULATE THE ECONOMIZER DAMPERS IN SEQUENCE TO MAINTAIN A SETPOINT 2F LESS THAN THE ZONE COOLING SETPOINT. THE OUTSIDE AIR DAMPERS SHALL MAINTAIN A MINIMUM ADJUSTABLE POSITION OF 20% (ADJ.) OPEN WHENEVER OCCUPIED.

- THE ECONOMIZER SHALL BE ENABLED WHENEVER:
- OUTSIDE AIR TEMPERATURE IS LESS THAN 65F (ADJ.).
- AND THE OUTSIDE AIR ENTHALPY IS LESS THAN 22BTU/LB (ADJ.).
- AND THE OUTSIDE AIR TEMPERATURE IS LESS THAN THE RETURN AIR TEMPERATURE.
- AND THE OUTSIDE AIR ENTHALPY IS LESS THAN THE RETURN AIR ENTHALPY.
- AND THE SUPPLY FAN STATUS IS ON.

H. DEHUMIDIFICATION:
THE CONTROLLER SHALL MEASURE THE RETURN AIR HUMIDITY AND OVERRIDE THE COOLING SEQUENCE TO MAINTAIN RETURN AIR HUMIDITY AT OR BELOW 60% RH (ADJ.).

DURING DEHUMIDIFICATION, THE MODULATING CONDENSER REHEAT SHALL MODULATE TO MAINTAIN A SETPOINT 1°F (ADJ.) LESS THAN THE ZONE COOLING SETPOINT.

- DEHUMIDIFICATION SHALL BE ENABLED WHENEVER:
- THE SUPPLY FAN STATUS IS ON.
- AND ZONE TEMPERATURE IS GREATER THAN THE COOLING SETPOINT.

I. MISCELLANEOUS MONITORING:
THE CONTROLLER SHALL MONITOR THE DIFFERENTIAL PRESSURE ACROSS THE PREFILTER.

THE CONTROLLER SHALL MONITOR THE MIXED AIR TEMPERATURE AND USE AS REQUIRED FOR ECONOMIZER CONTROL
THE CONTROLLER SHALL MEASURE THE RETURN AIR CO2 CONCENTRATION.

THE CONTROLLER SHALL MONITOR THE RETURN AIR HUMIDITY AND USE AS REQUIRED FOR ECONOMIZER CONTROL
THE CONTROLLER SHALL MONITOR THE RETURN AIR TEMPERATURE AND USE AS REQUIRED FOR ECONOMIZER CONTROL

THE CONTROLLER SHALL MONITOR THE SUPPLY AIR TEMPERATURE.
ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH ZONE TEMP: IF THE ZONE TEMPERATURE IS GREATER THAN THE COOLING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).
- LOW ZONE TEMP: IF THE ZONE TEMPERATURE IS LESS THAN THE HEATING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).
- SUPPLY FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- SUPPLY FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
- SUPPLY FAN RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT (ADJ.).
- RETURN FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- RETURN FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
- RETURN FAN RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT (ADJ.).
- FILTER CHANGE REQUIRED: PREFILTER DIFFERENTIAL PRESSURE EXCEEDS A USER DEFINABLE LIMIT (ADJ.).
- HIGH MIXED AIR TEMP: IF THE MIXED AIR TEMPERATURE IS GREATER THAN 90F (ADJ.).
- LOW MIXED AIR TEMP: IF THE MIXED AIR TEMPERATURE IS LESS THAN 45F (ADJ.).
- HIGH RETURN AIR CARBON DIOXIDE CONCENTRATION: IF THE RETURN AIR CO2 CONCENTRATION IS GREATER THAN 1000PPM (ADJ.) WHEN IN THE OCCUPIED MODE.

- HIGH RETURN AIR HUMIDITY: IF THE RETURN AIR HUMIDITY IS GREATER THAN 70% (ADJ.).
- LOW RETURN AIR HUMIDITY: IF THE RETURN AIR HUMIDITY IS LESS THAN 35% (ADJ.).
- HIGH RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS GREATER THAN 90F (ADJ.).
- LOW RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS LESS THAN 45F (ADJ.).

- HIGH SUPPLY AIR TEMP: IF THE SUPPLY AIR TEMPERATURE IS GREATER THAN 120F (ADJ.).
- LOW SUPPLY AIR TEMP: IF THE SUPPLY AIR TEMPERATURE IS LESS THAN 45F (ADJ.).

21.8 SYSTEM PUMPS (P-1, P-2, P-3, P-4, P-5, P-6)
A. RUN CONDITIONS:
THE HOT WATER PUMPS SHALL BE ENABLED WHENEVER OUTSIDE AIR TEMPERATURE IS LESS THAN 54F (ADJ.).

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THE PUMPS SHALL RUN FOR FREEZE PROTECTION ANYTIME OUTSIDE AIR TEMPERATURE IS LESS THAN 38F (ADJ.).
TO PREVENT SHORT CYCLING, THE PUMPS SHALL RUN FOR AND BE OFF FOR MINIMUM ADJUSTABLE TIMES (BOTH USER DEFINABLE).

B. LEAD/LAG OPERATION:
THE FOLLOWING SETS OF PUMPS SHALL BE GROUPED TOGETHER TO HAVE LEAD/LAG OPERATION:

- P-1 AND P-2
- P-3 AND P-4
- P-5 AND P-6

THE ABOVE GROUPED HOT WATER PUMPS SHALL OPERATE IN A LEAD/LAG FASHION.
- THE LEAD PUMP SHALL RUN FIRST.
- ON FAILURE OF THE LEAD PUMP, THE LAG PUMP SHALL RUN AND THE LEAD PUMP SHALL TURN OFF.

- ON DECREASING HOT WATER DIFFERENTIAL PRESSURE, THE LAG PUMP SHALL STAGE ON AND RUN IN UNISON WITH THE LEAD PUMP TO MAINTAIN HOT WATER DIFFERENTIAL PRESSURE SETPOINT.

THE DESIGNATED LEAD PUMP SHALL ROTATE UPON ONE OF THE FOLLOWING CONDITIONS (USER SELECTABLE):
- MANUALLY THROUGH A SOFTWARE SWITCH
- IF PUMP RUNTIME (ADJ.) IS EXCEEDED

- DAILY
- WEEKLY
- MONTHLY

(P-1, P-2) HOT WATER DIFFERENTIAL PRESSURE CONTROL:
THE CONTROLLER SHALL MEASURE HOT WATER DIFFERENTIAL PRESSURE AND MODULATE THE HOT WATER PUMP VFDS IN SEQUENCE TO MAINTAIN ITS HOT WATER DIFFERENTIAL PRESSURE SETPOINT.

THE FOLLOWING SETPOINTS ARE RECOMMENDED VALUES. ALL SETPOINTS SHALL BE FIELD MEASURED BY THE TESTING, ADJUSTING AND BALANCING CONTRACTOR AND ADJUSTED DURING THE COMMISSIONING PERIOD TO MEET THE REQUIREMENTS OF ACTUAL FIELD CONDITIONS.

THE CONTROLLER SHALL MODULATE HOT WATER PUMP SPEEDS TO MAINTAIN A HOT WATER DIFFERENTIAL PRESSURE OF 12LBF/IN2 (ADJ.). THE VFDS MINIMUM SPEED SHALL NOT DROP BELOW 30% (ADJ.).

ON DROPPING HOT WATER DIFFERENTIAL PRESSURE, THE VFDS SHALL STAGE ON AND RUN TO MAINTAIN SETPOINT AS FOLLOWS:
- THE CONTROLLER SHALL MODULATE THE LEAD VFD TO MAINTAIN SETPOINT.
- IF THE LEAD VFD SPEED IS GREATER THAN A SETPOINT OF 90% (ADJ.), THE LAG VFD SHALL STAGE ON.

- THE LAG VFD SHALL RAMP UP TO MATCH THE LEAD VFD SPEED AND THEN RUN IN UNISON WITH THE LEAD VFD TO MAINTAIN SETPOINT.

- ON RISING HOT WATER DIFFERENTIAL PRESSURE, THE VFDS SHALL STAGE OFF AS FOLLOWS:
- IF THE VFDS SPEEDS DROPS BACK TO 60% (ADJ.) BELOW SETPOINT, THE LAG VFD SHALL STAGE OFF.
- THE LEAD VFD SHALL CONTINUE TO RUN TO MAINTAIN SETPOINT.

P-3/P-4 AND P-5/P-6 OPERATION:
THE ABOVE GROUPS OF PUMPS SHALL RUN ANYTIME THE PUMPS ARE COMMANDED TO RUN, UNLESS SHUTDOWN ON SAFETIES. TO PREVENT SHORT CYCLING, THE PUMPS SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME AND OPERATE AT CONSTANT VOLUMETRIC FLOWRATE.

C. HOT WATER TEMPERATURE MONITORING:
THE FOLLOWING TEMPERATURES SHALL BE MONITORED:
- HOT WATER SUPPLY.
- HOT WATER RETURN.

- ALARMS SHALL BE PROVIDED AS FOLLOWS:
- HOT WATER PUMP (P-1, P-3, P-5)
- FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- RUNNING IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.

- RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT.
- VFD FAULT.
- HOT WATER PUMP (P-2, P-4, P-6)

- FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- RUNNING IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
- RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT.
- VFD FAULT.

- HIGH HOT WATER DIFFERENTIAL PRESSURE: IF 25% (ADJ.) GREATER THAN SETPOINT.
- LOW HOT WATER DIFFERENTIAL PRESSURE: IF 25% (ADJ.) LESS THAN SETPOINT.

- HIGH HOT WATER SUPPLY TEMP: IF THE HOT WATER SUPPLY TEMPERATURE IS GREATER THAN 200F (ADJ.).
- LOW HOT WATER SUPPLY TEMP: IF THE HOT WATER SUPPLY TEMPERATURE IS LESS THAN 120F (ADJ.).

21.9 PACKAGED AIR HANDLING UNIT (AHU-9, AHU-12)
A. RUN CONDITIONS:
THE UNIT SHALL RUN ACCORDING TO A USER DEFINABLE TIME SCHEDULE IN THE FOLLOWING MODES:

- OCCUPIED MODE: THE UNIT SHALL MAINTAIN
- A 75F (ADJ.) COOLING SETPOINT
- A 72F (ADJ.) HEATING SETPOINT
UNOCCUPIED MODE (NIGHT SETBACK): THE UNIT SHALL MAINTAIN
- A 85F (ADJ.) COOLING SETPOINT
- A 60F (ADJ.) HEATING SETPOINT

B. THE MAINTENANCE STAFF SHALL BE ABLE TO ADJUST THE ZONE TEMPERATURE HEATING AND COOLING SETPOINTS AT THE BAS.
THE UNIT SHALL SHUT DOWN AND GENERATE AN ALARM UPON RECEIVING AN EMERGENCY SHUTDOWN SIGNAL.

THE UNIT SHALL SHUT DOWN AND GENERATE AN ALARM UPON RECEIVING A FREEZESTAT STATUS. THE UNIT SHALL SHUT DOWN AND GENERATE AN ALARM UPON RECEIVING A SUPPLY AIR SMOKE DETECTOR STATUS.

C. SUPPLY FAN:
THE SUPPLY FAN SHALL RUN ANYTIME THE UNIT IS COMMANDED TO RUN, UNLESS SHUTDOWN ON SAFETIES. TO PREVENT SHORT CYCLING, THE SUPPLY FAN SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.

D. BUILDING STATIC PRESSURE CONTROL:
THE CONTROLLER SHALL MEASURE BUILDING STATIC PRESSURE AND COMMAND THE EXHAUST FAN TO RUN TO MAINTAIN A BUILDING STATIC PRESSURE SETPOINT OF 0.05IN H2O (ADJ.). THE EXHAUST FAN SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.

E. COOLING STAGES:
THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND STAGE THE COOLING TO MAINTAIN ITS COOLING SETPOINT. TO PREVENT SHORT CYCLING, THERE SHALL BE A USER DEFINABLE (ADJ.) DELAY BETWEEN STAGES, AND EACH STAGE SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.

THE HEATING SHALL BE ENABLED WHENEVER:
- OUTSIDE AIR TEMPERATURE IS GREATER THAN 60F (ADJ.).

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THE CONTRACTOR MUST FIELD VERIFY ALL DIMENSIONS AND MUST CONFIRM & CORRELATE ALL DETAILS WITHIN THE FULL DRAWING PACKAGE BEING RESPONSIBLE FOR SAME THROUGHOUT CONSTRUCTION REPORTING ANY DISCREPANCIES TO THE ARCHITECT PRIOR TO COMMENCING THE RELEVANT WORK

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- AND THE ECONOMIZER IS DISABLED OR FULLY OPEN.
- AND THE ZONE TEMPERATURE IS ABOVE COOLING SETPOINT.
- AND THE SUPPLY FAN STATUS IS ON.
- AND THE HEATING IS NOT ACTIVE.

F. GAS HEATING STAGES:

THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND STAGE THE HEATING TO MAINTAIN ITS HEATING SETPOINT. TO PREVENT SHORT CYCLING, THERE SHALL BE A USER DEFINABLE (ADJ.) DELAY BETWEEN STAGES, AND EACH STAGE SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.

THE HEATING SHALL BE ENABLED WHENEVER:

- OUTSIDE AIR TEMPERATURE IS LESS THAN 65°F (ADJ.).
- AND THE ZONE TEMPERATURE IS BELOW HEATING SETPOINT.
- AND THE SUPPLY FAN STATUS IS ON.
- AND THE COOLING IS NOT ACTIVE.

G. ECONOMIZER:

THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND MODULATE THE ECONOMIZER DAMPERS IN SEQUENCE TO MAINTAIN A SETPOINT 2°F LESS THAN THE ZONE COOLING SETPOINT. THE OUTSIDE AIR DAMPERS SHALL MAINTAIN A MINIMUM ADJUSTABLE POSITION OF 20% (ADJ.) OPEN WHENEVER OCCUPIED.

THE ECONOMIZER SHALL BE ENABLED WHENEVER:

- OUTSIDE AIR TEMPERATURE IS LESS THAN 65°F (ADJ.).
- AND THE OUTSIDE AIR TEMPERATURE IS LESS THAN THE RETURN AIR TEMPERATURE.
- AND THE SUPPLY FAN STATUS IS ON.

THE ECONOMIZER SHALL CLOSE WHENEVER:

- MIXED AIR TEMPERATURE DROPS FROM 45°F TO 40°F (ADJ.).
- OR ON LOSS OF SUPPLY FAN STATUS.
- OR FREEZESTAT (IF PRESENT) IS ON.

THE OUTSIDE AND EXHAUST AIR DAMPERS SHALL CLOSE AND THE RETURN AIR DAMPER SHALL OPEN WHEN THE UNIT IS OFF. IF OPTIMAL START UP IS AVAILABLE, THE MIXED AIR DAMPER SHALL OPERATE AS DESCRIBED IN THE OCCUPIED MODE EXCEPT THAT THE OUTSIDE AIR DAMPER SHALL MODULATE TO FULLY CLOSED.

THE OUTSIDE AIR DAMPERS SHALL MAINTAIN A MINIMUM POSITION (ADJ.) DURING BUILDING OCCUPIED HOURS AND BE CLOSED DURING UNOCCUPIED HOURS.

H. MISCELLANEOUS MONITORING:

THE CONTROLLER SHALL MONITOR THE DIFFERENTIAL PRESSURE ACROSS THE FILTER.

THE CONTROLLER SHALL MONITOR THE MIXED AIR TEMPERATURE AND USE AS REQUIRED FOR ECONOMIZER CONTROL.

THE CONTROLLER SHALL MONITOR THE RETURN AIR TEMPERATURE AND USE AS REQUIRED FOR ECONOMIZER CONTROL.

ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH ZONE TEMP: IF THE ZONE TEMPERATURE IS GREATER THAN THE COOLING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).
- LOW ZONE TEMP: IF THE ZONE TEMPERATURE IS LESS THAN THE HEATING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).
- SUPPLY FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- SUPPLY FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
- SUPPLY FAN RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT (ADJ.).
- EXHAUST FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- EXHAUST FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
- EXHAUST FAN RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT (ADJ.).
- HIGH BUILDING STATIC PRESSURE: IF THE BUILDING AIR STATIC PRESSURE IS 25% (ADJ.) GREATER THAN SETPOINT.
- LOW BUILDING STATIC PRESSURE: IF THE BUILDING AIR STATIC PRESSURE IS 25% (ADJ.) LESS THAN SETPOINT.
- FILTER CHANGE REQUIRED: FILTER DIFFERENTIAL PRESSURE EXCEEDS A USER DEFINABLE LIMIT (ADJ.).
- HIGH MIXED AIR TEMP: IF THE MIXED AIR TEMPERATURE IS GREATER THAN 90°F (ADJ.).
- LOW MIXED AIR TEMP: IF THE MIXED AIR TEMPERATURE IS LESS THAN 45°F (ADJ.).
- HIGH RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS GREATER THAN 90°F (ADJ.).
- LOW RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS LESS THAN 45°F (ADJ.).

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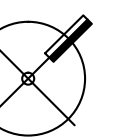
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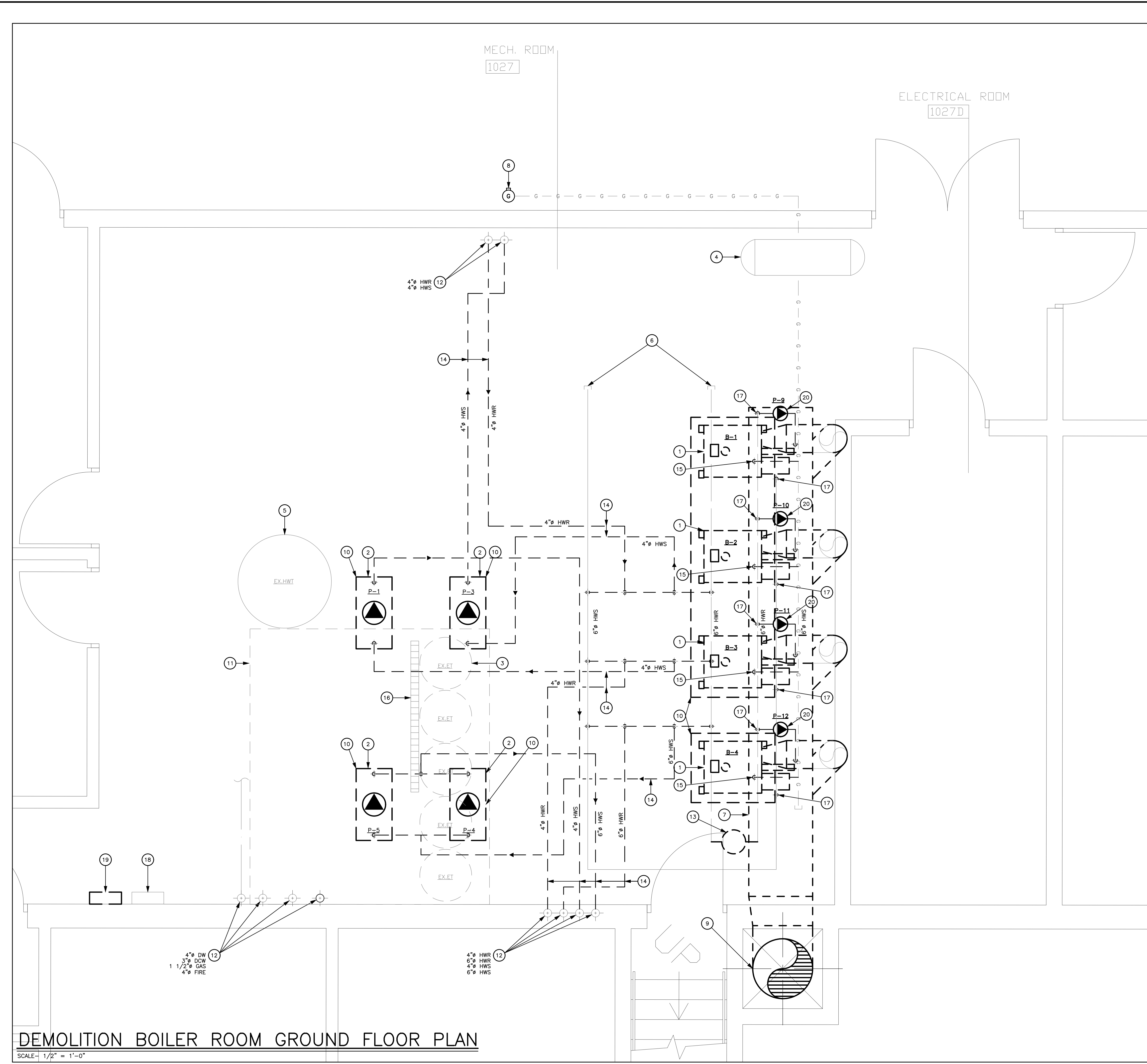
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DEMOLITION BOILER ROOM GROUND FLOOR PLAN
 SCALE = 1/2" = 1'-0"

DRAWING NOTES

- 1 DEMOLISH AND DISPOSE OF EXISTING BOILER AND CIRCULATION PUMP. REMOVE AND DISPOSE OF PIPING BACK TO MAIN HEADER. DEMOLISH VENTING AND COMBUSTION AIR INTAKE. DISCONNECT ALL CONTROL WIRING. REFER TO MECHANICAL SCHEMATICS.
- 2 DEMOLISH AND DISPOSE OF EXISTING HORIZONTAL BOILER SYSTEM PUMPS. PROVIDE CAPPED CONNECTION AND PREPARE PIPING FOR INSTALLATION OF NEW VERTICAL INLINE SYSTEM PUMPS.
- 3 EXISTING EXPANSION TANKS ON MEZZANINE LEVEL TO REMAIN.
- 4 EXISTING AIR COMPRESSOR TO REMAIN.
- 5 EXISTING DOMESTIC HOT WATER HEATER TO REMAIN
- 6 EXISTING HOT WATER SUPPLY AND RETURN HEADERS TO REMAIN AND BE REUSED.
- 7 EXISTING STAINLESS STEEL LINED CHIMNEY SERVING BOILERS IS TO BE REMOVED AND DISPOSED OF.
- 8 EXISTING GAS METER ON BUILDING EXTERIOR. CONTRACTOR IS TO COORDINATE WITH THE UTILITY AND OWNER FOR ALL SERVICE INTERRUPTIONS.
- 9 DEMOLISH AND DISPOSE OF EXISTING CHIMNEY VENTING. VENTING CONTINUES UP TO HIGH ROOF ABOVE AND TERMINATES AT 15' ABOVE FINISHED ROOF.
- 10 DEMOLISH EXISTING CONCRETE HOUSEKEEPING PAD SERVICING EXISTING MECHANICAL EQUIPMENT.
- 11 OUTLINE OF EXISTING EQUIPMENT MEZZANINE.
- 12 EXISTING PIPING TO REMAIN SIZE AND SERVICE AS INDICATED.
- 13 DEMOLISH EXISTING AIR SEPARATOR PROVIDE TEMPORARY TAPPED CONNECTIONS.
- 14 DEMOLISH EXISTING HYDRONIC PIPING TO EXTENT SHOWN. PROVIDE TEMPORARY CAPPED CONNECTION AT MAINS.
- 15 DISCONNECT NATURAL GAS PIPING BACK TO MAIN DISTRIBUTION HEADER WITHIN MECHANICAL ROOM.
- 16 EXISTING TRENCH DRAIN TO REMAIN.
- 17 DEMOLISH BOILER CONNECTION BACK TO PRIMARY HEADER AND PROVIDE CAPPED CONNECTION.
- 18 EXISTING BAS PANEL TO BE RE-USED TO INTERFACE NEW MECHANICAL EQUIPMENT.
- 19 DEMOLISH AND DISPOSE OF EXISTING BOILER CONTROL PANEL. REMOVE EXISTING CONDUIT.
- 20 DEMOLISH AND DISPOSE OF EXISTING BOILER CIRCULATION PUMP AND ASSOCIATED BRANCH PIPING.

GENERAL NOTES

- A) THE EXISTING SERVICES SHOWN ON THIS DRAWING HAVE BEEN TAKEN FROM THE ORIGINAL AS-BUILT DRAWINGS. THIS INFORMATION MUST NOT BE ASSUMED TO BE COMPLETE OR UP-TO-DATE. THE MECHANICAL CONTRACTOR SHALL CARRY OUT A FULL SURVEY OF ALL EXISTING SERVICES AND STRUCTURE TO CONFIRM THE SIZE AND LOCATION OF THESE SERVICES, BEFORE THE COMMENCEMENT OF ANY WORK.
- B) ALL DISCONNECTED DUCTWORK AND PIPING TO BE CAPPED OFF UNLESS OTHERWISE NOTED
- C) ALL CUTTING AND PATCHING OF EXISTING ROOF, FLOORS AND WALLS TO BE BY MECHANICAL CONTRACTOR
- D) FOR DRAWING LEGENDS SEE DRAWING M0.0
- E) ALL DEMOLITION WORK SHALL BE DONE VIA PIPE FREEZING. THE EXISTING HEATING SYSTEM SHALL NOT BE DRAINED DOWN.

