PIPING LEGEND		
	HOT WATER SUPPLY (HWS)	
	HOT WATER RETURN (HWR)	
D	EQUIPMENT DRAIN LINE	
G	GAS	
— s —	SUCTION LINE	
— L —	LIQUID LINE	
	BOTTOM TAKE-OFF	
<u></u>	TOP TAKE-OFF	
<b>—</b>	ELBOW UP	
<b></b>	ELBOW DOWN	
	VALVE – SEE SPECIFICATIONS	
	UNION CONNECTION	
	FLANGED CONNECTION	
[	PLUG CAP	
LWCO	LOW WATER CUT OFF	
	THERMOMETER	
Ø PG	PRESSURE GAUGE	
● P-1	PUMP AND DESIGNATION	
<b>∱</b> AV	AIR VENT	
<b>4</b> AAV	AUTOMATIC AIR VENT	
<u></u>	PETES PLUG	
	FLOW SWITCH	
T G	THERMOSTAT w/GUARD	
AFF	ABOVE FINISHED FLOOR	
CBV	CIRCUIT BALANCING VALVE	
GPM	GALLONS PER MINUTE	
REQ'D	REQUIRED	
тсу	THERMOSTATIC CONTROL VALVE	
TYP.	TYPICAL	
BFP	BACK FLOW PREVENTOR	
CFH	CUBIC FEET HOUR	

VALVE LEGEND		
	VALVE – SEE SPEC	
	CHECK VALVE	
	STRAINER	
	PRESSURE REDUCING VALVE	
	CONTROL VALVE	
	2-WAY CONTROL VALVE	
	3-WAY CONTROL VALVE	
R A	RELIEF VALVE	
	PLUG VALVE	
sv	SOLENOID VALVE	
	NORMALLY CLOSED VALVE	
<b>_</b>	PET COCK	
Ř	CIRCUIT BALANCE VALVE	

VEN	TILATION LEGEND
	SOUND INSULATION
	FLEXIBLE CONNECTION
	DUCT OFFSET
ب	DUCT OFFSET (SINGLE LINE)
	TURNING VANES
	BALANCING DAMPER
FD F	FIRE DAMPER
SD J	SPLITTER DAMPER
BDD -	BACKDRAFT DAMPER
- OBD -	OPPOSED BLADE DAMPER
	MOTORIZED DAMPER
	SUPPLY DUCT SECTION
	RETURN DUCT SECTION
	SUPPLY DIFFUSER
	LINEAR DIFFUSER
	EXHAUST GRILLE
D-XXX	DIFFUSER DESIGNATION AND CFM
G- XXX	GRILLE DESIGNATION AND CFM
~~~	FLEXIBLE ROUND DUCT
	CAPPED END DUCT
	DUCT REDUCER/ENLARGER
	THERMOSTAT
AD	ACCESS DOOR
AFF	ABOVE FINISHED FLOOR
CFM	CUBIC FEET PER MINUTE
CBV	CIRCUIT BALANCING VALVE

CC	NTROL LEGEND
Ţ	THERMOSTAT
TS	TEMPERATURE SENSOR
Ps	PRESSURE SENSOR
<u></u> нѕ	HUMIDITY SENSOR
<u> </u>	FLOW SWITCH
<u> </u>	SOLENOID VALVE
	PRESSURE DIFFERENTIAL SWITCH
<b>——</b> ■MD	MOTORIZED DAMPER
QPG	PRESSURE GAUGE
Ð	TEMPERATURE GAUGE
	2-WAY CONTROL VALVE
	3-WAY CONTROL VALVE
H_C	HEATING COIL
C	COOLING COIL
OA	OUTSIDE AIR
RA	RETURN AIR
SA	SUPPLY AIR
EA	EXHAUST AIR
NO	NORMALLY OPEN
NC	NORMALLY CLOSED
TCV	TEMPERATURE CONTROL VALVE

D	RAWING LIST
DWG No.	DRAWING TITLE
M0.0	MECHANICAL LEGEND AND DRAWING LIST
MO.1	MECHANICAL KEY PLAN
M0.2	MECHANICAL SPECIFICATIONS
M0.3	MECHANICAL SPECIFICATIONS
M0.4	MECHANICAL SPECIFICATIONS
M0.5	MECHANICAL SPECIFICATIONS
M0.6	MECHANICAL SPECIFICATIONS
M0.7	MECHANICAL SPECIFICATIONS
M0.8	MECHANICAL SPECIFICATIONS
M0.9	MECHANICAL SPECIFICATIONS
M0.10	MECHANICAL SPECIFICATIONS
M0.11	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
М3.0	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

.1**≬**M2.









## MECHANICAL SPECIFICATIONS - GENERAL

- . <u>GENERAL</u>
- 1.1 <u>GENERAL REQUIREMENTS</u>
- READ AND CONFORM TO:
   .1 THE CONTRACT CCDC 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 ONEROUS 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. ARRANGE 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.
- 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.
   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 REPLACE HVAC EQUIPMENT CONSTRUCTION FILTERS WITH NEW AT PROJECT TURNOVER. PROVIDE ADDITIONAL TWO (2) SETS OF SPARE FILTERS FOR ALL NEW EQUIPMENT.
- 1.3 <u>SUBMITTALS</u>
- 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. REQUESTS FOR SHUT-DOWN: OBTAIN PERMISSION FOR SYSTEMS SHUT-DOWN
- B. REQUESTS FOR SHOT-DOWN: OBTAIN PERMISSION FOR STSTEMS SHOT-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. REQUESTS FOR START-UP: OBTAIN PERMISSION FROM THE OWNER TO START-UP OR TO RETURN TO SERVICE ANY ITEM OF EQUIPMENT, SYSTEM OR SERVICE INSTALLED NEW OR PREVIOUSLY SHUT-DOWN.
   D. 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 ELASOMERS,
- 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
- 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
- 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

- HANGER RODS: GALVANIZED, CARBON STEEL CONTINUOUS THREADED.
   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)			
RO	D DIAMETER	(IN) SUPF	PORT SPACING (FT)
		STE	EL 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)		SUPPO	ORT 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			EVERY FLOOR
TUBING (ALL SIZE	ES)		6
3.5 DUCT HANGER SPACING:			
DUCT SIZES (LAR SPACING	GEST SIDE)	ANGLE SIZE	ROD SIZE
UP TO 30" DIAMETER 10	FT	1"X 1"X 1/8"	1/4"
31" TO 42"		1-1/2" X 1-1/2"	X 1/8" 1/4"
43" TO 60"	FT	1-1/2" X 1-1/2"	X 1/8" 3/8"
61" TO 84"		2"X 2"1/8"	3/8"

DIAMETER 8 FT

#### HVAC SPECIFICATIONS HVAC SPECIFICATIONS HVAC HYDRONIC PIPING .6 ACCEPTABLE PRODUCTS: S.A. ARMSTRONG CRV I INDICATED OR TOUR & ANDERSON STA-D OR NEWMAN HATTERSLEY. 1.1 <u>HYDRONIC PIPING – GENERAL</u>: B. CIRCUIT BALANCING VALVES 2 1/2" (65 MM) AND LARGER A. KEEP OPEN ENDS OF PIPE FREE FROM SCALE AND DIRT. PROTECT OPEN ENDS WITH TEMPORARY PLUGS OR CAPS. AFTER COMPLETION, FILL, CLEAN, .1 FLANGED, LINE SIZE CONNECTION, GLOBE STYLE DESIGN, NONFERROUS PRESSURE DIE-CAST, NONPOROUS AMETAL COPPER ALLOY. AND TREAT SYSTEMS. B. PROVIDE NON-CONDUCTING DIELECTRIC CONNECTIONS WHENEVER JOINTING .2 VALVES, SHALL PROVIDE THE FOLLOWING FUNCTIONS: DISSIMILAR METALS IN OPEN SYSTEMS. .1 PRECISE FLOW MEASUREMENT. PRIME COAT EXPOSED STEEL HANGERS AND SUPPORTS. HANGERS AND .2 PRECISION FLOW BALANCING. SUPPORTS LOCATED IN CRAWL SPACES, PIPE SHAFTS, AND SUSPENDED .3 POSITIVE SHUT OFF WITH NO DRIP SEAT AND TEFLON DISC. CEILING SPACES ARE NOT CONSIDERED EXPOSED. .3 VALVES SHALL HAVE TWELVE 360° ADJUSTMENT TURNS OF HANDWHEE AIR VENTS SHALL BE SELECTED TO SUIT THE SYSTEM OPERATING PRESSURES FOR MAXIMUM VERNIER-TYPE SETTING WITH "HIDDEN MEMORY" FEATURE AND SHALL BE AUTOMATIC AND COMPLETE WITH ISOLATING VALVES. TO PROGRAM THE VALVE WITH PRECISION TAMPER-PROOF BALANCING E. PIPE ALL DISCHARGE FROM TEMPERATURE & PRESSURE SAFETY RELIEF SETTING VALVES TO A POINT OF SAFE DISCHARGE DIRECTLY INTO A FLOOR DRAIN, HUB .4 VALVES SHALL BE SUITABLE FOR MAXIMUM WORKING PRESSURE OF 250 DRAIN OR SAFE OUTDOOR LOCATION. PSI (1720 KPA) AND MAXIMUM OPERATING TEMPERATURE OF 250°F F. AUTOMATIC FEED VALVES: PROVIDE AUTOMATIC FEED VALVE ON THE COLD (120°C) WATER MAKE-UP LINE TO EACH NEW HOT WATER HEATING SYSTEM. .5 ACCEPTABLE PRODUCTS: S.A. ARMSTRONG CBV II INDICATED OR TOUR & G. TEST LIQUID HEAT TRANSFER PIPING HYDROSTATICALLY AT NOT LESS THAN ANDERSON STA-F OR NEWMAN HATTERSLEY. 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 TIME EACH JOINT SHALL BE INSPECTED, 2 HVAC DUCT INSULATION GIVEN A SHARP TAP WITH A HAMMER AND CHECKED FOR LEAKS. 2.1 GLASS FIBRE, FLEXIBLE 1.2 <u>VALVES – GENERAL</u> A. MANUFACTURER: CERTAINTEED SOFT TOUCH AND WIDE WRAP A. CONFORM TO REQUIREMENTS OF ANSI, ASTM, ASME, AND APPLICABLE MSS B. OTHER ACCEPTABLE MANUFACTURERS: JOHNS MANVILLE MICROLITE. STANDARDS. INSULATION: ASTM C553; ASTM C1290, CAN 51.11-92, ASTM C1136, NFPA B. MANUFACTURER'S NAME AND PRESSURE RATING CLEARLY MARKED ON BOD 90A, ASTM E84, ASTM E136. TO MSS-SP-25. .1 'KSI' VALUE : ASTM C518, 0.039 AT 24 °C ( 0.27 @ 75.2 °F ) C. VALID CRN (CANADIAN REGISTRATION NUMBER) REQUIRED FOR EACH VALVE. .2 MAXIMUM SERVICE TEMPERATURE: 121 °C (250 °F). D. MATERIALS: .3 MAXIMUM MOISTURE ABSORPTION: ASTM C1104; <5% BY WEIGHT. .1 BRONZE: ASTM B62 OR B61 AS APPLICABLE .4 MAXIMUM FLAME SPREAD INDEX: 25 .2 BRASS: ASTM B283 C3770 .5 MAXIMUM SMOKE DEV INDEX: 50 .3 CAST IRON: ASTM A126 CLASS B D. VAPOUR BARRIER JACKET: E. END CONNECTIONS: .1 KRAFT PAPER WITH GLASS FIBRE YARN AND BONDED TO ALUMINIZED FILM .1 THREADED ENDS: ANSI B1.20.1 .2 FLANGED ENDS: ANSI B16.1 (CLASS 125), ANSI B16.5 .2 KRAFT PAPER REINFORCED WITH GLASS FIBRE YARN AND BONDED .3 FACE-TO-FACE DIMENSIONS: ANSI B16.10 WHITE METALIZED POLYPROPYLENE F. DESIGN AND TESTING: .3 MOISTURE VAPOUR TRANSMISSION: ASTM E96; 0.02 PERM. .1 BRONZE GATE & CHECK VALVES: MSS-SP-80 .4 SECURE WITH PRESSURE SENSITIVE TAPE. .2 BALL VALVES: MSS-SP-110 VAPOUR BARRIER TAPE: .3 CAST IRON GATE VALVES: MSS-SP-70 .1 KRAFT PAPER REINFORCED WITH GLASS FIBRE YARN AND BONDED T .4 CAST IRON GLOBE VALVES: MSS-SP-85 ALUMINIZED FILM, WITH PRESSURE SENSITIVE RUBBER BASED ADHESIVE. .5 CAST IRON CHECK: MSS-SP-71 F. DOOR VAPOUR BARRIER MASTIC: .6 BUTTERFLY VALVES: MSS-SP-67 .1 VINYL EMULSION TYPE ACRYLIC OR MASTIC, COMPATIBLE WITH INSULATION G. ACCEPTABLE MANUFACTURERS: KITZ, CRANE, JENKINS, CONBRACO, NIBCO BLACK COLOUR. G. TIE WIRE: ANNEALED STEEL, 1/16" (1.5 MM). .3 HYDRONIC SYSTEMS TO 150 PSIG, ABOVE GROUND 2.2 GLASS FIBRE, RIGID A. NOMINAL OPERATING PRESSURE 125 PSIG B. DESIGN PRESSURE A. MANUFACTURER: CERTAINTEED CERTAPRO BOARD. 150 PSIG C. TEST PRESSURE 225 PSIG B. OTHER ACCEPTABLE MANUFACTURERS: JOHNS MANVILLE 800 SERIES SPIN-D. DESIGN TEMPERATURE 350°F E. CORROSION ALLOWANCE 0.0625 IN. C. INSULATION: ASTM C612; RIGID, NONCOMBUSTIBLE BLANKET. ASTM A53 GR.B ERW OR ASTM A106 GR.B .1 'KSI' VALUE : ASTM C518, 0.25 BTU-in/Hr-Sq.Ft- F AT 75 F F. STEEL PIPE SMLS, SCH 4 .2 MAXIMUM SERVICE TEMPERATURE: 250 °F (121 °C). G. JOINTS, 2" AND SMALLER SCREWED .3 MAXIMUM MOISTURE ABSORPTION: ASTM C1104; <5% BY WEIGHT. H. SCREWED FITTINGS 150 LB. MALLEABLE IRON D. VAPOUR BARRIER JACKET: CL.150, ASTM A-47 MALLEABLE IRON, ASTM I. UNIONS .1 KRAFT PAPER WITH GLASS FIBRE YARN AND BONDED TO ALUMINIZED FILM. A-153 GALVANIZED, ANSI B2.1 THREADS. .2 MOISTURE VAPOUR TRANSMISSION: ASTM E96; 0.04 PERM. 2-1/2" AND LARGER WELDED, J. JOINTS WIT .3 SECURE WITH PRESSURE SENSITIVE TAPE. FLANGES AT CONNECTIONS TO EQUIPMENT K. BUTT WELD FITTINGS ASTM A234 GR. WFB 2.3 ALUMINUM JACKETING (APPLY TO OUTDOOR DUCTWORK) L. FLANGES ASTM A105, CLASS 150, RAISED FACE, WELD MANUFACTURER: JOHNS MANVILLE ALUMINUM ROLL AND SHEET NECK OR SLIP ON COMPLIANCE: ASTM C1729, ASTM E84 ASTM A307 C.S. BOLTS, SQ. HEAD; ASTM M. BOLTS FINISH: SMOOTH PLAIN MILL FINISH A563 NUTS, HEX HEAD EMITTANCE: ASTM C1371 N. GASKETS 1/16" (1.6 MM) THICK PREFORMED MAXIMUM FLAME SPREAD INDEX: 0 NON-ASBESTOS GRAPHITE FIBRE. MAXIMUM SMOKE DEVELOPMENT INDEX: 5 O. COPPER TUBING 2" AND SMALLER ASTM B88, TYPE L, HARD DUCT INSULATION SOLDER, LEAD FREE, ASTM B32, 95 P. JOINTS: A. INSULATE NEW OR ALTERED DUCTWORK AND RE-INSULATE EXISTING DUCTWORK TIN-ANTIMONY, OR TIN AND SILVER, WIT WHERE INSULATION HAS BEEN REMOVED OR DAMAGED AS FOLLOWS: MELTING RANGE 220°C TO 280°C. INSULATION TYPE THICKNESS SERVICE Q. FITTINGS: ASME B16.18, CAST BRASS, OR ASM B16.22, SOLDER WROUGHT COPPER AIR SUPPLY – RECTANGULAR RIGID 1" UNION WITH GALVANIZED OR PLATED STEEL R. DIELECTRIC UNIONS: FLEXIBLE AIR SUPPLY - ROUND THREADED END, COPPER SOLDER END, EXHAUST WITHIN 6' OF OUTSIDE – RECTANGULAR RIGID WATER IMPERVIOUS ISOLATION BARRIER. EXHAUST WITHIN 6' OF OUTSIDE – ROUND FLEXIBLE S. VALVES, 2" AND SMALLER: ASTM A105 RIGID EXHAUST AIR PLENUMS .1 GATE VALVES (ISOLATING) 300 PSIG NON-SHOCK WOG, ASTM B62 BRONZE BODY, SOLID WEDGE DISC, RISING STEM, BRONZE TRIM, THREADED ENDS, DUCTWORK OUTDOORS (SUPPLY & RETURN) RIGID KITZ #25 B. INLINE DUCT SILENCERS SHALL BE INSULATED IN THE SAME MANNER AS .2 GLOBE VALVES (THROTTLING) 300 PSIG NON-SHOCK WOG, ASTM B62 DUCTWORK. BRONZE BODY, COMPOSITION (TEFLON) DISC, RISING STEM, BRONZE TRIM, THREADED ENDS, KITZ #09 .3 CHECK VALVES (BACKFLOW) 300 PSIG NON-SHOCK WOG, ASTM B6 3. HVAC PIPING INSULATION BRONZE BODY, Y-PATTERN HORIZONTAL, SWING TYPE DISC, THREADED 3.1 <u>GLASS FIBRE</u> ENDS, KITZ #29 .4 BALL VALVES (DRAIN) 600 PSIG NON-SHOCK WOG, FORGED BRASS A. APPROVED MANUFACTURERS: JOHNSMANVILLE MICRO-LOK 2-PIECE, CHROME BALL AND STEM, FULL PORT, BLOW-OUT PROOF PTFE B. OTHER ACCEPTABLE MANUFACTURERS OFFERING EQUIVALENT PRODUCTS: OWENS SEATS & STEM, LEVER HANDLE, THREADED ENDS, KITZ #68AC. CORING FIBERGLASS, CERTAINTEED CRIMPWRAP. T. VALVES, 2-1/2" AND LARGER: ASTM A216 INSULATION: ASTM C547; ASTM C411, ASTM C356 ASTM E84, ASTM D774, .1 GATE VALVES (ISOLATING) 200 PSIG NON-SHOCK WOG, ASTM A126 CLASS NFPA 259. B CAST IRON BODY, BOLTED BONNET, BRONZE MOUNTED, SOLID WEDGE .1 'KSI' VALUE: 0.23 BTU-in/Hr-Sq.Ft°F AT 75°F, 0.33 W/m- C AT 24 °( DISC, OS&Y, NON-ASBESTOS PACKING, FLANGED ENDS, KITZ #72. .2 MINIMUM SERVICE TEMPERATURE: 0°F (-18°C). .2 GLOBE VALVES (THROTTLING) 200 PSIG NON-SHOCK WOG, ASTM A12 CLASS B CAST IRON BODY, BOLTED BONNET, BRONZE MOUNTED, BEVELLEI .3 MAXIMUM SERVICE TEMPERATURE: 850°F (454°C). WEDGE DISC, OS&Y, NON-ASBESTOS PACKING, FLANGED ENDS, KITZ #76. .4 MAXIMUM MOISTURE ABSORPTION: <5% BY WEIGHT. .3 CHECK (BACKFLOW) 200 PSIG NON-SHOCK WOG, ASTM 126 CLASS E D. VAPOUR BARRIER JACKET CAST IRON BODY, BOLTED COVER, BRONZE MOUNTED, SWING TYPE DISC, .1 ASTM C136 TYPE I, WHITE KRAFT PAPER REINFORCED WITH GLASS FIBRI FLANGED ENDS, KITZ #78 YARN AND BONDED TO ALUMINIZED FILM. . PROVIDE STEM EXTENSIONS FOR INSULATED PIPING. .2 MOISTURE VAPOUR TRANSMISSION: ASTM E96; 0.02 PERM. V. PROVIDE GEAR OPERATOR AND CHAIN ON VALVES INSTALLED ABOVE 10FT AFF .3 SECURE WITH SELF SEALING LONGITUDINAL LAPS AND BUTT STRIPS. W. STRAINERS, 2" AND SMALLER CLASS 250, 400 PSIG WOG, CAST IRON BODY, .4 SECURE WITH OUTWARD CLINCH EXPANDING STAPLES AND VAPOUR Y-PATTERN, SCREWED CAP AND ENDS, A167 304 STAINLESS STEEL SCREEN BARRIER MASTIC WITH 1/32" PERFORATIONS. MUELLER STEAM 11M. E. TIE WIRE: 1.3 MM STAINLESS STEEL WITH TWISTED ENDS ON MAXIMUM 12" X. STRAINERS, 2-1/2" AND LARGER CLASS 250 PSIG NON-SHOCK WOG, CAST (300 MM) CENTRES IRON, Y-PATTERN, BOLTED FLANGE COVER, BLOW-OUT PLUG, A167 304 VAPOUR BARRIER LAP ADHESIVE STAINLESS STEEL SCREEN WITH 1/32" PERFORATIONS, FLANGED ENDS, .1 COMPATIBLE WITH INSULATION. MUELLER STEAM 752. G. INSULATING CEMENT/MASTIC .4 EQUIPMENT DRAINS AND OVERFLOWS .1 ASTM C195; HYDRAULIC SETTING ON MINERAL WOOL, VOC CONTENT NC A. COPPER TUBING: ASTM B88, TYPE M AND DWV, HARD DRAWN. TO EXCEED 80 G/L. .1 FITTINGS: ASME B16.18, CAST BRASS, OR ASME B16.22 SOLDER WROUGH H. FIBROUS GLASS FABRIC .1 CLOTH: UNTREATED; 9 OZ/SQ YD (305 G/SQ M) WEIGHT. .2 JOINTS: SOLDER, LEAD FREE, ASTM B32, 95-5 TIN-ANTIMONY, OR TIN .2 BLANKET: 1.0 LB/CU FT (16 KG/CU M) DENSITY. AND SILVER, WITH MELTING RANGE 4428°F TO 536°F (220°C TO 280°C). INDOOR VAPOUR BARRIER FINISH 1.5 <u>CIRCUIT BALANCING VALVES</u> .1 VINYL EMULSION TYPE ACRYLIC, COMPATIBLE WITH INSULATION, WHIT COLOUR, VOC CONTENT NOT TO EXCEED 250 G/L. A. CIRCUIT BALANCING VALVES; 2" (50 MM) AND SMALLER) .1 SCREWED CONNECTION, GLOBE STYLE DESIGN, NONFERROUS, PRESSURE 3.2 <u>JACKETS</u> DIE-CAST. NONPOROUS AMETAL COPPER ALLOY. EACH VALVE SHALL E A. PVC PLASTIC SUCH THAT WHEN INSTALLED IN ANY DIRECTION, IT WILL NOT AFFEC FLOW MEASUREMENT .1 JACKET: ONE PIECE MOULDED TYPE FITTING COVERS AND SHEET MATERIAL .2 VALVES SHALL PROVIDE THE FOLLOWING FUNCTIONS: ASTM E84, ASTM D1784, ULC S102-M88. .1 PRECISE FLOW MEASUREMENT. .2 MAXIMUM SERVICE TEMPERATURE: 151°F (66°C). .2 PRECISION FLOW BALANCING. .3 FINISH: GLOSS. .3 POSITIVE SHUT OFF WITH NO DRIP SEAT AND TEFLON DISC. .4 MAXIMUM FLAME SPREAD: ASTM E84; 25 OR LESS. .4 DRAIN CONNECTION WITH PROTECTIVE CAP. .5 MAXIMUM SMOKE DEVELOPED: ASTM E84; 50 OR LESS. .3 VALVES SHALL HAVE FOUR 360" ADJUSTMENT TURNS OF HANDWHEEL FO .6 THICKNESS: 20 MIL (0.4 MM) MINIMUM. 30 MIL (0.8 MM) MINIMUM FOR MAXIMUM VERNIER-TYPE SETTING WITH "HIDDEN MEMORY" FEATURE OUTDOOR USE PROGRAM THE VALVE WITH PRECISION TAMPER-PROOF BALANCING SETTING .7 COLOUR: STANDARD OFF-WHITE .4 VALVES SHALL BE SHIPPED IN A 4.5 R FACTOR POLYURETHANE CONTAINER .8 COVERING ADHESIVE MASTIC THAT SHALL BE USED AS INSULATION AFTER VALVE IN INSTALLED. .1 COMPATIBLE WITH INSULATION, MAXIMUM VOC CONTENT OF 50 G/L. .5 PROVIDE VALVES SUITABLE FOR MAXIMUM WORKING PRESSURE OF 250 P .9 APPROVED MANUFACTURER: CEEL-CO 300 SERIES, ZESTON PVC (1720 KPA) AND MAXIMUM OPERATING TEMPERATURE OF 250°F (121°C).