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 THE CONTRACTOR MUST FIELD VERIFY ALL DIMENSIONS AND MUST CONFIRM & CORRELATE ALL DETAILS WITHIN THE FULL DRAWING PACKAGE BEING RESPONSIBLE FOR SAME THROUGHOUT CONSTRUCTION, REPORTING ANY DISCREPANCIES TO THE ARCHITECT PRIOR TO COMMENCING THE RELEVANT WORK.
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2. ISSUED FOR REVIEW 10.10.23
3. ISSUED FOR PERMIT 14.11.23
4. ISSUED FOR TENDER 14.02.24

PROJECT:
 HVAC Renovations
 Glendale Secondary School
 145 Rainbow Dr,
 Hamilton, ON
 For the HWDSB

SCALE:

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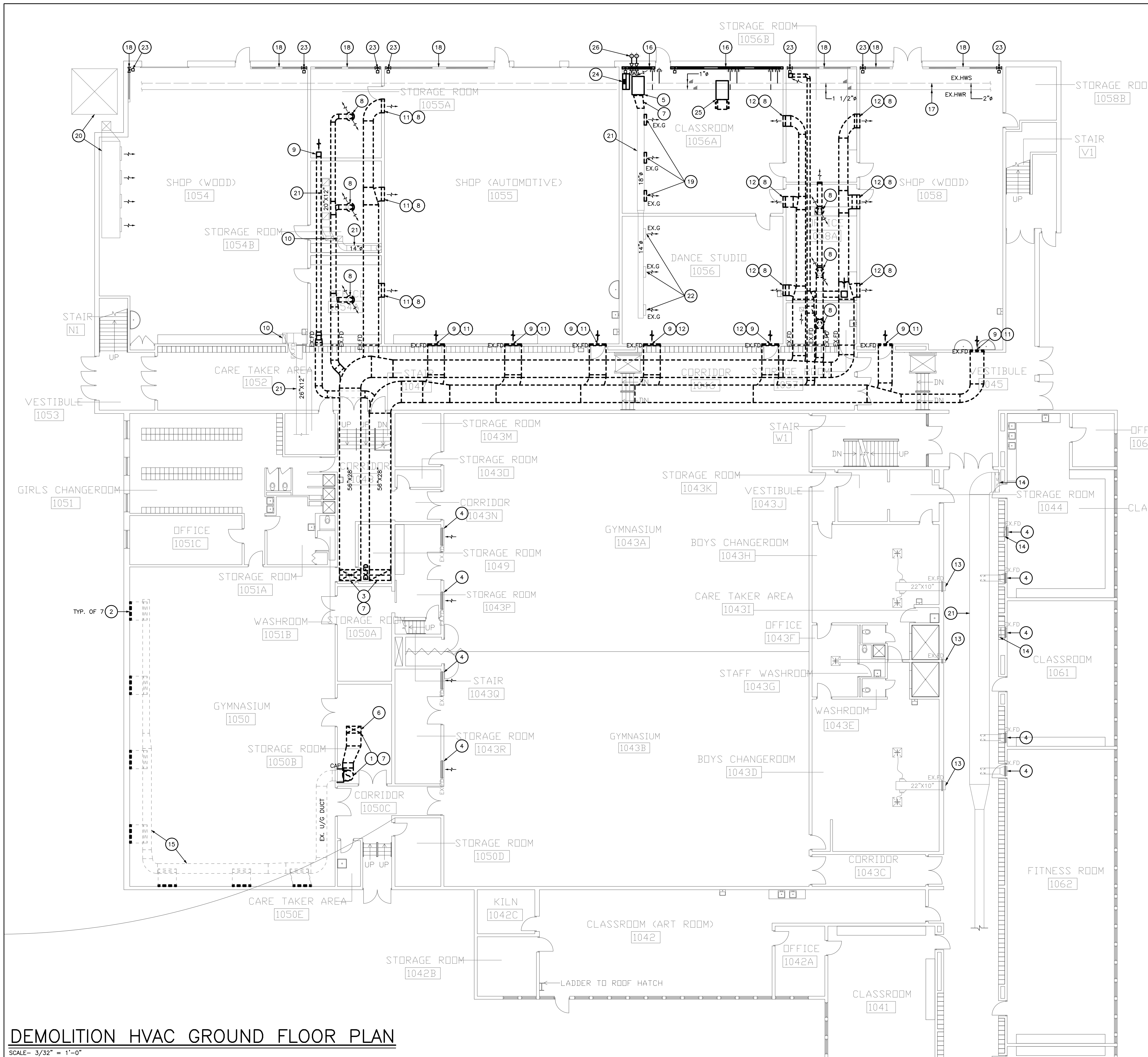


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DRAWING TITLE:
 Demolition Boiler Room Ground Floor Plan

SCALE:
 AS NOTED
 DRAWN:
 C.M. / J.L.
 DATE:
 SEPTEMBER 2023
 PROJECT #:
 ALL-23010629-A0
 DRAWING #:
 M1.0



DEMOLITION HVAC GROUND FLOOR PLAN

SCALE = 3/32" = 1'-0"

DRAWING NOTES

- 1 EXISTING SUPPLY AIR DUCTWORK DOWN TO BELOW GRADE. BELOW GRADE DUCT IS TO BE ABANDONED. DEMOLISH EXPOSED SECTION. CAP AT FLOOR LEVEL.
- 2 EXISTING DUCTWORK UP TO SIDEWALL GRILLE ABOVE. CONTRACTOR TO REMOVE GRILLE AND COVER OPENING. DUCTWORK BELOW GRADE TO BE ABANDONED.
- 3 EXISTING DUCTWORK UP TO MECHANICAL ROOM ABOVE TO BE DEMOLISHED AND DISPOSED OF. SEAL OPENING.
- 4 EXISTING GRILLE C/W FIRE DAMPERS TO REMAIN.
- 5 DEMOLISH AND DISPOSE OF EXISTING CEILING HUNG COOLING UNIT. CONTRACTOR TO DEMOLISH ASSOCIATED REMOTE CONDENSING UNIT AND PIPING.
- 6 DISCONNECT EXISTING SUPPLY AIR DUCTWORK FROM SUPPLY FAN THROUGH CEILING SLAB ABOVE.
- 7 EXISTING DUCTWORK TO BE DEMOLISHED TO EXTENT SHOWN.
- 8 EXISTING SUPPLY AIR REGISTER TO BE DEMOLISHED AND DISPOSED OF.
- 9 EXISTING RETURN AIR GRILLE TO BE DEMOLISHED AND DISPOSED OF.
- 10 EXISTING DUCT DOWN FROM ABOVE TO REMAIN.
- 11 EXISTING WALL OPENING FOR AIR GRILLE TO REMAIN AND BE REUSED.
- 12 EXISTING WALL OPENING FOR AIR GRILLE TO BE PATCHED. REFER TO ARCHITECTURAL AND STRUCTURAL DRAWINGS.
- 13 EXISTING CAPPED DUCTWORK C/W FIRE DAMPER. CONTRACTOR TO REMOVE CAPPING AND PREPARE FOR CONNECTION.
- 14 EXISTING DUCT RISER FROM ABOVE TO REMAIN.
- 15 EXISTING UNDERGROUND DUCTWORK TO BE ABANDONED.
- 16 DEMOLISH AND DISPOSE OF EXISTING PERIMETER RADIATOR. REMOVE ALL ASSOCIATED VALVES AND FITTINGS CUT PIPE BACK TO MAIN AND PROVIDE TEMPORARY CAPPED CONNECTION.
- 17 EXISTING HOT WATER SUPPLY AND RETURN PIPING TO REMAIN.
- 18 EXISTING PERIMETER RADIATOR TO REMAIN.
- 19 REMOVE AND DISPOSE OF EXISTING DUCT MOUNTED AIR GRILLE. BLANK OFF THE EXISTING OPENING AND SEAL DUCTWORK.
- 20 EXISTING DUST COLLECTOR AND ALL ASSOCIATED PIPING AND DUCTWORK TO REMAIN.
- 21 EXISTING DUCT WORK TO REMAIN.
- 22 EXISTING GRILLE TO REMAIN AND BE REBALANCED.
- 23 DEMOLISH EXISTING PNEUMATIC CONTROL VALVE ON EXISTING PERIMETER RADIATOR. DEMOLISH AND CAP EXISTING COMPRESSED AIR PIPES BACK TO EXISTING MAIN.
- 24 DEMOLISH AND DISPOSE OF ABANDONED FUME HOOD AND ALL ASSOCIATED DUCTWORK.
- 25 DEMOLISH AND DISPOSE OF ABANDONED EXHAUST FAN AND ASSOCIATED DUCTWORK.
- 26 EXISTING REFRIGERANT PIPING RUNNING UP TO ROOF LEVEL TO BE DEMOLISHED AND DISPOSED OF.

GENERAL NOTES

- A) THE EXISTING SERVICES SHOWN ON THIS DRAWING HAVE BEEN TAKEN FROM THE ORIGINAL AS-BUILT DRAWINGS. THIS INFORMATION MUST NOT BE ASSUMED TO BE COMPLETE OR UP-TO-DATE. THE MECHANICAL CONTRACTOR SHALL CARRY OUT A FULL SURVEY OF ALL EXISTING SERVICES AND STRUCTURE TO CONFIRM THE SIZE AND LOCATION OF THESE SERVICES, BEFORE THE COMMENCEMENT OF ANY WORK.
- B) ALL DISCONNECTED DUCTWORK AND PIPING TO BE CAPPED OFF UNLESS OTHERWISE NOTED
- C) ALL CUTTING AND PATCHING OF EXISTING ROOF, FLOORS AND WALLS TO BE BY MECHANICAL CONTRACTOR
- D) FOR DRAWING LEGENDS SEE DRAWING M0.0

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PROJECT:
HVAC Renovations

Glendale
Secondary
School

145 Rainbow Dr,
Hamilton, ON
For the HWDSB

SEAL:

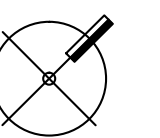
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DRAWING TITLE:
Demolition
HVAC Ground
Floor Plan

SCALE:

AS NOTED

DRAWN:

C.M. / J.L.

DATE:

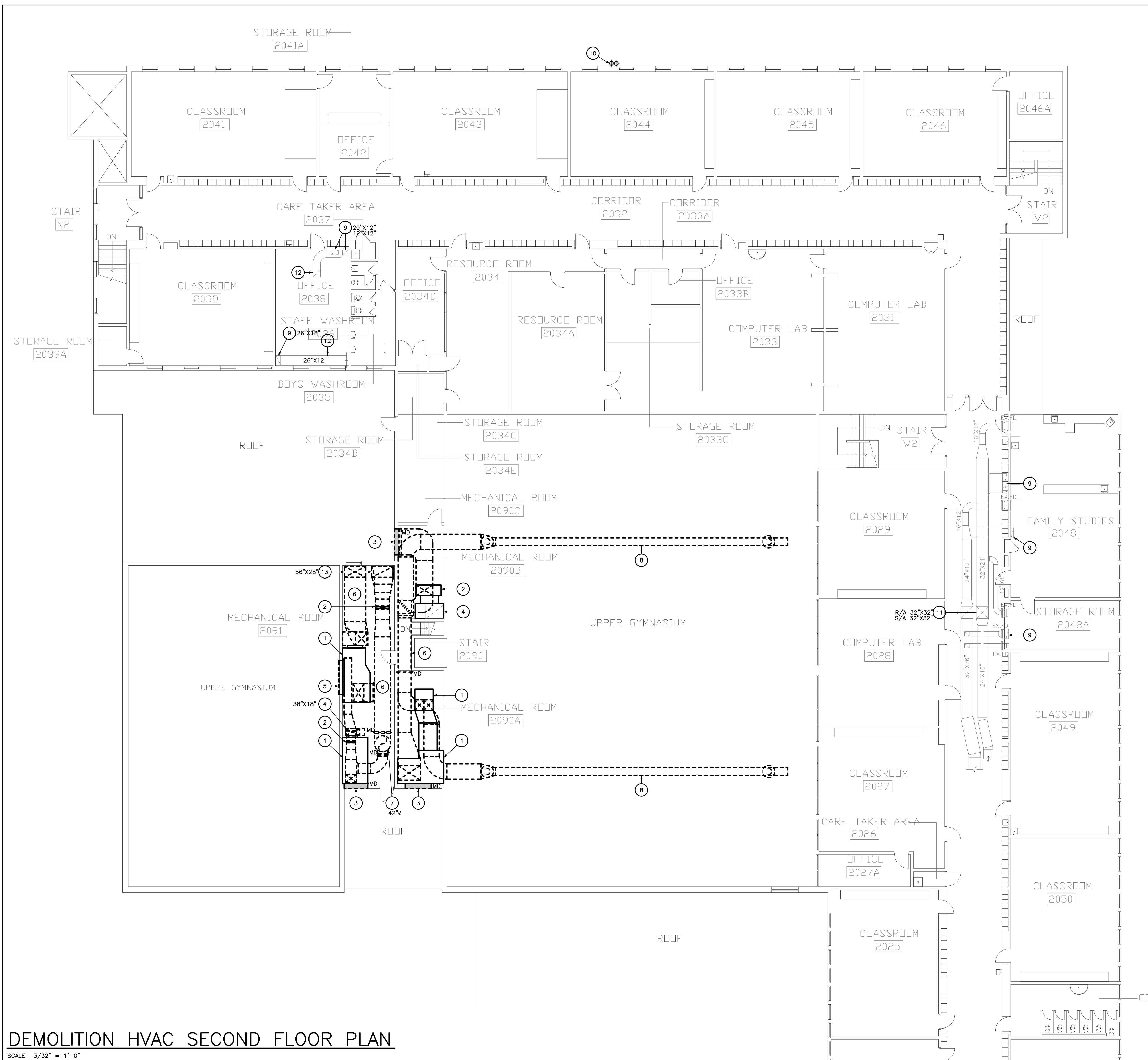
SEPTEMBER 2023

PROJECT #:

ALL-23010629-A0

DRAWING #:

M1.1



DEMOLITION HVAC SECOND FLOOR PLAN

SCALE - 3/32" = 1'-0"

DRAWING NOTES

- 1 DEMOLISH AND DISPOSE OF EXISTING AIR HANDLING UNIT. CUTBACK HYDRONIC LINES TO MAIN AND PROVIDE CAPPED CONNECTION.
- 2 DEMOLISH AND DISPOSE OF EXISTING RETURN FAN.
- 3 DEMOLISH EXISTING WALL LOUVER. REFER TO ARCHITECTURAL AND STRUCTURAL PLANS FOR PATCHING OF WALL OPENING.
- 4 EXISTING DUCT DROP TO BELOW IS TO BE REUSED.
- 5 RETURN AIR GRILLE TO BE DEMOLISHED. EXISTING OPENING TO BE FILLED IN. REFER TO ARCHITECTURAL AND STRUCTURAL DRAWINGS.
- 6 DEMOLISH AND DISPOSE OF DUCT WORK TO EXTENT SHOWN.
- 7 EXHAUST AIR STACK UP TO ROOF ABOVE TO BE DEMOLISHED.
- 8 DEMOLISH EXISTING DUCTWORK. DUCTWORK IS INSTALLED BETWEEN EXISTING ROOF STRUCTURE.
- 9 EXISTING DUCT RISER TO DOWN TO FLOOR BELOW TO REMAIN.
- 10 EXISTING REFRIGERANT PIPING RUNNING UP TO ROOF LEVEL TO BE DEMOLISHED AND DISPOSED OF.
- 11 DUCT CONTINUES UP TO AHU-10 ON ROOF ABOVE.
- 12 EXISTING DUCTWORK TO REMAIN.
- 13 DUCT DROP TO BELOW TO BE DEMOLISHED AND DISPOSED OF. PATCH AND SEAL OPENING. REFER TO STRUCTURAL AND ARCHITECTURAL DRAWINGS.

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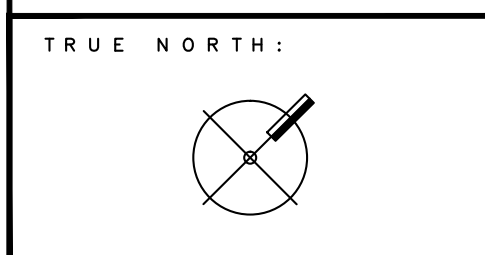
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Glendale Secondary School
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DRAWING TITLE:
Demolition HVAC Second Floor Plan

SCALE:
AS NOTED

DRAWN:
C.M. / J.L.

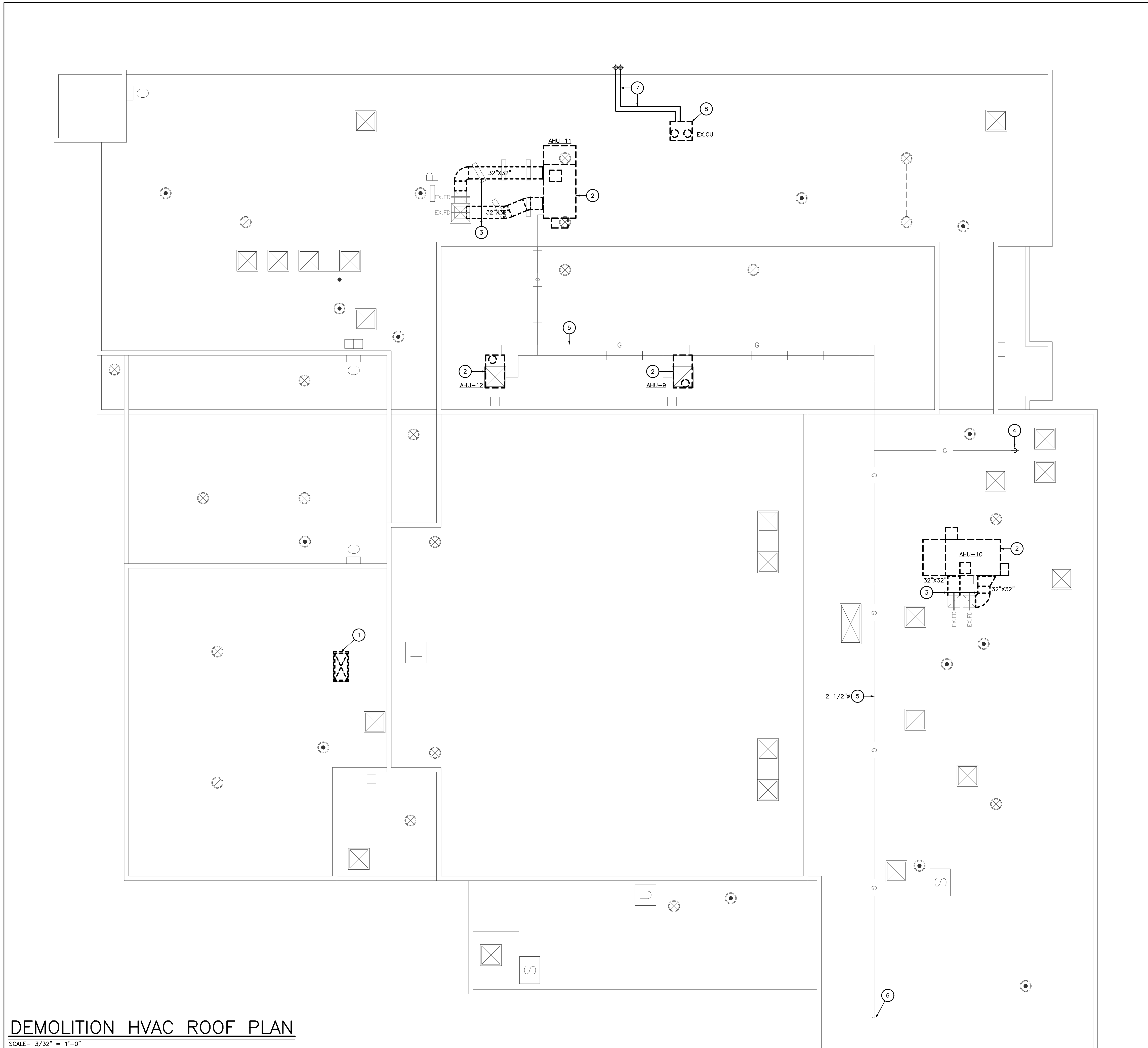
DATE:
SEPTEMBER 2023

PROJECT #:
ALL-23010629-A0

DRAWING #:
M1.2

GENERAL NOTES

- A) THE EXISTING SERVICES SHOWN ON THIS DRAWING HAVE BEEN TAKEN FROM THE ORIGINAL AS-BUILT DRAWINGS. THIS INFORMATION MUST NOT BE ASSUMED TO BE COMPLETE OR UP-TO-DATE. THE MECHANICAL CONTRACTOR SHALL CARRY OUT A FULL SURVEY OF ALL EXISTING SERVICES AND STRUCTURE TO CONFIRM THE SIZE AND LOCATION OF THESE SERVICES, BEFORE THE COMMENCEMENT OF ANY WORK.
- B) ALL DISCONNECTED DUCTWORK AND PIPING TO BE CAPPED OFF UNLESS OTHERWISE NOTED
- C) ALL CUTTING AND PATCHING OF EXISTING ROOF, FLOORS AND WALLS TO BE BY MECHANICAL CONTRACTOR
- D) FOR DRAWING LEGENDS SEE DRAWING M0.0



DEMOLITION HVAC ROOF PLAN
 SCALE - 3/32" = 1'-0"

DRAWING NOTES

- 1 DEMOLISH AND DISPOSE OF EXISTING EXHAUST AIR VENT. REFER TO ARCHITECTURAL AND STRUCTURAL DRAWINGS FOR PATCHING OF ROOF.
- 2 DEMOLISH AND DISPOSE OF EXISTING ROOF TOP UNIT. TEMPORARILY CAP NATURAL GAS SERVICE AND DUCT CONNECTIONS.
- 3 DEMOLISH EXISTING ROOFTOP DUCT WORK TO EXISTING PENETRATION THROUGH ROOF. EXISTING FIRE DAMPERS TO REMAIN.
- 4 EXISTING NATURAL GAS PIPE DROPS THROUGH ROOF TO BELOW.
- 5 EXISTING NATURAL GAS PIPING ROUTED ALONG THE ROOF.
- 6 EXISTING NATURAL GAS PIPING CONTINUES ALONG ROOF
- 7 EXISTING REFRIGERANT PIPING TO BE DEMOLISHED AND DISPOSED OF.
- 8 DEMOLISH AND DISPOSE OF EXISTING ROOFTOP CONDENSER UNIT ASSOCIATED WITH CEILING HUNG AC UNIT IN CLASSROOM 1056A. DEMOLISH ALL ASSOCIATED PIPING AND FITTINGS.

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PROJECT:
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 Glendale Secondary School
 145 Rainbow Dr,
 Hamilton, ON
 For the HWDSB

SEAL:

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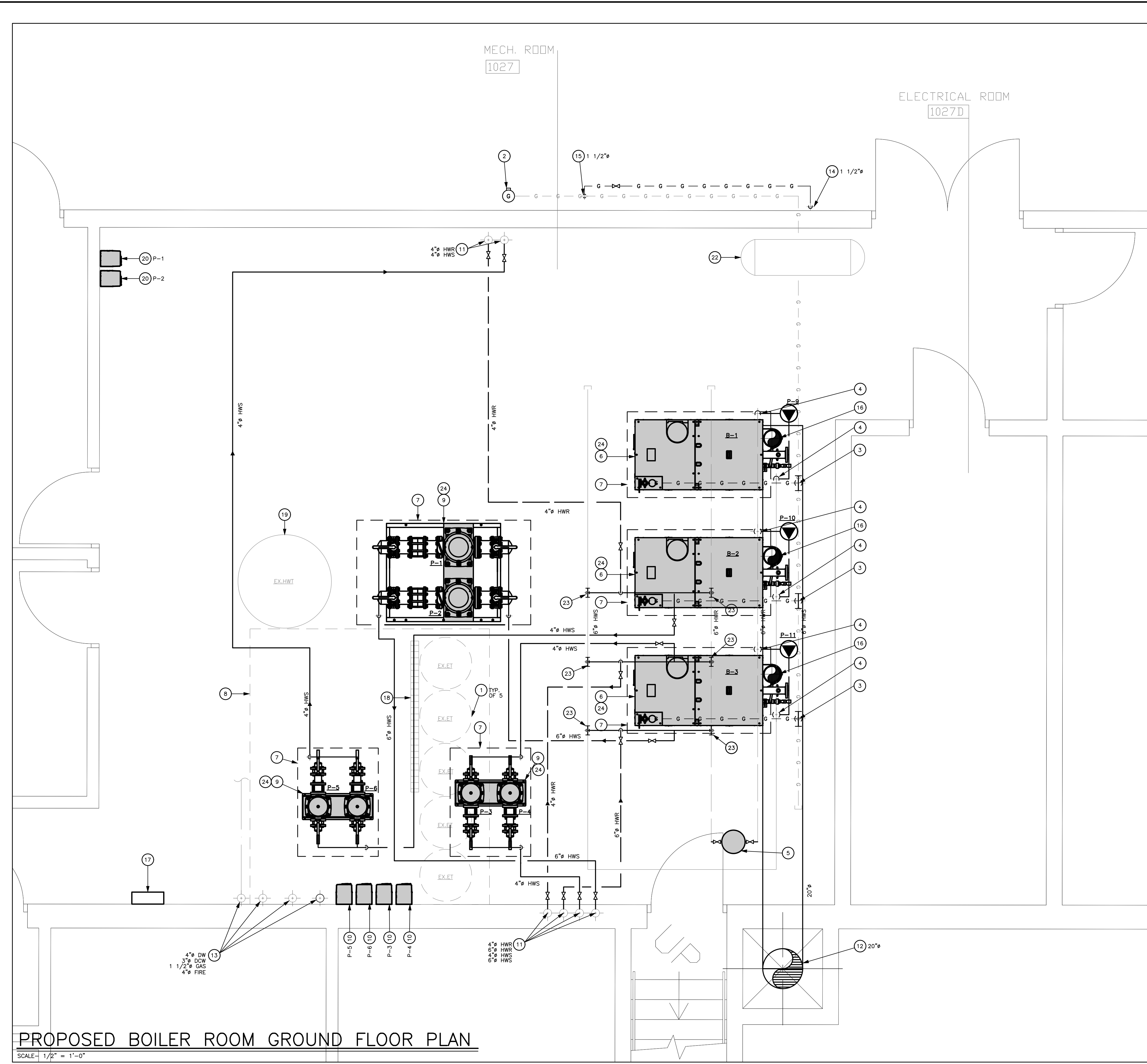


DRAWING TITLE:
 Demolition HVAC Roof Plan

SCALE:
 AS NOTED
 DRAWN:
 C.M. / J.L.
 DATE:
 SEPTEMBER 2023
 PROJECT #:
 ALL-23010629-A0
 DRAWING #:
 M1.3

GENERAL NOTES

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- B) ALL DISCONNECTED DUCTWORK AND PIPING TO BE CAPPED OFF UNLESS OTHERWISE NOTED
- C) ALL CUTTING AND PATCHING OF EXISTING ROOF, FLOORS AND WALLS TO BE BY MECHANICAL CONTRACTOR
- D) FOR DRAWING LEGENDS SEE DRAWING M0.0



PROPOSED BOILER ROOM GROUND FLOOR PLAN
 SCALE = 1/2" = 1'-0"

DRAWING NOTES

- 1 EXISTING EXPANSION TANKS TO REMAIN.
- 2 EXISTING GAS METER ON BUILDING EXTERIOR. CONTRACTOR IS TO COORDINATE WITH THE UTILITY AND OWNER FOR ALL SERVICE INTERRUPTIONS.
- 3 CONNECT TO EXISTING GAS LINE AT APPROXIMATE LOCATION INDICATED. PROVIDE GAS VALVE AND DIRT LEG. REFER TO SCHEMATICS FOR PIPE SIZES AND CONNECTION DETAILS.
- 4 CONNECT TO EXISTING HOT WATER RETURN AND SUPPLY HEADERS. PROVIDE ALL NECESSARY PIPE TRANSITIONS TO CONNECT FROM NEW 4" BOILER PIPING TO EXISTING 6" HEADERS.
- 5 INSTALL NEW AMTROL 6-ASL HYDRONIC AIR SEPARATOR OR EQUIVALENT WITHIN EXISTING RETURN PIPING.
- 6 INSTALL NEW BOILERS AS PER MANUFACTURERS INSTRUCTIONS. EQUIPMENT TO BE MOUNTED ON NEW 4" CONCRETE HOUSE KEEPING PAD. REFER TO M3.0 FOR PIPING SCHEMATIC.
- 7 PROVIDE NEW 4" THICK CONCRETE HOUSE KEEPING PAD.
- 8 OUTLINE OF EXISTING EQUIPMENT MEZZANINE.
- 9 INSTALL PACKAGED PUMP SKID AS PER MANUFACTURERS INSTRUCTION ON NEW HOUSEKEEPING PAD. PROVIDE ALL PIPE TRANSITIONS NEEDED TO SKID MANIFOLD. COMPLETE ALL REQUIRED WIRING BACK TO CORRESPONDING VFD. REFER TO M3.0 FOR PIPING SCHEMATIC.
- 10 INSTALL NEW PUMP VFD ON WALL SECURED TIGHT AS REQUIRED. PROVIDE ALL REQUIRED WIRING BACK TO MAIN PUMP INDICATED.
- 11 CONNECT TO EXISTING PIPE AT APPROXIMATE LOCATION INDICATED.
- 12 VENTING CONTINUES UP EXISTING CHIMNEY STRUCTURE AND TERMINATES AT 15' ABOVE ROOF LEVEL.
- 13 EXISTING PIPING TO BE PROTECTED DURING CONSTRUCTION.
- 14 GAS LINE CONTINUES UP TO ROOF ABOVE. REFER TO M0.2 AND M2.3 FOR CONTINUATIONS.
- 15 CONNECT NEW GAS PIPE SERVING NEW ERV AND RTUs TO EXISTING GAS TRAIN. COORDINATE WITH THE UTILITY FOR ALL SERVICE INTERRUPTIONS.
- 16 8" VENT CONNECTION ON BOILER CONTINUES UP TO 20' COMMON VENT. REFER TO SPECIFICATION FOR ADDITIONAL DETAILS.
- 17 EXPAND EXISTING BUILDING CONTROL PANEL AS REQUIRED TO CONNECT ALL NEW EQUIPMENT TO CONTROLLER TO SUIT NEW SEQUENCES AND POINTS.
- 18 EXISTING TRENCH DRAIN TO REMAIN.
- 19 EXISTING HOT WATER TANK TO REMAIN.
- 20 INSTALL NEW PUMP VFD ON WALL. COMPLETE ALL REQUIRED WIRING BACK TO MAIN PUMP SKID INDICATED.
- 21 (NOT USED)
- 22 EXISTING AIR COMPRESSOR TO REMAIN.
- 23 CONNECT NEW HOT WATER SUPPLY AND RETURN TO EXISTING MAIN HEADER.
- 24 EXISTING HYDRONIC SYSTEM IS TO BE FLUSHED PRIOR TO COMMISSIONING. CONTRACTOR IS RESPONSIBLE FOR COORDINATING WITH AQUARIAN CHEMICALS INC FOR WATER CHEMICAL TREATMENT. (MCSA@AQUARIANCHEMICALS.COM, P: 416-540-1883) PROVIDE PRE-START UP AND START UP REPORT.

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PROJECT:
 HVAC Renovations
 Glendale
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 School
 145 Rainbow Dr,
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DRAWING TITLE:
 Proposed
 Boiler Room
 Ground Floor
 Plan

SCALE:
 AS NOTED

DRAWN:
 C.M. / J.L.

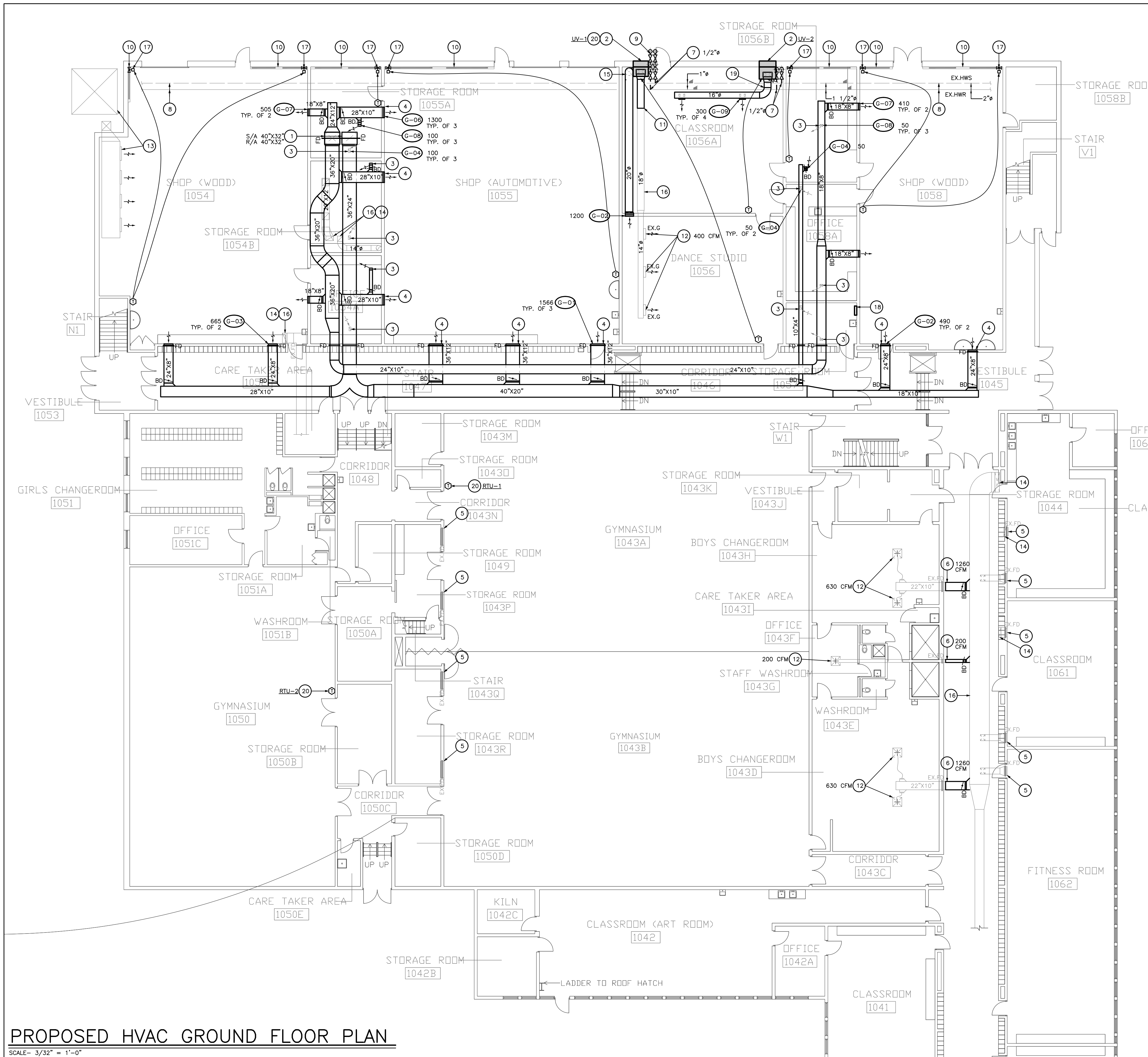
DATE:
 SEPTEMBER 2023

PROJECT #:
 ALL-23010629-A0

DRAWING #:
 M2.0

GENERAL NOTES

- A) FOR EXACT LOCATION OF GRILLES AND DIFFUSERS REFER TO ARCHITECTURAL REFLECTED CEILING PLAN.
- B) ALL DUCTWORK AND EQUIPMENT TO BE CONCEALED IN CEILING SPACE UNLESS NOTED OTHERWISE.
- C) DUCT RUNOUTS TO MATCH GRILLE/DIFFUSER SIZE UNLESS OTHERWISE NOTED.
- D) DUCTWORK LOCATIONS TO BE FULLY CO-ORDINATED WITH GENERAL, PLUMBING, SPRINKLER AND ELECTRICAL CONTRACTORS PRIOR TO FABRICATION OR INSTALLATION.
- E) FOR DRAWING LEGENDS SEE DRAWING M-1.
- F) ALL DEMOLITION WORK SHALL BE DONE VIA PIPE FREEZING. THE EXISTING HEATING SYSTEM SHALL NOT BE DRAINED DOWN.



PROPOSED HVAC GROUND FLOOR PLAN
 SCALE - 3/32" = 1'-0"

DRAWING NOTES

- 1 DUCTWORK CONTINUES UP TO FLOOR ABOVE. PROVIDE FIRE DAMPERS AS INDICATED.
- 2 INSTALL NEW UNIT VENTILATOR AS PER MANUFACTURER'S INSTRUCTIONS. CONNECT TO EXISTING HOT WATER SUPPLY AND RETURN AS PER MECHANICAL DETAILS. CONTRACTOR TO PROVIDE LOUVER BASED ON FINAL SHOP DRAWING DIMENSIONS. DRAIN CONDENSATE THROUGH EXTERIOR WALL.
- 3 DROP AIR GRILLE DOWN TO ROOM BELOW COMPLETE WITH BALANCING DAMPER.
- 4 REUSE EXISTING WALL OPENING FOR NEW GRILLE. GAPS AROUND NEW GRILLES TO BE PATCHED AND SEALED.
- 5 EXISTING RETURN GRILLE C/W FIRE DAMPERS.
- 6 CONNECT TO EXISTING DUCTWORK, BALANCE AIRFLOW TO VALUES INDICATED.
- 7 REMOVE TEMPORARY CAPS AND CONNECT TO EXISTING HOT WATER SUPPLY AND RETURN PIPING.
- 8 EXISTING HOT WATER SUPPLY AND RETURN PIPING TO REMAIN.
- 9 REFRIGERANT LINES CONTINUE UP TO CONDENSER ON ROOF ABOVE.
- 10 EXISTING PERIMETER RADIATOR TO REMAIN.
- 11 CONNECT TO EXISTING DUCTWORK. SIZE IS TO MATCH EXISTING ROUND DUCT. PROVIDE ALL NECESSARY TRANSITION PIECES TO MAKE CONNECTION TO NEW UV.
- 12 BALANCE EXISTING SUPPLY DIFFUSER/GRILLE TO AIRFLOW INDICATED.
- 13 EXISTING DUST COLLECTOR TO REMAIN.
- 14 EXISTING DUCT RISER FROM ABOVE TO REMAIN.
- 15 RUN DUCT DOWN TIGHT AGAINST WALL.
- 16 EXISTING DUCTWORK TO REMAIN
- 17 INSTALL NEW SOLENOID CONTROL VALVE ON EXISTING PERIMETER RADIATORS. WIRE CONTROL VALVES AND THERMOSTATS TO NEW CONTROLLER IN STORAGE ROOM 1057.
- 18 PROVIDE NEW CONTROLLER FOR RADIATOR CONTROL VALVES AND THERMOSTATS. PROVIDE WIRING BACK TO MAIN CONTROLLER IN BOILER ROOM.
- 19 OFFSET DUCTWORK FROM WALL AS REQUIRED TO AVOID INTERFERENCE WITH EXISTING HYDRONIC SYSTEM PIPING.
- 20 PIPE REFRIGERANT TO CORRESPONDING REMOTE CONDENSING UNIT. COORDINATE WITH MANUFACTURER FOR SIZING OF REFRIGERANT AND SUCTION LINES.
- 21 INSTALL SPACE THERMOSTAT AND WIRE BACK TO INDICATED HVAC UNIT ON ROOF ABOVE. CONTRACTOR TO CONFIRM EXACT THERMOSTAT LOCATION WITH OWNER PRIOR TO INSTALLATION.

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DRAWING TITLE:
 Proposed HVAC Ground Floor Plan

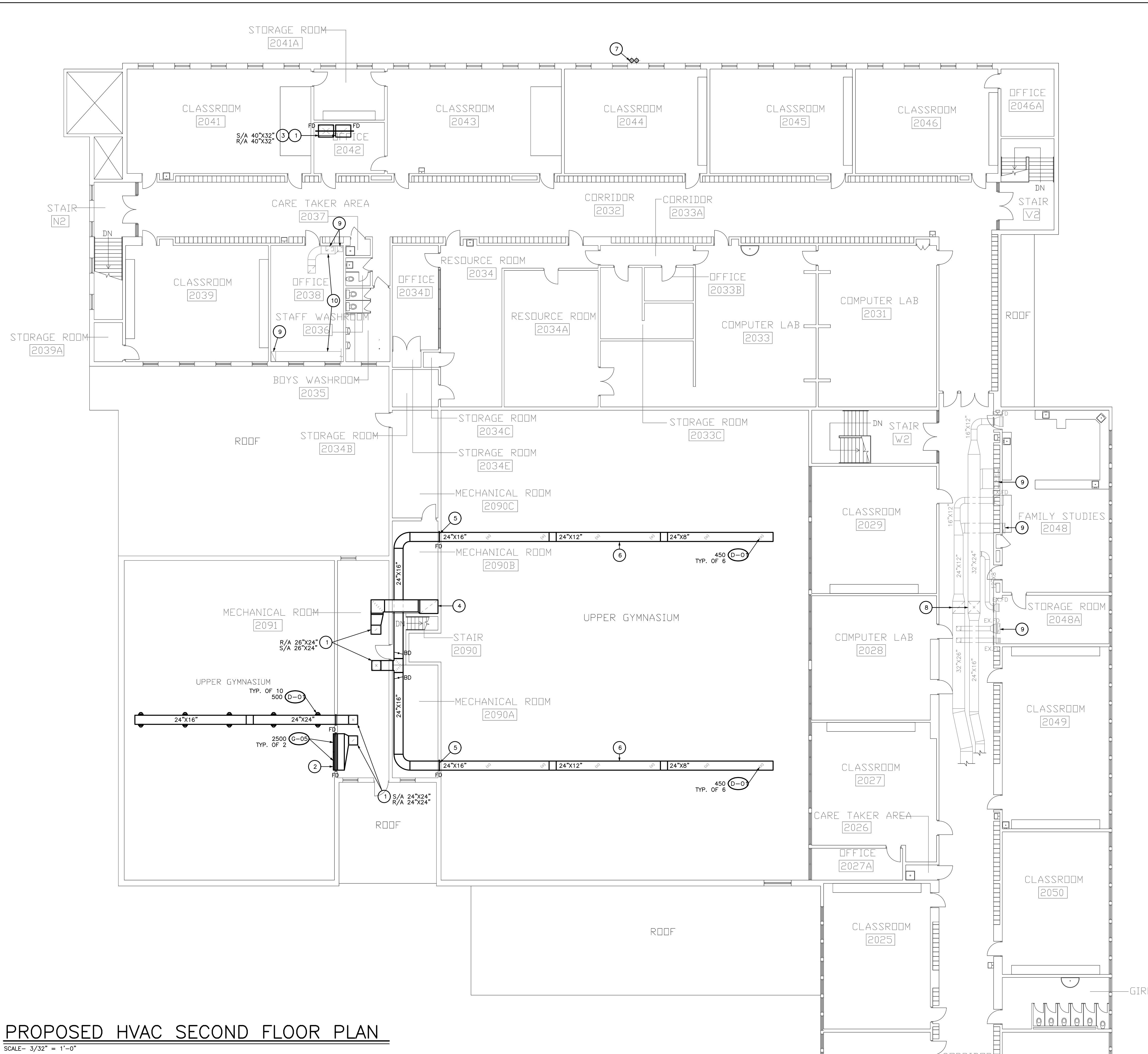
SCALE:
 AS NOTED
 DRAWN:
 C.M. / J.L.
 DATE:
 SEPTEMBER 2023

PROJECT #:
 ALL-23010629-A0

DRAWING #:
 M2.1

GENERAL NOTES

- A) FOR EXACT LOCATION OF GRILLES AND DIFFUSERS REFER TO ARCHITECTURAL REFLECTED CEILING PLAN.
- B) ALL DUCTWORK AND EQUIPMENT TO BE CONCEALED IN CEILING SPACE UNLESS NOTED OTHERWISE.
- C) DUCT RUNOUTS TO MATCH GRILLE/DIFFUSER SIZE UNLESS OTHERWISE NOTED.
- D) DUCTWORK LOCATIONS TO BE FULLY CO-ORDINATED WITH GENERAL, PLUMBING, SPRINKLER AND ELECTRICAL CONTRACTORS PRIOR TO FABRICATION OR INSTALLATION
- E) FOR DRAWING LEGENDS SEE DRAWING M-1.



PROPOSED HVAC SECOND FLOOR PLAN

SCALE - 3/32" = 1'-0"

DRAWING NOTES

- 1 DUCTWORK CONTINUES DOWN FROM ROOF ABOVE. PROVIDE FIRE DAMPERS AT THE PENETRATION. REFER TO M2.3 FOR CONTINUATION.
- 2 PROVIDE NEW TWINNED RETURN AIR GRILLE AT HIGH LEVEL IN GYMNASIUM 1050.
- 3 DUCTWORK THROUGH NEW MECHANICAL SHAFT TO BE ACOUSTICALLY INSULATED FROM FLOOR TO CEILING OF SECOND FLOOR.
- 4 CONNECT TO EXISTING RETURN AIR DUCT AT APPROXIMATE LOCATION INDICATED. PROVIDE ALL NECESSARY TRANSITION FITTINGS REQUIRED TO MAKE CONNECTION.
- 5 REUSE EXISTING WALL OPENINGS FOR NEW DUCTWORK. PATCH AND SEAL GAPS.
- 6 SUPPLY AIR DUCT WORK TO BE ROUTED THROUGH EXISTING ROOF STRUCTURE.
- 7 REFRIGERANT PIPING FROM ROOF ABOVE CONTINUE DOWN TO FLOOR BELOW. KEEP PIPING TIGHT AGAINST EXTERIOR WALL.
- 8 DUCT CONTINUES TO NEW AHU-10 ON ROOF ABOVE.
- 9 EXISTING DUCT RISER DOWN TO FLOOR BELOW.
- 10 EXISTING DUCTWORK TO REMAIN.

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PROJECT:
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DRAWING TITLE:
Proposed
HVAC Second
Floor Plan

SCALE:
AS NOTED

DRAWN:
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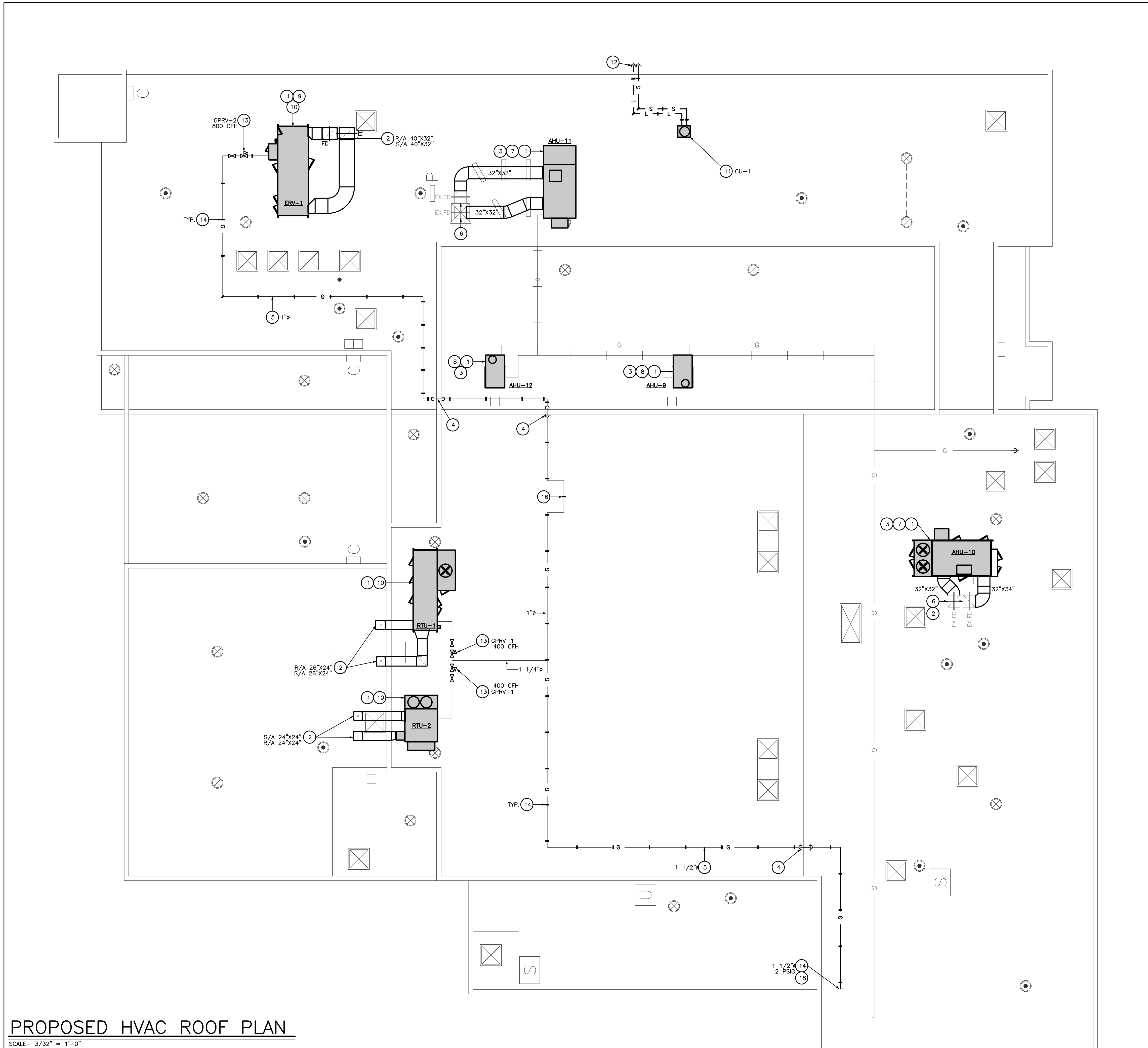
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SEPTEMBER 2023

PROJECT #:
ALL-23010629-A0

DRAWING #:
M2.2

GENERAL NOTES

- A) FOR EXACT LOCATION OF GRILLES AND DIFFUSERS REFER TO ARCHITECTURAL REFLECTED CEILING PLAN.
- B) ALL DUCTWORK AND EQUIPMENT TO BE CONCEALED IN CEILING SPACE UNLESS NOTED OTHERWISE.
- C) DUCT RUNOUTS TO MATCH GRILLE/DIFFUSER SIZE UNLESS OTHERWISE NOTED.
- D) DUCTWORK LOCATIONS TO BE FULLY CO-ORDINATED WITH GENERAL, PLUMBING, SPRINKLER AND ELECTRICAL CONTRACTORS PRIOR TO FABRICATION OR INSTALLATION.
- E) FOR DRAWING LEGENDS SEE DRAWING M-1.



PROPOSED HVAC ROOF PLAN
 SCALE - 3/32" = 1'-0"

DRAWING NOTES

1. INSTALL ROOFTOP UNIT AS PER MANUFACTURERS INSTRUCTIONS.
2. DUCTWORK CONTINUES DOWN THROUGH ROOF TO BELOW. REFER TO M2.2 FOR CONTINUATION.
3. RECONNECT NATURAL GAS PIPING TO NEW AHU
4. OFFSET NATURAL GAS PIPING AS REQUIRED TO ACCOMMODATE EXISTING ROOF.
5. RUN NEW GAS PIPING ALONG ROOF.
6. RECONNECT TO EXISTING DUCT DROPS THROUGH ROOF. FULLY SEAL INSULATION AND PROVIDE NEW FLASHING AT ROOF PENETRATIONS.
7. INSTALL ROOF TOP UNIT ON EXISTING STRUCTURAL PLATFORM.
8. INSTALL ROOF TOP UNIT ON EXISTING ROOF CURB. PROVIDE CURB ADAPTER FROM MANUFACTURER.
9. INSTALL ROOF TOP UNIT ON NEW STRUCTURAL PLATFORM.
10. CONNECT NEW HVAC EQUIPMENT TO NATURAL GAS PIPING.
11. INSTALL NEW CONDENSER UNIT ON ROOF AS PER MANUFACTURERS INSTRUCTIONS. SINGLE POINT ELECTRICAL CONNECTION. CONTRACTOR TO ENGAGE MANUFACTURER TO SIZE REFRIGERANT LINES.
12. REFRIGERANT PIPE DROPS DOWN TO BELOW. RUN TIGHT TO EXTERIOR WALL.
13. NATURAL GAS PRV TO NEW HVAC EQUIPMENT. C/W ISOLATION VALVE, UNION, DIRT LEG. GPRV SIZE, DESIGNATION AND CAPACITY AS INDICATED.
14. SUPPORT NATURAL GAS PIPING AS PER MECHANICAL DETAILS.
15. GAS PIPE CONTINUES ALONG ROOF. REFER TO M0.1 FOR CONTINUATION ON OVERALL ROOF PLAN.
16. PROVIDE EXPANSION LOOP IN NATURAL GAS PIPE RUN.
17. DUCT HEIGHT TO BE 5'-0" ABOVE ROOF LEVEL. MEASURED FROM TOP OF ROOF TO BOTTOM OF DUCT INSULATION. MAINTAIN 5'-0" CLEAR PATH BELOW TO SERVICE SIDE OF RTU-2
18. REFER TO DRAWING M0.1 FOR CONTINUATION OF GAS PIPE.

GENERAL NOTES

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- E) FOR DRAWING LEGENDS SEE DRAWING M-1.