VAC SPECIFICATIONS	1	
3 <u>PIPE INSULATION</u>		
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		THESE DRAWINGS
1-1/2 & LARGER 2		DETAILS THEREON OF THE CONSULT
<u>YDRONIC_SPECIALTIES</u> R_VENTS		WITHOUT THE WRITTEN CONSENT
MANUAL TYPE: SHORT VERTICAL SECTIONS OF 2" (50 MM) DIAMETER PIPE TO		THE CONTRACTOR
FORM AIR CHAMBER, WITH 3 MM BRASS NEEDLE VALVE AT TOP OF CHAMBER		CORRELATE ALL DRAWING PACKA
.1 MANUFACTURERS: ARMSTRONG, AMTROL, TACO		REPORTING ANY ARCHITECT PRIO
.2 BRASS OR SEMI-STEEL BODY, COPPER, POLYPROPYLENE, OR SOLID NON-METALLIC FLOAT, STAINLESS STEEL VALVE AND VALVE SEAT; SUITABLE		RELEVANT WORK
FOR SYSTEM OPERATING TEMPERATURE AND PRESSURE; WITH ISOLATING VALVE.		REPRESENTED IN BE USED FOR (
RAINERS		ACCORDINGLY
SIZE 2" (50 MM) AND UNDER: .1 MANUFACTURERS: SARCO SB, CRANE, ARMSTRONG, COLTON		1. ISSUED F
SCREWED BRASS OR IRON BODY FOR 175 PSI (1200 KPA) WORKING		2. ISSUED
PRESSURE, T PATTERN WITH U.8 MM STAINLESS STEEL PERFORATED SCREEN. SIZE 2-1/2" TO 4" (65 MM TO 100 MM):		3. ISSUED
.1 FLANGED IRON BODY FOR 175 PSI (1200 KPA) WORKING PRESSURE, Y PATTERN WITH 1.2 MM STAINLESS STEEL PERFORATED SCREEN		4. ISSUED
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.		
ELIEF VALVES		
. MANUFACTURERS: SARCO, WATTS, BELL & GOSSETT, CONBRAC B. BRONZE BODY, TEFLON SFAT, STAINLESS STEEL STEM AND SPRINGS		
AUTOMATIC, DIRECT PRESSURE ACTUATED, CAPACITIES ASME CERTIFIED AND		
EFRIGERATION PIPING & SPECIALTIES PING		PROJECT: ∐\/A∩ □
. COPPER TUBING: ASTM B280, TYPE ACR HARD DRAWN OR ANNEALED.		IIVAU K
.1 FITTINGS: ASME B16.22 WROUGHT COPPER. .2 JOINTS: BRAZE, AWS AS & BOLIP SILVER /PHOSPHOPUS /COPPER ALLOY		Cland
WITH MELTING RANGE 640 TO 805 DEGREES C.		
.1 FITTINGS: ASME B16.26 CAST COPPER.		Seco
.2 JOINTS: FLARED. PIPE SUPPORTS AND ANCHORS:		Scho
.1 CONFORM TO ASME B31.5.		
.Z HANGERS FOR PIPE SIZES 13 TO 38 MM: MALLEABLE IRON ADJUSTABLE SWIVEL, SPLIT RING.		145 Rai
<ul> <li>.3 HANGERS FOR PIPE SIZES 50 MM AND OVER: CARBON STEEL, ADJUSTABLE, CLEVIS.</li> </ul>		Hamilto
.4 MULTIPLE OR TRAPEZE HANGERS: STEEL CHANNELS WITH WELDED SPACERS AND HANGER RODS.		For the
.5 WALL SUPPORT FOR PIPE SIZES TO 75 MM: CAST IRON HOOK.		
BRACKET AND WROUGHT STEEL CLAMP.		SEAL:
.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.		
MANUFACTURER: ARMACELL AP ARMAFLEX		
COMPLIANCE: ASTM C534, ASTM E84, ULC-S102, NFPA 90A, ASTM D1056		FYD Sonvior
AT 10 C)		t: 905.525.6069
PERMEABILITY: 0.05 PERM-IN MAXIMUM FLAME SPREAD INDEX: 25		1266 South Servi Suite C1-1, Stone
MAXIMUM SMOKE DEVELOPMENT INDEX: 50		ON, L8E 5R9 Canada
MAXIMUM SERVICE TEMPERATURE: 220 F (105 C)		www.exp.com
MINIMUM SERVICE TEMPERATURE: -297 F (-183 C) FOR OUTDOOR USF: PAINT INSULATION WITH ARMAFLEY WE STANDARD WHITE		_• <b>?</b> _
FINISH. PIGMENTED LATEX. VOC < 50 G/L.		
RIGERANT INSULATION SIZES		1
INSULATE LIQUID LINES WHERE EXPOSED TO EXTERIOR CONDITIONS. INSULATION		
FOR PIPE 1" (25 MM) O.D. AND SMALLER; 3/4" (20 MM) THICK FOR PIPE		
1-1/8 (28 MM) 10 2° (50 MM) O.D.; 1″ (25 MM) THICK FOR PIPES 2-1/8″ (54 MM) O.D. AND LARGER	l l	• BUILDINGS • EAR
SLIP INSULATION ON TO TUBING BEFORE TUBING SECTIONS AND FITTINGS ARE ASSEMBLED. KEEP SLITTING OF INSULATION TO A VERY MINIMUM. SEAL ALL		INDUSTRIAL      INFRA
JOINTS IN THE INSULATION WITH ARMAFLEX 520 BLV. INSULATE FLEXIBLE PIPE CONNECTORS.		
ON INSULATION EXPOSED OUTSIDE THE BUILDING, PLACE "SLIT" JOINT SEAMS ON BOTTOM OF PIPE AND PROVIDE TWO COATS OF ARMAFLEX WE FINISH.		NUI
EXTEND INSULATION THROUGH PIPE SUPPORT CLAMPS. PROVIDE A 6" (150 MM) LONG, 20 GAUGE (1.1 MM) GAI VANIZED STEEL SLEEVE AROUND PIPE		7
INSULATION AT EACH SUPPORT		(
STURE AND LIQUID INDICATORS		, 
FLARED OR SOLDER ENDS, SIGHT GLASS, COLOUR CODED PAPER MOISTURE	l [	DRAWING
INDICATOR WITH REMOVABLE ELEMENT CARTRIDGE AND PLASTIC CAP; FOR MAXIMUM WORKING PRESSURE OF 3450 KPA, AND MAXIMUM TEMPERATURE OF 93 DECREES C		Mecha
ES DEGREES C.		Specif
BALL VALVES:		1
.1 TWO PIECE BOLTED FORGED BRASS BODY WITH TEFLON BALL SEALS AND COPPER TUBE EXTENSIONS, BRASS BONNET AND SEAL CAP, CHROME		
PLATED BALL, STEM WITH NEOPRENE RING STEM SEALS; FOR MAXIMUM WORKING PRESSURE OF 3450 KPA AND MAXIMUM TEMPERATURE OF 149		
DEGREES C. SERVICE VALVES:		
.1 FORGED BRASS BODY WITH COPPER STUBS, BRASS CAPS, REMOVABLE VALVE CORE, INTEGRAL BALL CHECK VALVE. FLARED OR SOLDER FNDS		SCALE:
FOR MAXIMUM PRESSURE OF 3450 KPA.		
STRAIGHT LINE OR ANGLE LINE TYPE:		C.M. / J.L.
.1 BRASS OR STEEL SHELL, STEEL CAP AND FLANGE, AND REPLACEABLE CARTRIDGE. WITH SCRFFN OF STAINIESS STEEL WIRE OP MONEL		, DATE:
REINFORCED WITH BRASS; FOR MAXIMUM WORKING PRESSURE OF 2960 KPA.		SEPTEMBER 20
STRAIGHT LINE, NON-CLEANABLE TYPE:		PROJECT #
.I SIEEL SHELL, COPPER PLAIED FILLINGS, STAINLESS STEEL WIRE SCREEN,		ALL-23010629

DRAWING #

M0.2

## HVAC SPECIFICATIONS

FOR MAXIMUM WORKING PRESSURE TO SUIT APPLICATION.

## 5.7 <u>CHECK VALVES</u>

- 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 <u>PRESSURE RELIEF VALVES</u>
- 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

#### 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,
- SUPERHEAT SETTING, REPLACEABLE INLET STRAINER, WITH NON-REPLACEABLE 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 UNDERSIZED AT FULL LOAD AND EXCESSIVELY OVERSIZED AT PART LOAD.

#### 5.13 <u>RECEIVERS</u>

- 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. B. 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 <u>HVAC DUCTWORK</u>

- 5.1 <u>HVAC DUCTWORK GENERAL:</u>
   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 SCREW TO ENSURE AGAINST AIR LEAKAGE. WHERE 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 AABC 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/FT2) TO ASTM A90. SHEETS FREE OF PITS, BLISTERS, SLIVERS, AND UNGALVANIZED SPOTS.

#### 6.3 DUCT SEALING

- SEAL DUCTWORK IN ACCORDANCE WITH SMACNA SEALING REQUIREMENT AS FOLLOWS:
- A. SEAL CLASS A: ALL TRANVERSE JOINTS, LONGITUDINAL SEAMS AND DUCT WALL PENETRATIONS
- B. SEAL CLASS B: ALL TRANVERSE JOINTS AND LONGITUDINAL SEAMS

C. SEAL CLASS C: ALL TRANVERSE JOINTS

- 6.4 <u>DUCTWORK</u> 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, GAUGES, REINFORCING, AND SEALING FOR OPERATING PRESSURES INDICATED IN ACCORDANCE WITH RECOMMENDATIONS OF ASHRAE AND SMACNA.
- . 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.
- . 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 FOIL 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 DOWNSTREAM.
- . 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

## HVAC SPECIFICATIONS

### 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.

## .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 VAPOR BARRIER OF FIBERGLASS REINFORCED METALLIZED FILM LAMINATE.
- G. 20/50 FLAME/SMOKE SPREAD RATING.H. 0.05 PERM VAPOR TRANSMISSION RATING

### 7 <u>DUCT ACCESSORIES</u>

- 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 "DUCTURN", DYN-AIR OR TUTTLE AND BAILY.
- 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 <u>BACKDRAFT DAMPERS.</u>

- 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 STOP, 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 <u>VOLUME CONTROL DAMPERS</u>

- A. FABRICATE TO SMACNA HVAC DUCT CONSTRUCTION STANDARDS METAL AND FLEXIBLE, AND AS INDICATED.
  B. SPLITTER DAMPERS:
- .1 MATERIAL: SAME GAUGE AS 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 FRAMES, 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. G. ACCEPTABLE MANUFACTURERS: DURO-DYNE, DYN-AIR, PRICE, LAWSON & TAYLOR

## .4 <u>FIRE DAMPERS</u>

- A. MANUFACTURERS: PRICE, RUSKIN, NAILOR
- B. FIRE DAMPERS SHALL BE ULC LISTED, LABELLED, OR WARNOCK-HERSEY LABEL, MEET ALL REQUIREMENTS OF NFPA 90A, AND CONSTRUCTED AND
- RATED IN CONFORMANCE WITH: .1 CAN4-S92-M82, "STANDARD FOR FIRE DAMPERS", WHEN USED IN A FIR SEPARATION OF NOT MORE THAN 2 HOURS, AND WHICH IS NOT
- 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 ASSEMBLIES", WHEN USED IN A CEILING FIRE SEPARATION.
- C. FIRE DAMPERS SHALL BE GALVANIZED STEEL CHANNEL FRAME CURTAIN TYPE GALVANIZED STEEL INTERLOCKING BLADES, MINIMUM 22 GAUGE (0.9 MM) GALVANIZED STEEL ENCLOSURE, AND 160°F (71°C) 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 ULC LABELLED, FOR FIRE RATED MEMBRANI TYPE CEILINGS, GALVANIZED STEEL CONSTRUCTION WITH HEAT RETARDANT BLANKET (NON-ASBESTOS) WITH STANDARD 160°F (71°C) FUSIBLE LINK.
- G. THERMAL BLANKET SHALL BE ULC 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.
  I. FUSIBLE LINKS: UL 33, SEPARATE AT 160°F (71°C) WITH ADJUSTABLE LINK
- STRAPS FOR COMBINATION FIRE/BALANCING DAMPERS.
- 1.5 <u>FIRE DAMPERS (DYNAMIC)</u>
- A. DYNAMIC FIRE DAMPERS TESTED, CONSTRUCTED AND LABELED 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 165°F (74°C) FUSIBLE LINK AND SHALL BE LABELED 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.

A. FABRICATE TO SMACNA HVAC DUCT CONSTRUCTION STANDARDS - METAL AND

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

D. ACCEPTABLE PRODUCT: RUSKIN DIBD2/DIBD23, NCA, VENTEX, PRICE, CONTROLLED AIR.

### 7.6 DUCT ACCESS DOORS

FLEXIBLE, AND AS INDICATED.

## 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, KREUGER

7.7 DUCT TEST HOLES

- A. PROVIDE TEST PORTS TO SUIT INTENDED APPLICATION, (IE.
- INSULATED/UNINSULATED DUCT, 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 NFPA 701 TESTS FOR FLAME PROPAGATION OF FABRICS AND FILM.
- .3 10/120 ASTM E84 FLAME/SMOKE RATING. .4 -40F TO 250F CONTINUOUS TEMPERATURE RANGE.
- .4 -40F TO 250F CONTINUOUS TEMPERATURE RAN .5 WHITE WOVEN FIBERGLASS COLOUR
- .6 GALVANIZED STEEL CONFORMING TO ASTM-A-525 G 60 OR BETTER
- B. ACCEPTABLE MANUFACTURERS" DURO-DYNE, DDFDC.7.9 <u>HANGERS AND SUPPORTS</u>
- 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.

#### .10 ACOUSTIC LINING

- MANUFACTURER: ARMACELL AP ARMAFLEX SA COMPLIANCE: ASTM C54, ASTM E84, ULC-S102, NFPA 90A, ASTM C1534, ASTM D1056
- 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.

## .11 DUCT SEALANT

- A. GENERAL: LOW VOC, WATER BASED SEALANT, NON-TOXIC, NON-COMBUSTIBLE,NON-FLAMMABLE, AND TESTED IN ACCORDANCE WITH CAN4/ULC-S102. 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 AABC OR NBCC CERTIFIED AGENCY.
- B. PROVIDE A FINAL TESTING AND BALANCING REPORT TO ENGINEER FOR REVIEW PRIOR TO PROJECT CLOSEOUT.
  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 IN SPACE 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
- OPERCENT OF DESIGN FOR ROOMS UNDER POSITIVE PRESSURE AND WITHIN PLUS OPERCENT 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 OWNER. 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 ALTITUDE.B. MAKE AIR QUANTITY MEASUREMENTS IN DUCTS BY PITOT 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 QUANTITY. PROVIDE DRIVE CHANGES AS REQUIRED. MAKE ALLOWANCES FOR LOADING OF FILTERS TO 50% OF MANUFACTURERS' 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

## HVAC SPECIFICATIONS

- EXHAUST DAMPERS FOR DESIGN CONDITIONS. J. MEASURE 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.WG. (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.

## HVAC EQUIPMENT

- 9.1 <u>PACKAGED ROOFTOP AIR CONDITIONING UNITS (RTU-2, AHU-9, AHU-12)</u> 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 AHRI CERTIFIED WITHIN SCOPE OF AHRI STANDARD 210–240 FOR 6 TO 25 TONS AND ANSIZ21.47 AND 10 CFR PART 431 PERTAINING TO COMMERCIAL WARM AIR FURNACES (ALL GAS HEATING UNITS).
- .2 ROOFTOP UNIT SHALL BE FACTORY ASSEMBLED, INTERNALLY WIRED, FULLY CHARGED WITH R-410A, AND 100 PERCENT RUN TESTED TO CHECK COOLING OPERATION, FAN AND BLOWER ROTATION, 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. .5 SYMBIO CONTROLS OPERATING RANGE SHALL BE BETWEEN 0°F AND 125°F COOLING MODE.
- 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 UNIT'S BASE PAN SHALL HAVE A RAISED 1 1/8 INCH HIGH LIP AROUND THE SUPPLY AND RETURN OPENINGS FOR WATER INTEGRITY.
- .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 FAIL 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.

EXCHANGER WITH CORROSION-RESISTANT ALUMINIZED STEEL TUBES AND

BE INTEGRAL TO UNIT, UL OR CSA APPROVED SPECIFICALLY FOR OUTDOOR

APPLICATIONS FOR USE DOWNSTREAM FROM REFRIGERANT COOLING COILS.

COMBUSTION PRODUCTS THROUGH THE FIRING TUBES. SYSTEM SHALL USE

AFTER THREE UNSUCCESSFUL IGNITION ATTEMPTS, ENTIRE HEATING SYSTEM

SHALL BE LOCKED OUT UNTIL MANUALLY RESET AT THE THERMOSTAT/ZONE

MEDIUM, AND HIGH HEAT CAPACITIES. CORROSION-RESISTANT ALUMINIZED

LIMIT CONTROLS: HIGH TEMPERATURE LIMIT CONTROLS WILL SHUT OFF GAS

PERFORMANCE DUE TO FLAT, STREAMLINED TUBES WITH SMALL PORTS, AND

PROVIDE VERTICAL DISCHARGE, DIRECT DRIVE FANS WITH ALUMINUM BLADES

LUBRICATED, WITH INTEGRAL THERMAL OVERLOAD PROTECTION IN A WEATHER

FANS SHALL BE STATICALLY BALANCED. MOTORS SHALL BE PERMANENTLY

PROVIDE A REMOVABLE, REVERSIBLE, CLEANABLE DOUBLE SLOPED DRAIN

FLOW IN THE EVENT OF EXCESSIVE TEMPERATURES RESULTING FROM

.1 COOLING ONLY, GAS HEAT, AND ELECTRIC HEAT UNIT EVAPORATORS SHALL

ALUMINUM MICROCHANNEL THAT PROVIDE OPTIMAL HEAT TRANSFER

.2 ON INITIAL CALL FOR HEAT, THE COMBUSTION BLOWER SHALL PURGE THE

.3 COMPLETELY ASSEMBLED AND FACTORY INSTALLED HEATING SYSTEM SHALL

.4 HEATING SECTION SHALL BE FACTORY RUN TESTED PRIOR TO SHIPMENT.