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DRAWING TITLE:
 Proposed
 HVAC Roof
 Plan

SCALE:
 AS NOTED

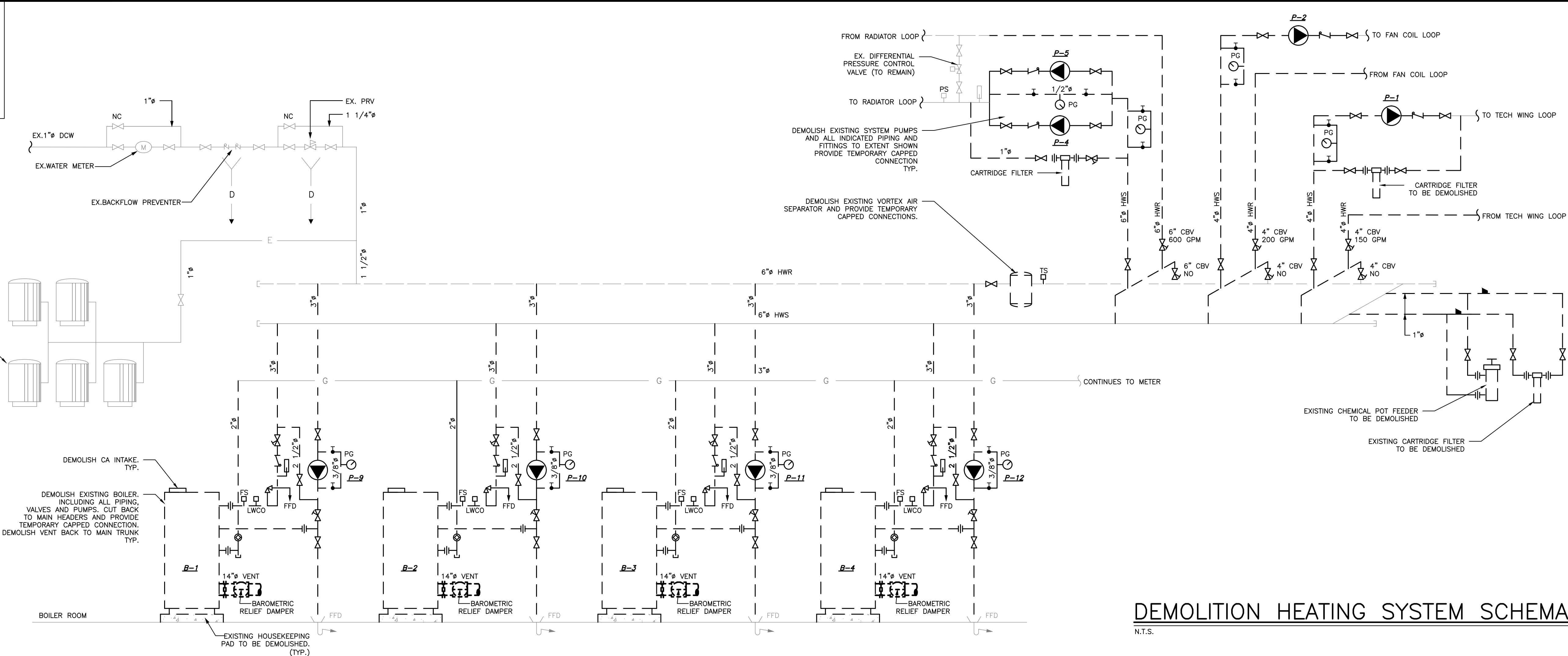
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DATE:
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PROJECT #:
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DRAWING #:
 M2.3

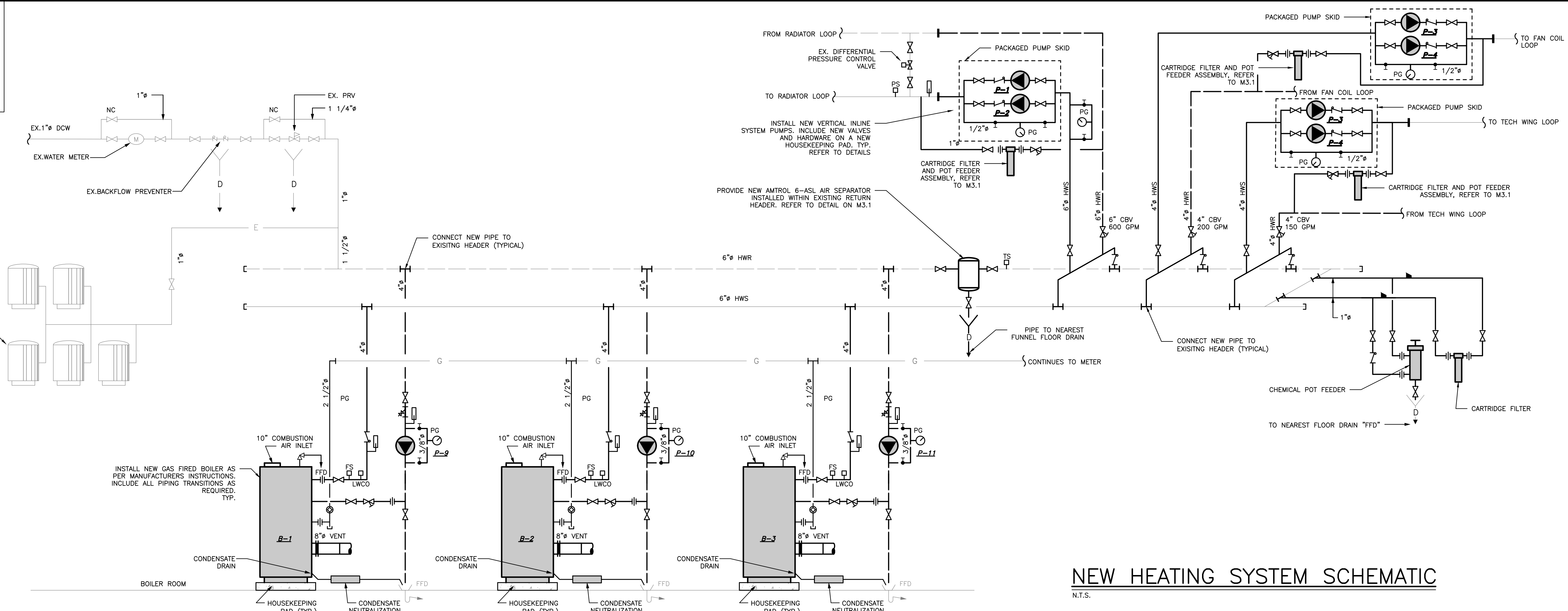
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DEMOLITION HEATING SYSTEM SCHEMATIC

N.T.S.

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NEW HEATING SYSTEM SCHEMATIC

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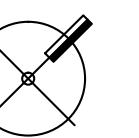
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DRAWING TITLE:
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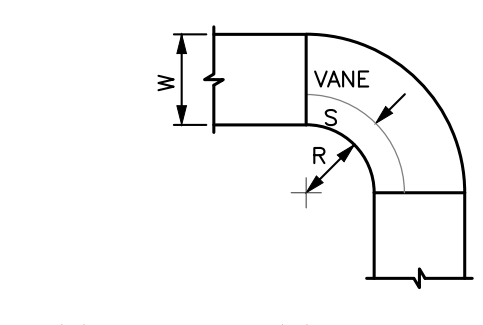
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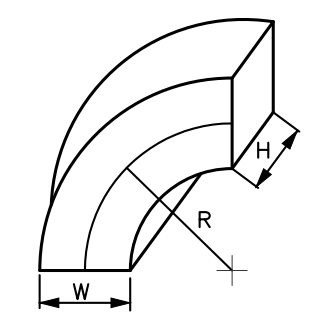
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M3.0

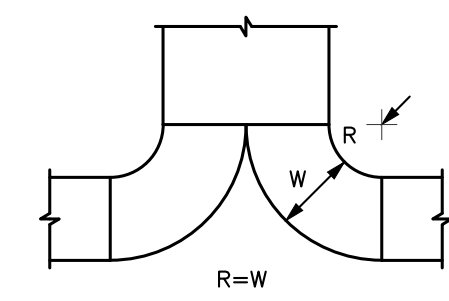


SHORT RADIUS ELBOW - DESIGNATED E3

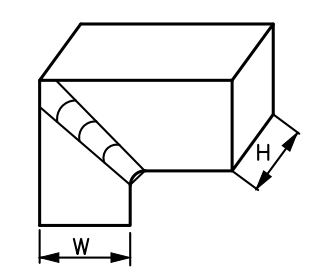


FULL RADIUS RECTANGULAR ELBOW - SMACNA 14-10.6 ELBOW-DESIGNATED E1

- H/W AND R/W: 1.0 AND LESS SPLITTER TYPE TURNING VANES MUST BE USED SO THAT 'C' IS LESS THAN 0.15
- H/W R/W: 1.5 AND LARGE SPLITTER TYPE TURNING VANES ARE NOT REQUIRED WHEN 'C' IS LESS THAN 0.15

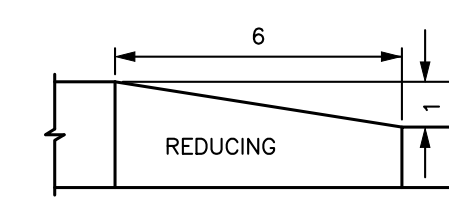


FULL RADIUS TEE - DESIGNATED T1

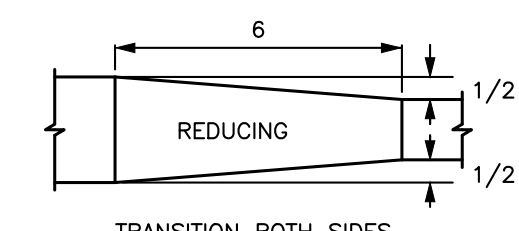


MITRED RECTANGULAR ELBOW - SMACNA 14-10.10 D ELBOW-DESIGNATED E2

- ALL ELBOWS GREATER THAN 30° TO HAVE 115MM SINGLE THICKNESS TURNING VANES ON CENTRE.
- ALL ELBOWS TO HAVE A 45° OR RADIUS THROAT. 90° THROAT IS NOT ACCEPTABLE HIGH LOSS.
- ALL TURNING VANES ARE TO BE ADJUSTED SO THAT THE TRAILING EDGE ARE TANGENT TO THE AIR STREAM. SMACNA FIG.5-15
- DOUBLE THICKNESS TURNING VANES THAT REDUCE THE DUCT AREA MAY NOT BE USED.



TRANSITION ONE SIDE



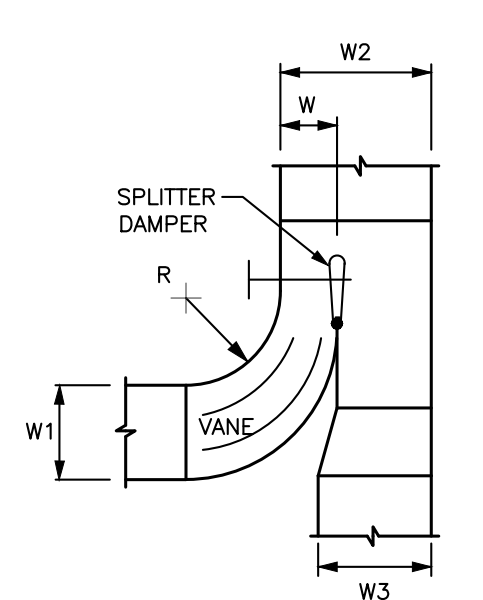
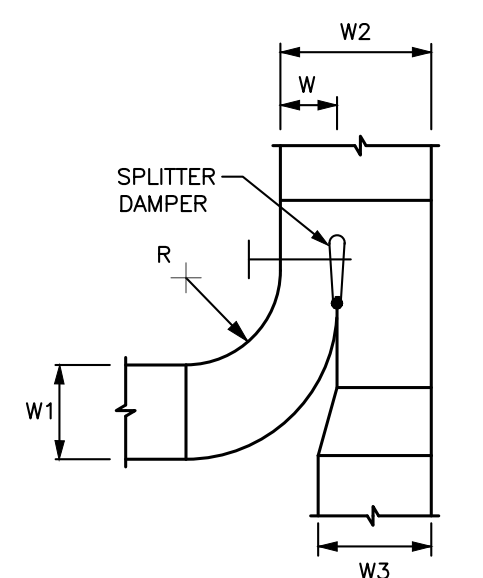
TRANSITION BOTH SIDES

DUCT CONSTRUCTION NOTES:

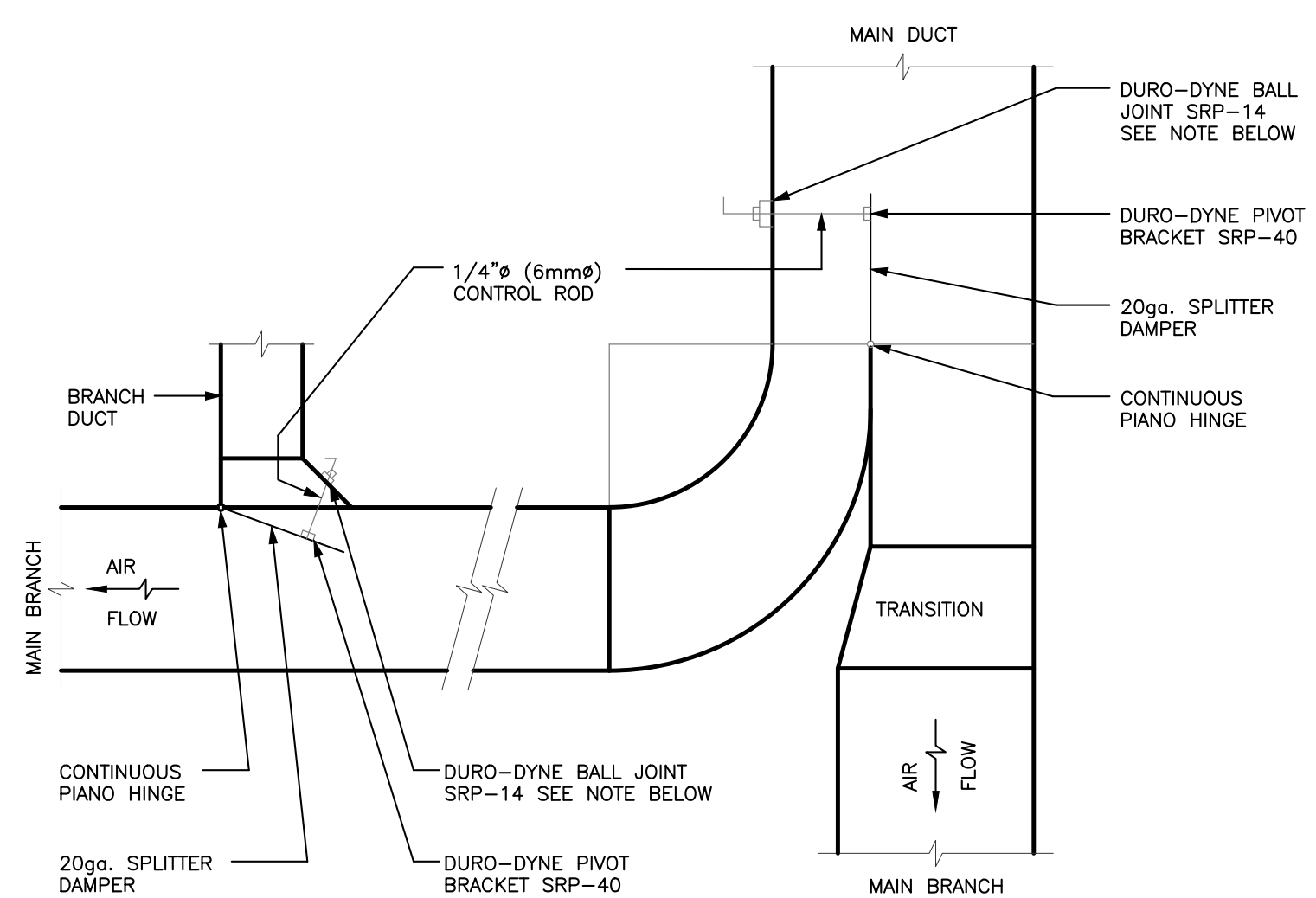
- ALL DUCTS AND FITTINGS TO BE CONSTRUCT FABRICATED TO SMACNA H.V.A.C. SYSTEMS DUCT DESIGN 1990 THIRD EDITION LOW FITTING LOSS PRACTICE.
- TRANSITIONS SHALL NOT EXCEED 20° AT VELOCITIES ABOVE 1000/PM.
- R/W EXCEEDING 1.0 SHALL BE USED IN ALL OPEN AREAS.

SQUARE, RADIUS ELBOW AND TRANSITION FITTINGS

N.T.S.



BRANCH DUCT - DESIGNATED W2



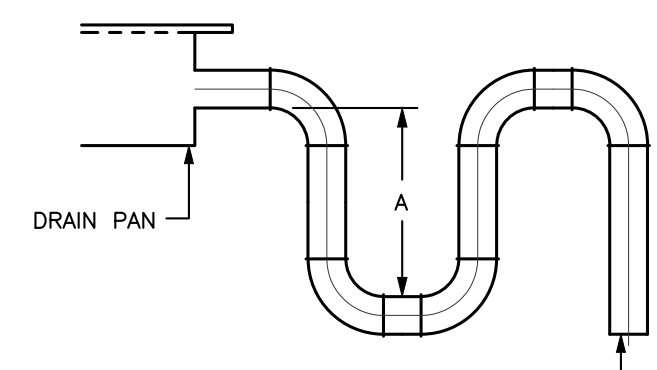
NOTE:

- DUCT DEPTH UP TO 24"(600mm)
1 CONTROL ROD AND BALL JOINT REQUIRED
- DUCT DEPTH OVER 24"(600mm)
2 CONTROL ROD AND BALL JOINTS REQUIRED

HARDWARE SHOWN IS DURO-DYNE (SEE SPECIFICATIONS FOR ALTERNATIVES)

TYPICAL DUCT CONNECTION

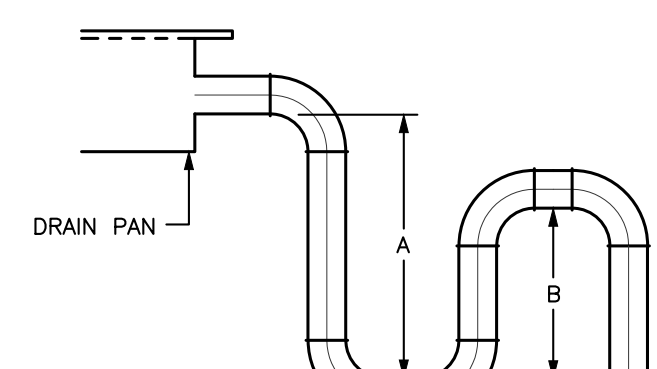
N.T.S.



BLOW - THRU SUPPLY AIR UNIT

MINIMUM DIMENSIONS:

- OPERATING PRESSURE (mm OF WATER) + 25mm (IN OF WATER) + 1 IN



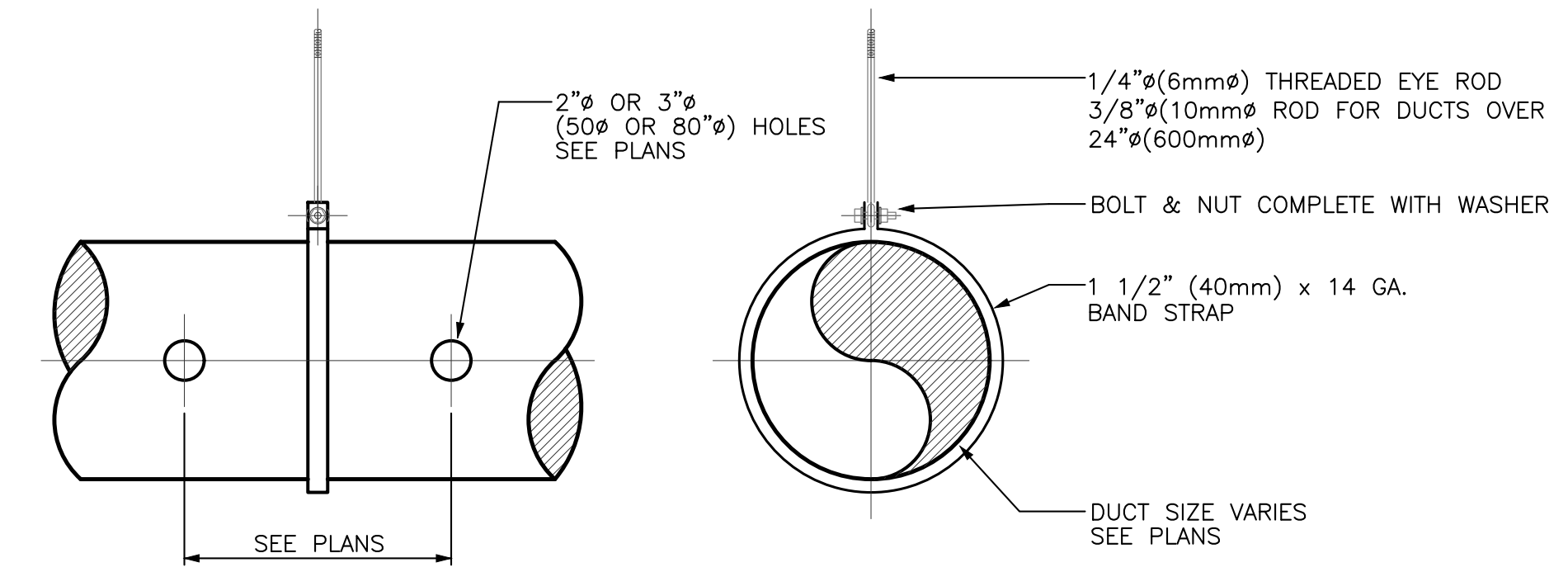
DRAW - THRU SUPPLY AIR UNIT

MINIMUM DIMENSIONS:

- 1 1/2 TIMES THE OPERATING STATIC PRESSURE (mm OF WATER) + 50mm (IN OF WATER) + 2 IN
- 3/4 OF THE OPERATING STATIC PRESSURE (mm OF WATER) + 25mm (IN OF WATER) + 1 IN

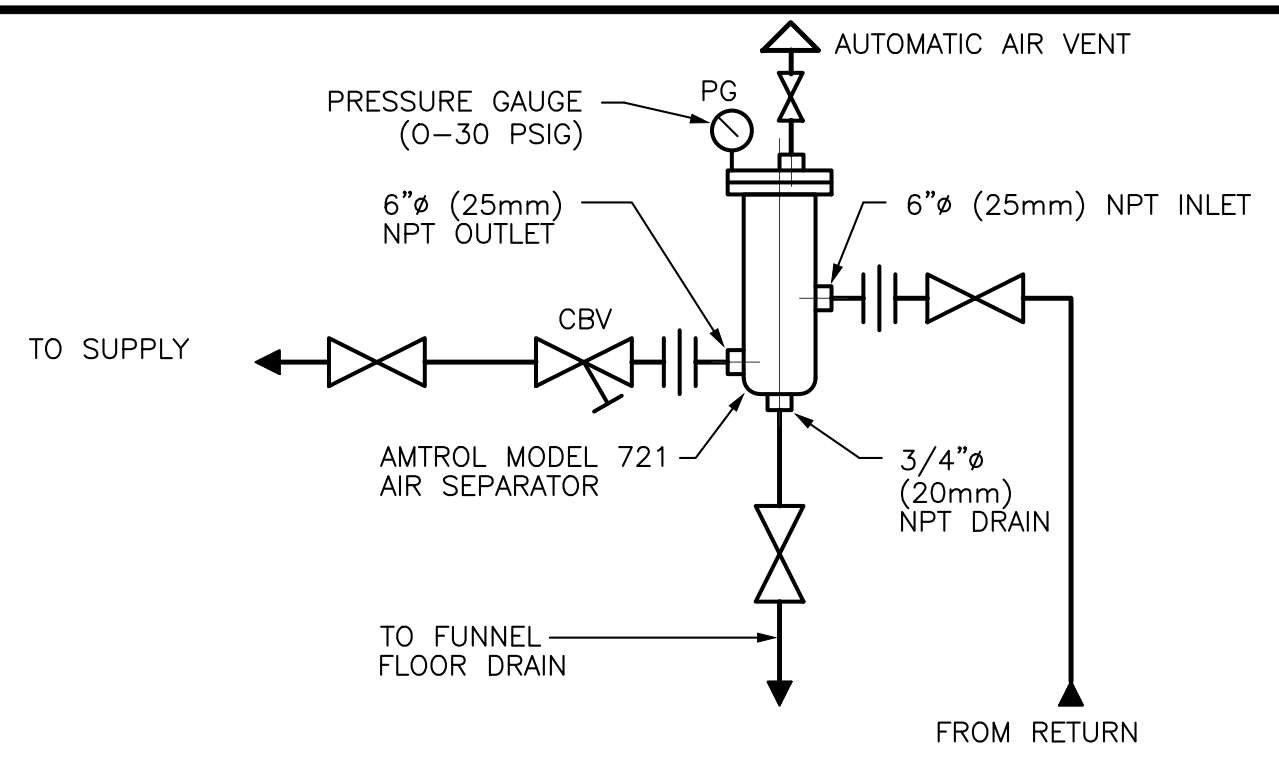
TYPICAL DRAIN PIPE TRAPS

N.T.S.



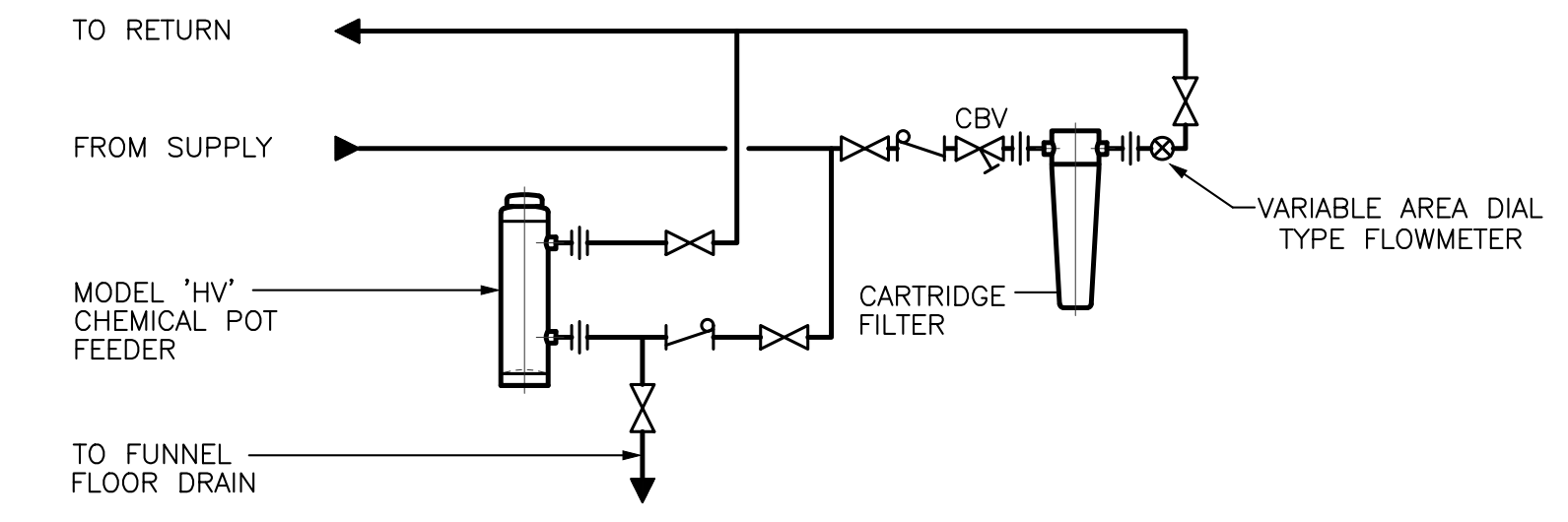
DETAIL - SPIRAL DUCT SUPPORT

N.T.S.



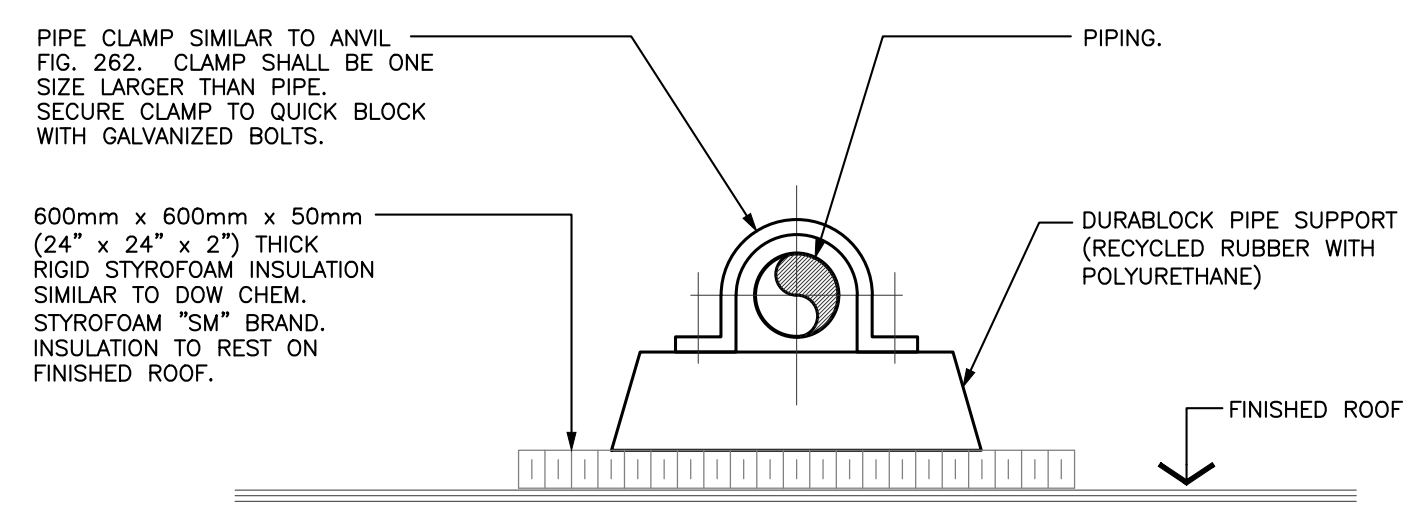
AIR SEPARATOR SCHEMATIC

N.T.S.



TYPE 'HV' CHEMICAL FEEDER SCHEMATIC PIPING AND BY-PASS FILTER

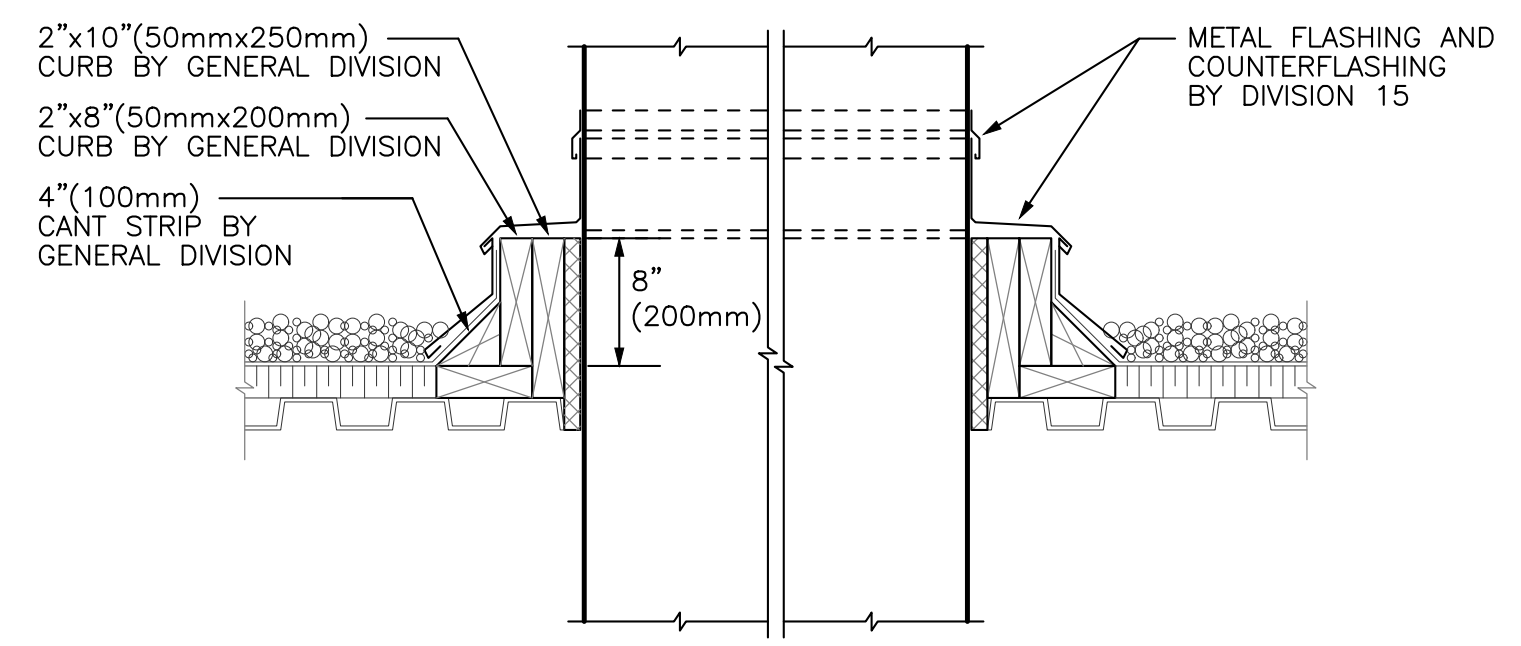
N.T.S.



NOTE: PIPE SUPPORTS TO BE MAXIMUM 2400mm (8'-0") APART.

TYPICAL GAS PIPING SUPPORT ON ROOF

N.T.S.

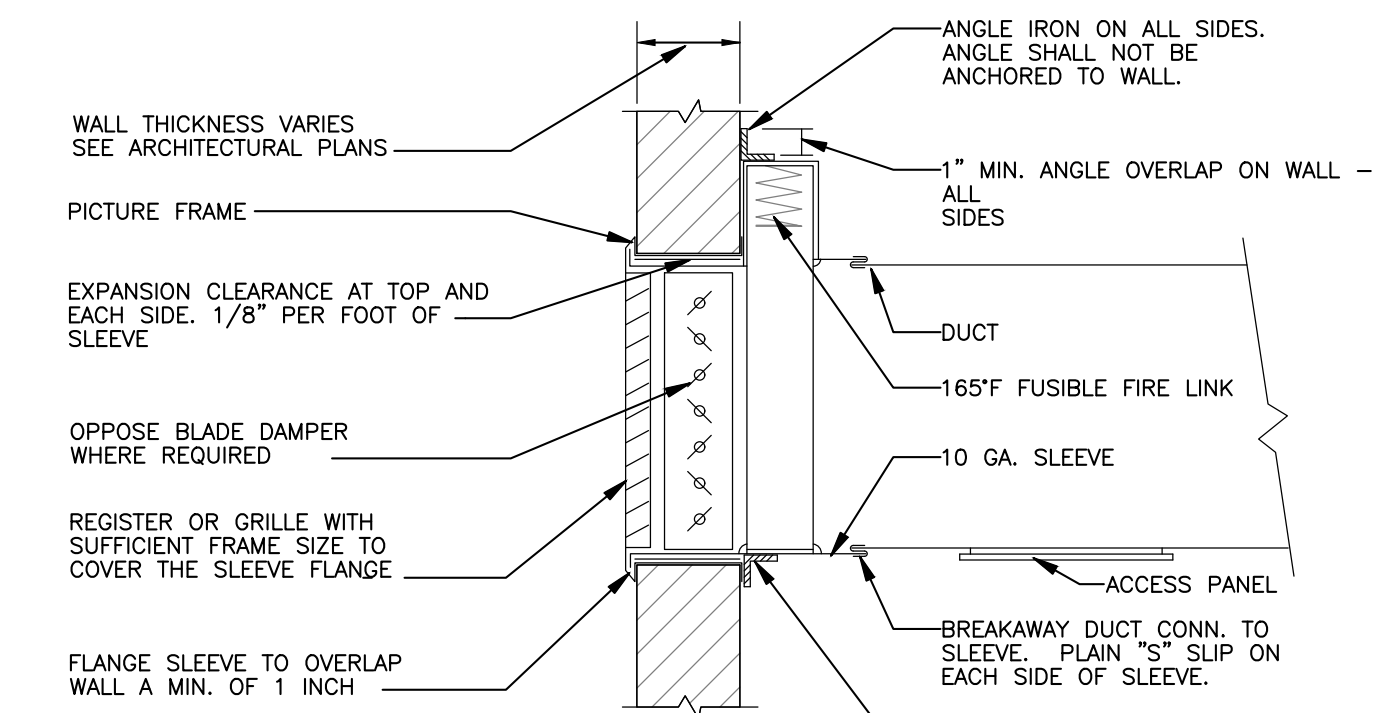


DETAIL WOOD CURB FOR DUCTS THRU ROOF

N.T.S.

NOTES:

- WHERE MANUFACTURER'S INSTALLATION INSTRUCTIONS EXCEED THE REQUIREMENTS OF THIS DETAIL, THEY SHALL BE FOLLOWED.
- USE ONLY STATE OF CALIFORNIA FIRE MARSHAL LISTED FIRE DAMPERS & INSTALL IN ACCORDANCE WITH STATE FIRE MARSHAL LISTING NO. 3225 & U.L. STANDARD 555.
- DAMPERS ASSEMBLIES INCLUDING SLEEVES AND INSTALLATION PROCEDURES SHALL BE APPROVED BY THE BUILDING INSPECTOR PRIOR TO INSTALLATION.



ANGLE IRON & FASTENER DIMENSIONS		
LENGTH	MIN. ANGLE SIZE	FASTENER LOCATION
0 - 48"	1-1/2" x 1-1/2" x 1/8"	8" ON CENTER
49" - 96"	2" x 2" x 1/8"	6" ON CENTER
OVER 96"	2-1/2" x 2-1/2" x 3/16"	6" ON CENTER

FULL WELD AT 4 CORNERS TO MAKE INTEGRAL FRAME

FIRE DAMPER AT WALL GRILLE

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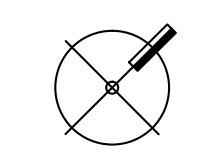
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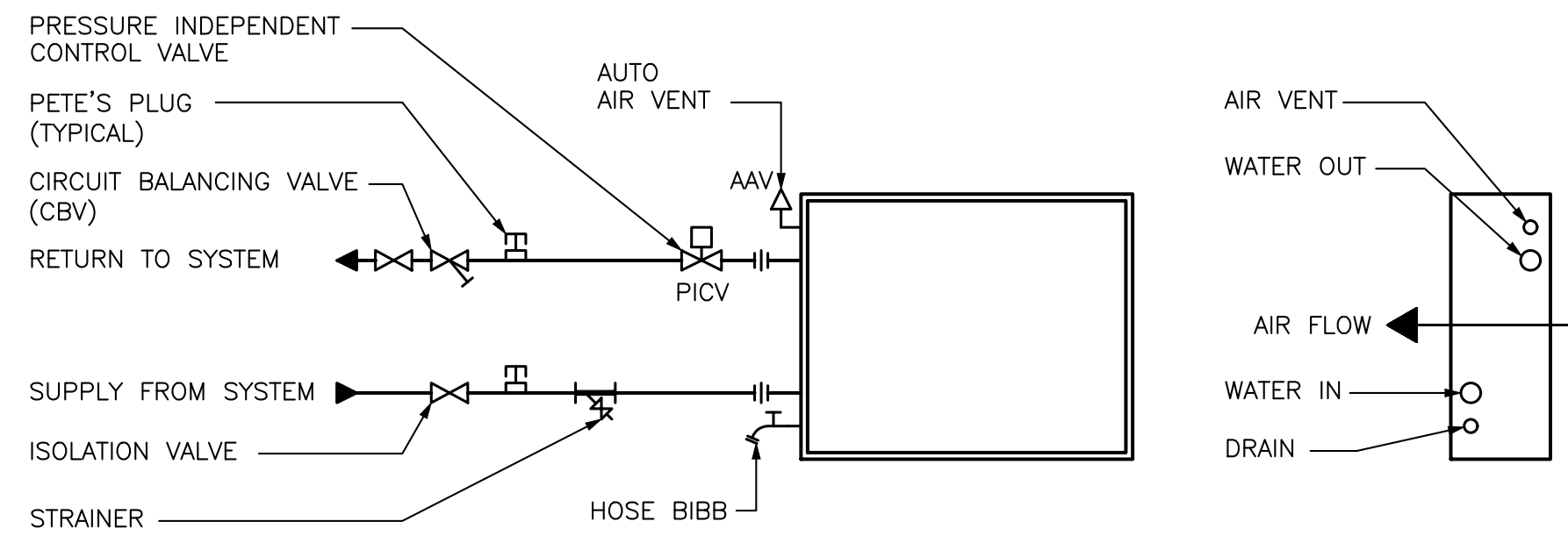
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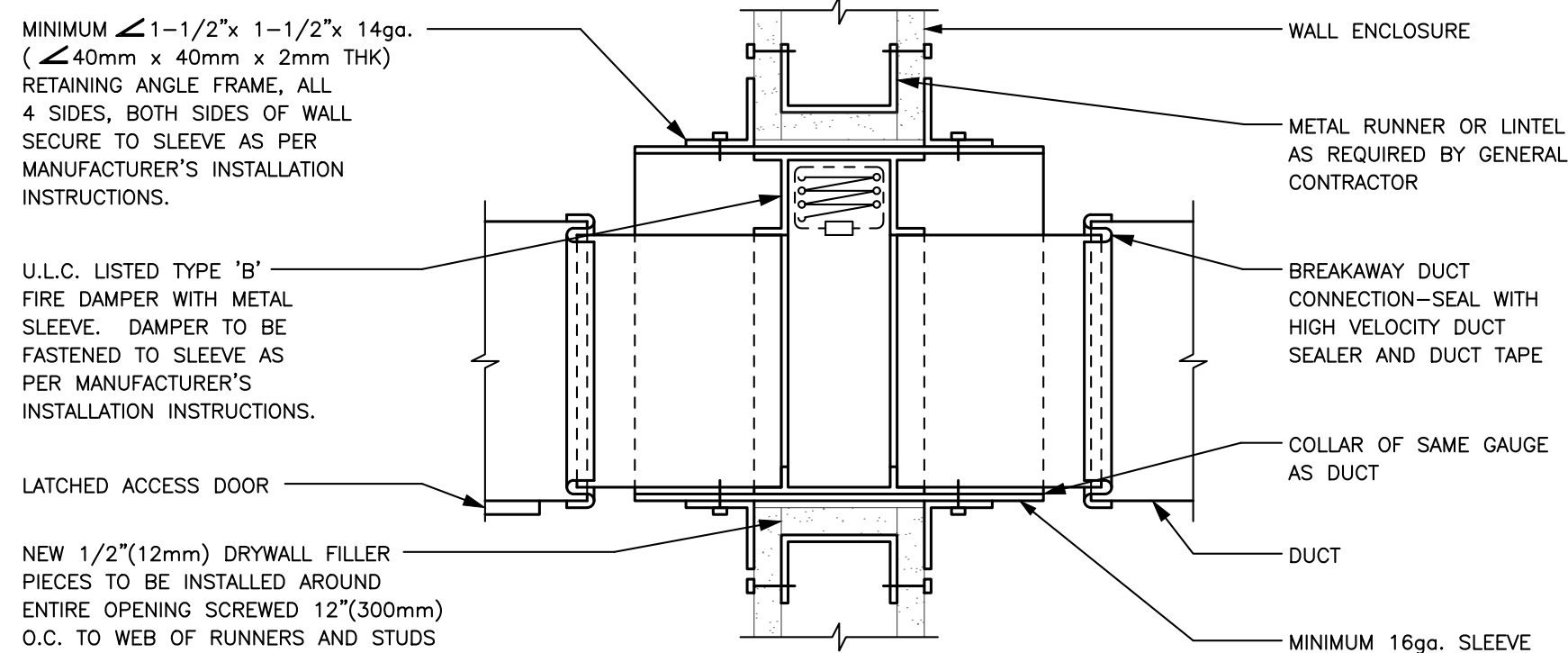
PROJECT #:
ALL-23010629-A0

DRAWING #:
M3.1



HEATING COIL UNIT TWO-WAY CONTROL VALVE PIPING SCHEMATIC

N.T.S.

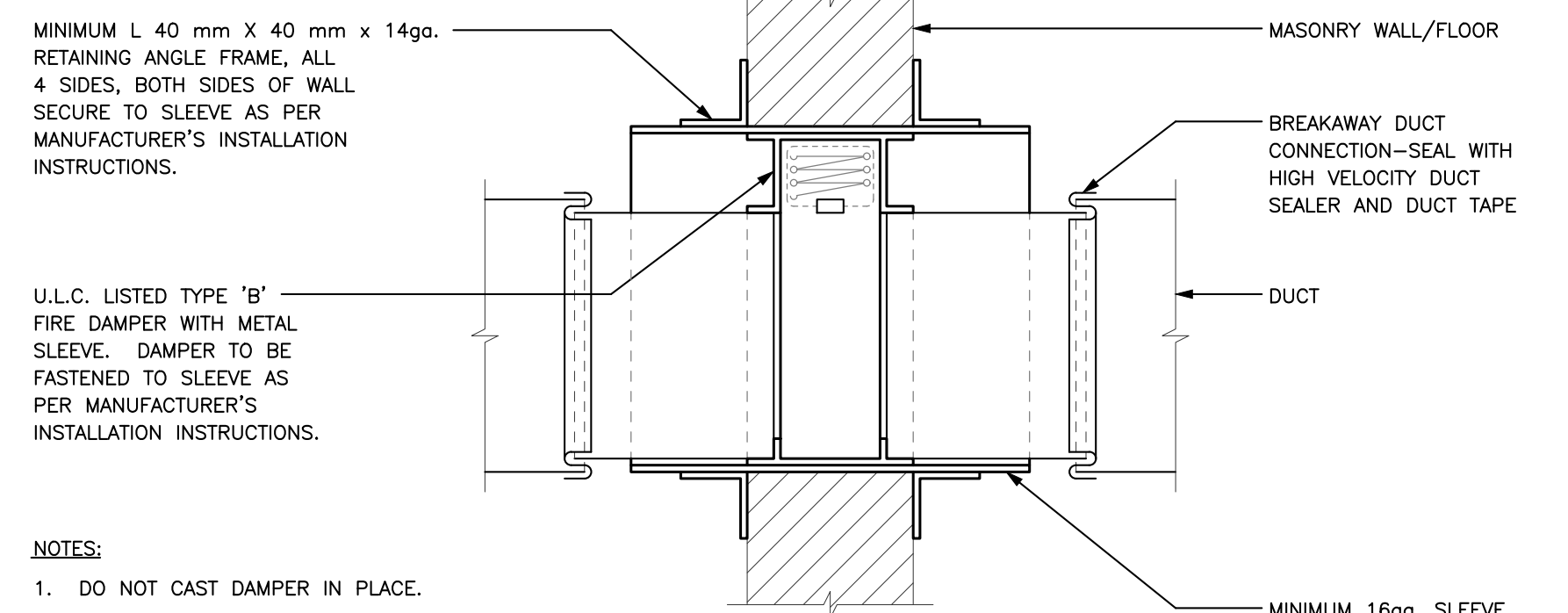


NOTES:

- DO NOT CAST DAMPER IN PLACE.
- DO NOT FASTEN RETAINING ANGLE OR DAMPER DIRECTLY TO WALL OR FLOOR.
- CYCLE DAMPER AFTER INSTALLATION TO INSURE FREE MOVEMENT.
- INSTALL DAMPER IN PLANE OF FIRE SEPARATION.

DETAIL OF FIRE DAMPER IN DUCT (TYPE 'B')

N.T.S.

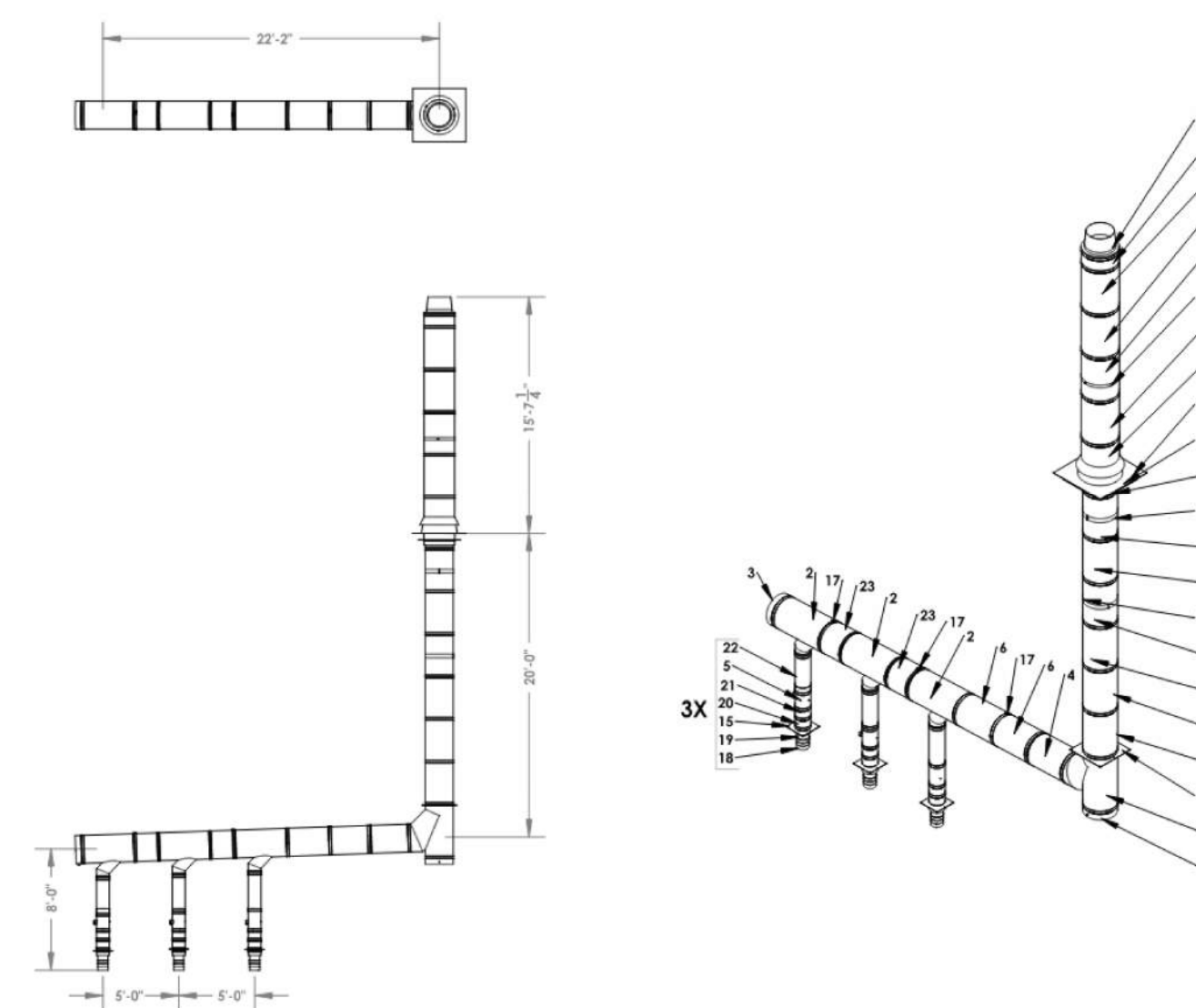


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- INSTALL DAMPER IN PLANE OF FIRE SEPARATION.

DETAIL OF FIRE DAMPER IN MASONRY WALL

N.T.S.

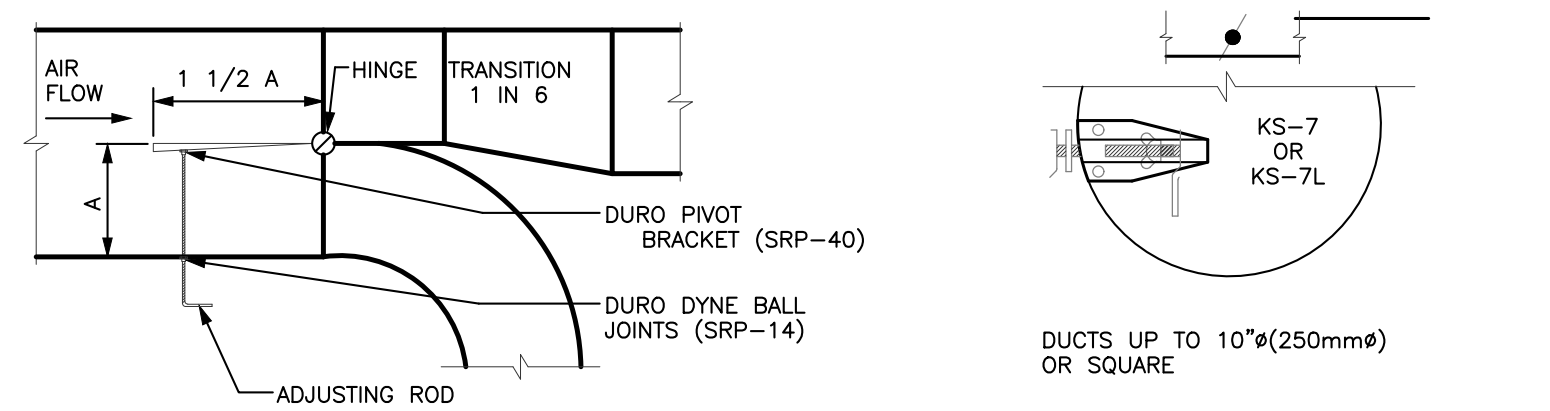


NOTES:

- EXACT BOILER VENTING DIMENSIONS ARE TO BE FINALIZED BASED ON SITE CONDITIONS AND SITE MEASUREMENTS.
- REFER TO MECHANICAL SPECIFICATIONS FOR ADDITIONAL DETAIL AND BOILER MANUFACTURER CONTACT INFORMATION.

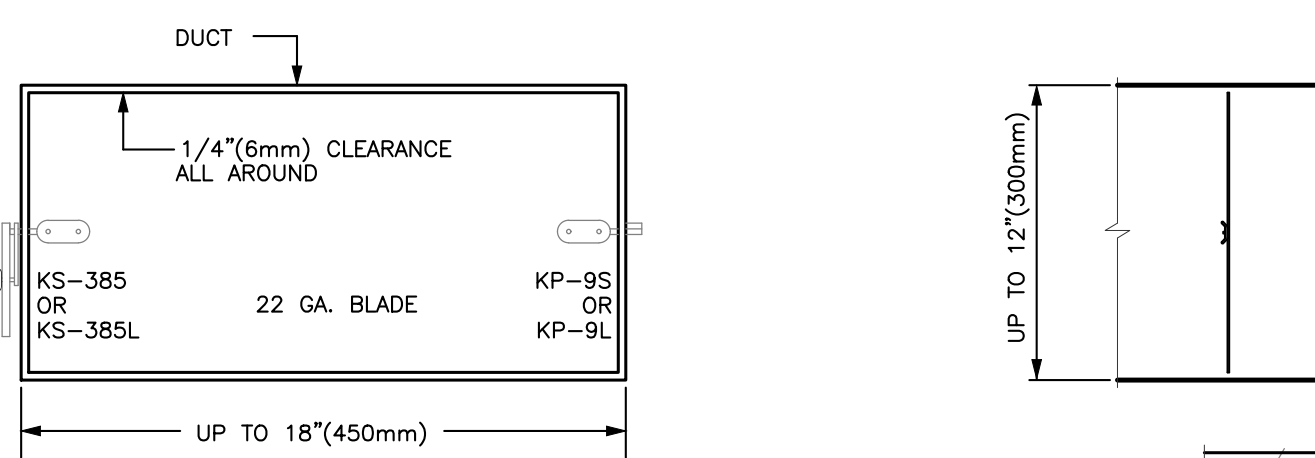
BOILER VENTING SCHEMATIC

N.T.S.