.5 INDUCED DRAFT COMBUSTION BLOWER SHALL BE USED TO PULL THE

.7 INDUCED DRAFT BLOWER TO PULL THE GAS MIXTURE THROUGH THE

STEEL TUBES AND BURNERS ARE STANDARD ON ALL MODELS.

RESTRICTED INDOOR AIRFLOW OR LOSS OF INDOOR AIRFLOW.

PAN FOR BASE OF EVAPORATOR COIL CONSTRUCTED OF PVC.

COMPACT CABINET FEATURES A TUBULAR HEAT EXCHANGER IN LOW,

F. GAS FIRED HEATING SECTION .1 THE HEATING SECTION SHALL HAVE A PROGRESSIVE TUBULAR HEAT

DIRECT SPARK IGNITION (DSI)

METALLURGICAL TUBE-TO-FIN BOND.

SENSOR

G. EVAPORATOR COIL

CONDENSER SECTION

TIGHT CASING.

BURNER TUBES.

BURNERS AS STANDARD ON ALL MODELS.

HEAT EXCHANGER FOR 20 SECONDS BEFORE IGNITION.

THREADED CONNECTION WITH PLUG OR CAP PROVIDED.

## HVAC SPECIFICATIONS

- COOLING ONLY, GAS HEAT, AND ELECTRIC HEAT CONDENSERS SHALL BE .2 MICROCHANNEL. PROVIDE TOOL-LESS FACTORY INSTALLED CORROSION RESISTANT LOUVERED HAIL/VANDALISM GUARDS TO PROTECT CONDENSER COILS FROM HAIL OR PHYSICAL DAMAGE. REFRIGERATION SYSTEM 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. 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. 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 THAT WILL ASSURE PROPER INSTALLATION AND OPERATION. 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) OPTION WHICH SHALL CONSIST OF THE FOLLOWING REFRIGERATION COMPONENTS: 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 THAT SHALL ASSIST THE BAROMETRIC RELIEF DAMPER IN THE ECONOMIZER IN RELIEVING BUILDING PRESSURIZATION.
   K. OUTDOOR AIR SECTION
- .1 UNITS SHALL BE AVAILABLE WITH OR WITHOUT BAROMETRIC RELIEF.
   .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 SENSOR PROVIDES PROPORTIONAL INTEGRAL ROOM CONTROL. THIS UCM SHALL PERFORM ALL UNIT FUNCTIONS BY MAKING ALL HEATING, COOLING AND VENTILATING DECISIONS THROUGH RESIDENT SOFTWARE LOGIC.
- .6 PROVIDE FACTORY-INSTALLED INDOOR EVAPORATOR DEFROST CONTROL TO PREVENT COMPRESSOR SLUGGING BY INTERRUPTING COMPRESSOR OPERATION.
- .7 PROVIDE AN ANTI-CYCLE TIMING AND MINIMUM ON/OFF BETWEEN STAGES TIMING IN THE MICROPROCESSOR. L. SYSTEM CONTROL
- .1 MULTI-SPEED INDOOR FAN SYSTEM UNIT SHALL BE PROVIDED WITH INDOOR FAN SYSTEM DESIGNED FOR USE IN APPLICATIONS FOR MEETING THE MINIMUM REQUIREMENTS OF CA TITLE 24. THIS SYSTEM INCORPORATES A MULTI-SPEED FAN CONTROL TO CHANGE SPEED OF THE FAN TO 66% OF FULL AIRFLOW BASED OFF OF COMPRESSOR STAGES.
   M. ROOF CURB ADAPTER
- .1 CONTRACTOR SHALL PROVIDE FACTORY SUPPLIED ROOF CURB ADAPTER FOR AHU-9 & AHU-12. N. ROOF CURBS
- .1 CONTRACTOR SHALL FURNISH AND INSTALL A ROOF CURB FOR RTU-2. O. EXECUTION
- .1 CONTRACTOR SHALL VERIFY THAT ROOF IS READY TO RECEIVE WORK 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 WATERTIGHT ENCLOSURE TO PROTECT DUCTWORK AND UTILITY SERVICES. INSTALL ROOF MOUNTING CURB LEVEL.

#### 9.2 REPLACEMENT CUSTOM ROOFTOP UNITS (AHU10, AHU-11)

A. SUMMARY

- .1 THE CONTRACTOR SHALL INSTALL PACKAGED 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 PRE-ORDERED BY OWNER. REFER TO ARCHITECTURAL SPECIFICATIONS 01030 FOR FULL DETAILS.
   B. GENERAL
- .2 THE CONTRACTOR SHALL INSTALL PACKAGED ROOFTOP AIR CONDITIONING UNITS. THE UNITS SHALL BE INSTALLED IN ACCORDANCE WITH THIS SPECIFICATION AND PERFORM AT THE CONDITIONS SPECIFIED, SCHEDULED OR AS SHOWN ON THE CONTRACT DRAWINGS.
   C. UNIT CABINET
- .1 THE SUPPORT FRAME WILL BE MADE OF PAINTED HEAVY GAUGE FORMED GALVANIZED STEEL. STANDARD HEIGHT IS 6" BUT VARIES IN FUNCTION OF UNIT SIZE. THE WALLS AND ROOF OF THE HEAT EXCHANGER SECTION WILL BE DOUBLE WALLED WITH OUTER WALLS TO BE BUILT WITH A MINIMUM 20 GAUGE GALVANEAL STEEL (ALSO KNOWN AS SATIN FINISH); INNER WALLS TO BE BUILT WITH A MINIMUM 22 GAUGE G-90 GALVANIZED STEEL; HIGH TEMPERATURE INSULATION 2-INCHES THICK R 13 FOAM.
- .2 THE WALLS AND ROOF OF THE UNIT WILL BE DOUBLE WALL AND BUILT WITH OUTER WALLS TO BE A MINIMUM 20 GAUGE GALVANEAL STEEL; INNER WALLS A MINIMUM 22 GAUGE G-90 GALVANIZED STEEL; INSULATION 2-INCHES THICK R 13 FOAM.
- .3 FLOORS WILL BE A MINIMUM INNER 18 GAUGE G-90 GALVANIZED STEEL; OUTER FLOOR TO BE BUILT WITH A MINIMUM 22 GAUGE G-90 GALVANIZED STEEL; INSULATION TO BE MINIMUM 2-INCHES THICK R 13. UPTURN LIP AND COMPLETELY SEALED INTERNAL UNIT FOR WASHDOWN PURPOSES.
- .4 THE ROOF SHALL BE CONSTRUCTED WITH A BENT 20 GAUGE G-90 GALVANIZED STEEL FULL PARAMETER EXTERIOR GUTTER. THE ROOF PANELS WILL BE SCREWED ASSEMBLED TOGETHER AND SEALED WITH A URETHANE JOINT FOR POSITIVE WATERPROOFING AND AIR TIGHTNESS.
- .5 CONTROLS AND PIPING SHALL BE INSTALLED INSIDE A PROTECTIVE ENCLOSURE WITH FULL—SIZED HINGED ACCESS DOOR FOR EASY MAINTENANCE.
   .6 DRAIN PANS: ALL DRAIN PANS IN THE EQUIPMENT, UNLESS NOTED
- OTHERWISE, TO BE CONTINUOUSLY WELDED 304L STAINLESS STEEL 2" DEEP DOUBLE SLOPED DRAIN PAN WITH A MINIMUM 1" NPT DRAIN. THE DRAIN PANS ARE TO BE INSTALLED ON THE UNIT FLOOR AND NOT PART OF THE UNIT'S WELDED BASE. D. FINISH
- .1 THE EXTERNAL SURFACES OF THE UNITS ARE MANUFACTURED IN G90 GALVANIZED STEEL STANDARD. THE FINISH CAN BE LEFT AS SUCH OR PAINTED WITH STANDARD AIR-DRIED ACRYLIC ENAMEL PAINT. IF PAINTED, THE PROCESS MEETS AND EXCEEDS 1500 H ASTM B117-19, THE CANADIAN (TYPE 1-GP-40) AND AMERICAN (TYPE TT-P-636 D) STANDARDS FOR SALT, MIST AND HUMIDITY.
   E. DOORS
- .1 EACH UNIT SECTION WILL HAVE A HINGED ACCESS DOOR LINED UL RECOGNIZED AUTOMOTIVE CONTINUOUS BULB GASKETS AND BE EQUIPPED WITH LEVER HANDLES TO HAVE ACCESS TO EVERY COMPONENT OF THE EQUIPMENT. DOORS CAN SWING IN OR OUT DEPENDING ON WHICH SECTION THEY ACCESS. THEY SHALL ALWAYS BE DESIGNED TO OPEN AGAINST THE CABINET PRESSURE TO PREVENT ANY HARM WHILE OPENING THE DOOR.
   .2 THE DOORS SHALL BE DOUBLE WALL AND CONSTRUCTED OF THE SAME MATERIALS AS THE UNIT CASING. THE DOOR FRAME SHALL BE CONSTRUCTED OF MINIMUM 18 GAUGE G-90 GALVANIZED STEEL. THE DOOR OPENING HEIGHT SHALL BE ADJUSTED TO EACH DOOR WITH A MINIMUM 4 INCHES SMALLER THAN THE CABINET HEIGHT. THESE DIMENSIONS SHALL BE CUSTOMIZED TO THE FUNCTION OR REQUIREMENTS OF THE CLIENT/APPLICATION.

# 2. ISSUED FOR REVIEW 10.10.23 3. ISSUED FOR PERMIT 14.11.23 4. ISSUED FOR TENDER 14.02.24

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HV	٩C	SPECIFICATIONS	HVAC	SF	PECIFICATIONS
Α.	HEA <sup>-</sup>	T EXCHANGER PROVIDE HEATCO INC. INDIRECT GAS-FIRED DUCT FURNACE MODULE LISTED	.10	OUTE INST/	DOOR UNITS SHALL BE WEATHERPROOFED AND EQUIPPED FOR ALLATION OUTDOORS, UNITS SHALL BE FABRICATED TO PREVENT THE
		BY INTERTEK TESTING SERVICES (ITS / ETL), 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 BLOWER ONLY DUCT FURNACE MODULE SHALL		INFIL PROV DIVE SHAL SHAL	TRATION OF RAIN AND SNOW: LOUVERS OR HOODS SHALL BE /IDED ON AIR INTAKES AND EXHAUST OPENINGS. RAIN GUTTERS OR RTERS SHALL BE INSTALLED OVER ALL ACCESS DOORS. ALL JOINTS L BE CAULKED WITH A WATER RESISTANT SEALANT. THE ROOF JOIN L BE TURNED UP 2" (51 MM) WITH THREE BREAK INTERLOCKING
	.2	PROVIDE A MINIMUM COMBUSTION EFFICIENCY OF 80%. THE HEAT EXCHANGER CONSIST OF A PRIMARY DRUM AND SECONDARY TUBES ENTIRELY MADE OF 409 STAINLESS STEEL REQUIRING NO THERMAL TREATMENT TO PREVENT THE CRACKING OF WELDED JOINTS. HEAT	C. FAN .1	DESI MM) IS CENT	GN AND THE OUTER WALL PANELS SHALL EXTEND A MINIMUM OF 1/4" BELOW THE FLOOR PANEL. TRIFUGAL FANS SHALL BE RATED IN ACCORDANCE WITH AMCA
В.	BUR .1	EXCHANGER IS GUARANTEED FOR TO YEARS PRO-RATED ON PARTS. INER AND GAS PIPING 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.		DYNA BE S CRITI	IDARD TEST CODE _ BULLETIN 210. FAN MANUFACTURER SHALL BE BER OF AMCA. ALL FANS AND FAN ASSEMBLIES SHALL BE MICALLY BALANCED DURING FACTORY TEST RUN. FAN SHAFTS SHAL SELECTED FOR STABLE OPERATION AT LEAST 20% BELOW THE FIRST CAL RPM. FAN SHAFTS SHALL BE PROVIDED WITH A RUST INHIBITIN
	.2 .3	THE GAS PILOT PIPING WILL BE EQUIPPED WITH AN ELECTRONIC SPARK IGNITER, MANUAL SHUT-OFF VALVE, PRESSURE REGULATOR, AUTOMATIC SHUT-OFF VALVES AND MANUAL COCK. THE GAS SUPPLY OF THE BURNER WILL INCLUDE A PRESSURE REGULATOR,	.2	COAT BACK EQUI BLOC	WARD INCLINED FANS WITH AIRFOIL OR FLAT BLADE DESIGN SHALL E WARD INCLINED FANS WITH AIRFOIL OR FLAT BLADE DESIGN SHALL E PPED WITH GREASEABLE SELF—ALIGNING BALL OR ROLLER TYPE PILL CK BEARINGS.
0	.4	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 US. THE BURNER AND GAS PIPING ASSEMBLY WILL HAVE A MODULATING TURNDOWN RATIO OF AT LEAST 10:1 ON ALL MODELS.	.3	FANS IN S PARA MOVE SIDE	S SHALL BE BELT DRIVEN PLENUM TYPE CONFIGURATION WHERE NOT CHEDULES. THRUST RESTRAINT ISOLATORS SHALL BE PROVIDED ALLEL TO THE SHAFT CENTERLINE WHEN REQUIRED TO MINIMIZE AXIAI EMENT AND BENDING MOVEMENTS OF THE BLOWER ASSEMBLY(S). DR BEARINGS ON PLENUM FANS SHALL BE ADAPTER STYLE TO ENSURE
С.	.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 RIS ISOLATORS. A HINGED ACCESS DOOR WILL PROVIDE ACCESS FOR MAINTENANCE OF THE FAN. MOTOR. BEARINGS. BELTS AND	.4	EVEN .1 FAN KW)	I CLAMPING OF THE BEARING SLEEVE TO THE SHAFT. PROVIDE INLET SCREEN & OPEN WIRE MESH PROTECTIVE DISCHARGI SCREEN. MOTOR SHEAVES SHALL BE ADJUSTABLE WITH MOTORS 7 1/2 HP ( AND SMALLER. ON FANS WITH LARGER MOTORS, FIXED DRIVES SHA AND SMALLER. ON FANS WITH LARGER MOTORS, FIXED DRIVES SHALL PROVIDED ALL DRIVES SHALL BE PROVIDED WITH A RUST INHIBITING.
D.	FILT	PULLEYS. THE FAN WILL BE A FC/DWDI TWIN FANS ON COMMON SHAFT FROM COMEFRI. THE MOTOR WILL BE TOTALLY ENCLOSED FAN-COOLED (TEFC) AND PREMIUM EFFICIENCY RATED FOR HIGHER EFFICIENCY; THE FAN/MOTOR ASSEMBLY WILL BE INSTALLED ON A UNITARY BASE. FRS	.5	COAT REQU PROV POWI	TING. THE AIR BALANCER SHALL BE PROVIDE FOR DRIVE CHANGES (IF JIRED) DURING THE AIR BALANCE PROCEDURE. /IDE FULL SECTION RETURN AIR FAN(S) AS SCHEDULED. THE USE ( ER EXHAUST PROPELLER TYPE ARRANGEMENTS WILL NOT BE
2.	.1	THE FILTERS SHALL BE PLEATED LARGE SURFACE DISPOSABLE TYPE, 2-INCH THICK MERV 13, CLASS 2, UL RATED. THESE WILL BE INSTALLED IN THE FRESH FLOW. FILTERS WILL BE MOUNTED INSIDE THE UNIT IN GALVANIZED STEEL SLIDING	.6 .7	FAN AND VARI	AND MOTOR SHEAVES SHALL BE FACTORY INSTALLED, FAN BALANCED TESTED PRIOR TO SHIPMENT. ABLE FREQUENCY DRIVES A PULSE WIDTH MODULATED (PWM) INVERTER DESIGNED FOR USE
F	DAM	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 MAXIMIZE FILTRATION.		.2	WITH BOTH ASYNCHRONOUS AND PERMANENT MAGNET MOTORS SHAL BE PROVIDED. IEEE 519–2014 IS AN ELECTRICAL SYSTEM STANDARD FOR HARMON MITIGATION AND NOT INTENDED TO BE APPLIED TO AN INDIVIDUAL
.1 F.	THE EXTE SPR DX	DAMPERS WILL BE OPPOSED BLADES STANDARD LOW LEAKAGE, ALUMINIUM RUDED, AIRFOIL TAMCO-1000 OPPOSED BLADES. ACTUATORS TO BE ING RETURN, OPEN/CLOSED FROM BELIMO. COOLING			PIECE OF EQUIPMENT. DRIVES ARE ONLY ONE OF MANY SOURCES 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 THE DRIVE SCHEDULE HA
0	.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.		.3 .4	SPECIFIED PROPER HARMONIC MITIGATION FOR THE DRIVES. DRIVES SHALL BE UL LABELED AS A COMPLETE ASSEMBLY. THE BASE DRIVE SHALL BE SEMI-F47 CERTIFIED. THE DRIVE 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
6.	.1 .2 .3	THE INTAKE HOODS WILL BE MOUNTED ON UNIT END, AND EQUIPPED WITH A 1" GALVANIZED STEEL BIRD SCREEN AS WELL AS RAIN GUTTERS. HOOD AIR VELOCITY SHALL NOT EXCEED 500 FPM. HOODS SHALL BE CONSTRUCTED OF THE SAME MATERIALS AS THE UNIT'S		.5	ONE SECOND. 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 $-35\%$ NOMINAL VOLTAGE
Н.	BUR	EXTERIOR WITH A MINIMUM 20GA G-90 GALVANIZED STEEL CONSTRUCTION. IT SHALL ALSO BE OF THE SAME FINISH AS THE EQUIPMENT FOR ESTHETICAL REASONS (PAINTED OR GALVANIZED). INER CONTROLS		.6 .7	MULTIPLE HOME VIEW SCREENS SHALL BE CAPABLE OF DISPLAYING UP TO 21 POINTS OF INFORMATION. THE CONTROL PANEL SHALL DISPLAY THE FOLLOWING ITEMS ON A SINGLE SCREEN: OUTPUT FREQUENCY, OUTPUT CURRENT, REFERENC
Ι.	.1 .2 .3 ELE(	SIEMENS FLAME SAFETY CONTROLLER; DDC DISTECH CONTROLLER BACNET / EC SMART VUE W/ ROOM SENSOR; BACNET BTL COMPATIBLE AS WELL FOR BAS SYSTEM; CTRICITY & CONTROLS SUPPLY VOLTAGE AS PER UNIT SCHEDULE.		.8	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. THERE SHALL BE A BUILT-IN TIME CLOCK. THE CLOCK SHALL HAVE
	.1 .2 .3 .4 .5	TERMINAL BLOCK FOR POWER CONNECTION TEMPERATURE CONTROL E SAFEGUARD WITH INDICATING LIGHTS AND SCREEN AIR CONTROL LIMIT		.9	BATTERY BACKUP WITH 10 YEARS MINIMUM LIFE SPAN. DAYLIGHT SAVINGS TIME SHALL BE SELECTABLE. THE DRIVE SHALL AUTOMATICALLY BACKUP PARAMETERS TO ITS CONTROL PANEL. IN ADDITION TO THE AUTOMATIC BACKUP, THE DRIVE SHALL AUTOM TWO ADDITIONAL LINIOUE BACKUP PARAMETER
J.	CER .1 .2	TIFICATION ALL PAC UNITS MUST BE CETLUS APPROVED AND CERTIFIED ACCORDING TO STANDARDS ANSI Z83.8/CSA 2.6 ET Z21.47/CSA 2.3 ALL TBI UNITS MUST BE CSA APPROVED AND CERTIFIED ACCORDING TO STANDARDS CAN/CGA3.2 AND UL 795			SETS 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 ON THE REPLACEMENT DRIVE, AND PARAMETERS FROM THAT CONTROL PANEL
к.	STAF .1 TO TECI	STANDARDS CARY COAD, 2 AND OF 753. RTUP & FACTORY ADJUSTMENT EACH UNIT SHALL BE FIRE TESTED AND PRE-ADJUSTED AT FACTORY PRIOR SHIPMENT. ON SITE START-UP SHALL BE PERFORMED BY A QUALIFIED HNICIAN WITH APPROPRIATE CREDENTIALS FOR GAS EQUIPMENT AND HORIZED BY THE MANUFACTURER		.10 .11	CAN BE DOWNLOADED INTO THE REPLACEMENT DRIVE. THE CONTROL PANEL SHALL BE REMOVABLE CAPABLE OF REMOTE MOUNTING. THE CONTROL PANEL SHALL HAVE THE ABILITY TO STORE SCREEN SHOTS WHICH ARE DOWNLOADABLE VIA USB.
L.	EXE .1 .2	CUTION CONTRACTOR SHALL VERIFY THAT ROOF IS READY TO RECEIVE WORK AND OPENING DIMENSIONS ARE CORRECT. CONTRACTOR SHALL VERIFY THAT PROPER POWER SUPPLY IS AVAILABLE.		.12	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
	.4	INSTRUCTIONS. MOUNT UNITS ON FACTORY-BUILT ROOF MOUNTING FRAME PROVIDING WATERTIGHT ENCLOSURE TO PROTECT DUCTWORK AND UTILITY SERVICES. INSTALL ROOF MOUNTING CURB LEVEL.			<ul> <li>THAT REQUIRE ACCESS TO INTERNAL COMPONENTS TO PERFOR THESE FUNCTIONS ARE NOT ACCEPTABLE.</li> <li>TWO (2) PROGRAMMABLE ANALOG OUTPUTS. AT LEAST ONE O THE ANALOG OUTPUTS SHALL BE ADJUSTABLE FOR CURRENT O VOLTAGE SIGNAL CONFIGURED VIA THE VFD CONTROL PANEL.</li> </ul>
9.3 A.	<u>AIR</u> GEN .1	HANDLER (RTU-1) ERAL AIR HANDLING UNITS SHALL BE BUILT TO THE LEVEL OF QUALITY AS HEREIN SPECIFIED AND TO THE DESCRIPTION OF THE AIR HANDLING UNIT			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 AN ACTIVE LOW LOGIC AND SHALL INCLUDE ADJUSTABLE ON /OFF
	.2	SCHEDULE 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 WHERE SPECIFIED AND APPLICABLE, BE PRE-WIRED AND FACTORY			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 ON/OFF TIME DELAYS. THE RELAYS SHALL BE RATED FOR A CONTINUOUS
	.3 .4	CERTIFIED BY AN APPROVED TESTING AGENCY SUCH AS ETL, UL, OR CSA FOR THE DESTINATION. ALL ELECTRICAL CIRCUITS SHALL UNDERGO A DIELECTRIC STRENGTH TEST AND SHALL BE FACTORY TESTED AND CHECKED AS TO PROPER FUNCTION. THE AIR HANDLING UNITS AND MAJOR COMPONENTS SHALL BE PRODUCTS OF MANUFACTURERS REGULARLY ENGAGED IN THE PRODUCTION OF SUCH			CURRENT RATING OF 2 AMPS AND MAXIMUM SWITCHING VOLTAG 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 CARI TO PROVIDE ADDITIONAL RELAY OUTPUTS.