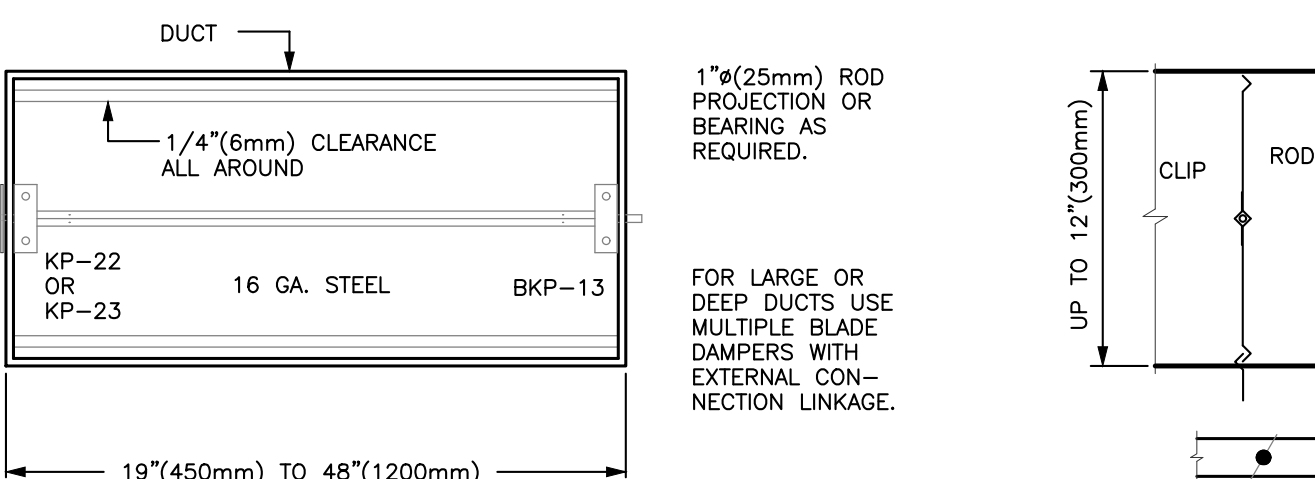


SPLITTER DAMPER

ROUND DUCT BLADE DAMPER



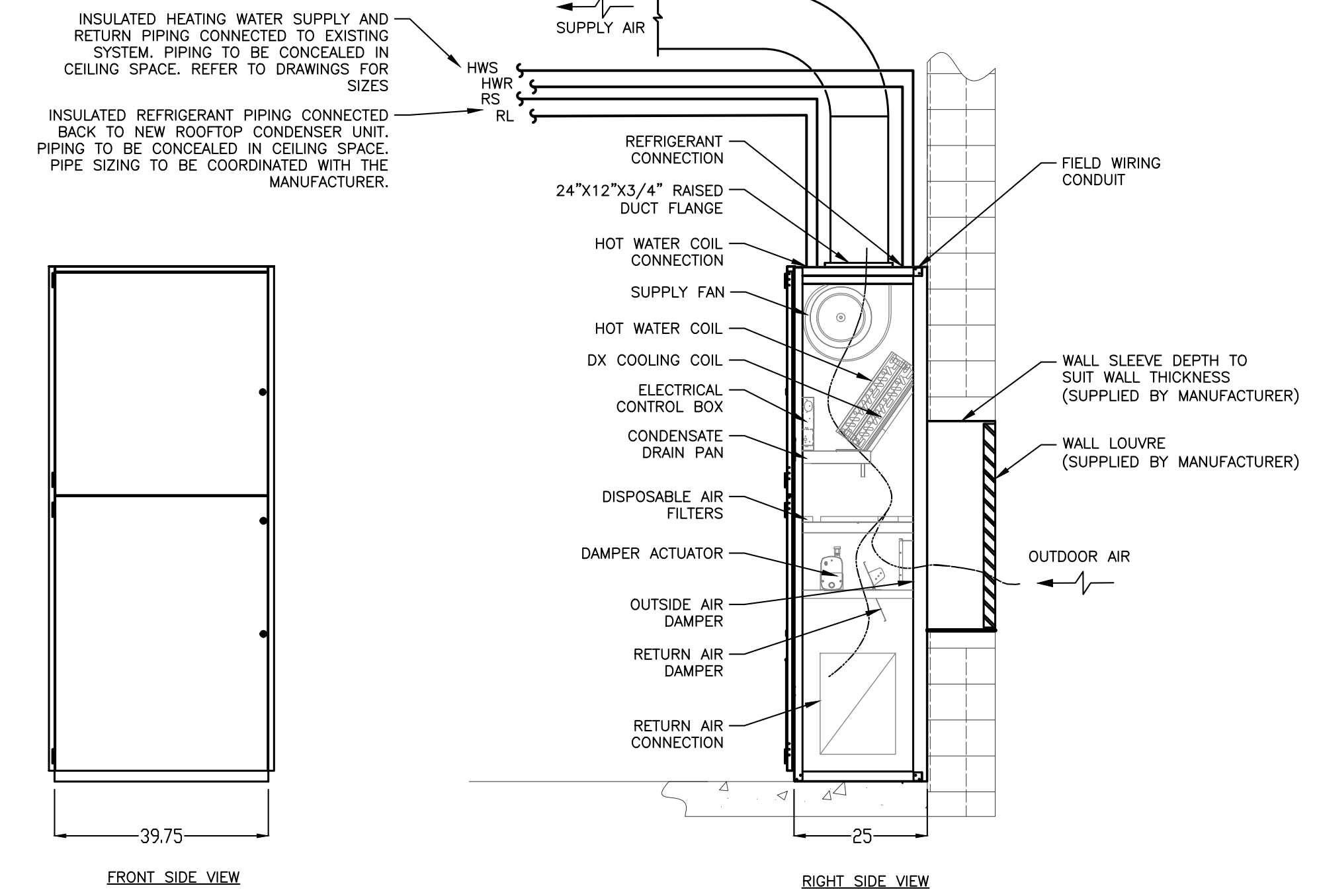
SMALL DUCT BLADE DAMPER



LARGE DUCT BLADE DAMPER

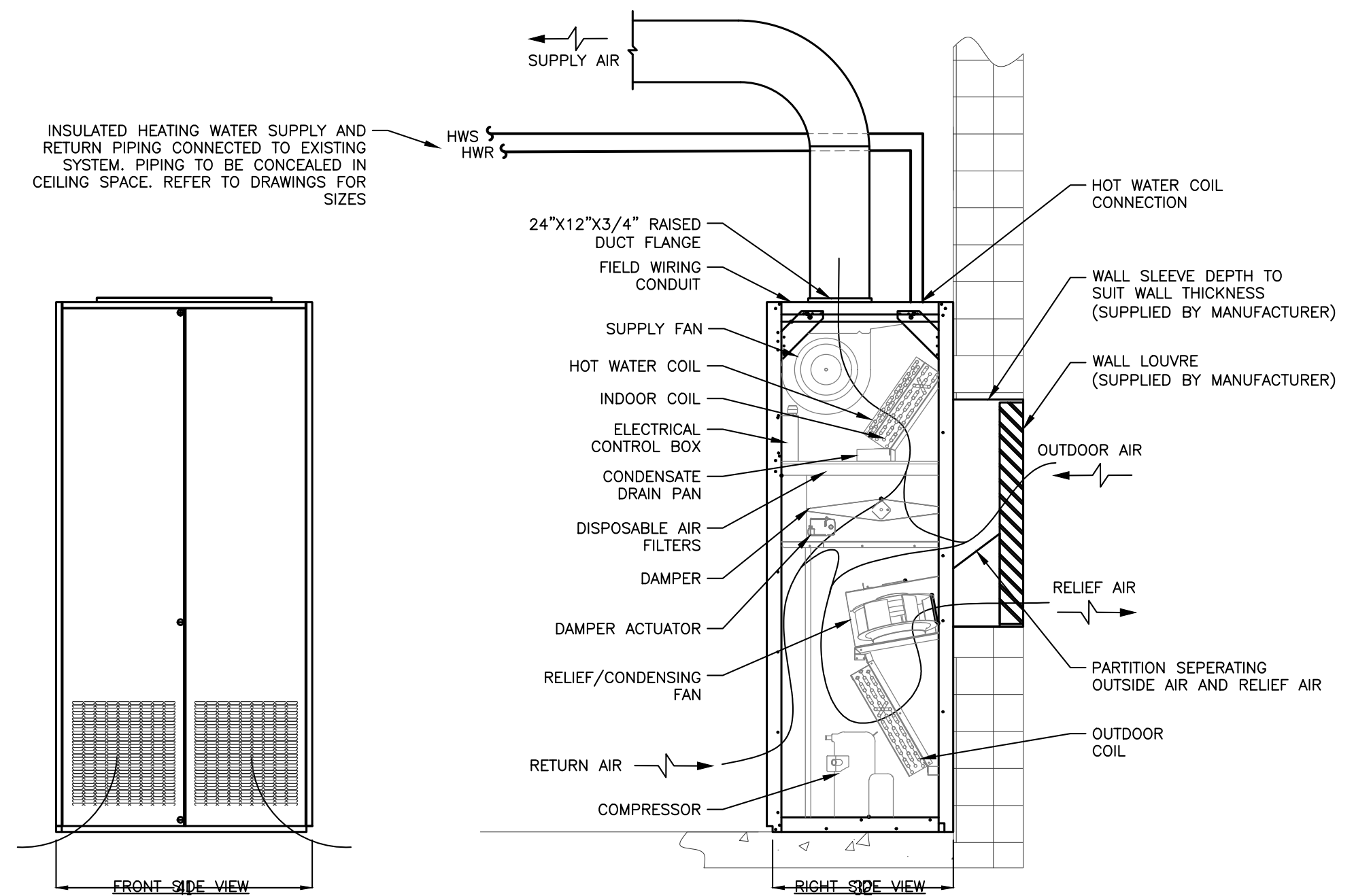
VOLUME DAMPERS

N.T.S.



UNIT VENTILATOR EXTERIOR WALL INSTALLATION DETAIL (UV-1)

N.T.S.



UNIT VENTILATOR EXTERIOR WALL INSTALLATION DETAIL (UV-2)

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PROJECT:
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145 Rainbow Dr,
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For the HWDSB

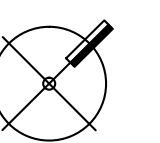
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DRAWING TITLE:
Mechanical
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Schedules

SCALE:
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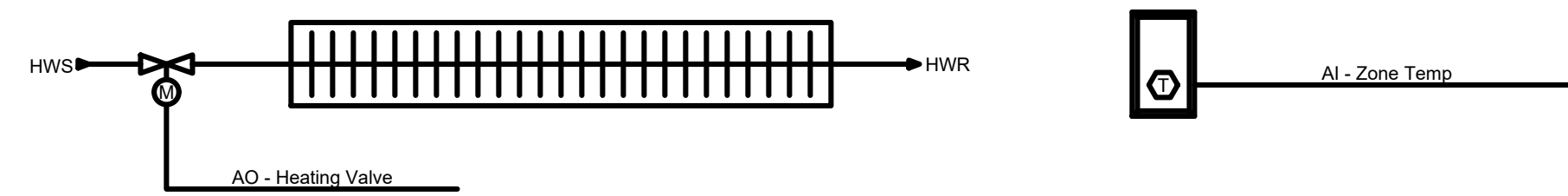
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DATE:
SEPTEMBER 2023

PROJECT #:
ALL-23010629-A0

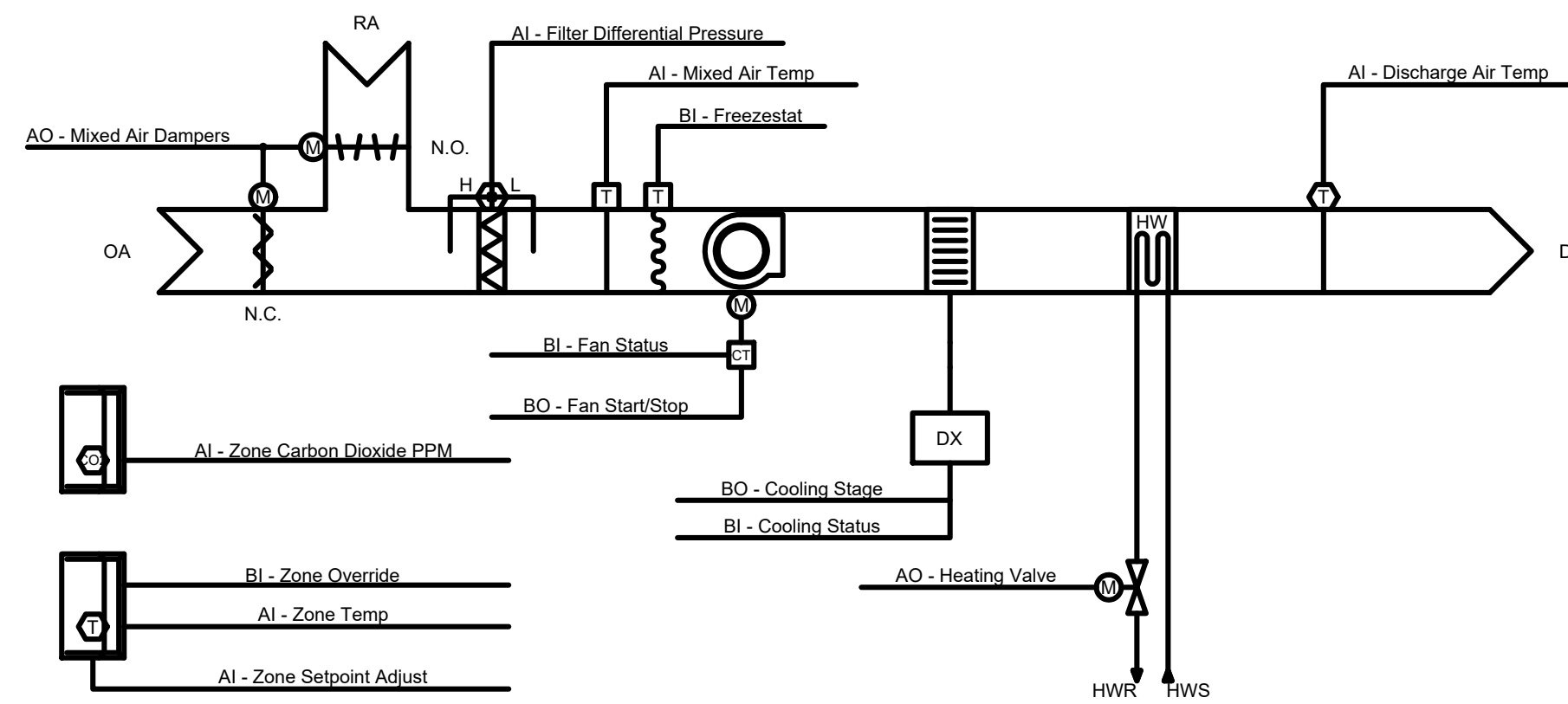
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M3.2



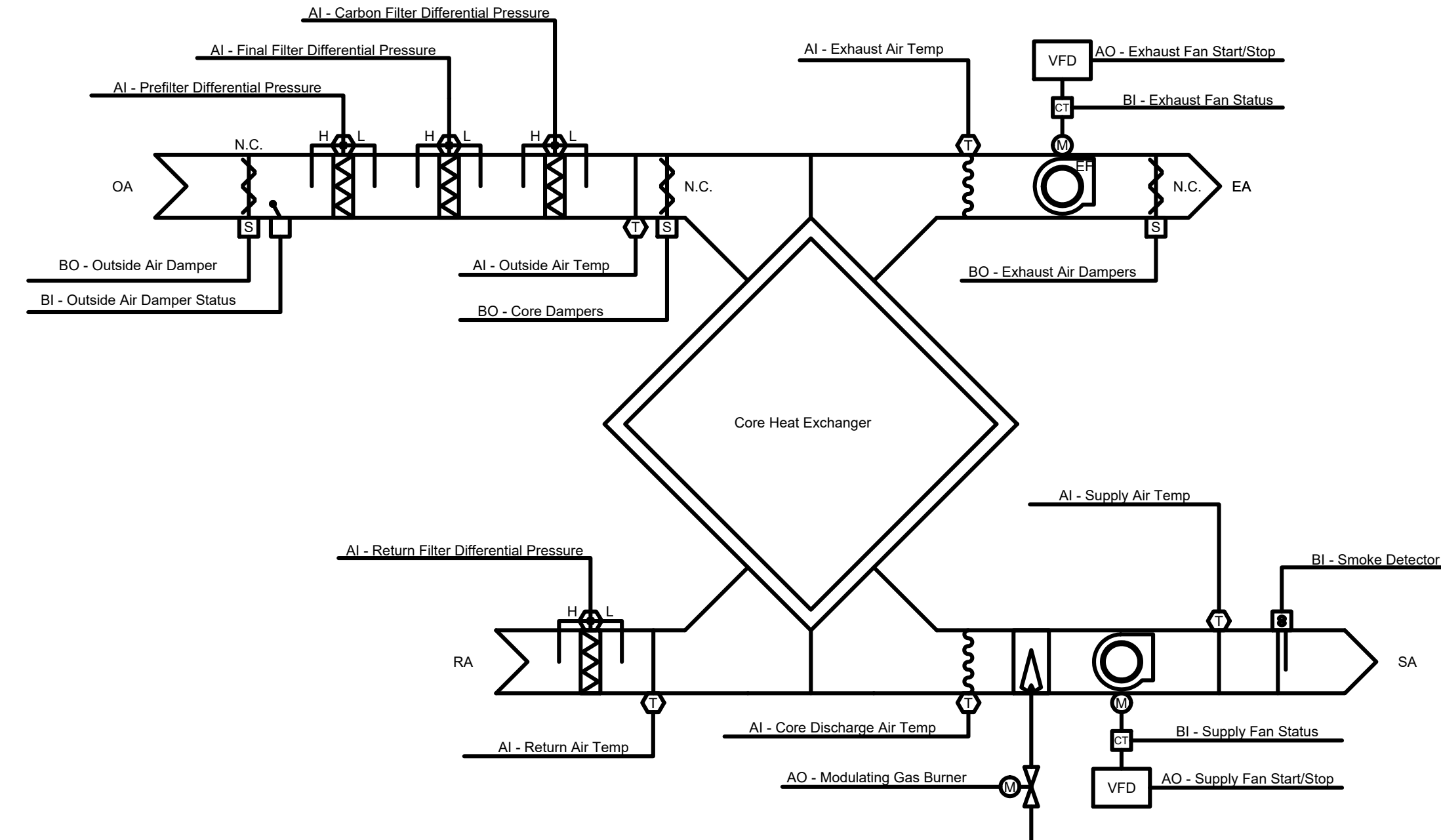
POINT NAME	HARDWARE POINTS	SOFTWARE POINTS	TREND	ALARM	SHOW ON GRAPHIC
ZONE TEMP	AI	-	Y	N	Y
HEATING VALVE	AO	-	Y	N	Y
HEATING SET POINT	-	AV	Y	N	Y
LOW ZONE TEMP	-	-	N	Y	N

PERIMETER RADIATOR CONTROL SCHEMATIC
N.T.S.



POINT NAME	HARDWARE POINTS	SOFTWARE POINTS	TREND	ALARM	SHOW ON GRAPHIC
DISCHARGE AIR TEMP	AI	-	Y	N	Y
MIXED AIR TEMP	AI	-	Y	N	Y
FILTER DIFFERENTIAL PRESSURE	AI	-	Y	N	Y
ZONE CARBON DIOXIDE PPM	AI	-	Y	N	Y
ZONE SETPOINT ADJUST	AI	-	N	N	Y
ZONE TEMP	AI	-	Y	N	Y
HEATING VALVE	AO	-	Y	N	Y
MIXED AIR DAMPERS	AO	-	Y	N	Y
FAN STATUS	BI	-	Y	N	Y
FREEZESTAT	BI	-	Y	Y	Y
SMOKE DETECTOR	BI	-	Y	Y	Y
ZONE OVERRIDE	BI	-	Y	N	Y
COOLING STATUS	BI	-	Y	N	Y
COOLING STAGE (REFER TO SHOP DRAWINGS FOR QTY OF STAGES)	BO	-	Y	N	Y
FAN START/STOP	BO	-	Y	N	Y
COOLING SETPOINT	-	AV	Y	N	Y
HEATING SETPOINT	-	AV	Y	N	Y
ZONE CARBON DIOXIDE PPM SETPOINT	-	AV	Y	N	Y
FAN FAILURE	-	-	N	Y	N
FAN IN HAND	-	-	N	Y	N
FAN RUNTIME EXCEEDED	-	-	N	Y	N
CONDENSER FAN FAILURE	-	-	N	Y	N
CONDENSER FAN IN HAND	-	-	N	Y	N
CONDENSER FAN RUNTIME EXCEEDED	-	-	N	Y	N
FILTER CHANGE REQUIRED	-	-	N	Y	N
HIGH DISCHARGE AIR TEMP	-	-	N	Y	N
HIGH ZONE CARBON DIOXIDE CONCENTRATION	-	-	N	Y	N
HIGH ZONE TEMP	-	-	N	Y	N
LOW DISCHARGE AIR TEMP	-	-	N	Y	N
LOW ZONE TEMP	-	-	N	Y	N

UNIT VENTILATOR CONTROL SCHEMATIC
N.T.S.



REFER TO M4.2 FOR VARIABLE SPEED DRIVE CONTROL SCHEMATIC.

Point Name	HARDWARE POINTS	SOFTWARE POINTS	Trend	Alarm	Show On Graphic
Exhaust Air Temp	AI	-	Y	N	Y
Final Filter Differential Pressure	AI	-	Y	N	N
Core Discharge Air Temp	AI	-	Y	N	Y
Outside Air Temp	AI	-	Y	N	Y
Prefilter Differential Pressure	AI	-	Y	N	N
Return Air Temp	AI	-	Y	N	Y
Supply Air Temp	AI	-	Y	N	Y
Carbon Filter Differential Pressure	AI	-	Y	N	Y
Return Filter Differential Pressure	AI	-	Y	N	Y
Exhaust Fan Status	BI	-	Y	N	Y
Outside Air Damper Status	BI	-	Y	N	Y
Smoke Detector	BI	-	Y	Y	Y
Supply Fan Status	BI	-	Y	N	Y
Exhaust Fan Start/Stop	BO	-	Y	N	Y
Core Dampers	BO	-	Y	N	Y
Exhaust Air Dampers	BO	-	Y	N	Y
Modulating Gas Burner	AO	-	Y	N	Y
Outside Air Damper	BO	-	Y	N	Y
Supply Fan Start/Stop	BO	-	Y	N	Y
Supply Air Temp Setpoint	-	AV	Y	N	Y
Exhaust Fan Failure	-	-	N	Y	N
Exhaust Fan in Hand	-	-	N	Y	N
Exhaust Fan Runtime Exceeded	-	-	N	Y	N
Final Filter Change Required	-	-	N	Y	Y
Prefilter Change Required	-	-	N	Y	Y
Carbon Filter Change Required	-	-	N	Y	Y
Return Filter Change Required	-	-	N	Y	Y
High Supply Air Temp	-	-	N	Y	N
Low Supply Air Temp	-	-	N	Y	N
Outside Air Damper Failure	-	-	N	Y	N
Outside Air Damper in Hand	-	-	N	Y	N
Supply Fan Failure	-	-	N	Y	N
Supply Fan in Hand	-	-	N	Y	N
Supply Fan Runtime Exceeded	-	-	N	Y	N

ERV CONTROL SCHEMATIC
N.T.S.

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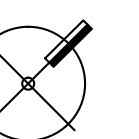
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DRAWING TITLE:
Control
Schematics

SCALE:

AS NOTED

DRAWN:

C.M. / J.L.

DATE:

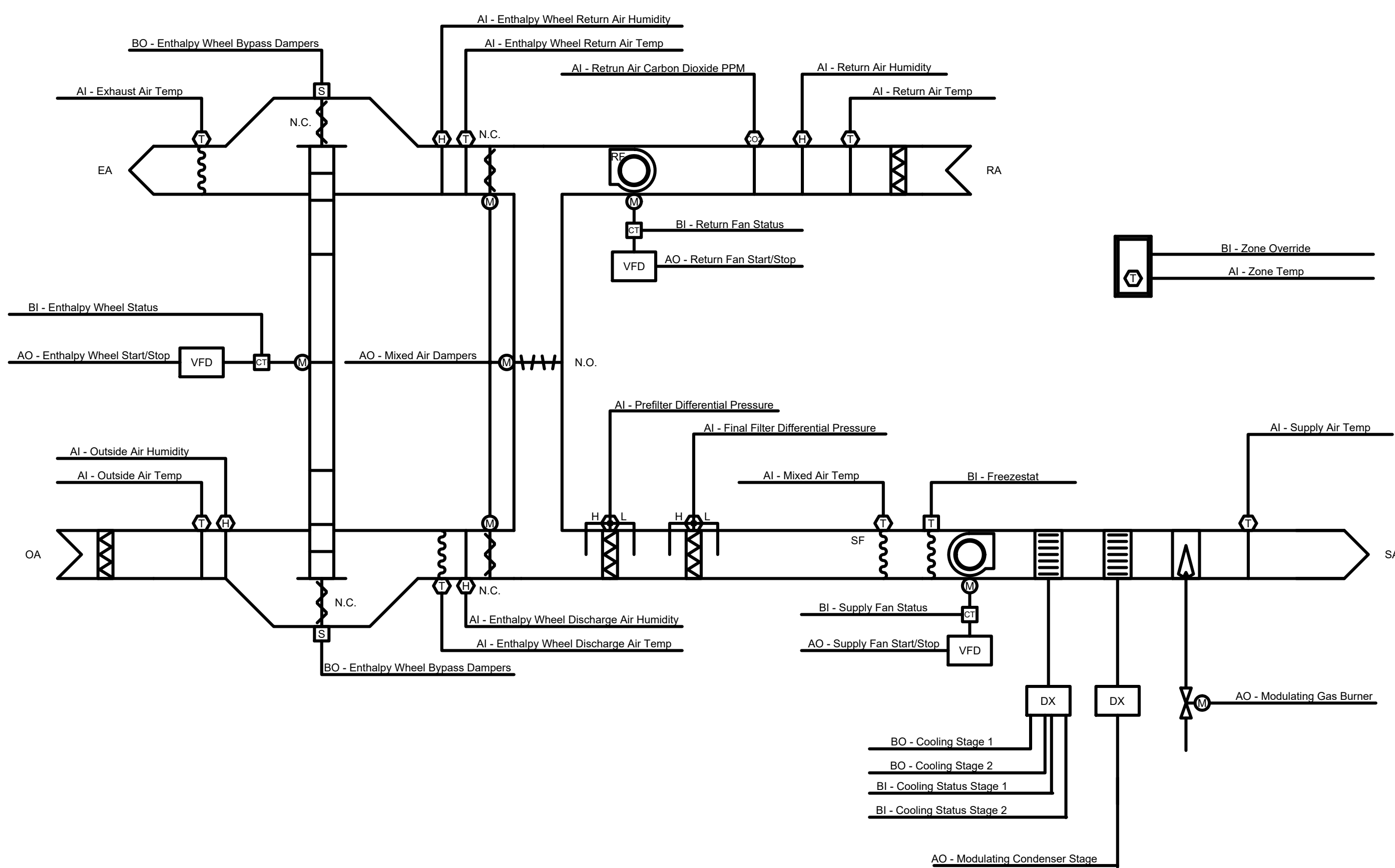
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PROJECT #:

ALL-23010629-A0

DRAWING #:

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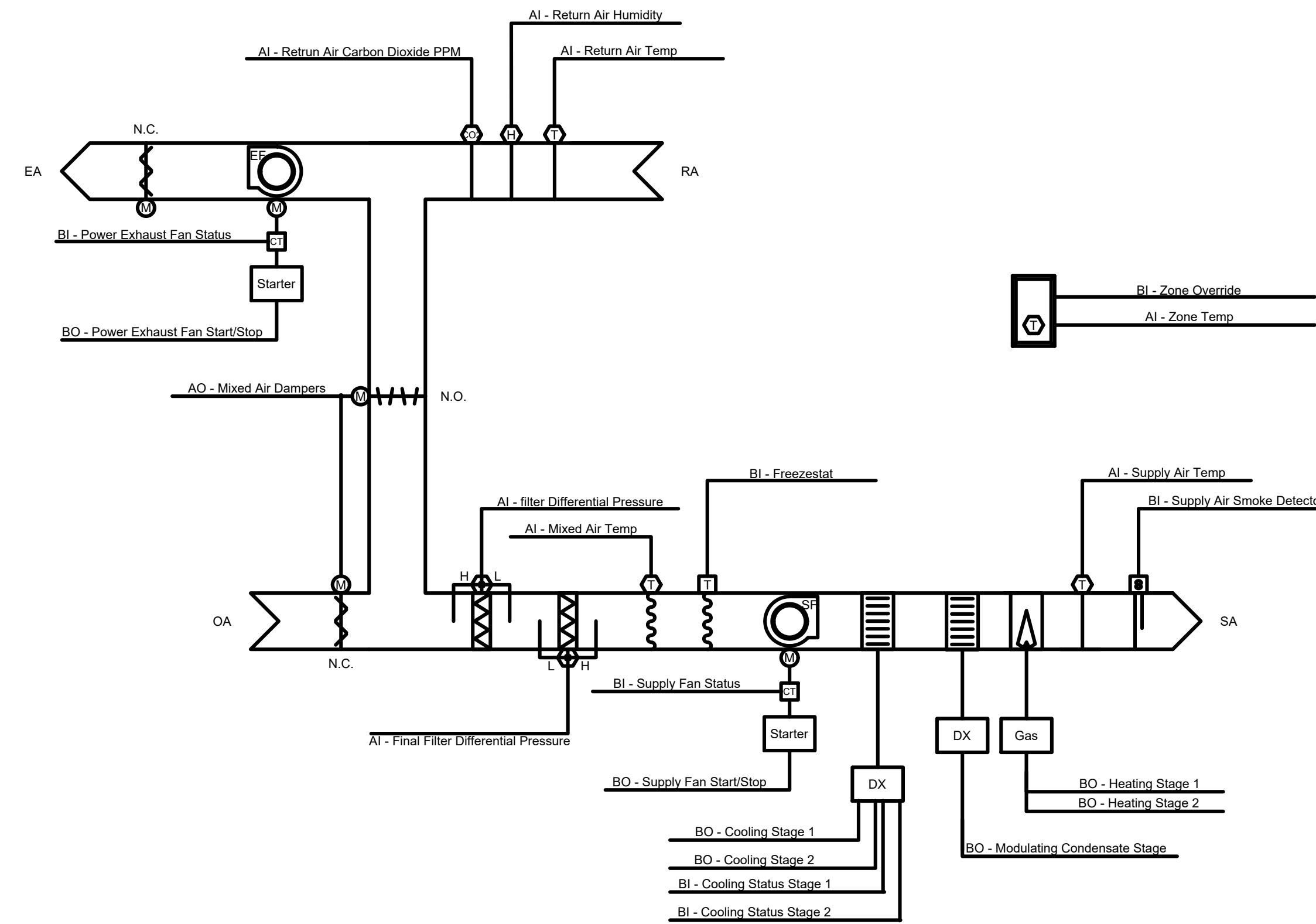


REFER TO M4.2 FOR VARIABLE SPEED DRIVE CONTROL SCHEMATIC.

POINT NAME	HARDWARE POINTS	SOFTWARE POINTS	SCHED	TREND	ALARM	SHOW ON GRAPHIC
ENTHALPY WHEEL DISCHARGE AIR HUMIDITY	AI	-	-	Y	N	Y
ENTHALPY WHEEL DISCHARGE AIR TEMP	AI	-	-	Y	N	Y
ENTHALPY WHEEL RETURN AIR HUMIDITY	AI	-	-	Y	N	Y
ENTHALPY WHEEL RETURN AIR TEMP	AI	-	-	Y	N	Y
EXHAUST AIR TEMP	AI	-	-	Y	N	Y
FINAL FILTER DIFFERENTIAL PRESSURE	AI	-	-	Y	N	N
MIXED AIR TEMP	AI	-	-	Y	N	Y
OUTSIDE AIR HUMIDITY	AI	-	-	Y	N	Y
OUTSIDE AIR TEMP	AI	-	-	Y	N	Y
OUTSIDE AIR TEMP	AI	-	-	Y	N	Y
PREFILTER DIFFERENTIAL PRESSURE	AI	-	-	Y	N	N
RETURN AIR CARBON DIOXIDE PPM	AI	-	-	Y	N	Y
RETURN AIR HUMIDITY	AI	-	-	Y	N	Y
RETURN AIR TEMP	AI	-	-	Y	N	Y
SUPPLY AIR TEMP	AI	-	-	Y	N	Y
ZONE TEMP	AI	-	-	Y	N	Y
MIXED AIR DAMPERS	AO	-	-	Y	N	Y
ENTHALPY WHEEL STATUS	BI	-	-	Y	N	Y
FREEZESTAT	BI	-	-	Y	Y	Y
RETURN FAN STATUS	BI	-	-	Y	N	Y
SUPPLY FAN STATUS	BI	-	-	Y	N	Y
ZONE OVERRIDE	BI	-	-	Y	N	Y
COOLING STAGE	BO	-	-	Y	N	Y
COOLING STAGE 2	BO	-	-	Y	N	Y
COOLING STAGE 1 STATUS	BI	-	-	Y	N	Y
COOLING STAGE 2 STATUS	BI	-	-	Y	N	Y
ENTHALPY WHEEL BYPASS DAMPERS	BO	-	-	Y	N	Y
ENTHALPY WHEEL PREHEATER	BO	-	-	Y	N	Y
ENTHALPY WHEEL START/STOP	BO	-	-	Y	N	Y
HEATING VALVE	AO	-	-	Y	N	Y
MODULATING CONDENSER	AO	-	-	Y	N	Y
RETURN FAN START/STOP	BO	-	-	Y	N	Y
SUPPLY FAN START/STOP	BO	-	-	Y	N	Y
COOLING SETPOINT	-	AV	-	Y	N	Y
DEHUMIDIFICATION SETPOINT	-	AV	-	Y	N	Y

ECONOMIZER ZONE TEMP SETPOINT	-	AV	-	Y	N	Y
ENTHALPY WHEEL DISCHARGE AIR DEWPOINT	-	AV	-	Y	N	Y
ENTHALPY WHEEL DISCHARGE AIR ENTHALPY	-	AV	-	Y	N	Y
ENTHALPY WHEEL RETURN AIR DEWPOINT	-	AV	-	Y	N	Y
ENTHALPY WHEEL RETURN AIR ENTHALPY	-	AV	-	Y	N	Y
HEATING SETPOINT	-	AV	-	Y	N	Y
OUTSIDE AIR DEWPOINT	-	AV	-	Y	N	Y
OUTSIDE AIR ENTHALPY	-	AV	-	Y	N	Y
RETURN AIR CARBON DIOXIDE PPM SETPOINT	-	AV	-	Y	N	Y
SCHEDULE	-	-	Y	N	N	N
COMPRESSOR RUNTIME EXCEEDED	-	-	-	N	Y	N
ENTHALPY WHEEL IN HAND	-	-	-	N	Y	N
ENTHALPY WHEEL ROTATION FAILURE	-	-	-	N	Y	N
ENTHALPY WHEEL RUNTIME EXCEEDED	-	-	-	N	Y	N
FINAL FILTER CHANGE REQUIRED	-	-	-	N	Y	Y
HIGH MIXED AIR TEMP	-	-	-	N	Y	N
HIGH RETURN AIR CARBON DIOXIDE CONCENTRATION	-	-	-	N	Y	N
HIGH RETURN AIR HUMIDITY	-	-	-	N	Y	N
HIGH RETURN AIR TEMP	-	-	-	N	Y	N
HIGH SUPPLY AIR TEMP	-	-	-	N	Y	N
HIGH ZONE TEMP	-	-	-	N	Y	N
LOW MIXED AIR TEMP	-	-	-	N	Y	N
LOW RETURN AIR HUMIDITY	-	-	-	N	Y	N
LOW RETURN AIR TEMP	-	-	-	N	Y	N
LOW SUPPLY AIR TEMP	-	-	-	N	Y	N
LOW ZONE TEMP	-	-	-	N	Y	N
PREFILTER CHANGE REQUIRED	-	-	-	N	Y	Y
RETURN FAN FAILURE	-	-	-	N	Y	N
RETURN FAN IN HAND	-	-	-	N	Y	N
RETURN FAN RUNTIME EXCEEDED	-	-	-	N	Y	N
SUPPLY FAN FAILURE	-	-	-	N	Y	N
SUPPLY FAN IN HAND	-	-	-	N	Y	N
SUPPLY FAN RUNTIME EXCEEDED	-	-	-	N	Y	N

RTU-1 CONTROL SCHEMATIC
N.T.S.



POINT NAME	HARDWARE POINTS	SOFTWARE POINTS	SCHED	TREND	ALARM	SHOW ON GRAPHIC
FINAL FILTER DIFFERENTIAL PRESSURE	AI	-	-	Y	N	N
MIXED AIR TEMP	AI	-	-	Y	N	Y
OUTSIDE AIR HUMIDITY	AI	-	-	Y	N	Y
OUTSIDE AIR TEMP	AI	-	-	Y	N	Y
PREFILTER DIFFERENTIAL PRESSURE	AI	-	-	Y	N	N
RETURN AIR CARBON DIOXIDE PPM	AI	-	-	Y	N	Y
RETURN AIR HUMIDITY	AI	-	-	Y	N	Y
RETURN AIR TEMP	AI	-	-	Y	N	Y
SUPPLY AIR TEMP	AI	-	-	Y	N	Y
ZONE TEMP	AI	-	-	Y	N	Y
MIXED AIR DAMPERS	AO	-	-	Y	N	Y
FREEZESTAT	BI	-	-	Y	Y	Y
POWER EXHAUST FAN STATUS	BI	-	-	Y	N	Y
SUPPLY FAN STATUS	BI	-	-	Y	N	Y
ZONE OVERRIDE	BI	-	-	Y	N	Y
COOLING STAGE 1	BO	-	-	Y	N	Y
COOLING STAGE 2	BO	-	-	Y	N	Y
COOLING STAGE 1 STATUS	BI	-	-	Y	N	Y
COOLING STAGE 2 STATUS	BI	-	-	Y	N	Y
HEATING VALVE	AO	-	-	Y	N	Y
MODULATING CONDENSER	AO	-	-	Y	N	Y
POWER EXHAUST FAN START/STOP	BO	-	-	Y	N	Y
SUPPLY FAN START/STOP	BO	-	-	Y	N	Y
COOLING SETPOINT	-	AV	-	Y	N	Y
DEHUMIDIFICATION SETPOINT	-	AV	-	Y	N	Y
ECONOMIZER ZONE TEMP SETPOINT	-	AV	-	Y	N	Y
HEATING SETPOINT	-	AV	-	Y	N	Y
RETURN AIR CARBON DIOXIDE PPM SETPOINT	-	AV	-	Y	N	Y
SCHEDULE	-	-	Y	N	N	N
COMPRESSOR RUNTIME EXCEEDED	-	-	-	N	Y	N
FINAL FILTER CHANGE REQUIRED	-	-	-	N	Y	Y
HIGH MIXED AIR TEMP	-	-	-	N	Y	N
HIGH RETURN AIR CARBON DIOXIDE CONCENTRATION	-	-	-	N	Y	N
HIGH RETURN AIR HUMIDITY	-	-	-	N	Y	N
HIGH RETURN AIR TEMP	-	-	-	N	Y	N
HIGH SUPPLY AIR TEMP	-	-	-	N	Y	N
LOW ZONE TEMP	-	-	-	N	Y	N
PREFILTER CHANGE REQUIRED	-	-	-	N	Y	Y
RETURN FAN FAILURE	-	-	-	N	Y	N
RETURN FAN IN HAND	-	-	-	N	Y	N
RETURN FAN RUNTIME EXCEEDED	-	-	-	N	Y	N
SUPPLY FAN FAILURE	-	-	-	N	Y	N
SUPPLY FAN IN HAND	-	-	-	N	Y	N
SUPPLY FAN RUNTIME EXCEEDED	-	-	-	N	Y	N

RTU-2 CONTROL SCHEMATIC
N.T.S.

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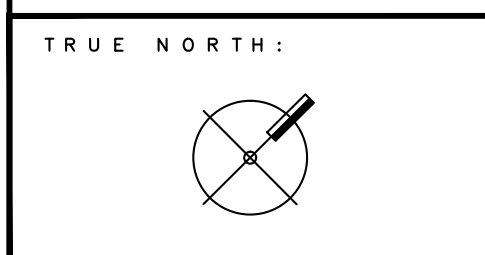
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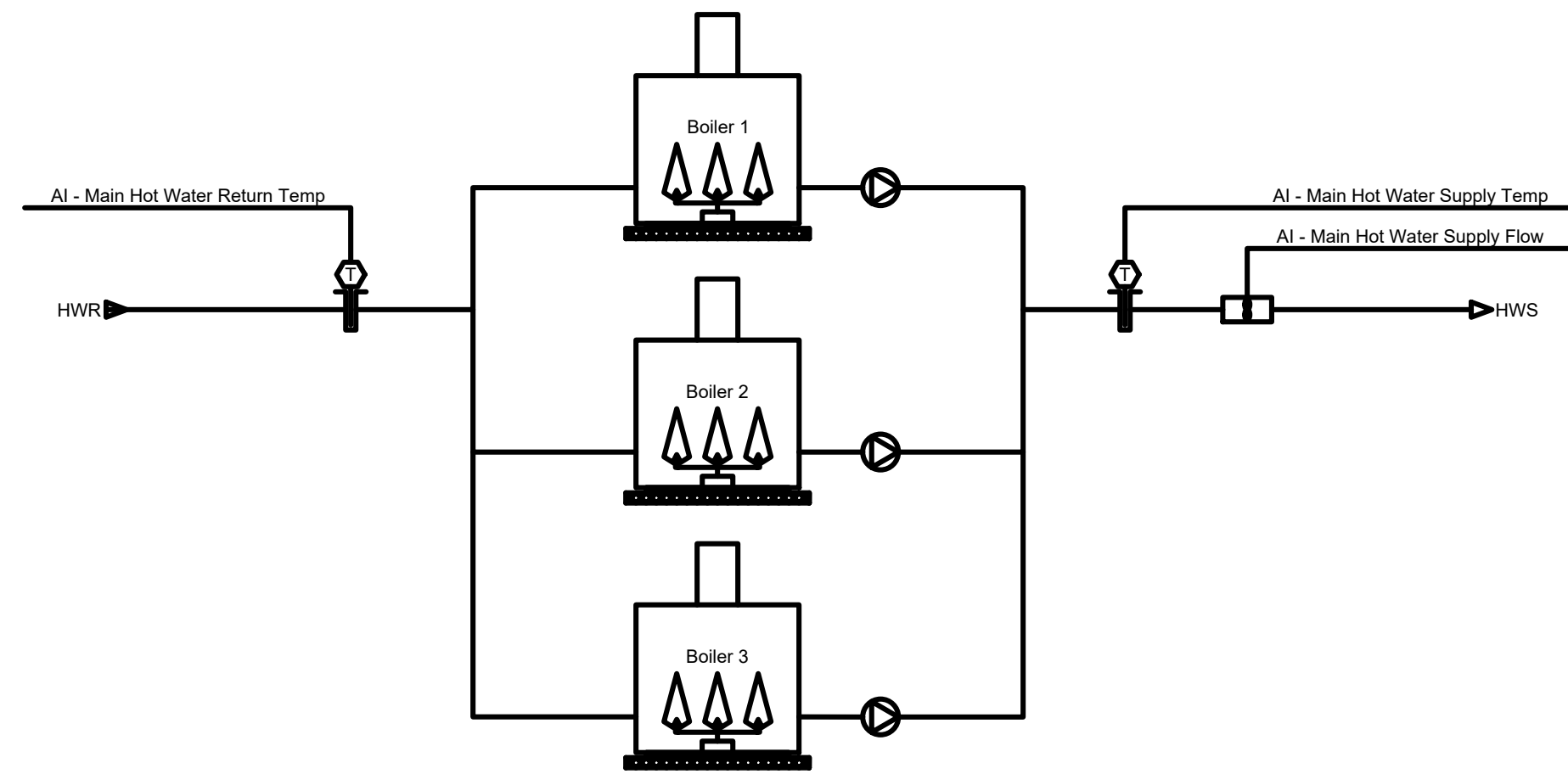
DRAWING TITLE:
Control Schematics

SCALE:
AS NOTED
DRAWN:
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DATE:
SEPTEMBER 2023

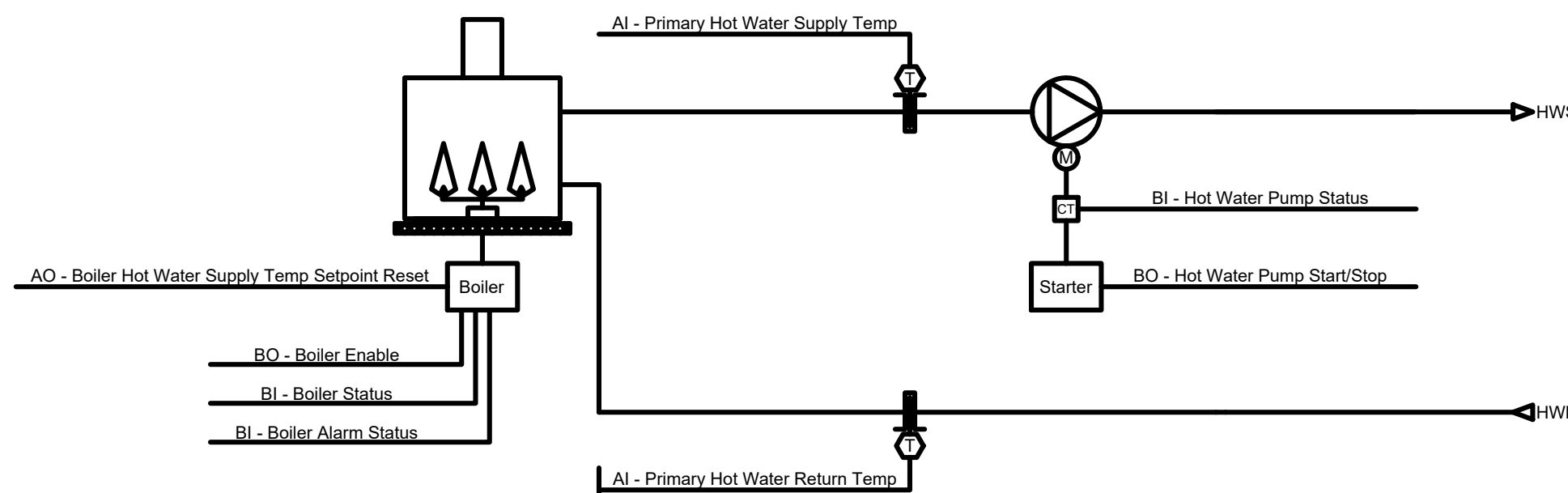
PROJECT #:
ALL-23010629-A0

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M4.1

The boiler manager calls each boiler to run based on load. See individual boiler schematics for specific points.



Individual boiler control (Typical of 3.)

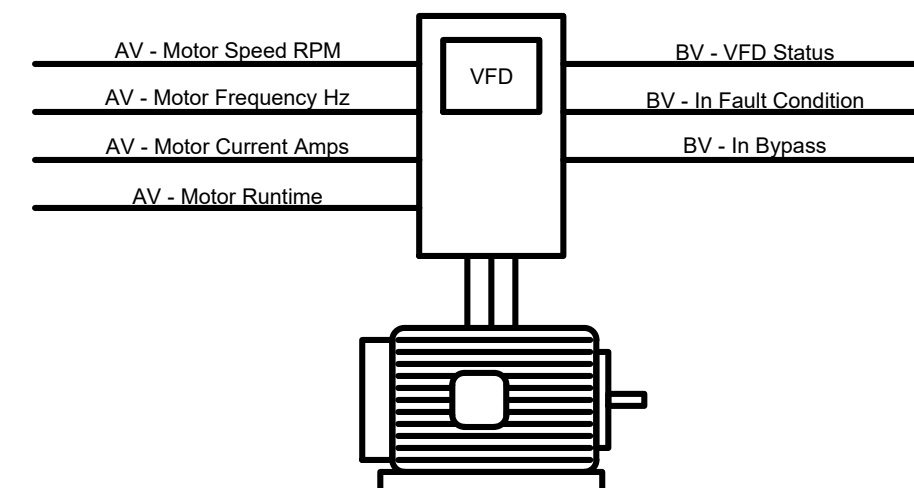


POINT NAME	HARDWARE POINTS	SOFTWARE POINTS	TREND	ALARM	SHOW ON GRAPHIC
PRIMARY HOT WATER RETURN TEMP	AI	-	Y	N	Y
PRIMARY HOT WATER SUPPLY TEMP	AI	-	Y	N	Y
BOILER HOT WATER SUPPLY TEMP SETPOINT RESET	AO	-	Y	N	Y
BOILER ALARM STATUS (TYP. OF 3)	BI	-	Y	Y	Y
BOILER STATUS (TYP. OF 3)	BI	-	Y	N	Y
HOT WATER PUMP STATUS (TYP. OF 3)	BI	-	Y	N	Y
BOILER ENABLE (TYP. OF 3)	BO	-	N	N	Y
HOT WATER PUMP START/STOP (TYP. OF 3)	BO	-	Y	N	Y
OUTSIDE AIR TEMP	-	AV	N	N	Y
BOILER FAILURE (TYP. OF 3)	-	-	N	Y	N
BOILER RUNNING IN HAND (TYP. OF 3)	-	-	N	Y	N
BOILER RUNTIME EXCEEDED (TYP. OF 3)	-	-	N	Y	N
HIGH PRIMARY HOT WATER SUPPLY TEMP	-	-	N	Y	N
LOW PRIMARY HOT WATER SUPPLY TEMP	-	-	N	Y	N
HOT WATER PUMP FAILURE (TYP. OF 3)	-	-	N	Y	N
HOT WATER PUMP RUNNING IN HAND (TYP. OF 3)	-	-	N	Y	N
HOT WATER PUMP RUNTIME EXCEEDED (TYP. OF 3)	-	-	N	Y	N

BOILER CONTROL SCHEMATIC
N.T.S.