	.5	EQUIPMENT AND WITH A MINIMUM OF FIFTY (50) CONTINUOUS YEARS OF PROVEN PRODUCTION EXPERIENCE. AIR HANDLING UNITS SHALL BE INSTALLED BY THE CONTRACTOR AS SHOWN AND SCHEDULED ON THE DOCUMENTS. AIR HANDLING UNITS ARE PRE-PURCHASED BY OWNER. REFER TO ARCHITECTURAL SPECIFICATIONS			<ul> <li>IDENTIFICATION OF FUNCTION.</li> <li>THE DRIVE SHALL INCLUDE AN ISOLATED USB PORT FOR INTERFACE BETWEEN THE DRIVE AND A LAPTOP. A NON-ISOLATED USB PORT IS NOT ACCEPTABLE.</li> <li>AN AUXILIARY POWER SUPPLY RATED AT 24 VDC, 250 MA SHA</li> </ul>
В.	.6 UNIT 1	01030 FOR FULL DETAILS. RTU-1 ROOF CURB SHALL BE FURNISHED AND INSTALLED BY CONTRACTOR. CONSTRUCTION			BE INCLUDED. .8 AT A MINIMUM, THE DRIVES SHALL HAVE INTERNAL IMPEDANCE EQUIVALENT TO 5% TO REDUCE THE HARMONICS TO THE POWE LINE. 5% IMPEDANCE MAY BE FROM DUAL (POSITIVE AND NECATIVE DC LINK) CHOKES OF AC LINE PEACTOR DRIVES
		GALVANIZED SHEET METAL. SURFACES ON INDOOR AND OUTDOOR UNITS SHALL BE CLEANED WITH A DEGREASING 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 EACTORY COATED			<ul> <li>WITH ONLY ONE DC LINK CHOKE SHALL ADD AN AC LINE CHO INTEGRAL TO THE DRIVE ENCLOSURE.</li> <li>.9 THE DRIVE SHALL HAVE COOLING FANS THAT ARE DESIGNED FOR FIELD REPLACEMENT. THE PRIMARY COOLING FAN SHALL</li> </ul>
	.2 .3	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. ALL WALLS, ROOFS, AND FLOORS SHALL BE OF FORMED CONSTRUCTION			INCREASED LONGEVITY AND LOWER NOISE LEVELS. DRIVES WHOSE PRIMARY COOLING FANS ARE NOT VARIABLE SPEED SHA INCLUDE A SPARE COOLING FAN. .10 THE OVERLOAD RATING OF THE DRIVE SHALL BE 110% OF ITS
		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.			NORMAL DUTY CURRENT RATING FOR 1 MINUTE 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
	.4 .5	PROVIDED A 22 GA (.85 MM) SOLID METAL LINER OVER INSULATED AREAS. UNITS SHALL BE PROVIDED WITH ACCESS DOORS TO THE FOLLOWING COMPONENTS: FANS, MOTORS, FILTERS, DAMPERS AND OPERATORS, ACCESS PLENUMS, HUMIDIFIERS/WET CELLS, ELECTRICAL CONTROL PANELS AND BURNER/COMPRESSOR COMPARTMENTS ACCESS DOORS SHALL BE AS			GREATER THAN THE OUTPUT CURRENT RATING. .12 CIRCUIT BOARDS SHALL BE COATED PER IEC 60721-3-3, CHEMICAL GASSES CLASS 3C2 AND SOLID PARTICLES CLASS 3C2 .13 EARTH (GROUND) FAULT DETECTION SHALL FUNCTION IN BOTH MODULATING (RUNNING) AND NON-MODULATING MODES
	.6	LARGE AS PRACTICAL FOR EASY ACCESS. SCREWED WALL PANEL ACCESS WILL NOT BE ACCEPTABLE FOR THE ABOVE LISTED COMPONENTS. UNITS SHALL BE PROVIDED WITH HINGED ACCESS DOORS WITH E-PROFILE GASKET, FULLY LINED, AND A MINIMUM OF TWO LEVER HANDLES.			.14 COORDINATED AC TRANSIENT SURGE PROTECTION SYSTEM CONSISTING OF 4 MOVS (PHASE-TO-PHASE AND PHASE-TO-GROUND), A CAPACITOR CLAMP, AND INTERNAL CHOKES. THE MOVS SHALL COMPLY WITH UL 1449 4TH/
	. <i>1</i> .8	1/2 LB./ FT.3/ (24 KG/M3/) DENSITY COATED WITH 2 (51 MM) THICK, 1 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 FNDS SHALL BE			EDITION. DRIVES THAT DO NOT INCLUDE COORDINATED AC TRANSIENT SURGE PROTECTION SHALL INCLUDE AN EXTERNAL TVSS/SPD (TRANSIENT VOLTAGE SURGE SUPPRESSOR/SURGE PROTECTION DEVICE). .15 THE DRIVE SHALL INCLUDE A ROBUST DC BUS TO PROVIDE
	.9	COVERED BY A SHEET METAL BREAK TO PREVENT DETERIORATION OF EXPOSED EDGES. DRAIN PANS AND ALL FLOOR AREAS SHALL BE INSULATED ON THE UNDERSIDE. COOLING COIL DRAIN PANS SHALL BE FABRICATED OF 304 STAINLESS STEEL AND ARE AN INTEGRAL PART OF THE FLOOR PANELING A MINIMUM			SHORT TERM POWER-LOSS RIDE THROUGH. THE DC BUS JOU TO DRIVE KVA RATIO SHALL BE 4.5 J/KVA OR HIGHER. AN INERTIA-BASED RIDE THROUGH FUNCTION SHOULD HELP MAINTA THE DC BUS VOLTAGE DURING POWER LOSS EVENTS. DRIVES WITH CONTROL POWER PIPE THROUGH ONLY ARE NOT
		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 A 1 $\frac{1}{2}$ " (38 MM) S.S. M.P.T. DRAIN CONNECTION. ALL COOLING COIL DRAIN PANS SHALL HAVE A FAST PAN AND BE SLOPED AND			ACCEPTABLE. .16 ALL DRIVES SHALL HAVE THE FOLLOWING SOFTWARE FEATURES AS STANDARD: .17 A FAULT LOGGER THAT STORES THE LAST 16 FAULTS IN
		PITCHED SUCH THAT THERE IS NO STANDING WATER. INTERMEDIATE DRAIN PANS SHALL BE PROVIDED WHERE REQUIRED FOR EFFECTIVE MOISTURE			NON-VOLATILE MEMORY. THE MOST RECENT 5 FAULTS SAVE A LEAST 9 DATA POINTS INCLUDING BUT NOT LIMITED TO:

REMOVAL.

#### HVAC SPECIFICATIONS HVAC SPECIFICATIONS STATUS, TEMPERATURE, AND STATUS WORDS. THE DATE AND TIME OF EACH FAULT AND FAULT RESET ATTEMPT SHALL BE STORED IN THE FAULT LOGGER. .18 AN EVENT LOGGER THAT STORES THE LAST 16 WARNINGS OR EVENTS THAT OCCURRED IN NON-VOLATILE MEMORY. EVENTS SHALL INCLUDE. BUT NOT LIMITED TO: WARNING MESSAGES. CHECKSUM MISMATCH, RUN PERMISSIVE OPEN, START INTERLOCH OPEN, AND AUTOMATIC RESET OF A FAULT. THE DATE AND TIM VARIATIONS IN BELT TENSION. OF EACH EVENT'S START AND COMPLETION POINTS SHALL BE STORED IN THE EVENT LOGGER. .19 PROGRAMMABLE START METHOD. START METHOD SHALL BE SELECTABLE BASED ON THE APPLICATION: FLYING-START, NORMAL-START, AND BRAKE-ON-START. .20 PROGRAMMABLE LOSS-OF-LOAD (BROKEN BELT / COUPLING) INDICATION. INDICATION SHALL BE SELECTABLE AS A CONTROL FABRIC TO METAL CONNECTION. PANEL WARNING, RELAY OUTPUT, OR OVER NETWORK COMMUNICATIONS. THIS FUNCTION TO INCLUDE A PROGRAMMABLE TIME DELAY TO ELIMINATE FALSE LOSS-OF-LOAD INDICATIONS .21 MOTOR HEATING FUNCTION TO PREVENT CONDENSATION BUILD U IN THE MOTOR. MOTOR HEATING ADJUSTMENT, VIA PARAMETER, SHALL BE IN "WATTS." HEATING FUNCTIONS BASED ONLY ON "PERCENT CURRENT" ARE NOT ACCEPTABLE.

- .22 ADVANCED POWER METERING ABILITIES SHALL BE INCLUDED IN THE DRIVE. DRIVES WITHOUT THESE DATA POINTS MUST INCLUDE A SEPARATE POWER METER WITH EACH DRIVE. INSTANTANEOUS OUTPUT POWER (KW)
- TOTAL POWER BROKEN DOWN BY KWH, MWH, AND GWH UNITS OF MEASUREMENT. POWER METERS THAT ONLY DISPLAY KWH AND ROLL OVER OR "MAX OUT" ONCE THE MAXIMUM KWH VALUE IS REACHED ARE NOT ACCEPTABLE THERE SHALL BE RESETTABLE AND NON-RESETTABLE TOTA POWER METERS WITHIN THE DRIVE .3 TIME BASED KWH METERING FOR: CURRENT HOUR,
- PREVIOUS HOUR, CURRENT DAY, AND PREVIOUS DAY. ENERGY SAVING CALCULATION SHALL BE INCLUDED THAT
- SHOWS THE ENERGY AND DOLLARS SAVED BY THE DRIVE. THAT WILL AUTOMATICALLY REDUCE APPLIED MOTOR VOLTAGE TO THE MOTOR TO OPTIMIZE ENERGY CONSUMPTION AND REDUCE AUDIBLE MOTOR NOISE.
- .24 EXTERNAL FAULT CIRCUIT THREE SEPARATE EXTERNAL FAULT INPUTS SHALL BE PROVIDED. THIS CIRCUIT SHALL HAVE THE SAME FEATURES AND FUNCTIONALITY AS THE START INTERLOCK CIRCUIT EXCEPT IT SHALL REQUIRE A MANUAL RESET BEFORE THE DRIVE IS ALLOWED TO OPERATE THE MOTOR.
- .25 THE DRIVE SHALL INCLUDE A SWITCHING FREQUENCY CONTROL CIRCUIT THAT REDUCES THE SWITCHING FREQUENCY BASED ON ACTUAL DRIVE TEMPERATURE AND ALLOWS HIGHER SWITCHING FREQUENCY SETTINGS WITHOUT DERATING THE DRIVE. IT SHALL BE POSSIBLE TO SET A MINIMUM AND A TARGET SWITCHING FREQUENCY.
- .26 THE ABILITY TO AUTOMATICALLY RESTART AFTER AN OVER-CURRENT, OVER-VOLTAGE, UNDER-VOLTAGE. EXTERNAL FAULT. OR LOSS OF INPUT SIGNAL PROTECTIVE TRIP. THE NUMBER OF RESTART ATTEMPTS, TRIAL TIME, AND TIME BETWEEN ATTEMPTS SHALL BE PROGRAMMABLE. EACH OF THESE FAULTS MAY HAVE AUTOMATIC RESTART INDIVIDUALLY DISABLED VIA A PARAMETER SELECTION.
- .27 THREE (3) PROGRAMMABLE CRITICAL FREQUENCY LOCKOUT RANGES TO PREVENT THE DRIVE FROM OPERATING THE LOAD CONTINUOUSLY AT AN UNSTABLE SPEED/LOAD.
- .28 SEVEN (7) PROGRAMMABLE PRESET FREQUENCIES/SPEEDS .29 TWO INDEPENDENTLY ADJUSTABLE ACCEL AND DECEL RAMPS WIT 1 – 1800 SECONDS ADJUSTABLE TIME RAMPS. .30 AT LEAST 4 PARAMETER USER SETS THAT CAN BE SAVED TO
- THE PERMANENT MEMORY AND RECALLED USING A DIGITAL INPU TIMED FUNCTION, OR SUPERVISION FUNCTION. .31 DRIVE SHALL BE COMPATIBLE WITH AN ACCESSORY THAT ALLOWS THE CONTROL BOARD TO BE POWERED FROM AN EXTERNAL 24
- VDC/VAC SOURCE ALLOWING THE DRIVE CONTROL TO REMAIN POWERED BY A UPS DURING AN EXTENDED POWER OUTAGE. .32 THE DRIVE SHALL INCLUDE A FIREMAN'S OVERRIDE MODE. UPC RECEIPT OF A CONTACT CLOSURE FROM THE FIRE ALARM LIFE SAFETY SYSTEM, THE DRIVE SHALL OPERATE IN A DEDICATED OVERRIDE MODE DISTINCT AND SEPARATE FROM THE DRIVE'S
- NORMAL OPERATION MODE. THE FOLLOWING FEATURES WILL BE AVAILABLE IN THE DRIVE OVERRIDE FUNCTION: .1 THE OVERRIDE MODE SHALL BE SECURED BY PASSWORD T PREVENT CHANGES ONCE PROGRAMMED.
- .2 THE DRIVE SHALL IGNORE EXTERNAL INPUTS AND COMMANDS NOT DEFINED AS PART OF THE OVERRIDI FUNCTION
- OVERRIDE OPERATION MODE SHALL BE SELECTABLE .3 BETWEEN: SINGLE FREQUENCY, MULTIPLE FIXED
- FREQUENCIES, FOLLOW AN ANALOG INPUT SIGNAL, PID CONTROL, OR COME TO A FORCED STOP.
- .4 HIGH PRIORITY SAFETIES SHALL STOP THE DRIVE AND LOWER PRIORITY SAFETIES SHALL BE IGNORED IN OVERRIDE .5 DRIVE FAULTS SHALL BE DEFINED IN CRITICAL AND LOW
- PRIORITY GROUPS. CRITICAL FAULTS SHALL STOP THE DRIVE. LOW PRIORITY FAULTS SHALL BE RESET. RESET TRIALS AND TIMING SHALL BE PROGRAMMABLE. THE DRIVE SHALL BE CONFIGURABLE TO RECEIVE FROM
- TO 3 DISCRETE DIGITAL INPUT SIGNALS AND OPERATE AT UP TO THREE DISCRETE SPEEDS. .13 SECURITY FEATURES
- .1 THE DRIVE SHALL INCLUDE PASSWORD PROTECTION AGAINST PARAMETER CHANGES.
- .2 THERE SHALL BE MULTIPLE LEVELS OF PASSWORD PROTECTION INCLUDING: END USER, SERVICE, ADVANCED, AND OVERRIDE.
- .3 THE DRIVE SHALL SUPPORT A CUSTOMER GENERATED UNIQUE PASSWORD BETWEEN 0 AND 99,999,999.
- .4 THE DRIVE SHALL LOG AN EVENT WHENEVER THE DRIVE
- PASSWORD HAS BEEN ENTERED .5 THE DRIVE SHALL PROVIDE A SECURITY SELECTION THAT
- PREVENTS ANY "BACK DOOR" ENTRY. THIS SELECTION EVEN PREVENTS THE DRIVE MANUFACTURER FROM BEING ABLE TO
- BYPASS THE SECURITY OF THAT DRIVE .6 A SECURITY LEVEL SHALL BE AVAILABLE THAT PREVENTS THE DRIVE FROM BEING FLASHED WITH NEW FIRMWARE.
- .14 NETWORK COMMUNICATIONS .1 THE DRIVE SHALL HAVE AN EIA-485 PORT WITH REMOVABLE TERMINAL BLOCKS. THE ONBOARD PROTOCOLS SHALL BE BACNE MS/TP, MODBUS, AND JOHNSON CONTROLS N2. THE USE OF
- THIRD PARTY GATEWAYS ARE NOT ACCEPTABLE. .2 THE DRIVE SHALL HAVE THE ABILITY TO COMMUNICATE VIA TWO PROTOCOLS AT THE SAME TIME, ONE ONBOARD PROTOCOL, AND ONE OPTION CARD BASED PROTOCOL. ONCE INSTALLED, THE DRIVE SHALL AUTOMATICALLY RECOGNIZE ANY OPTIONAL COMMUNICATION CARDS WITHOUT THE NEED FOR ADDITIONAL
- PROGRAMMING. .3 THE DRIVE SHALL NOT REQUIRE A POWER CYCLE AFTER COMMUNICATION PARAMETERS HAVE BEEN UPDATED.
- .4 THE EMBEDDED BACNET CONNECTION SHALL BE A MS/TP INTERFACE. THE DRIVE SHALL BE BTL LISTED TO REVISION 14 OR LATER. USE OF NON-BTL LISTED DRIVES ARE NOT
- ACCEPTABLE .5 THE DRIVE SHALL BE CLASSIFIED AS AN APPLICATIONS SPECIFIC CONTROLLER (B\_ASC). THE INTERFACE SHALL SUPPORT ALL BIBBS DEFINED BY THE BACNET STANDARD PROFILE FOR A B-ASC INCLUDING, BUT NOT LIMITED TO .1 DATA SHARING: READ PROPERTY MULTIPLE-B, WRITE PROPERTY MULTIPLE\_B, COV-B
- DEVICE MANAGEMENT: TIME SYNCHRONIZATION-B OBJECT TYPE SUPPORT: MSV, LOOP
- .6 THE DRIVE'S RELAY OUTPUT STATUS, DIGITAL INPUT STATUS, ANALOG INPUT/OUTPUT VALUES, HAND-AUTO STATUS, WARNING, AND FAULT INFORMATION SHALL BE CAPABLE OF BEING MONITORED OVER THE NETWORK. THE DRIVE'S START/STOP COMMAND, SPEED REFERENCE COMMAND, RELAY OUTPUTS, AND ANALOG OUTPUTS SHALL BE CAPABLE OF BEING CONTROLLED OVER THE NETWORK. REMOTE DRIVE FAULT RESET SHALL BE
- POSSIBLE. .15 UNIT MOUNTED MANUAL VFD BYPASS SWITCH SHALL LOCK OUT VFD. FAN SHALL RUN ON MAXIMUM SET VOLUME. BYPASS SWITCH AND
- ALL INTERLOCK CONTACTS ARE FACTORY MOUNTED AND PRE-WIRED. .16 LOAD REACTORS SHALL BE PROVIDED FOR ALL 460 AND 575 VOLT APPLICATIONS.
- .17 DRIVE(S) SHALL BE FACTORY SUPPLIED AND INSTALLED IN A VENTILATED CABINET COMPLETE WITH EXTERNALLY WIRED BYPASS
- .18 MINIMUM AIR FLOW RATE OF 50% CFM ON MIXED AIR DX COOLING, GAS FIRED HEAT EXCHANGERS, AND ELECTRIC HEAT SYSTEMS. .19 PROVIDE VARIABLE AIR VOLUME FAN CONTROL FOR UNITS WITH INLET VANE ASSEMBLIES MOUNTED ON FAN INLETS COMPLETE WITH FULLY MODULATING ELECTRIC VANE OPERATOR(S). A STATIC PRESSURE

SENSOR FOR FIELD MOUNTING AND WIRING BY CONTRACTOR AT A

- REPRESENTATIVE LOCATION IN SUPPLY AIR DUCT SHALL BE SUPPLIED. VANES TO BE LIMITED TO 35% CFM OF AIR FLOW RATE WHEN APPLIED TO DIRECT EXPANSION COOLING SYSTEMS, GAS FIRED HEAT
- EXCHANGERS, AND ELECTRIC HEAT COILS. MOTOR, FAN BEARINGS, AND DRIVE SHEAVES ASSEMBLY SHALL BE LOCATED INSIDE THE FAN PLENUM TO MINIMIZE BEARING WEAR AND TO ALLOW FOR INTERNAL VIBRATION ISOLATION OF THE FAN-MOTOR ASSEMBLY WHERE
- REQUIRED. MOTOR MOUNTING SHALL BE ADJUSTABLE TO ALLOW FOR .9 FAN-MOTOR ASSEMBLIES SHALL BE PROVIDED WITH VIBRATION ISOLATORS. ISOLATORS SHALL BE BOLTED TO STEEL CHANNEL WELDED TO UNIT FLOOP THAT IS WELDED TO THE STRUCTURAL FRAME OF THE UNIT. USE OF SEPARATE BUMPERS OR SNUBBERS ARE NOT ACCEPTABLE. FANS SHALL BE ATTACHED TO THE DISCHARGE PANEL BY A POLYVINYL CHLORIDE
- COATED POLYESTER WOVEN FABRIC WITH A SEALED DOUBLE LOCKING .10 BACKWARD INCLINED FANS WITH AIRFOIL OR FLAT BLADE DESIGN SHALL INCORPORATE VERTICAL SPRING ISOLATORS WITH LEVELING BOLTS AND
- BRIDGE BEARING WAFFLED PADS WITH MINIMUM 1" (25 MM STATIC DEFLECTION DESIGNED TO ACHIEVE HIGH ISOLATION FEEICIENCY. .11 PLENUM FANS SHALL INCORPORATE VERTICAL SPRING ISOLATORS WITH LEVELING BOLTS AND BRIDGE BEARING WAFFLED PADS WITH MINIMUM 1' (25 MM) STATIC DEFLECTION DESIGNED TO ACHIEVE HIGH ISOLATION EFFICIENCY. THRUST RESTRAINTS SHALL BE PROVIDED TO MINIMIZE AXIAL MOVEMENT OF THE FAN ASSEMBLY.
- .12 PROVIDE SINGLE EXTENDED GREASE LINE FROM FAR SIDE TO ACCESS SIDE BEARING .13 FAN MOTORS SHALL BE ODP (OPEN DRIP PROOF) HIGH EFFICIENCY TYPE.
- COILS .1 COILS SHALL BE CONSTRUCTED OF COPPER TUBE, ALUMINUM FIN, AND COPPER HEADERS WITH SWEAT CONNECTORS FINS CONSTRUCTED OF ALUMINUM OR COPPER SHALL BE CORRUGATED FOR MAXIMUM HEAT TRANSFER AND SHALL BE MECHANICALLY BONDED TO THE TUBES BY MECHANICAL EXPANSION OF THE TUBES. THE COILS SHALL HAVE A GALVANIZED STEEL CASING. ALL HYDRONIC AND DX REFRIGERAN COILS SHALL BE FACTORY TESTED WITH AIR AT 300 PSIG (2068 KPA) WHILE IMMERSED IN AN ILLUMINATED WATER TANK. ALL CONDENSER
- REFRIGERANT COILS SHALL BE FACTORY TESTED WITH AIR AT 650 PSIG (4482 KPA) WHILE IMMERSED IN AN ILLUMINATED WATER TANK HEADERS SHALL BE OUTSIDE THE AIR-HANDLING UNIT FOR MAXIMUM SERVICEABILITY EXCEPT FOR BLOW THROUGH APPLICATIONS WHERE HEADERS ARE INTERNAL. THE NON-HEADERED END OF THE COIL SHALL
- BE FULLY CONCEALED. COILS SHALL BE REMOVABLE FROM THE UNIT AT THE HEADER END UNLES SHOWN OTHERWISE ON THE DRAWINGS. ALL WATER COILS SHALL BE EQUIPPED WITH A CAPPED VENT TAPPING AT THE TOP OF THE RETURN HEADER OR CONNECTION AND A CAPPED DRAIN TAPPING AT THE BOTTOM OF THE SUPPLY HEADER OR CONNECTION.
- .5 DX REFRIGERANT COILS SHALL BE CIRCUITED TO PROVIDE ADEQUATE TUBE VELOCITIES TO MEET DESIGN REQUIREMENTS. INTERNAL TURBULATORS ARE NOT ACCEPTABLE. REFRIGERANT EVAPORATOR TYPE COILS SHALL BE EQUIPPED WITH
- DISTRIBUTORS CONNECTED TO THE COIL BY COPPER TUBES. REFRIGERANT COILS WITH MULTIPLE COMPRESSORS SHALL BE ALTERNATE TUBE CIRCUITED IN ORDER TO DISTRIBUTE THE COOLING EFFECT OVER THE ENTIRE COIL FACE AT REDUCED LOAD CONDITIONS. E. GAS HEAT SECTION - INDIRECT HEAT
- GENERAL HEATING UNITS SHALL BE INDIRECT NATURAL GAS FIRED APPROVED FOR BOTH SEA LEVEL AND HIGH ALTITUDE ELEVATIONS. THE ENTIRE PACKAGE INCLUDING DAMPER CONTROLS, FAN CONTROLS, AND ALL OTHER MISCELLANFOUS CONTROLS AND ACCESSORIES SHALL BE PRE-WIRED AND FACTORY CERTIFIED BY AN APPROVED TESTING AGENCY SUCH AS ETL, UL, OR CSA FOR THE DESTINATION.
- OPERATING NATURAL GAS PRESSURE AT UNIT(S) SHALL BE 7"WC .2 (1750 PA)INSTALLATION AND VENTING PROVISIONS MUST BE IN ACCORDANCE .3
- WITH INSTALLATION CODE CAN/CSA B149.1, ANSI Z223.1-NFPA54 AND THE REQUIREMENTS OF THE LOCAL AUTHORITIES HAVING JURISDICTION. .2 HEAT EXCHANGER/BURNER ASSEMBLY
- HEAT EXCHANGER SHALL BE A PRIMARY DRUM AND MULTI-TUBE SECONDARY ASSEMBLY CONSTRUCTED OF TITANIUM STAINLESS STEEL WITH MULTI-PLANE METAL TURBULATORS AND SHALL BE OF A FLOATING STRESS RELIFE DESIGN HEAT EXCHANGER SHALL BE PROVIDED WITH CONDENSATE DRAIN CONNECTION. THE HEAT EXCHANGER CASING SHALL HAVE 1" (25 MM) OF INSULATION BETWEEN THE OUTER CABINET AND INNER HEAT REFLECTIVE SATIN COAT GALVANIZED STEEL LINER. BLOWER LOCATION SHALL BE ENGINEERED TO OPTIMIZE THE REQUIRED AIR FLOW PATTERN AROUND THE HEAT EXCHANGER. DUCT TYPE FURNACES WITH CLOSED COUPLED BLOWERS ARE NOT ACCEPTABLE.
- HIGH FEFICIENCY HEAT FYCHANGERS AND CERTIFIED TO THE NATIONAL ENERGY CODE OF CANADA AND LOCAL AUTHORITIES HAVING JURISDICTION. A MINIMUM OF 80% EFFICIENCY SHALL BE PROVIDED THROUGHOUT THE ENTIRE OPERATING RANGE OF THE HEAT EXCHANGER. THE MANUFACTURER SHALL BE
- ROUTINELY ENGAGED IN THE MANUFACTURE OF THIS TYPE OF HIGH EFFICIENCY EQUIPMENT THE HEAT EXCHANGER/BURNER ASSEMBLY SHALL BE A BLOW THROUGH POSITIVE PRESSURE TYPE. UNITS INCORPORATING THE DJM MODULE SHALL HAVE AN INTERRUPTED PILOT IGNITION SYSTEM TO PROVIDE INCREASED SAFETY. UNITS USING CONTINUOUS OR
- INTERMITTENT PILOTS ARE NOT ACCEPTABLE. .4 FLAME SURVEILLANCE SHALL BE FROM THE MAIN FLAME AFTER IGNITION NOT THE PILOT FLAME. THE BURNER AND GAS TRAIN SHAL BE IN A CABINET ENCLOSURE. ATMOSPHERIC BURNERS OR BURNERS REQUIRING POWER ASSISTED VENTING ARE NOT ACCEPTABLE.
- OUTDOOR DJ UNIT PROVIDED WITH WEDGE STYLE VENT. .3 THE HEAT EXCHANGER/BURNER ASSEMBLY SHALL INCLUDE 15:1 TURNDOWN FOR ALL INPUT RANGES. THE HIGH TURN DOWN HEAT EXCHANGER/BURNER ASSEMBLY MINIMUM INPUT SHALL BE CAPABLE OF
- CONTROLLING DOWN TO 6.7% OF ITS RATED INPUT, EXCLUDING THE PILOT ASSEMBLY, WITHOUT ON/OFF CYCLING AND INCLUDE BUILT IN ELECTRONIC LINEARIZATION OF FUEL AND COMBUSTION AIR. EFFICIENCY SHALL INCREASE FROM HIGH TO LOW FIRE. .4 THE CENCON C/W J-XM MODULE (MODULATING FUEL AND COMBUSTION
- AIR) SHALL BE COMPLETE WITH PROPORTIONAL AND INTEGRAL CONTROL AND DISCHARGE AIR SENSOR TO MAINTAIN SET POINT TEMPERATURE AND PROVIDE RAPID RESPONSE TO INCREMENTAL CHANGES IN THE DISCHARGE AIR TEMPERATURE.
- THE CONTROLLER SHALL BE CERTIFIED BY ETL THE COMBUSTION AIR MOTOR SPEED SHALL VARY PROPORTIONALLY I RESPONSE TO THE MODULATION OF GAS FLOW TO PROVIDE OPTIMUM FUEL/AIR MIXTURE AND EFFICIENCY AT ALL CONDITIONS. THE COMBUSTION BLOWER RPM SHALL BE PROVED USING A HALL EFFECT SPEED SENSOR. EFFICIENCY OF THE HEAT EXCHANGER SHALL
- INCREASE AS THE FIRING RATE DECREASES. .3 THE CONTROLLER SHALL PROVIDE A PRE-PURGE AND POST PURGE CYCLE TO PROVIDE A MINIMUM OF FOUR AIR CHANGES FOR EACH
- PURGE CYCLE THROUGH THE HEAT EXCHANGER. .4 THE CONTROLLER SHALL PROVIDE A LOW FIRE START WITH
- CONTROLLED BURNER STARTUP AND SHUTDOWN TO ENSURE LONGEVITY OF THE EQUIPMENT, THE CONTROLLER SHALL .5 PROVIDE HEAT EXCHANGER COOLDOWN TIMING.
- .6 FOR MUA APPLICATIONS, THE BLOWER SHALL NOT START UNTIL AFTER THE BURNER PRE-PURGE AND WARMUP ARE COMPLETED IF THE AMBIENT TEMPERATURE IS MORE THAN 8°F (4.4°C) COOLER THAN THE SETPOINT AND AMBIENT IS BELOW 20°F (-7°C) .5 CONTROLLERS FOR HEATING ONLY UNITS TO INCORPORATE LOW LIMIT
- .6 DISCHARGE AIR SENSOR SHALL BE FIELD MOUNTED IN SUPPLY DUCTWORK BY INSTALLING CONTRACTOR. .7 ON MAKE-UP AIR UNITS, PROVIDE A REVERSE AIRFLOW HIGH LIMIT SWITCH IN SERIES WITH THE STANDARD HIGH LIMIT SWITCH MOUNTED IN THE BLOWER DISCHARGE.
- F. FILTERS .1 FILTER SECTIONS SHALL BE PROVIDED WITH ADEQUATELY SIZED ACCESS DOORS TO ALLOW EASY REMOVAL OF FILTERS. FILTER REMOVAL SHALL BE FROM ONE SIDE OF THE UNIT AS NOTED ON THE DRAWINGS. .2 THE FILTERS SHALL BE DESIGNED TO SLIDE OUT OF THE UNIT. SIDE REMOVAL FILTERS SHALL SLIDE INTO A FORMED METAL TRACK SEALING
- AGAINST METAL SPACERS AT EACH END OF THE TRACK. .3 CARTRIDGE OR BAG FILTERS SHALL SLIDE INTO AN EXTRUDED ALUMINUM TRACK AGAINST A GASKETED SEALER STRIP. ASSOCIATED 2" (50 MM) PRE-FILTERS SHALL SLIDE INTO AN INTEGRAL TRACK IN THE ALUMINUM EXTRUSION.
- .4 (50 MM) EXTENDED MEDIA (PLEATED) DISPOSABLE FILTERS: FILTERS SHALL BE EXTENDED SURFACE PLEATED COMPLETE WITH 100% SYNTHETIC MEDIA THAT DOES NOT SUPPORT MICROBIAL GROWTH. FRAME SHALL BE / HIGH WET STRENGTH BEVERAGE BOARD WITH A CROSS MEMBER DESIGN THAT INCREASES FILTER RIGIDITY AND PREVENT BREACHING. FRAME SHAL BE RECYCLABLE. FILTERS SHALL HAVE AN EXPANDED METAL SUPPORT GRID BONDED TO THE AIR-EXITING SIDE OF THE FILTER TO MAINTAIN PLEAT UNIFORMITY AND PREVENT FLUTTERING. METAL SUPPORT GRID SHALL BE RECYCLABLE. THE FILTERS SHALL BE MERV 8 PER ASHRAE 52.2. AND RATED U.L. 900 CLASS II. A PERMANENT RE-USABLE METAL ENCLOSING FRAME SHALL BE PROVIDED FOR SIDE LOADED APPLICATIONS. .5 4" (100 MM) EXTENDED MEDIA (PLEATED) DISPOSABLE FILTERS: FILTERS

SHALL BE MINI\_PLEAT AIR FILTERS COMPLETE WITH 100% SYNTHETIC MEDIA

TIME/DATE, FREQUENCY, DC BUS VOLTAGE, MOTOR CURRENT, DI

## HVAC SPECIFICATIONS

THAT DOES NOT SUPPORT MICROBIAL GROWTH. FRAME SHALL BE CONSTRUCTED WITH HIGH\_IMPACT PLASTIC AND IMPERVIOUS TO MOISTURE AND HIGH HUMIDITY. MEDIA PACK SHALL BE ADHERED TO PLASTIC FRAME ON ALL SIDES TO PREVENT AIR BY\_PASS. FILTERS SHALL HAVE A HOT MELT BEAD SEPARATOR TO MAINTAIN PLEAT PACK STABILITY AND ENSURE CONSISTENT PLEAT SPACING FOR OPTIMUM AIR FLOW. THE FILTERS SHALL BE MERV 13 PER ASHRAE 52.2 AND RATED U.L. 900 CLASS II. A PERMANENT RE-USABLE METAL ENCLOSING FRAME SHALL BE PROVIDED FOR SIDE LOADED APPLICATIONS.

- DAMPERS DAMPERS SHALL BE EXTRUDED ALUMINUM, LOW LEAK, INSULATED BLADE TAMCO SERIES 9000. MIXING DAMPERS SHALL BE PARALLEL BLADE TYPE.
- TWO POSITION INLET DAMPERS SHALL BE PARALLEL BLADE TYPE. MECHANICAL COOLING COMPRESSORS SHALL BE HERMETIC SCROLL TYPE SET ON RESILIENT NEOPRENE MOUNTS. THE COMPRESSORS SHALL INCORPORATE AN INTERNAL OR EXTERNAL PRESSURE-LIMITING DEVICE TO PROTECT THE COMPRESSOR IN THE EVENT OF OVERPRESSURE. COMPRESSORS SHALL BI PROVIDED WITH A MEANS OF OVERLOAD PROTECTION. EXTERNAL CRANKCASE HEATERS SHALL BE LOCKED OUT DURING COMPRESSOR OPERATION.
- .2 PACKAGED AIR CONDITIONING UNITS .1 THE ENTIRE PACKAGE INCLUDING FAN CONTROLS. HEAD PRESSURE CONTROL. AND ALL OTHER MISCELLANEOUS CONTROLS AND ACCESSORIES SHALL BE PRE-WIRED AND FACTORY CERTIFIED BY AN APPROVED TESTING AGENCY SUCH AS ETL, UL, OR CSA FOR THE
  - DESTINATION. UNIT MUST CONFORM TO REGULATIONS SET OUT IN THE CANADIAN ENERGY EFFICIENCY ACT FOR LARGE AIR CONDITIONERS. PACKAGED UNITS SHALL BE TESTED TO CSA STANDARD C746-17 AND MUST BEAR AN EEV (ENERGY EFFICIENCY VERIFICATION) LABEL PROVIDED BY
  - .3 UNIT MUST CONFORM TO REGULATIONS SET OUT BY THE DEPARTMENT OF ENERGY FOR LARGE AIR CONDITIONERS. PACKAGED UNITS SHALL BE TESTED TO AHRI 340/360-2007 AND MUST BEAR AN EEV (ENERGY EFFICIENCY VERIFICATION) LABEL PROVIDED BY CSA.
  - .4 EQUIPMENT SHALL OPERATE DOWN TO 50°F (10°C) AMBIENT TEMPERATURE FOR MIXED AIR AND 58°F (14.4°C) AMBIENT TEMPERATURE FOR MAKE-UP-AIR APPLICATIONS. WHERE APPLICABLE. MULTIPLE REFRIGERATION CIRCUITS SHALL BE SEPARATE FROM EACH OTHER. REFRIGERATION CIRCUITS SHALL BE COMPLETE WITH TX VALVES, SIGHT GLASS, LIQUID LINE FILTER-DRIERS, AND SERVICE PORTS FITTED WITH SCHRADER FITTINGS. EQUIPMENT SHALL HAVE CONDENSERS DESIGNED FOR 15°F (8°C) LIQUID SUB-COOLING. THE COMPLETE PIPING SYSTEM SHALL BE PURGED AND PRESSURE TESTED WITH DRY NITROGEN. THEN TESTED AGAIN UNDER VACUUM. EACH SYSTEM SHALL BE FACTORY RUN AND ADJUSTED PRIOR TO SHIPMENT.
  - PACKAGED UNITS SHALL BE SUPPLIED WITH R-410A REFRIGERANT. CONTROLS FOR HERMETIC COMPRESSOR UNITS SHALL INCLUDE COMPRESSOR AND CONDENSER FAN MOTOR CONTACTORS, SUPPLY FAI CONTACTORS AND OVERLOAD PROTECTION, CONTROL CIRCUIT TRANSFORMER, COOLING RELAYS, AMBIENT COMPRESSOR LOCKOUT. ANTI\_SHORT\_CYCLE AND INTER\_STAGE TIMERS, AND AUTOMATIC RESET LOW PRESSURE CONTROLS. COMPRESSORS OVER 6 TONS (21 KW) SHALL BE COMPLETE WITH MANUAL RESET HIGH PRESSURE CONTRÓLS HEAD PRESSURE ACTUATED FAN CYCLING CONTROL SHALL BE PROVIDED ON ALL MULTIPLE CONDENSER FAN UNITS.
  - PROVIDE HOT GAS BYPASS ON THE LEAD COMPRESSOR TO PROVIDE FREEZE PROTECTION IN THE EVENT OF LOW LOADS. .8 MODULATING CONDENSER REHEAT COIL WITH STEPPER VALVE INFINITE MODULATING CONTROL TO EITHER INDEPENDENT CONDENSER REHEAT COIL OR AMBIENT CONDENSER. SYSTEM MUST INCLUDE RECEIVER(S).
  - SUB-COOLING CONDENSER CIRCUIT(S), AND CHECK VALVES. .9 COMPRESSORS SHALL BE LOCATED ON THE SIDE OF THE UNIT IN A SERVICE ENCLOSURE COMPLETE WITH HINGED ACCESS DOORS C/W LEVER HANDLES FOR EASE OF SERVICE. .10 MAKE-UP AIR AND VAV UNITS TO HAVE A MINIMUM OF THREE
- COMPRESSORS. .3 COOLING CONTROL
- .1 THE CENCON C/W C-XM MODULE SHALL BE COMPLETE WITH PROPORTIONAL AND INTEGRAL CONTROL WITH A DISCHARGE AIR SENSOR TO MAINTAIN SET POINT TEMPERATURE AND PROVIDE RAPID RESPONSE TO INCREMENTAL CHANGES IN DISCHARGE AIR TEMPERATURE. .1 THE CONTROLLER SHALL PROVIDE 3 STAGES OF MECHANICAL
- COOLING. MAXIMUM 6 STAGES FOR CENCON C/W C-XM MODULE.
- THE CONTROLLER SHALL HAVE BUILT-IN MINIMUM RUN TIME AND ANTI-CYCLE TIMERS.
- .3 MECHANICAL COOLING SHALL BE DISABLED BELOW A FIXED LOW AMBIENT TEMPERATURE SETPOINT.
- .4 COOLING ENABLE/DISABLE SHALL BE THROUGH CONTROLLER DEMAND
- WHEN CONTROLLER IS IN ECONOMIZER MODE, THE MECHANICAL COOLING SHALL BE DISABLED.
- .6 DEHUMIDIFICATION IS ENABLED THROUGH DIGITAL INPUT. FACTORY SUPPLIED CONTROLS/WIRING
- .1 PROVIDE A SYSTEM OF MOTOR CONTROL, INCLUDING ALL NECESSARY TERMINAL BLOCKS, MOTOR CONTACTORS, MOTOR OVERLOAD PROTECTION, GROUNDING LUGS, CONTROL TRANSFORMERS, AUXILIARY CONTACTORS, AND TERMINALS FOR THE CONNECTION OF EXTERNAL CONTROL DEVICES OR
- .2 GAS FIRED UNITS SHALL ALSO INCLUDE HIGH LIMIT AND COMBUSTION AIRFLOW SAFETIES.
- .3 FIRE ALARM CIRCUITS (WHERE REQUIRED) SHALL BE POWERED FROM A RELAY IN UNIT CIRCUITRY. .4 FACTORY INSTALLED AND WIRED NON-FUSED DISCONNECT SWITCH IN NEMA
- TYPE 3R WEATHERPROOF CONFIGURATION .5 CONTROLS SHALL BE HOUSED IN A CONTROL PANEL MOUNTED IN OR ON THE UNIT THAT WILL MEET THE STANDARD OF THE SPECIFIC INSTALLATION. .6 PROVIDE A DISCHARGE AIR LOW LIMIT EQUIPPED WITH AN AUTOMATIC BY-PASS TIME DELAY TO ALLOW FOR COLD WEATHER START-UP. ON A HEATING SYSTEM FAILURE, THIS DEVICE WILL SHUT DOWN THE FAN AND
- CLOSE THE OUTDOOR AIR DAMPER. .7 CENCON THE CONTROLLER SHALL BE ETL AND BTL CERTIFIED. .2 A GRAPHIC OLED DISPLAY MODULE SHALL PROVIDE TEMPERATURES
  - AND STATUS OF THE EQUIPMENT. .3 THE CONTROLLER SHALL HAVE A 9-BUTTON KEYPAD FOR NAVIGATION OF SCREENS.
  - .4 THE CONTROLLER SHALL HAVE A COMPUTER CONNECTION DIAGNOSTICS VIA ETHERNET COMPLETE WITH WEB BASED INTERFACE. .5 THE CONTROLLER SHALL HAVE 4 DISTINCT MODES (HEATING,
  - ECONOMIZER, VENTILATION AND COOLING). EACH MODE CHANGE IS DETERMINED BY THE DEMAND OF THE SYSTEM.