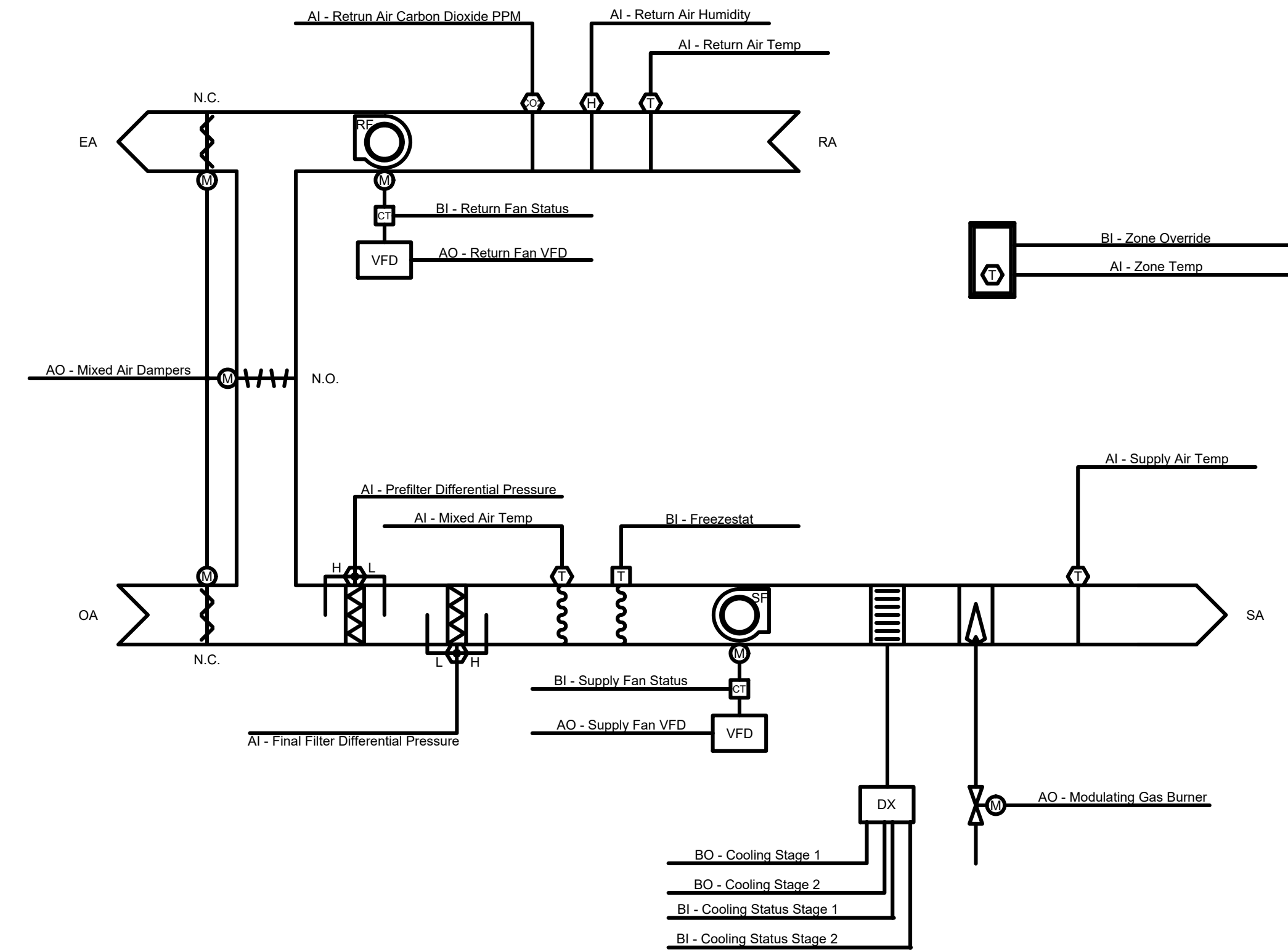
POINT NAME	HARDWARE POINTS	SOFTWARE POINTS	SCHED	TREND	ALARM	SHOW ON GRAPHIC
FINAL FILTER DIFFERENTIAL PRESSURE	AI	-	-	Y	N	N
MIXED AIR TEMP	AI	-	-	Y	N	Y
OUTSIDE AIR HUMIDITY	AI	-	-	Y	N	Y
OUTSIDE AIR TEMP	AI	-	-	Y	N	Y
PREFILTER DIFFERENTIAL PRESSURE	AI	-	-	Y	N	N
RETURN AIR CARBON DIOXIDE PPM	AI	-	-	Y	N	Y
RETURN AIR HUMIDITY	AI	-	-	Y	N	Y
RETURN AIR TEMP	AI	-	-	Y	N	Y
SUPPLY AIR TEMP	AI	-	-	Y	N	Y
ZONE TEMP	AI	-	-	Y	N	Y
MIXED AIR DAMPERS	AO	-	-	Y	N	Y
FREEZESTAT	BI	-	-	Y	Y	Y
RETURN FAN STATUS	BI	-	-	Y	N	Y
SUPPLY FAN STATUS	BI	-	-	Y	N	Y
ZONE OVERRIDE	BI	-	-	Y	N	Y
COOLING STAGE (AS PER EQUIP. SCHEDULE)	BO	-	-	Y	N	Y
COOLING STATUS (AS PER EQUIP. SCHEDULE)	BI	-	-	Y	N	Y
HEATING VALVE	AO	-	-	Y	N	Y
RETURN FAN VFD	AO	-	-	Y	N	Y
SUPPLY FAN VFD	AO	-	-	Y	N	Y
COOLING SETPOINT	-	AV	-	Y	N	Y
ECONOMIZER ZONE TEMP SETPOINT	-	AV	-	Y	N	Y
HEATING SETPOINT	-	AV	-	Y	N	Y
RETURN AIR CARBON DIOXIDE PPM SETPOINT	-	AV	-	Y	N	Y
SCHEDULE	-	-	Y	N	N	N
COMPRESSOR RUNTIME EXCEEDED	-	-	-	N	Y	N
FINAL FILTER CHANGE REQUIRED	-	-	-	N	Y	Y
HIGH MIXED AIR TEMP	-	-	-	Y	Y	N
HIGH RETURN AIR CARBON DIOXIDE CONCENTRATION	-	-	-	Y	Y	N
HIGH RETURN AIR TEMP	-	-	-	Y	Y	N
HIGH SUPPLY AIR TEMP	-	-	-	Y	Y	N
HIGH ZONE TEMP	-	-	-	Y	Y	N
LOW MIXED AIR TEMP	-	-	-	Y	Y	N
LOW RETURN AIR HUMIDITY	-	-	-	Y	Y	N
LOW ZONE TEMP	-	-	-	Y	Y	N
PREFILTER CHANGE REQUIRED	-	-	-	Y	Y	Y
RETURN FAN FAILURE	-	-	-	Y	Y	N
RETURN FAN IN HAND	-	-	-	Y	Y	N
RETURN FAN RUNTIME EXCEEDED	-	-	-	Y	Y	N
SUPPLY FAN FAILURE	-	-	-	Y	Y	N
SUPPLY FAN IN HAND	-	-	-	Y	Y	N
SUPPLY FAN RUNTIME EXCEEDED	-	-	-	Y	Y	N

- VARIABLE FREQUENCY DRIVE INTERFACE (TYPICAL FOR ERVS, RTUS, PUMPS)VFD INTERFACE MONITOR.
CURRENT VFD STATUS AND OPERATING CONDITIONS SHALL BE MONITORED THROUGH ITS COMMUNICATIONS INTERFACE PORT. THE INTERFACE SHALL MONITOR AND TREND THE POINTS AS SHOWN ON THE POINTS LIST.
- THIS VARIABLE FREQUENCY DRIVE (VFD) INTERFACE SCHEMATIC MAY NOT REFLECT THE ACTUAL SENSORS AND POINTS AS SUPPLIED BY THE VFD MANUFACTURER. ALL INTERFACE POINTS SHALL BE COORDINATED WITH THE VFD SUPPLIER.



POINT NAME	SOFTWARE POINTS	TREND	ALARM	SHOW ON GRAPHIC
MOTOR CURRENT AMPS	AV	Y	N	Y
MOTOR FREQUENCY HERTZ	AV	Y	N	Y
MOTOR RUNTIME	AV	N	N	Y
MOTOR SPEED RPM	AV	Y	N	Y
IN BYPASS	BV	Y	Y	Y
IN FAULT CONDITION	BV	Y	Y	Y
VFD STATUS	BV	Y	N	Y

VARIABLE SPEED DRIVE SCHEMATIC
N.T.S.



AHU-10,11 CONTROL SCHEMATIC
N.T.S.

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PROJECT:
HVAC Renovations

Glendale
Secondary
School

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Hamilton, ON
For the HWDSB

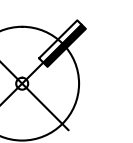
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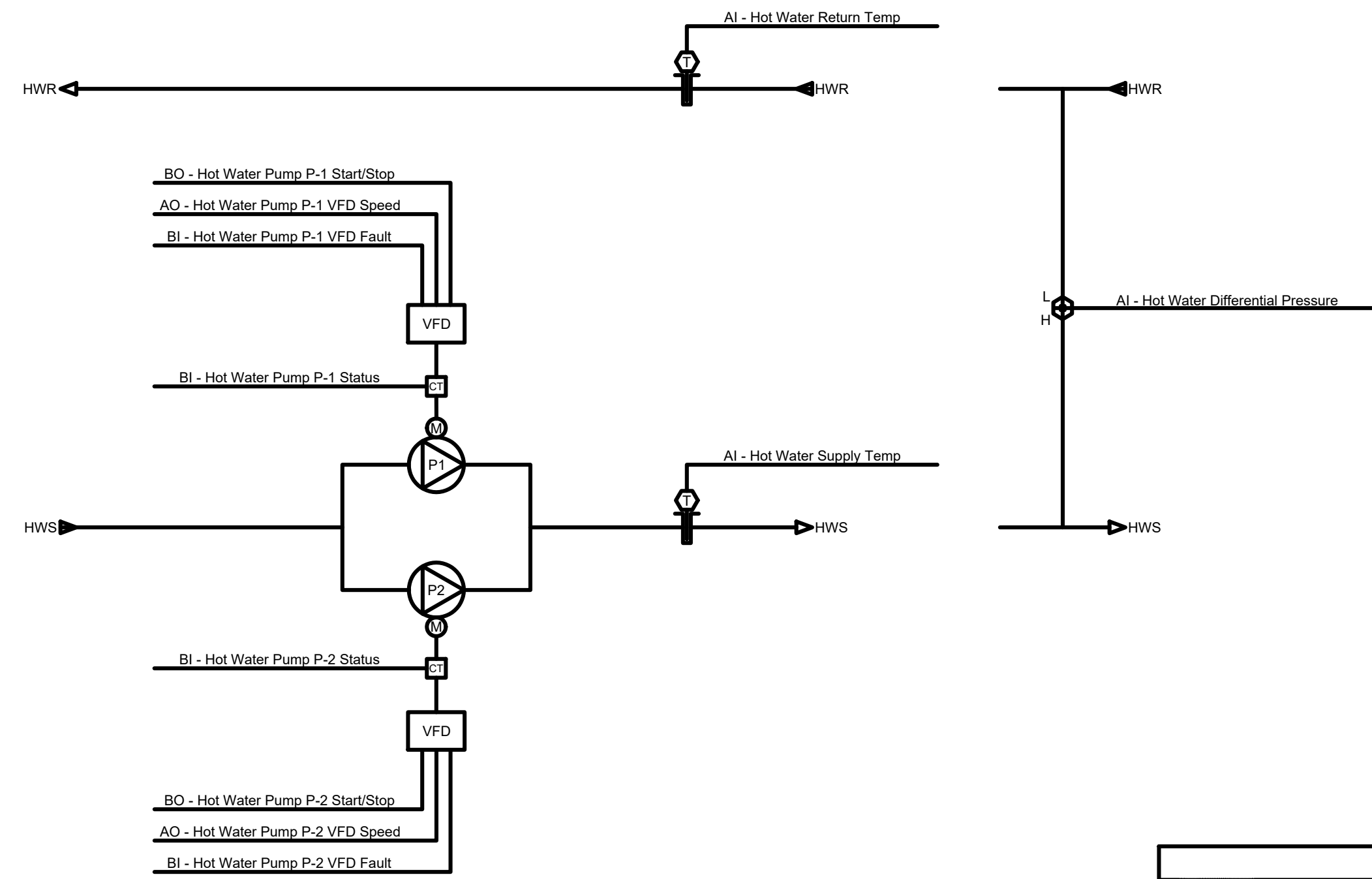
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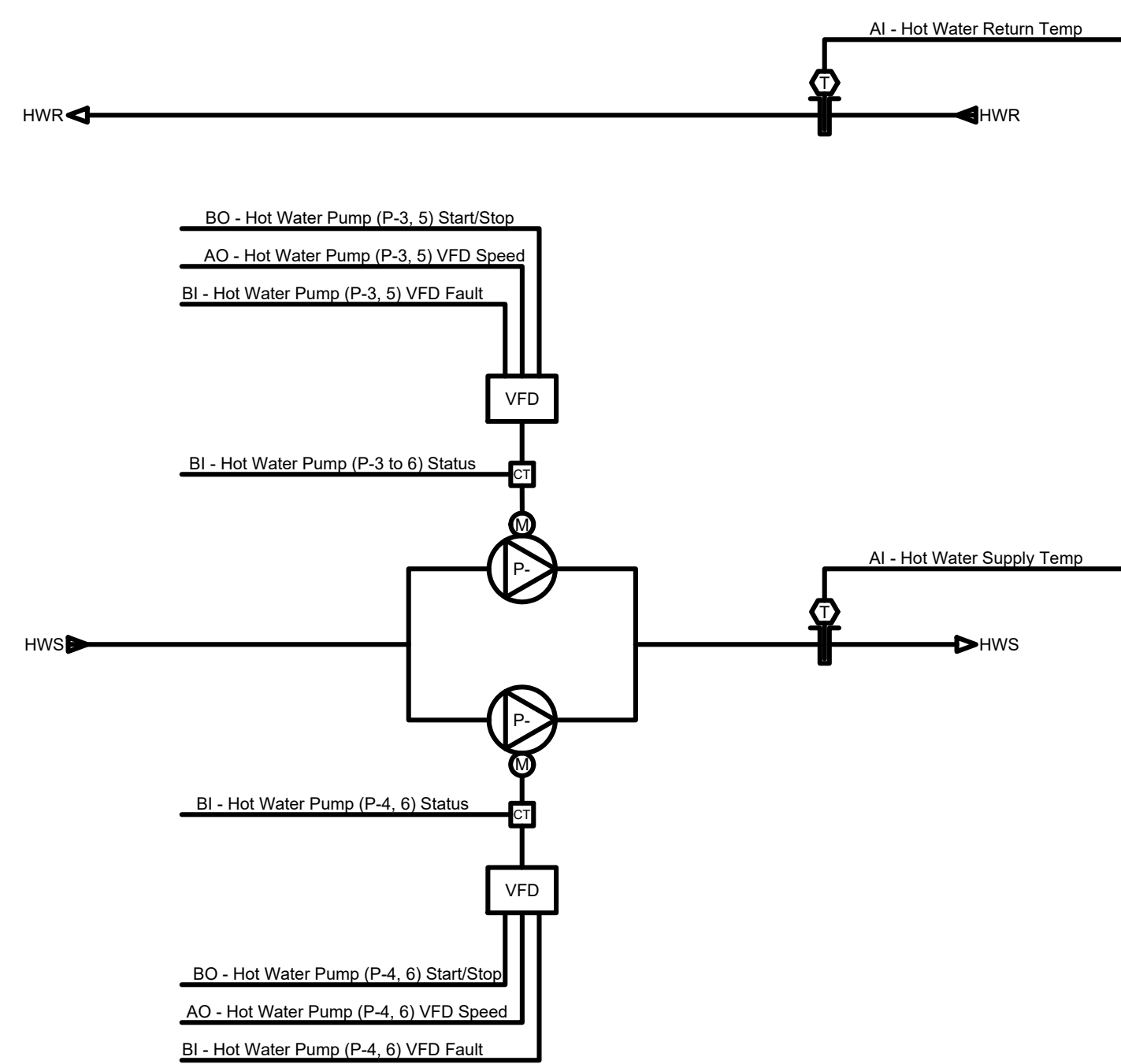
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ALL-23010629-A0

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M4.2



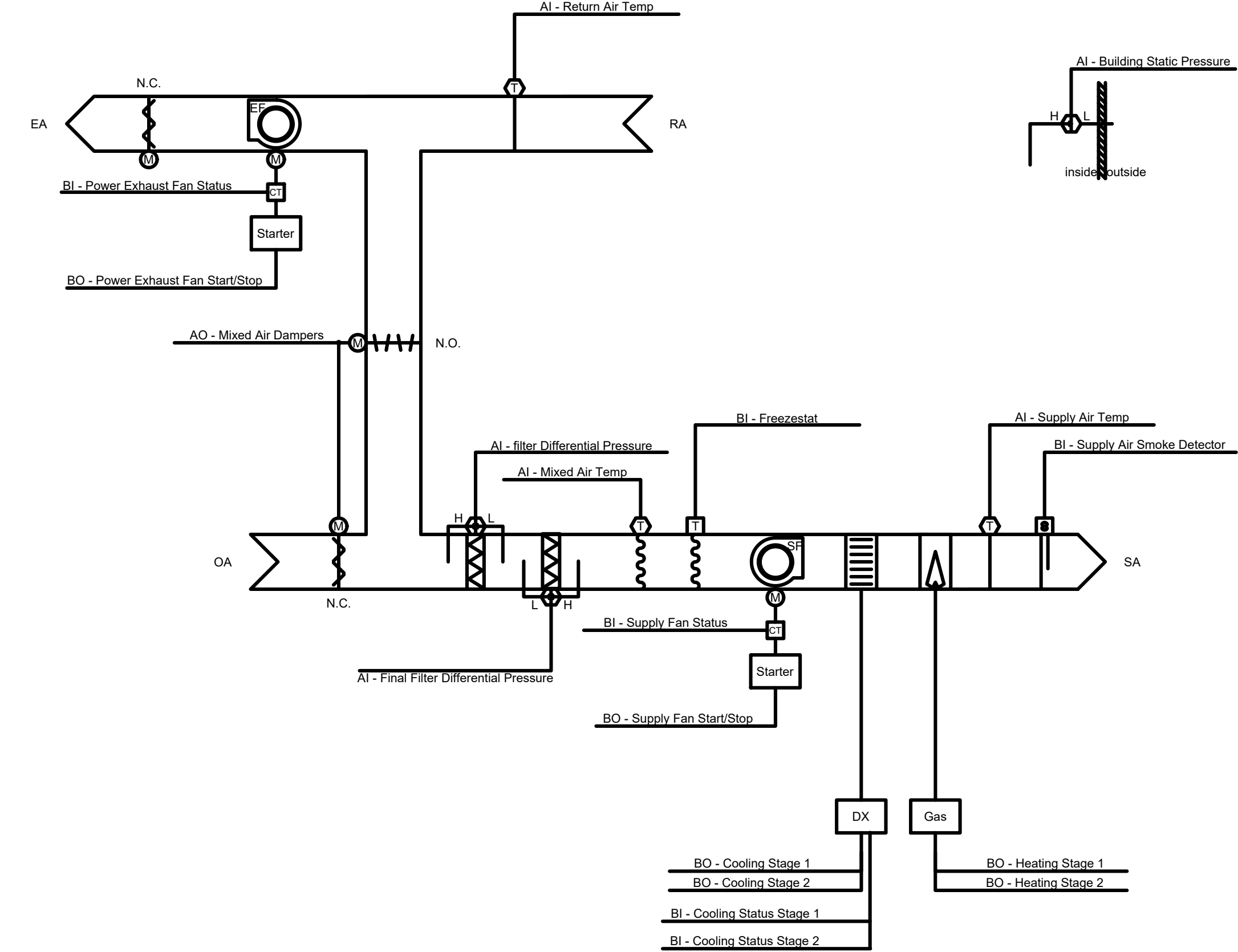
P-1 & P-2



P-3/P-5 & P-4/P-6

POINT NAME	HARDWARE POINTS	SOFTWARE POINTS	TREND	ALARM	SHOW ON GRAPHIC
HOT WATER DIFFERENTIAL PRESSURE	AI	-	Y	N	Y
HOT WATER RETURN TEMP	AI	-	Y	N	Y
HOT WATER SUPPLY TEMP	AI	-	Y	N	Y
HOT WATER PUMP (P-1 TO P-6) VFD SPEED	AO	-	Y	N	Y
HOT WATER PUMP (P-1 TO P-6) STATUS	BI	-	Y	N	Y
HOT WATER PUMP (P-1 TO P-6) VFD FAULT	BI	-	N	Y	Y
HOT WATER PUMP (P-1 TO P-6) START/STOP	BO	-	Y	N	Y
HOT WATER DIFFERENTIAL PRESSURE SETPOINT	-	AV	N	N	Y
OUTSIDE AIR TEMP	-	AV	N	N	Y
HIGH HOT WATER DIFFERENTIAL PRESSURE	-	-	N	Y	N
HIGH HOT WATER SUPPLY TEMP	-	-	N	Y	N
HOT WATER PUMP (P-1 TO P-6) FAILURE	-	-	N	Y	N
HOT WATER PUMP (P-1 TO P-6) RUNNING IN HAND	-	-	N	Y	N
HOT WATER PUMP (P-1 TO P-6) RUNTIME EXCEEDED	-	-	N	Y	N
LOW HOT WATER DIFFERENTIAL PRESSURE	-	-	N	Y	N
LOW HOT WATER SUPPLY TEMP	-	-	N	Y	N

SYSTEM PUMP CONTROL SCHEMATIC
N.T.S.



POINT NAME	Hardware Points	Software Points	SCHED	TREND	ALARM	SHOW ON GRAPHIC
BUILDING STATIC PRESSURE	AI	-	-	Y	N	Y
FILTER DIFFERENTIAL PRESSURE	AI	-	-	Y	N	N
MIXED AIR TEMP	AI	-	-	Y	N	Y
OUTSIDE AIR TEMP	AI	-	-	Y	N	Y
RETURN AIR TEMP	AI	-	-	Y	N	Y
ZONE SETPOINT ADJUST	AI	-	-	N	N	Y
ZONE TEMP	AI	-	-	Y	N	Y
MIXED AIR DAMPERS	AO	-	-	Y	N	Y
FREEZESTAT	BI	-	-	Y	Y	Y
SUPPLY FAN STATUS	BI	-	-	Y	N	Y
EXHAUST FAN STATUS	BI	-	-	Y	N	Y
SUPPLY AIR SMOKE DETECTOR	BI	-	-	Y	Y	Y
COOLING STAGE (AS PER EQUIP. SCHEDULE)	BO	-	-	Y	N	Y
COOLING STATUS (AS PER EQUIP. SCHEDULE)	BI	-	-	Y	N	Y
HEATING STAGE 1	BO	-	-	Y	N	Y
HEATING STAGE 2	BO	-	-	Y	N	Y
SUPPLY FAN START/STOP	BO	-	-	Y	N	Y
EXHAUST FAN START/STOP	BO	-	-	Y	N	Y
BUILDING STATIC PRESSURE SETPOINT	-	AV	-	Y	N	Y
COOLING SETPOINT	-	AV	-	Y	N	Y
ECONOMIZER ZONE TEMP SETPOINT	-	AV	-	Y	N	Y
HEATING SETPOINT	-	AV	-	Y	N	Y
EMERGENCY SHUTDOWN	-	BV	-	N	Y	Y
SCHEDULE	-	-	Y	N	N	N
COMPRESSOR RUNTIME EXCEEDED	-	-	-	N	Y	N
FILTER CHANGE REQUIRED	-	-	-	N	Y	Y
HIGH MIXED AIR TEMP	-	-	-	N	Y	N
HIGH RETURN AIR TEMP	-	-	-	N	Y	N
HIGH ZONE TEMP	-	-	-	N	Y	N
LOW MIXED AIR TEMP	-	-	-	N	Y	N
LOW RETURN AIR TEMP	-	-	-	N	Y	N
LOW ZONE TEMP	-	-	-	N	Y	N
LOW BUILDING STATIC PRESSURE	-	-	-	N	Y	N
HIGH BUILDING STATIC PRESSURE	-	-	-	N	Y	N
SUPPLY FAN IN HAND	-	-	-	N	Y	N
SUPPLY FAN RUNTIME EXCEEDED	-	-	-	N	Y	N
EXHAUST FAN FAILURE	-	-	-	N	Y	N
EXHAUST FAN IN HAND	-	-	-	N	Y	N

AHU-9,12 CONTROL SCHEMATIC
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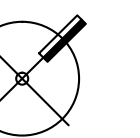
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DRAWING TITLE:
Control
Schematics

SCALE:
AS NOTED

DRAWN:
C.M. / J.L.

DATE:
SEPTEMBER 2023

PROJECT #:
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DRAWING #:

M4.3

MECHANICAL SCHEDULE - BOILERS. Table with columns for DWG. DESIGNATION, SYSTEM and ROOM, MODEL, Type, WEIGHT (LBS), OUTPUT (MBH), INPUT (MBH), EFFICIENCY (%), WATER CONDITIONS (FLOW, PD, BWT, LWT), MECHANICAL REMARKS, WIRING FOR MECHANICAL EQUIPMENT SCHEDULE (MOTOR, MCA, MCOP, VAC, ROOM STARTER TYPE, REMOTE CONTROL DEVICE, DISC. TYPE), and ELECTRICAL WIRING INSTRUCTIONS.

MECHANICAL SCHEDULE - PUMPS. Table with columns for DWG. DESIGNATION, SYSTEM and ROOM, MODEL, SPEC TYPE, FLOW (GPM), HEAD (FT), EFF. (%), VFD, MECHANICAL REMARKS, WIRING FOR MECHANICAL EQUIPMENT SCHEDULE (MOTOR W or HP, MCA FLA, MCOP, VAC, ROOM STARTER TYPE, REMOTE CONTROL DEVICE, DISC. TYPE), and ELECTRICAL WIRING INSTRUCTIONS.

MECHANICAL SCHEDULE - GRILLES AND REGISTERS. Table with columns for DWG. DESIGNATION, MODEL (CORE, BORDER, FRAME), SIZE (Length, Width, MIN, MAX), CFM (MIN, MAX), SP (IN W.G.) (MIN, MAX), and MECHANICAL REMARKS. Includes notes on OBD and fasteners.

NOTES - ELECTRICAL WIRING INSTRUCTIONS:

- 1. DEEMED LIFE SAFETY EQUIPMENT IE SMOKE CONTROL, AREA PRESSURIZATION ETC.
2. USE FIRE RATED CABLES FOR POWER FEEDER TO EQUIPMENT
3. USING ONE FACR, INTERLOCK WITH FIRE ALARM SYSTEM SO THAT FAN STARTS/RUNS BY MANUALLY SELECTING "RUN" POSITION ON THE ASSOCIATED SELECTOR SWITCH AT THE CACF.
...
33. RUNS Nos 30, 31 AND 32 SHARE A COMMON BREAKER AND A COMMON CONTROL THERMOSTAT.

WIRING FOR MECHANICAL EQUIPMENT SCHEDULE LEGEND

- AM - ACTUATOR MOTOR
APS - AIR PROVING SWITCH
AST - AQUASTAT
BAS - CONTROL BY BUILDING AUTOMATION SYSTEM CONTRACTOR
BIC - BUILT IN CONTROLLER
C1 - EEMAC-1 TYPE DISC. SWITCH
...
KSW/PL - KEY SWITCH(15A, 120V,SPST, LOCK TYPE C/W PILOT LIGHT)

WIRING FOR MECHANICAL EQUIPMENT SCHEDULE LEGEND

- LS - LEVEL SWITCH
LWCO - LOW WATER CUT OFF
MAG - MAGNETIC STARTER
MAN - MANUAL STARTER
MCA - MINIMUM CIRCUIT AMPS
MCC - MOTOR CONTROL CENTRE
MFA - MAXIMUM FUSE AMPACITY
MOCCP - MAXIMUM OVER CURRENT PROTECTION
MVS - MONITORED VALVE SWITCH
ODT - OFF DELAY TIMER
PB - PUSHBUTTON ON/OFF SWITCH IN STARTER COVER
PL - PILOT LIGHT IN STARTER COVER
PLG - 120V RECEPTACLE BY ELECTRICAL DIVISION
PS - PRESSURE SWITCH
RPB - REMOTE STOP/START PUSHBUTTON
RPL - REMOTE PILOT LIGHT
SD - SMOKE DETECTOR (DUCT TYPE)
SS - SPEED SWITCH
SLS & PL - SELECTOR SWITCH AND PILOT LIGHT
SV - SOLENOID VALVE
SW - HP RATED TOGGLE SWITCH
TC - TEMPERATURE CONTROLLER
TI - TIMER (INTERVAL)
T7 - TIMER (7-DAY)
TRS - THERMOSTAT REVERSING SWITCH
TS - THERMOSTAT
T - THERMOSTAT OR TEMPERATURE SENSING UNIT
VM - VALVE MOTOR
VFD - VARIABLE FREQUENCY (OR SPEED) DRIVE (VSD)
TOA - TEST/OFF/AUTO SWITCH IN STARTER COVER.

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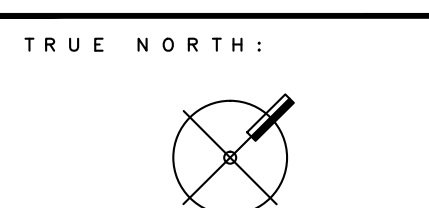
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DRAWING TITLE: Mechanical & Electrical Schedules

SCALE: AS NOTED

DRAWN: C.M. / J.L.

DATE: SEPTEMBER 2023

PROJECT #: ALL-23010629-A0

DRAWING #: ME1.1