  - MINIMUM OPERATING AMBIENT TEMPERATURE SHALL BE -40°F (-40°C) .7 THE CONTROLLER SHALL PROVIDE CONTINUOUS AMBIENT TEMPERATURE
  - .8 SELF-CHECK ON START-UP SHALL BE PROVIDED TO ENSURE AIR PROVING AND ALL SENSORS ARE OPERATING WITHIN DESIGN TOLERANCES.
  - .9 BLOWER DELAY FUNCTIONALITY SHALL BE PROVIDED TO ENSURE DAMPER(S) ARE OPEN BEFORE BLOWER STARTS .1 A DAMPER END SWITCH SHALL BE PROVIDED. CONTROLLER SHALL HAVE AN INPUT FOR EXTERNAL DAMPER END SWITCH
  - CONTACT THAT ENABLES THE FAN TO START ONCE DAMPER CONTACT IS CLOSED (INTERNAL TIME DELAYS ARE BYPASSED) .10 THE CONTROLLER SHALL HAVE NON-RECYCLING AUTO BY-PASS LOW
  - LIMIT WITH ALARM CONTACTS. .11 BUILT-IN ALTERNATE BLOWER AND DAMPER FUNCTIONS FOR UNOCCUPIED HEATING MODE OPERATION USING A ROOM THERMOSTAT
- SHALL BE INTERMITTENT BLOWER OPERATION FOR UNOCCUPIED MODE. .12 TEMPERATURE CONTROL SHALL BE DISCHARGE AIR C/W 0-10VDC RESET J. HRW TOTAL ENERGY WHEEL (RTU-1)
- .1 TOTAL ENERGY WHEEL CERTIFICATION
- .1 PROVIDE AN ARI CERTIFIED (SIZES AEW10-1200 TO AEW10-3500) RECOVERY AIR TOTAL ENERGY WHEEL. THE PERFORMANCE OF THE TOTAL ENERGY WHEEL SHALL BE CERTIFIED TO THE ARI AIR-TO-AIR ENERGY RECOVERY VENTILATION EQUIPMENT CERTIFICATION PROGRAM IN ACCORDANCE WITH ARI STANDARD 1060-2001. THE EFFECTIVENESS

## 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

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AS NOTED

DRAWN C.M. / J.L.

DATE: SEPTEMBER 2023

PROJECT #:

ALL-23010629-A0 DRAWING #:

HVAC	SPECIFICATIONS	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 (2018) ASTM E84.		SHALL BE CAULKED WITH A WATER RESISTANT SEALANT. THE ROOF JOINT SHALL BE TURNED UP 2" (51 MM) WITH THREE BREAK INTERLOCKING DESIGN AND THE OUTER WALL PANELS SHALL EXTEND A MINIMUM OF ½" ( MM) BELOW THE FLOOR PANEL.
.2	HEAT TRANSFER MEDIA .1 THE TOTAL ENERGY WHEEL SHALL BE CONSTRUCTED OF SHEET ALUMINIUM WITH ALTERNATE LAYERS CORRUGATED AND WITH ADJACENT LAYERS GLUED TO EACH OTHER FOR STABILITY. TWO PLY LUBRICATED POLYESTER/COTTON THREAD C/W A TENSILE STRENGTH OF 4.35 LBS (1.98 KG) WITH A TYPE "Z" TWIST DIRECTION SHALL BE GLUED TO THE SHEET ALUMINIUM FOR ADDITIONAL STRENGTH. THE SHEET ALUMINIUM	C. FAN: .1	S CENTRIFUGAL FANS SHALL BE RATED IN ACCORDANCE WITH AMCA STANDARD TEST CODE _ BULLETIN 210. FAN MANUFACTURER SHALL BE MEMBER OF AMCA. ALL FANS AND FAN ASSEMBLIES SHALL BE DYNAMICALLY BALANCED DURING FACTORY TEST RUN. 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
	SHALL BE TENSION WOUND ONTO A CENTRAL HUB. ALL ALUMINIUM SURFACES SHALL BE COATED WITH A "ZEOLITE" 4Å MOLECULAR SIEVE COATING TO PROVIDE WATER VAPOUR TRANSFER FROM ONE AIR	.2	COATING. BACKWARD INCLINED FANS WITH AIRFOIL OR FLAT BLADE DESIGN SHALL BE EQUIPPED WITH GREASEABLE SELF-ALIGNING BALL OR ROLLER TYPE PILLO
	STREAM TO THE OTHER. 2 WHERE LATENT HEAT TRANSFER IS NOT REQUIRED, A RECOVERY AIR SENSIBLE WHEEL SHALL BE CONSTRUCTED OF SHEET ALUMINIUM WITH ALTERNATE LAYERS CORRUGATED AND WITH ADJACENT LAYERS GLUED TO EACH OTHER FOR STABILITY. TWO PLY LUBRICATED POLYESTER/COTTON THREAD C/W A TENSILE STRENGTH OF 4.35 LBS	.3	BLOCK BEARINGS. FANS SHALL BE BELT DRIVEN PLENUM TYPE CONFIGURATION WHERE NOTED IN SCHEDULES. THRUST RESTRAINT ISOLATORS SHALL BE PROVIDED PARALLEL TO THE SHAFT CENTERLINE WHEN REQUIRED TO MINIMIZE AXIAL MOVEMENT AND BENDING MOVEMENTS OF THE BLOWER ASSEMBLY(S). DRIV SIDE BEARINGS ON PLENUM FANS SHALL BE ADAPTER STYLE TO ENSURE
	<ul> <li>(1.98 KG) WITH A TYPE "2" TWIST DIRECTION SHALL BE GLUED TO THE SHEET ALUMINIUM FOR ADDITIONAL STRENGTH. THE SHEET ALUMINIUM SHALL BE TENSION WOUND ONTO A CENTRAL HUB.</li> <li>.3 THE WHEEL SHALL BE CLEANABLE BY VACUUMING WITHOUT DAMAGE TO THE ALUMINIUM OR DESICCANT. ALTERNATE RECLAIM DEVICES SHALL MEET OR EXCEED THE PERFORMANCE NOTED IN THE</li> </ul>	.4	<ul> <li>PROVIDE INLET SCREEN &amp; OPEN WIRE MESH PROTECTIVE DISCHARGE SCREEN.</li> <li>FAN MOTOR SHEAVES SHALL BE ADJUSTABLE WITH MOTORS 7 1/2 HP (5. KW) AND SMALLER. ON FANS WITH LARGER MOTORS, FIXED DRIVES SHALL BE PROVIDED. ALL DRIVES SHALL BE PROVIDED WITH A RUST INHIBITING</li> </ul>
.3	SCHEDULES WITHOUT EXCEEDING THE FAN POWER REQUIREMENTS SPECIFIED. WHEEL STRUCTURE	.5	COATING. THE AIR BALANCER SHALL PROVIDE FOR DRIVE CHANGES (IF REQUIRED) DURING THE AIR BALANCE PROCEDURE. PROVIDE FULL SECTION RETURN AIR FAN(S) AS SCHEDULED. THE USE OF
	.1 WHEELS SHALL BE HELD SECURELY TOGETHER WITH METAL SPOKES EXTENDING RADIALLY FROM THE HUB TO THE PERIPHERAL BANDING. WHEELS OF 1800 MM DIAMETER AND SMALLER ARE PROVIDED IN ONE PIECE CONSTRUCTION. WHEELS OF 2100 MM AND 2400 MM DIAMETER SHALL BE CONSTRUCTED WITH FOUR REMOVABLE PIECES, AND 2700 MM TO 3500 MM WHEELS SHALL BE CONSTRUCTED WITH	.6 .7	POWER EXHAUST PROPELLER TYPE ARRANGEMENTS WILL NOT BE CONSIDERED. FAN AND MOTOR SHEAVES SHALL BE FACTORY INSTALLED, FAN BALANCED, AND TESTED PRIOR TO SHIPMENT. VARIABLE FREQUENCY DRIVES
.4	EIGHT REMOVABLE PIECES. WHEEL SUPPORT .1 THE WHEEL SHALL BE SUPPORTED BY TWO PILLOW BLOCK BEARINGS WHICH IN TURN ARE SUPPORTED BY A STEEL SUPPORT. THE BEARINGS SHALL BE LOCATED TO MAXIMIZE THE FREE AREA OF THE ROTOR AS MUCH AS POSSIBLE. THE BEARINGS SHALL BE		<ul> <li>WITH BOTH ASYNCHRONOUS AND PERMANENT MAGNET MOTORS SHALL BE PROVIDED.</li> <li>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 ONLY ONE OF MANY SOURCES</li> </ul>
.5	REPLACEABLE WITHOUT REMOVING THE WHEEL FROM THE AIR HANDLING UNIT. WHEEL SEALS .1 WHEELS SHALL BE PROVIDED WITH NON-CONTACT ADJUSTABLE LABYRINTH SEALS AROUND THE PERIMETER OF THE WHEEL AND		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 THE DRIVE SCHEDULE HAS SPECIFIED PROPER HARMONIC MITIGATION FOR THE DRIVES. DRIVES SHALL BE ULLABELED AS A COMPLETE ASSEMBLY
.6	ACROSS THE FACE AT THE DIVISION BETWEEN THE SUPPLY AND EXHAUST SECTORS TO ELIMINATE DRAG, WEAR, AND ENSURE LONGEVITY. PURGE SYSTEM		.4 THE BASE DRIVE SHALL BE SEMI-F47 CERTIFIED. THE DRIVE 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
.7	THE UNIT SHALL BE PROVIDED WITH A PURGE SYSTEM TO ALLOW A PERCENTAGE OF OUTDOOR AIR THROUGH THE EXHAUST AIR SECTOR TO REDUCE THE EXHAUST AIR ENTERING THE SUPPLY AIR STREAM. WHEEL DRIVE SYSTEM		.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
	THE WHEEL SHALL BE DRIVEN BY A CONTINUOUS V-BELT AROUND THE OUTER PERIMETER OF THE WHEEL CONNECTED TO AN INVERTER DRIVEN, THREE PHASE, AC MOTOR FOR VARIABLE SPEED APPLICATIONS. ACCESS TO THE MOTOR AND THE DRIVE SHALL BE EROM THE FACE OF THE WHEET		.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
.8	TEMPERATURE CONTROL 1 THE CENCON C/W ER-XM MODULE SHALL BE COMPLETE WITH PROPORTIONAL AND INTEGRAL CONTROL AND DISCHARGE AIR SENSOR TO MAINTAIN SET POINT TEMPERATURE AND PROVIDE RAPID RESPONSE TO INCREMENTAL CHANGES IN THE DISCHARGE AIR TEMPERATURE.		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 BATTERY BACKUP WITH 10 YEARS MINIMUM LIFE SPAN. DAYLIGHT
	<ul> <li>.2 THE CONTROLLER SHALL PROVIDE TEMPERATURE AND FROST CONTROL OPERATION C/W ACCURATE SUPPLY AIR TEMPERATURE CONTROL AND SUMMER/WINTER OPERATION.</li> <li>.2 ENERGY RECOVERY CONTROL FUNCTION SHALL BE INCORPORATED INTO THE CONTROL OF THE SYSTEM DISCHARGE AIR SETPOINT. THE</li> </ul>		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 UNIQUE BACKUP PARAMETER SETS TO BE STORED. BACKUP FILES SHALL INCLUDE A TIME AND DATE STAND. IN THE DISTU OF A DRIVE FAILURE THE CONTROL
	CONTROLLER SHALL UTILIZE THE HEAT RECOVERY DEVICE TO ITS FULL ABILITY PRIOR TO ENABLING ADDITIONAL HEATING OR COOLING DEVICES. .3 CONTROLLER SHALL PROVIDE FROST PREVENTION. .1 WHEN THE EXHAUST AIR TEMPERATURE DROPS BELOW THE EPOST TUPESHOLD THE CONTROLLED SETTOINT SHALL DE		DATE STAMP. IN THE EVENT OF A DRIVE FAILURE, THE CONTROL PANEL OF THE ORIGINAL DRIVE CAN BE INSTALLED ON THE REPLACEMENT DRIVE, AND PARAMETERS FROM THAT CONTROL PANEL CAN BE DOWNLOADED INTO THE REPLACEMENT DRIVE. .10 THE CONTROL PANEL SHALL BE REMOVABLE CAPABLE OF REMOTE MOUNTING.
	OVERRIDDEN TO MAINTAIN A SPECIFIC SETPOINT SHALL BE AIRSTREAM. THIS SETPOINT IS CALCULATED BASED ON THE DEWPOINT OF THE RETURN AIR TO ENSURE MAXIMUM HEAT RECOVERY IS MAINTAINED WHILE NOT ALLOWING FROST TO ACCUMULATE ON THE HEAT RECOVERY DEVICE.		<ul> <li>.11 THE CONTROL PANEL SHALL HAVE THE ABILITY TO STORE SCREEN SHOTS WHICH ARE DOWNLOADABLE VIA USB.</li> <li>.12 ALL DRIVES SHALL HAVE THE FOLLOWING HARDWARE FEATURES/CHARACTERISTICS AS STANDARD: <ul> <li>.1 TWO (2) PROGRAMMABLE ANALOG INPUTS SHALL ACCEPT</li> </ul> </li> </ul>
4 <u>ENE</u> A. GENI .1	RGY RECOVERY VENTILATOR (ERV-1) ERAL AIR HANDLING UNITS SHALL BE BUILT TO THE LEVEL OF QUALITY AS		CURRÈNT 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	SCHEDULE. 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.		.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	ALL EQUIPMENT SHALL WHERE SPECIFIED AND APPLICABLE, BE PRE-WIRED AND FACTORY CERTIFIED BY AN APPROVED TESTING AGENCY SUCH AS ETL, UL, OR CSA FOR THE DESTINATION. PRE-WIRED AIR HANDLING UNITS SHALL BEAR AN APPROVED LABEL WITH ALL THE NECESSARY IDENTIFICATION MARKS, ELECTRICAL DATA.		.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.
	ENERGY EFFICIENCY ACT FOR LARGE AIR CONDITIONERS. PACKAGED UNITS SHALL BE TESTED TO CSA STANDARD C746–98 AND MUST BEAR AN EEV (ENERGY EFFICIENCY VERIFICATION) LABEL PROVIDED BY CSA. .2 WHERE SPECIFIED AS FACTORY PACKAGED AIR CONDITIONING UNIT,		.4 THREE (S) PROGRAMMABLE FORM-C RELAY OUTPUTS. THE RELAY OUTPUTS SHALL INCLUDE PROGRAMMABLE ON/OFF 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 ADE NOT ACCEPTABLE DRIVES THAT HAVE LESS THAN
.4	FACTORY ASSEMBLED SPLIT SYSTEMS DO NOT CONFORM TO THE CANADIAN ENERGY EFFICIENCY ACT AND WILL NOT BE CONSIDERED. ALL ELECTRICAL CIRCUITS SHALL UNDERGO A DIELECTRIC STRENGTH TEST AND SHALL BE FACTORY TESTED AND CHECKED AS TO PROPER FUNCTION.		<ul> <li>(3) FORM-C RELAY OUTPUTS SHALL PROVIDE AN OPTION CARD TO PROVIDE ADDITIONAL RELAY OUTPUTS.</li> <li>5. DRIVE TERMINAL BLOCKS SHALL BE COLOR CODED FOR EASY IDENTIFICATION OF FUNCTION.</li> <li>6. THE DRIVE SHALL INCLUDE AN ISOLATED USB PORT FOR</li> </ul>
.5	THE AIR HANDLING UNITS AND MAJOR COMPONENTS SHALL BE PRODUCTS OF MANUFACTURERS REGULARLY ENGAGED IN THE PRODUCTION OF SUCH EQUIPMENT AND WITH A MINIMUM OF FIFTY (50) CONTINUOUS YEARS OF PROVEN PRODUCTION EXPERIENCE. AIR HANDLING LINITS SHALL BE INSTALLED BY CONTRACTOR AS SHOWN AND		INTERFACE BETWEEN THE DRIVE AND A LAPTOP. A NON-ISOLATED USB PORT IS NOT ACCEPTABLE. .7 AN AUXILIARY POWER SUPPLY RATED AT 24 VDC, 250 MA SHAL BE INCLUDED.
.unit .1	SCHEDULED ON THE DOCUMENTS. AIR HANDLING UNITS ARE PRE-ORDERED BY OWNER. SEE ARCHITECTURAL SPECIFICATION 01030 FOR FULL DETAILS. CONSTRUCTION UNIT CASING SHALL BE OF MINIMUM 18 GA (1.3 MM) SATIN COAT		.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 CHOKE SHALL ADD AN AC LINE CHOKI
2	GALVANIZED SHEET METAL. SURFACES ON INDOOR AND OUTDOOR UNITS SHALL BE CLEANED WITH A DEGREASING 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.		INTEGRAL TO THE DRIVE ENCLOSURE. .9 THE DRIVE SHALL HAVE COOLING FANS THAT ARE DESIGNED FOF FIELD REPLACEMENT. THE PRIMARY COOLING FAN SHALL OPERATE ONLY WHEN REQUIRED AND BE VARIABLE SPEED FOR INCREASED LONGEVITY AND LOWER NOISE LEVELS. DRIVES
.∠ .3	EXPOSED SURFACES WITH AN ASTM B117_11 SALT SPRAY RATING OF 500 HRS. ALL WALLS, ROOFS, AND FLOORS SHALL BE OF FORMED CONSTRUCTION WITH AT LEAST TWO BREAKS AT EACH JOINT. JOINTS SHALL BE SECURED		WHOSE PRIMARY COOLING FANS ARE NOT VARIABLE SPEED SHAL INCLUDE A SPARE COOLING FAN. .10 THE OVERLOAD RATING OF THE DRIVE SHALL BE 110% OF ITS NORMAL DUTY CURRENT RATING FOR 1 MINUTE EVERY 10 MINUTES 130% OVERLOAD FOR 2 SECONDS OF (ED. 10)
·	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.		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.
.4 .5	PROVIDED A 22 GA (.85 MM) SOLID METAL LINER OVER INSULATED AREAS. UNITS SHALL BE PROVIDED WITH ACCESS DOORS TO THE FOLLOWING COMPONENTS: FANS, MOTORS, FILTERS, DAMPERS AND OPERATORS, ACCESS PLENUMS, HUMIDIFIERS/WET CELLS, ELECTRICAL CONTROL PANELS AND		.12 CIRCUIT BOARDS SHALL BE COATED PER IEC 60721-3-3, CHEMICAL GASSES CLASS 3C2 AND SOLID PARTICLES CLASS 3S2 .13 EARTH (GROUND) FAULT DETECTION SHALL FUNCTION IN BOTH MODULATING (RUNNING) AND NON-MODULATING MODES.
.6	BURNER/COMPRESSOR COMPARTMENTS. ACCESS DOORS SHALL BE AS LARGE AS PRACTICAL FOR EASY ACCESS. SCREWED WALL PANEL ACCESS WILL NOT BE ACCEPTABLE FOR THE ABOVE LISTED COMPONENTS. UNITS SHALL BE PROVIDED WITH HINGED ACCESS DOORS WITH E-PROFILE		.14 COORDINATED AC TRANSIENT SURGE PROTECTION SYSTEM CONSISTING OF 4 MOVS (PHASE-TO-PHASE AND PHASE-TO-GROUND), A CAPACITOR CLAMP, AND INTERNAL CHOKES. THE MOVS SHALL COMPLY WITH HILL 1440. 4TH
.7 .8	GASKET, FULLY LINED, AND A MINIMUM OF TWO LEVER HANDLES. ALL UNITS SHALL BE INTERNALLY INSULATED WITH 2" (51 MM) THICK, 1 1/2 LB./ FT.3/ (24 KG/M3/) DENSITY COATED INSULATION. THE COATED INSULATION SHALL BE SECURED TO METAL PANELS WITH A		EDITION. DRIVES THAT DO NOT INCLUDE COORDINATED AC TRANSIENT SURGE PROTECTION SHALL INCLUDE AN EXTERNAL TVSS/SPD (TRANSIENT VOLTAGE SURGE SUPPRESSOR/SURGE
	FIRE RETARDANT ADHESIVE AND WELDED STEEL PINS AT 18" (450 MM) O/C. ALL LONGITUDINAL INSULATION JOINTS AND BUTT ENDS SHALL BE COVERED BY A SHEET METAL BREAK TO PREVENT DETERIORATION OF EXPOSED EDGES. DRAIN PANS AND ALL FLOOR AREAS SHALL BE INSULATED ON THE UNDERSIDE.		<ul> <li>PROTECTION DEVICE).</li> <li>.15 THE DRIVE SHALL INCLUDE A ROBUST DC BUS TO PROVIDE SHORT TERM POWER-LOSS RIDE THROUGH. THE DC BUS JOUL TO DRIVE KVA RATIO SHALL BE 4.5 J/KVA OR HIGHER. AN INERTIA-BASED RIDE THROUGH FUNCTION SHOULD HELP MAINTAIL THE DO DUE VIEW FUNCTION SHOULD HELP MAINTAIL</li> </ul>
.9	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		THE DC BUS VOLTAGE DURING POWER LOSS EVENTS. DRIVES WITH CONTROL POWER RIDE THROUGH ONLY ARE NOT ACCEPTABLE. .13 ALL DRIVES SHALL HAVE THE FOLLOWING SOFTWARE FEATURES AS STANDARD:
	PROVIDED WITH A 1 ½" (38 MM) S.S. 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.		.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 BUT NOT LIMITED TO: TIME/DATE, FREQUENCY, DC BUS VOLTAGE, MOTOR CURRENT, DI STATUS,
.10	OUTDOOR UNITS SHALL BE WEATHERPROOFED AND EQUIPPED FOR INSTALLATION OUTDOORS. UNITS SHALL BE FABRICATED TO PREVENT THE INFILTRATION OF RAIN AND SNOW: LOUVERS OR HOODS SHALL BE PROVIDED ON AIR INTAKES AND EXHAUST OPENINGS. RAIN GUTTERS OR DIVERTERS SHALL BE INSTALLED OVER ALL ACCESS DOORS. ALL JOINTS		ILMPERATURE, AND STATUS WORDS. THE DATE AND TIME OF EACH FAULT AND FAULT RESET ATTEMPT SHALL BE STORED IN THE FAULT LOGGER. .2 AN EVENT LOGGER THAT STORES THE LAST 16 WARNINGS OR EVENTS THAT OCCURRED IN NON-VOLATILE MEMORY. EVENTS SHALL INCLUDE

## 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. .3 PROGRAMMABLE START METHOD. START METHOD SHALL BE SELECTABLE BASED ON THE APPLICATION: FLYING-START,
- NORMAL-START, AND BRAKE-ON-START .4 PROGRAMMABLE LOSS-OF-LOAD (BROKEN BELT / COUPLING)
- INDICATION. INDICATION SHALL BE SELECTABLE AS A CONTROL PANEL WARNING, RELAY OUTPUT, OR OVER NETWORK COMMUNICATIONS. TH FUNCTION TO INCLUDE A PROGRAMMABLE TIME DELAY TO ELIMINATE FALSE LOSS-OF-LOAD INDICATIONS.
- .5 MOTOR HEATING FUNCTION TO PREVENT CONDENSATION BUILD UP IN THE MOTOR. MOTOR HEATING ADJUSTMENT, VIA PARAMETER, SHALL BE IN "WATTS." HEATING FUNCTIONS BASED ONLY ON "PERCENT
- CURRENT" ARE NOT ACCEPTABLE. .6 ADVANCED POWER METERING ABILITIES SHALL BE INCLUDED IN THE DRIVE. DRIVES WITHOUT THESE DATA POINTS MUST INCLUDE A SEPARATE POWER METER WITH EACH DRIVE
  - INSTANTANEOUS OUTPUT POWER (KW) TOTAL POWER BROKEN DOWN BY KWH, MWH, AND GWH UNITS OF MEASUREMENT. POWER METERS THAT ONLY DISPLAY KWH AND ROLL OVER OR "MAX OUT" ONCE THE MAXIMUM KWH VALUE IS REACHED ARE NOT ACCEPTABLE. THERE SHALL BE RESETTABLE AND NON-RESETTABLE TOTAL POWER METERS WITHIN THE DRIVE
  - TIME BASED KWH METERING FOR: CURRENT HOUR, PREVIOUS HOUR, CURRENT DAY, AND PREVIOUS DAY.
- ENERGY SAVING CALCULATION SHALL BE INCLUDED THAT SHOWS THE ENERGY AND DOLLARS SAVED BY THE DRIVE. .3 THE DRIVE SHALL INCLUDE A MOTOR FLUX OPTIMIZATION CIRCUIT THAT WILL AUTOMATICALLY REDUCE APPLIED MOTOR VOLTAGE TO THE MOTOR TO OPTIMIZE ENERGY CONSUMPTION AND REDUCE
- AUDIBLE MOTOR NOISE. .4 EXTERNAL FAULT CIRCUIT - THREE SEPARATE EXTERNAL FAULT INPUTS SHALL BE PROVIDED. THIS CIRCUIT SHALL HAVE THE SAME FEATURES AND FUNCTIONALITY AS THE START INTERLOCK CIRCUIT EXCEPT IT SHALL REQUIRE A MANUAL RESET BEFORE
- THE DRIVE IS ALLOWED TO OPERATE THE MOTOR. .5 THE DRIVE SHALL INCLUDE A SWITCHING FREQUENCY CONTROL CIRCUIT THAT REDUCES THE SWITCHING FREQUENCY BASED ON ACTUAL DRIVE TEMPERATURE AND ALLOWS HIGHER SWITCHING FREQUENCY SETTINGS WITHOUT DERATING THE DRIVE. IT SHALL BE POSSIBLE TO SET A MINIMUM AND A TARGET SWITCHING FREQUENCY.
- .6 THE ABILITY TO AUTOMATICALLY RESTART AFTER AN OVER-CURRENT, OVER-VOLTAGE, UNDER-VOLTAGE, EXTERNAL FAULT, OR LOSS OF INPUT SIGNAL PROTECTIVE TRIP. TH NUMBER OF RESTART ATTEMPTS, TRIAL TIME, AND TIME BETWEEN ATTEMPTS SHALL BE PROGRAMMABLE. EACH OF THESE FAULTS MAY HAVE AUTOMATIC RESTART INDIVIDUALLY DISABLED VIA A PARAMETER SELECTION.
- .7 THREE (3) PROGRAMMABLE CRITICAL FREQUENCY LOCKOUT RANGES TO PREVENT THE DRIVE FROM OPERATING THE LOAD CONTINUOUSLY AT AN UNSTABLE SPEED/LOAD.
- .8 SEVEN (7) PROGRAMMABLE PRESET FREQUENCIES/SPEEDS. .9 TWO INDEPENDENTLY ADJUSTABLE ACCEL AND DECEL RAMPS WIT 1 – 1800 SECONDS ADJUSTABLE TIME RAMPS. .10 AT LEAST 4 PARAMETER USER SETS THAT CAN BE SAVED TO
- THE PERMANENT MEMORY AND RECALLED USING A DIGITAL INPU TIMED FUNCTION, OR SUPERVISION FUNCTION. .11 DRIVE SHALL BE COMPATIBLE WITH AN ACCESSORY THAT ALLOWS
- THE CONTROL BOARD TO BE POWERED FROM AN EXTERNAL 24 VDC/VAC SOURCE ALLOWING THE DRIVE CONTROL TO REMAIN POWERED BY A UPS DURING AN EXTENDED POWER OUTAGE. .12 THE DRIVE SHALL INCLUDE A FIREMAN'S OVERRIDE MODE. UPC
- RECEIPT OF A CONTACT CLOSURE FROM THE FIRE ALARM LIFE SAFETY SYSTEM, THE DRIVE SHALL OPERATE IN A DEDICATED OVERRIDE MODE DISTINCT AND SEPARATE FROM THE DRIVE'S NORMAL OPERATION MODE. THE FOLLOWING FEATURES WILL BE AVAILABLE IN THE DRIVE OVERRIDE FUNCTION: THE OVERRIDE MODE SHALL BE SECURED BY PASSWORD
- PREVENT CHANGES ONCE PROGRAMMED. THE DRIVE SHALL IGNORE EXTERNAL INPUTS AND COMMANDS NOT DEFINED AS PART OF THE OVERRIDE
- FUNCTION. OVERRIDE OPERATION MODE SHALL BE SELECTABLE .3 BETWEEN: SINGLE FREQUENCY, MULTIPLE FIXED
- FREQUENCIES, FOLLOW AN ANALOG INPUT SIGNAL, PID CONTROL, OR COME TO A FORCED STOP. HIGH PRIORITY SAFETIES SHALL STOP THE DRIVE AND LOWER PRIORITY SAFETIES SHALL BE IGNORED IN OVERRID
- MODE DRIVE FAULTS SHALL BE DEFINED IN CRITICAL AND LOW .5 PRIORITY GROUPS. CRITICAL FAULTS SHALL STOP THE DRIVE. LOW PRIORITY FAULTS SHALL BE RESET. RESET
- TRIALS AND TIMING SHALL BE PROGRAMMABLE. THE DRIVE SHALL BE CONFIGURABLE TO RECEIVE FROM TO 3 DISCRETE DIGITAL INPUT SIGNALS AND OPERATE AT UP TO THREE DISCRETE SPEEDS.
- .14 SECURITY FEATURES .1 THE DRIVE SHALL INCLUDE PASSWORD PROTECTION AGAINST
- PARAMETER CHANGES. .2 THERE SHALL BE MULTIPLE LEVELS OF PASSWORD PROTECTION
- INCLUDING: END USER, SERVICE, ADVANCED, AND OVERRIDE. .3 THE DRIVE SHALL SUPPORT A CUSTOMER GENERATED UNIQUE PASSWORD BETWEEN 0 AND 99,999,999.
- .4 THE DRIVE SHALL LOG AN EVENT WHENEVER THE DRIVE PASSWORD HAS BEEN ENTERED.
- .5 THE DRIVE SHALL PROVIDE A SECURITY SELECTION THAT PREVENTS ANY "BACK DOOR" ENTRY. THIS SELECTION EVEN PREVENTS THE DRIVE MANUFACTURER FROM BEING ABLE TO
- BYPASS THE SECURITY OF THAT DRIVE .6 A SECURITY LEVEL SHALL BE AVAILABLE THAT PREVENTS THE DRIVE FROM BEING FLASHED WITH NEW FIRMWARE. .15 NETWORK COMMUNICATIONS
- .1 THE DRIVE SHALL HAVE AN EIA-485 PORT WITH REMOVABLE TERMINAL BLOCKS. THE USE OF THIRD PARTY GATEWAYS ARE NOT ACCEPTABLE.
- .2 THE DRIVE SHALL HAVE THE ABILITY TO COMMUNICATE VIA TWO PROTOCOLS AT THE SAME TIME, ONE ONBOARD PROTOCOL, AND ONE OPTION CARD BASED PROTOCOL. ONCE INSTALLED, THE DRIVE SHALL AUTOMATICALLY RECOGNIZE ANY OPTIONAL COMMUNICATION CARDS WITHOUT THE NEED FOR ADDITIONAL
- PROGRAMMING. .3 THE DRIVE SHALL NOT REQUIRE A POWER CYCLE AFTER
- COMMUNICATION PARAMETERS HAVE BEEN UPDATED. .4 THE EMBEDDED BACNET CONNECTION SHALL BE A MS/TP INTERFACE. THE DRIVE SHALL BE BTL LISTED TO REVISION 14
- OR LATER. USE OF NON-BTL LISTED DRIVES ARE NOT ACCEPTABLE.
- .5 THE DRIVE SHALL BE CLASSIFIED AS AN APPLICATIONS SPECIFIC CONTROLLER (B\_ASC). THE INTERFACE SHALL SUPPORT ALL BIBBS DEFINED BY THE BACNET STANDARD PROFILE FOR A B-ASC INCLUDING, BUT NOT LIMITED TO: DATA SHARING: READ PROPERTY MULTIPLE-B, WRITE
- PROPERTY MULTIPLE\_B. COV-B DEVICE MANAGEMENT: TIME SYNCHRONIZATION-B OBJECT TYPE SUPPORT: MSV, LOOP
- .6 THE DRIVE'S RELAY OUTPUT STATUS, DIGITAL INPUT STATUS, ANALOG INPUT/OUTPUT VALUES, HAND-AUTO STATUS, WARNING, AND FAULT INFORMATION SHALL BE CAPABLE OF BEING MONITORED OVER THE NETWORK. THE DRIVE'S START/STOP COMMAND, SPEED REFERENCE COMMAND, RELAY OUTPUTS, AND ANALOG OUTPUTS SHALL BE CAPABLE OF BEING CONTROLLED OVER THE NETWORK. REMOTE DRIVE FAULT RESET SHALL BE POSSIBLE.
- .16 UNIT MOUNTED MANUAL VFD BYPASS SWITCH SHALL LOCK OUT VFD. FAN SHALL RUN ON MAXIMUM SET VOLUME. BYPASS SWITCH AND ALL INTERLOCK CONTACTS ARE FACTORY MOUNTED AND PRE-WIRED. .17 LOAD REACTORS SHALL BE PROVIDED FOR ALL 460 AND 575 VOLT
- APPLICATIONS. .18 DRIVE(S) SHALL BE FACTORY SUPPLIED AND INSTALLED IN A VENTILATED CABINET COMPLETE WITH EXTERNALLY WIRED BYPASS
- SWITCH. .19 MINIMUM AIR FLOW RATE OF 50% CFM ON MIXED AIR DX COOLING,
- GAS FIRED HEAT EXCHANGERS, AND ELECTRIC HEAT SYSTEMS. PROVIDE VARIABLE AIR VOLUME FAN CONTROL FOR UNITS WITH IN FT VAN ASSEMBLIES MOUNTED ON FAN INLETS COMPLETE WITH FULLY MODULATING ELECTRIC VANE OPERATOR(S). A STATIC PRESSURE SENSOR FOR FIELD MOUNTING AND WIRING BY CONTRACTOR AT A REPRESENTATIVE LOCATION I SUPPLY AIR DUCT SHALL BE SUPPLIED. VANES TO BE LIMITED TO 35% CEM OF AIR FLOW RATE WHEN APPLIED TO DIRECT EXPANSION COOLING
- SYSTEMS. GAS FIRED HEAT EXCHANGERS, AND ELECTRIC HEAT COILS. MOTOR, FAN BEARINGS, AND DRIVE SHEAVES ASSEMBLY SHALL BE LOCATED INSIDE THE FAN PLENUM TO MINIMIZE BEARING WEAR AND TO ALLOW FOR INTERNAL VIBRATION ISOLATION OF THE FAN-MOTOR ASSEMBLY WHERE REQUIRED. MOTOR MOUNTING SHALL BE ADJUSTABLE TO ALLOW FOR VARIATIONS IN BELT TENSION.
- .10 FAN-MOTOR ASSEMBLIES SHALL BE PROVIDED WITH VIBRATION ISOLATORS.

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- ISOLATORS SHALL BE BOLTED TO STEEL CHANNEL WELDED TO UNIT FLOOR THAT IS WELDED TO THE STRUCTURAL FRAME OF THE UNIT. USE OF SEPARATE BUMPERS OR SNUBBERS 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 CONNECTION.
- .11 BACKWARD INCLINED FANS WITH AIRFOIL OR FLAT BLADE DESIGN SHALL INCORPORATE VERTICAL SPRING ISOLATORS WITH LEVELING BOLTS AND BRIDGE BEARING WAFFLED PADS WITH MINIMUM 1" (25 MM STATIC DEFLECTION DESIGNED TO ACHIEVE HIGH ISOLATION EFFICIENCY. .12 PLENUM FANS SHALL INCORPORATE VERTICAL SPRING ISOLATORS WITH
- LEVELING BOLTS AND BRIDGE BEARING WAFFLED PADS WITH MINIMUM 1' (25 MM) STATIC DEFLECTION DESIGNED TO ACHIEVE HIGH ISOLATION EFFICIENCY. THRUST RESTRAINTS SHALL BE PROVIDED TO MINIMIZE AXIAL MOVEMENT OF THE EAN ASSEMBLY
- .13 PROVIDE SINGLE EXTENDED GREASE LINE FROM FAR SIDE TO ACCESS SIDE BEARING .14 FAN MOTORS SHALL BE ODP (OPEN DRIP PROOF) HIGH EFFICIENCY TYPE.
- D. GAS HEAT SECTION INDIRECT FIRED GENERAL HEATING UNITS SHALL BE INDIRECT NATURAL GAS FIRED APPROVED FOR BOTH SEA LEVEL AND HIGH ALTITUDE ELEVATIONS. THE ENTIRE PACKAGE INCLUDING DAMPER CONTROLS, FAN CONTROLS, AND ALL
  - OTHER MISCELLANEOUS CONTROLS AND ACCESSORIES SHALL BE PRE-WIRED AND FACTORY CERTIFIED BY AN APPROVED TESTING AGENCY SUCH AS ETL, UL, OR CSA FOR THE DESTINATION. OPERATING NATURAL GAS PRESSURE AT UNIT(S) SHALL BE 7"WC
  - 1750 PA). INSTALLATION AND VENTING PROVISIONS MUST BE IN ACCORDANCE WITH INSTALLATION CODE CAN/CSA B149.1, ANSI Z223.1-NFPA54 AN
- THE REQUIREMENTS OF THE LOCAL AUTHORITIES HAVING JURISDICTION. HEAT EXCHANGER / BURNER ASSEMBLY HEAT EXCHANGER SHALL BE A PRIMARY DRUM AND MULTI-TUBE SECONDARY ASSEMBLY CONSTRUCTED OF TITANIUM STAINLESS STEEL WITH MULTI-PLANE METAL TURBULATORS AND SHALL BE OF A FLOATING STRESS RELIEF DESIGN. HEAT EXCHANGER SHALL BE PROVIDED WITH CONDENSATE DRAIN CONNECTION. THE HEAT EXCHANGER CASING SHALL HAVE 1" (25 MM) OF INSULATION BETWEEN THE OUTER CABINET AND INNER HEAT REFLECTIVE SATIN COAT GALVANIZED STEEL LINER. BLOWER LOCATION SHALL BE
- ENGINEERED TO OPTIMIZE THE REQUIRED AIR FLOW PATTERN AROUND HE HEAT EXCHANGER. DUCT TYPE FURNACES WITH CLOSED COUPLED BLOWERS ARE NOT ACCEPTABLE. UNITS WITH HIGH EFFICIENCY HEAT EXCHANGERS SHALL BE TESTED AND CERTIFIED TO THE NATIONAL ENERGY CODE OF CANADA AND LOCAL AUTHORITIES HAVING JURISDICTION. A MINIMUM OF 80%
- EFFICIENCY SHALL BE PROVIDED THROUGHOUT THE ENTIRE OPERATING RANGE OF THE HEAT EXCHANGER. THE MANUFACTURER SHALL BE ROUTINELY ENGAGED IN THE MANUFACTURE OF THIS TYPE OF HIGH EFFICIENCY EQUIPMENT. THE HEAT EXCHANGER/BURNER ASSEMBLY SHALL BE A BLOW
- THROUGH POSITIVE PRESSURE TYPE. UNITS INCORPORATING THE DJM MODULE SHALL HAVE AN INTERRUPTED PILOT IGNITION SYSTEM TO PROVIDE INCREASED SAFETY. UNITS USING CONTINUOUS OR INTERMITTENT PILOTS ARE NOT ACCEPTABLE
- FLAME SURVEILLANCE SHALL BE FROM THE MAIN FLAME AFTER IGNITION NOT THE PILOT FLAME. THE BURNER AND GAS TRAIN SHAL BE IN A CABINET ENCLOSURE. ATMOSPHERIC BURNERS OR BURNERS REQUIRING POWER ASSISTED VENTING ARE NOT ACCEPTABLE. OUTDOOR DJ UNIT PROVIDED WITH WEDGE STYLE VENT.
- .3 THE HEAT EXCHANGER/BURNER ASSEMBLY SHALL INCLUDE 15:1 TURNDOWN FOR ALL INPUT RANGES. THE HIGH TURN DOWN HEAT EXCHANGER/BURNER ASSEMBLY MINIMUM INPUT SHALL BE CAPABLE OF CONTROLLING DOWN TO 6.7% OF ITS RATED INPUT, EXCLUDING THE PILOT ASSEMBLY. WITHOUT ON/OFF CYCLING AND INCLUDE BUILT IN ELECTRONIC LINEARIZATION OF FUEL AND COMBUSTION AIR. EFFICIENCY SHALL
- INCREASE FROM HIGH TO LOW FIRE. .4 THE CENCON C/W J-XM MODULE (MODULATING FUEL AND COMBUSTION AIR) SHALL BE COMPLETE WITH PROPORTIONAL AND INTEGRAL CONTROL AND DISCHARGE AIR SENSOR TO MAINTAIN SET POINT TEMPERATURE AND PROVIDE RAPID RESPONSE TO INCREMENTAL CHANGES IN THE DISCHARGE
- AIR TEMPERATURE THE CONTROLLER SHALL BE CERTIFIED BY ETL THE COMBUSTION AIR MOTOR SPEED SHALL VARY PROPORTIONALLY I RESPONSE TO THE MODULATION OF GAS FLOW TO PROVIDE OPTIMUM FUEL/AIR MIXTURE AND EFFICIENCY AT ALL CONDITIONS. THE COMBUSTION BLOWER RPM SHALL BE PROVED USING A HALL EFFECT SPEED SENSOR. EFFICIENCY OF THE HEAT EXCHANGER SHALL
- INCREASE AS THE FIRING RATE DECREASES. THE CONTROLLER SHALL PROVIDE A PRE-PURGE AND POST PURGE .3 CYCLE TO PROVIDE A MINIMUM OF FOUR AIR CHANGES FOR EACH PURGE CYCLE THROUGH THE HEAT EXCHANGER.
- .4 THE CONTROLLER SHALL PROVIDE A LOW FIRE START WITH CONTROLLED BURNER STARTUP AND SHUTDOWN.
- TO ENSURE LONGEVITY OF THE EQUIPMENT, THE CONTROLLER SHALL PROVIDE HEAT EXCHANGER COOLDOWN TIMING.
- .6 FOR MUA APPLICATIONS, THE BLOWER SHALL NOT START UNTIL AFTER THE BURNER PRE-PURGE AND WARMUP ARE COMPLETED IF THE AMBIENT TEMPERATURE IS MORE THAN 8°F (4.4°C) COOLER THAN THE SETPOINT AND AMBIENT IS BELOW 20°F (-7°C)
- .5 CONTROLLERS FOR HEATING ONLY UNITS TO INCORPORATE LOW LIMIT FFATURE
- .6 DISCHARGE AIR SENSOR SHALL BE FIELD MOUNTED IN SUPPLY DUCTWORK BY INSTALLING CONTRACTOR. .7 ON MAKE-UP AIR UNITS, PROVIDE A REVERSE AIRFLOW HIGH LIMIT SWITCH IN SERIES WITH THE STANDARD HIGH LIMIT SWITCH MOUNTED IN THE
- BLOWER DISCHARGE E. FILTERS FILTER SECTIONS SHALL BE PROVIDED WITH ADEQUATELY SIZED ACCESS DOORS TO ALLOW EASY REMOVAL OF FILTERS. FILTER REMOVAL SHALL BE FROM ONE SIDE OF THE UNIT AS NOTED ON THE DRAWINGS.
- .2 THE FILTERS SHALL BE DESIGNED TO SLIDE OUT OF THE UNIT. SIDE REMOVAL FILTERS SHALL SLIDE INTO A FORMED METAL TRACK SEALING AGAINST METAL SPACERS AT EACH END OF THE TRACK. CARTRIDGE OR BAG FILTERS SHALL SLIDE INTO AN EXTRUDED ALUMINUM
- TRACK AGAINST A GASKETED SEALER STRIP. ASSOCIATED 2" (50 MM) PRE-FILTERS SHALL SLIDE INTO AN INTEGRAL TRACK IN THE ALUMINUM EXTRUSION. .4 (50 MM) EXTENDED MEDIA (PLEATED) DISPOSABLE FILTERS: FILTERS
- SHALL BE EXTENDED SURFACE PLEATED COMPLETE WITH 100% SYNTHETIC MEDIA THAT DOES NOT SUPPORT MICROBIAL GROWTH. FRAME SHALL BE HIGH WET STRENGTH BEVERAGE BOARD WITH A CROSS MEMBER DESIGN THAT INCREASES FILTER RIGIDITY AND PREVENT BREACHING. FRAME SHAL BE RECYCLABLE. FILTERS SHALL HAVE AN EXPANDED METAL SUPPORT GRID BONDED TO THE AIR-EXITING SIDE OF THE FILTER TO MAINTAIN PLEAT UNIFORMITY AND PREVENT FLUTTERING. METAL SUPPORT GRID SHALL BE RECYCLABLE. THE FILTERS SHALL BE MERV 8 PER ASHRAE
- 52.2. AND RATED U.L. 900 CLASS II. A PERMANENT RE-USABLE METAL ENCLOSING FRAME SHALL BE PROVIDED FOR SIDE LOADED APPLICATIONS. 4" (100 MM) EXTENDED MEDIA (PLEATED) DISPOSABLE FILTERS: FILTERS SHALL BE MÍNI\_PLEAT AIR FILTERS COMPLETE WITH 100% SYNTHETIC MEDIA THAT DOES NOT SUPPORT MICROBIAL GROWTH. FRAME SHALL BE CONSTRUCTED WITH HIGH\_IMPACT PLASTIC AND IMPERVIOUS TO MOISTURE AND HIGH HUMIDITY. MEDIA PACK SHALL BE ADHERED TO PLASTIC FRAME
- ON ALL SIDES TO PREVENT AIR BY PASS. FILTERS SHALL HAVE A HOT MELT BEAD SEPARATOR TO MAINTAIN PLEAT PACK STABILITY AND ENSURE CONSISTENT PLEAT SPACING FOR OPTIMUM AIR FLOW. THE FILTERS SHALL BE MERV 13 PER ASHRAE 52.2 AND RATED U.L. 900 CLASS II. A PERMANENT RE-USABLE METAL ENCLOSING FRAME SHALL BE PROVIDED FOR SIDE LOADED APPLICATIONS. .6 CARBON FILTERS:
- .1 AIR FILTERS SHALL BE HIGH PERFORMANCE 18" (440MM) MEDIUM DUTY DISPOSABLE PLASTIC V-CELL MODULES TO REMOVE ODORS C/W ACTIVATED CARBON. F. DAMPERS
- DAMPERS SHALL BE EXTRUDED ALUMINUM, LOW LEAK, INSULATED BLADE TAMCO SERIES 9000. MIXING DAMPERS SHALL BE PARALLEL BLADE TYPE
- TWO POSITION INLET DAMPERS SHALL BE PARALLEL BLADE TYPE. MAKEUP AIR INLET DAMPER CONTROL SHALL BE COMPLETE WITH A TWO POSITION, NORMALLY CLOSED ELECTRIC DAMPER OPERATOR. THIS DAMPER OPERATOR SHALL BE INTERLOCKED SO THAT WHEN THE UNIT IS SHUT DOWN, OR ON A POWER FAILURE, THE DAMPER SHALL RETURN TO THE CLOSED POSITION.
- .1 FOR BLOW THROUGH HEAT EXCHANGER MAKE-UP AIR APPLICATIONS (INDIRECT FIRED GAS FIRED UNITS), A FLOW COMPENSATOR DAMPER PACKAGE CONSISTING OF OPPOSED BLADE INLET AIR DAMPERS. THREE POSITION DAMPER OPERATOR, AND AMBIENT SETBACK THERMOSTAT TO COMPENSATE FOR AMBIENT TEMPERATURE VARIATIONS. G. FACTORY SUPPLIED WIRING/CONTROL
- PROVIDE A SYSTEM OF MOTOR CONTROL, INCLUDING ALL NECESSARY TERMINAL BLOCKS, MOTOR CONTACTORS, MOTOR OVERLOAD PROTECTION, GROUNDING LUGS, CONTROL TRANSFORMERS, AUXILIARY CONTACTORS, AND TERMINALS FOR THE CONNECTION OF EXTERNAL CONTROL DEVICES OR
- RELAYS. .2 GAS FIRED UNITS SHALL ALSO INCLUDE HIGH LIMIT AND COMBUSTION AIRFLOW SAFETIES.
- .3 FIRE ALARM CIRCUITS (WHERE REQUIRED) SHALL BE POWERED FROM A

## HVAC SPECIFICATIONS

- RELAY IN UNIT CIRCUITRY. .4 FACTORY INSTALLED AND WIRED NON-FUSED DISCONNECT SWITCH IN NEMA TYPE 3R WEATHERPROOF CONFIGURATION.
- CONTROLS SHALL BE HOUSED IN A CONTROL PANEL MOUNTED IN OR ON HE UNIT THAT WILL MEET THE STANDARD OF THE SPECIFIC INSTALLATION.
- PROVIDE A DISCHARGE AIR LOW LIMIT EQUIPPED WITH AN AUTOMATIC BY-PASS TIME DELAY TO ALLOW FOR COLD WEATHER START-UP. ON A HEATING SYSTEM FAILURE, THIS DEVICE WILL SHUT DOWN THE FAN AND CLOSE THE OUTDOOR AIR DAMPER.
- .7 CENCON
- THE CONTROLLER SHALL BE ETL AND BTL CERTIFIED. A GRAPHIC OLED DISPLAY MODULE SHALL PROVIDE TEMPERATURES
- AND STATUS OF THE EQUIPMENT. THE CONTROLLER SHALL HAVE A 9-BUTTON KEYPAD FOR NAVIGATION
- OF SCREENS. .4 THE CONTROLLER SHALL HAVE A COMPUTER CONNECTION DIAGNOSTICS VIA ETHERNET COMPLETE WITH WEB BASED INTERFACE.
- .5 THE CONTROLLER SHALL HAVE 4 DISTINCT MODES (HEATING, ECONOMIZER, VENTILATION AND COOLING). EACH MODE CHANGE IS
- DETERMINED BY THE DEMAND OF THE SYSTEM. MINIMUM OPERATING AMBIENT TEMPERATURE SHALL BE -40°F (-40°C) THE CONTROLLER SHALL PROVIDE CONTINUOUS AMBIENT TEMPERATURE
- SENSING SELF-CHECK ON START-UP SHALL BE PROVIDED TO ENSURE AIR
- PROVING AND ALL SENSORS ARE OPERATING WITHIN DESIGN TOLERANCES .9 BLOWER DELAY FUNCTIONALITY SHALL BE PROVIDED TO ENSURE
- DAMPER(S) ARE OPEN BEFORE BLOWER STARTS. .1 A DAMPER END SWITCH SHALL BE PROVIDED. CONTROLLER SHALL HAVE AN INPUT FOR EXTERNAL DAMPER END SWITCH CONTACT THAT ENABLES THE FAN TO START ONCE DAMPER
- CONTACT IS CLOSED (INTERNAL TIME DELAYS ARE BYPASSED) .10 THE CONTROLLER SHALL HAVE NON-RECYCLING AUTO BY-PASS LOW LIMIT WITH ALARM CONTACTS. .11 BUILT-IN ALTERNATE BLOWER AND DAMPER FUNCTIONS FOR
- UNOCCUPIED HEATING MODE OPERATION USING A ROOM THERMOSTAT SHALL BE INTERMITTENT BLOWER OPERATION FOR UNOCCUPIED MODE. TEMPERATURE CONTROL SHALL BE DISCHARGE AIR C/W 0-10VDC RESET
- H. TRP SERIES (HRA) PLATE TYPE AIR TO AIR HEAT EXCHANGER THE EXCHANGER SHALL BE FIXED PLATE TYPE.
- THE HEAT RECOVERY SECTION SHALL INCORPORATE THE TRP AIR TO AIR HEAT EXCHANGER CONSTRUCTED OF HIGH QUALITY 1100 ALLOY ALUMINUM WITH A STACKED RIBBED DESIGN. THE PLATE HEAT TRANSFER SURFACE THICKNESS SHALL BE 0.008" (0.2 MM) ALUMINUM. FRAME TUBING SHALL BE CONSTRUCTED OF 1" X 1" (25 MM X 25 MM) EXTRUDED ALUMINUM SQUARE TUBING WITH A 0.065" (1.7 MM) WALL THICKNESS AND CAST ALUMINUM FOR THE FRAME CORNERS. PROVIDE 0.032" (0.8 MM) THICK ALUMINUM OUTER CASING PANELS.
- THE HEAT EXCHANGER SHALL BE OF THE CROSS flow DESIGN AND SO CONSTRUCTED TO PREVENT ANY INTERMIXING OR CROSS CONTAMINATION OF THE SUPPLY AIR AND EXHAUST AIR STREAMS. ALL JOINTS SHALL BE SEALED WITH A SEALANT THAT IS RESISTANT TO HIGH AND LOW TEMPERATURES. THE STANDARD HEAT EXCHANGER SHALL BE SUITABLE FOR TEMPERATURES FROM -60°F TO 212°F (-51°C TO 1000/C). THE EFFICIENCY OF THE AIR TO AIR HEAT EXCHANGER SHALL BE AS SPECIFIED IN THE UNIT SCHEDULE. THE UNIT'S HEAT EXCHANGER SECTION SHALL BE COMPLETE WITH SOLID LINER.
- .4 PROVIDE HEAT EXCHANGER WITH INTEGRAL FACE AND BYPASS DAMPERS COMPLETE WITH CONTROLLER TO KEEP THE HEAT EXCHANGER EXHAUST AIR TEMPERATURE ABOVE 32°F (00/C). THE DAMPERS, CONTROLLER, AND DAMPER OPERATOR(S) SHALL BE FACTORY INSTALLED AND TESTED BY ENGINEERED AIR. .5 THE CENCON C/W ER-XM MODULE SHALL BE COMPLETE WITH
- PROPORTIONAL AND INTEGRAL CONTROL AND DISCHARGE AIR SENSOR TO MAINTAIN SET POINT TEMPERATURE AND PROVIDE RAPID RESPONSE TO INCREMENTAL CHANGES IN THE DISCHARGE AIR TEMPERATURE. THE CONTROLLER SHALL PROVIDE TEMPERATURE AND FROST CONTROL OPERATION C/W ACCURATE SUPPLY AIR TEMPERATURE CONTROL AND
- SUMMER/WINTER OPERATION. .2 ENERGY RECOVERY CONTROL FUNCTION SHALL BE INCORPORATED INTO THE CONTROL OF THE SYSTEM DISCHARGE AIR SETPOINT. THE CONTROLLER SHALL UTILIZE THE HEAT RECOVERY DEVICE TO ITS FULL ABILITY PRIOR TO ENABLING ADDITIONAL HEATING OR COOLING DEVICES.
- .3 CONTROLLER SHALL PROVIDE FROST PREVENTION. WHEN THE EXHAUST AIR TEMPERATURE DROPS BELOW THE FROST THRESHOLD, THE CONTROLLER SETPOINT SHALL BE OVERRIDDEN TO MAINTAIN A SPECIFIC SETPOINT IN THE EXHAUST AIRSTREAM. THIS SETPOINT IS CALCULATED BASED ON THE DEWPOINT OF THE RETURN AIR TO ENSURE MAXIMUM HEAT RECOVERY IS MAINTAINED WHILE NOT ALLOWING FROST TO ACCUMULATE ON THE HEAT RECOVERY DEVICES.

#### 9.5 UNIT VENTILATORS (UV-1, UV-2) A. GENERAL

- .1 THE CONTRACTOR SHALL INSTALL A VERTICAL CLASSROOM UNIT VENTILATOR WITH AN UP-FLOW DESIGN. AN EXTERIOR WALL-MOUNTED UNIT WILL NOT BE ACCEPTABLE. UNIT VENTILATORS ARE PRE-PURCHASED BY OWNER. REFER TO ARCHITECTURAL SPECIFICATION 01030 FOR FULL DETAILS. .2 INTERNAL DESIGN INCLUDING FRESH AIR INTAKE AND CONDENSING FAN RELIEF SHALL BE SUCH THAT ALL EXTERIOR WALL PENETRATIONS WILL BE
- ABOVE 35" FROM THE FINISHED FLOOR LEVEL. .3 UNIT SHALL BE ETL (OR EQUIVALENT) CERTIFIED AND LABELED INDICATING THAT THE EQUIPMENT HAS BEEN INDEPENDENTLY TESTED AND MEETS THE REQUIRED CURRENT APPLICABLE SAFETY STANDARDS, UL 1995 AND CAN/CSA 22.2 NO.236. FOR BOTH IN THE UNITED STATES AND CANADA. UNITS SHALL BE MANUFACTURED IN AN ISO 9001 REGISTERED FACILITY OR BY A COMPANY MANUFACTURING VENTILATION EQUIPMENT FOR AT LEAST 2
- .4 THE MANUFACTURER SHALL PROVIDE SOUND DATA IN ACCORDANCE TO AHR STANDARD 260 "SOUND RATING OF DUCTED AIR MOVING AND CONDITIONING EQUIPMENT". SOUND DATA MUST BE COLLECTED IN AN AMCA ACCREDITED REVERBERANT LABORATORY
- .5 SOUND RATINGS ARE TO BE IN THE FORM OF OCTAVE BAND SOUND POWER LEVELS (DB) FROM 63 TO 8000 HZ DERIVED FROM ONE-THIRD OCTAVE BAND MEASUREMENTS. SOUND DATA PROVIDED MUST MEET OR EXCEED MINIMUM REQUIREMENTS FOR USE WITHIN ANSI S12.60 CALCULATIONS CABINET CONSTRUCTION
- .1 CABINET CONSTRUCTION SHOULD BE SUCH THAT THE INTERNAL 16-GAUGE FRAME SUPPORTS ALL INTERNAL METAL PANS AND COMPONENTS. EXTERIOR PANELS SHOULD NOT SUPPORT ANY INTERNAL COMPONENTS. .2 THE OUTER CABINET DOORS AND SIDES WILL BE MADE OF 18-GAUGE STEEL AND CABINET PANELS SHALL ATTACH TO THE FRAME WITHOUT
- VISIBLE SCREWS, RIVETS OR FASTENERS. .3 THE CABINET FRONT SHALL INCORPORATE TWO FULLY INSULATED
- FULL-SIZED HINGED PANELS HELD CLOSED BY NO LESS THAN TWO TAMPER-RESISTANT CAM LOCKS IN EACH PANEL. FRONT DOORS SHALL ALLOW ACCESS TO ALL THE INTERNAL COMPONENTS. THE CABINET SHALL BE PAINTED WITH A POWDER COAT BAKED
- ENAMEL-TEXTURED FINISH TO AN APPLIANCE STANDARD. THE COLOR SHALL BE THE MANUFACTURER'S STANDARD SAND. C. INSULATION: .1 NON-FIBROUS INSULATION: CABINET PANELS SHALL BE
- THERMALLY/ACOUSTICALLY INSULATED WITH A MINIMUM 1" (2.54CM) THICK, FIBER-FREE, LOW DENSITY, FOAM INSULATION. IT SHALL OFFER HIGH SOUND ABSORPTION, LOW THERMAL CONDUCTIVITY, EXCELLENT EMISSION PROPERTIES MICROBIOLOGICAL RESISTANCE AND HIGH FIRE RESISTANCE. SHALL HAVE LOW VOC EMISSION PROPERTIES AND MUST MEET OR EXCEED ISO 16000 CLASS A REQUIREMENTS OF INDOOR AIR QUALITY ACCEPTABILITY. IT SHALL BE TESTED TO ISO 846:2019 (A/B/C) TO DETERMINE BACTERIAL AND FUNGAL GROWTH RESISTANCES. MICROBIOLOGICAL RESISTANCE TESTING TO ASTM G21 WILL NOT BE SUFFICIENT. THE INSULATION SHALL MEET MINIMUM FIRE HAZARD CLASSIFICATION RATINGS OF 25 FLAME SPREAD INDEX AND 50 SMOKE DEVELOPED INDEX WHEN TESTED TO ASTM E84, HAVE A UL94 VO/HF-1 FLAME RATING AND CAN/ULC S102. BLOWING AGENTS USED IN THE MANUFACTURE OF THE FOAM SHALL HAVE A LOW GLOBAL WARMING POTENTIAL (GWP) AND BE ACCEPTED WITHIN THE REGULATIONS OUTLINED IN THE EPA SNAP RULE 21 AND 22 PROGRAMS. D. AIR DISTRIBUTION
- .1 A DUCT COLLAR 24" X 12" IS SUPPLIED WITH THE UNIT VENTILATOR FOR CONNECTION OF DUCTWORK. THE STATIC OF EXTERNAL DUCTING AND CEILING DIFFUSERS SHOULD BE WITHIN THE 0.1"-0.5" ESP RANGE. ALL EXTERNAL DUCTWORK AND DIFFUSERS MUST BE CORRECTLY SIZED, FABRICATED, AND SUPPLIED BY OTHERS.

# 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

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DATE: SEPTEMBER 2023

PROJECT #:

ALL-23010629-A0 DRAWING #:

M0.5

## HVAC SPECIFICATIONS

#### RETURN GRILLES THE UNIT SHALL BE SUPPLIED WITH MATCHING COLOR STANDARD PUNCHED RETURN GRILLES. THE RETURN PUNCHED GRILLES SHALL BE DESIGNED TO REDUCE THE GENERATED SOUND. UV-1 WILL HAVE THE FRONT DOOR REPLACED WITH A BLANK DOOR TO ALLOW FOR DUCTED SIDE-RETURN. MIXED AIR FILTERS EACH UNIT SHALL BE EQUIPPED WITH TWO 2" PLEATED DISPOSABLE FILTERS (MERV 13). THE LOCATION OF THE FILTER SHALL BE IN SUCH A WAY THAT IT PROVIDES 100% FILTRATION OF BOTH RE-CIRCULATED AND OUTSIDE FRESH AIR. HEATING - HOT WATER COIL THE UNIT SHALL BE SUPPLIED WITH A HOT WATER COIL CONSTRUCTED OF SEAMLESS DRAWN COPPER TUBES MECHANICALLY EXPANDED INTO DIE-FORMED FIN COLLARS OF TEMPERED, CORRUGATED ALUMINUM FIN STOCK, ASSURING A POSITIVE BOND FOR OPTIMAL HEAT TRANSFER AND THE PREVENTION OF ELECTROLYTIC ACTION. THE COIL SHALL BE SUPPLIED WITH A MANUAL AIR VENT AND DRAIN PLUG. THE COIL SHALL BE SIZED T PROVIDE THE REQUIRED HEATING CAPACITY AS SHOWN IN THE SCHEDULE. SUPPLY AND RETURN CONNECTIONS (3/4" OR 1" NOMINAL TUBING) STUBBED OUT THE TOP LEFT OF THE UNIT. HOT WATER FREEZE PROTECTION: EACH UNIT SHALL BE EQUIPPED WITH A FREEZE SENSOR SNAP DISC TO PREVENT THE HOT WATER FROM FREEZING DUE TO AN ABNORMAL DROP IN THE DISCHARGE AIR TEMPERATURE. WATER CONTROL VALVES AND PIPING COMPONENTS: A MODULATING CONTROL VALVE SHALL BE SUPPLIED FACTORY INSTALLED WITH EACH UNIT BY THE MANUFACTURER. ISOLATION VALVES, CIRCUIT BALANCING VALVE AND STRAINER SHALL BE SUPPLIED AND INSTALLED BY THE MANUFACTURER. SINGLE PACKAGED AIR CONDITIONING (UV-2)ALL REFRIGERANT COMPONENTS SHALL BE FACTORY INSTALLED AND CONNECTED, REQUIRING NO FIELD FABRICATION OR INSTALLATION OF COILS, LINE-SETS OR CONDENSING UNITS. THE PACKAGED AIR CONDITIONING SYSTEM SHALL BE DESIGNED AND CHARGED WITH R410A. THE SYSTEM SHALL BE EQUIPPED WITH ONE DIRECT EXPANSION VALVE AND MATCHED WITH THE COMPRESSOR, DESIGNED TO PROVIDE THE REQUIRED COOLING CAPACITY. A DIRECT EXPANSION (DX) COIL SHALL BE MOUNTED IN THE EVAPORATOR COIL SECTION, AND CONNECTED TO THE CORRECTLY SIZED CONDENSING COIL IN THE CONDENSER COIL SECTION. COILS ARE ORIENTED IN A WAY O PROVIDE OPTIMAL HEAT TRANSFER. THE COIL SHALL BE CONSTRUCTED OF SEAMLESS DRAWN COPPER TUBES MECHANICALLY EXPANDED INTO DIE-FORMED FIN COLLARS OF TEMPERED, CORRUGATED ALUMINUM FIN STOCK. ASSURING A POSITIVE BOND FOR OPTIMAL HEAT TRANSFER AND THE PREVENTION OF ELECTROLYTIC ACTION. COIL SHALL BE INTERNALLY COMMERCIALLY CLEAN, AND DEHYDRATED. THE ENDPLATES SHALL BE OF GALVANIZED STEEL CONSTRUCTION. COMPRESSORS (UV-2) UNITS SHALL BE FOUIPPED WITH A FACTORY-INSTALLED. HERMETICALLY SEALED. TWO-STAGED. SCROLL TYPE COMPRESSOR SIZED CORRECTLY TO MATCH THE COILS AND PROVIDE THE SPECIFIED CAPACITY. THE COMPRESSOR SHOULD BE MOUNTED ON RUBBER ISOLATORS TO REDUCE VIBRATION TRANSMISSION. THE COMPRESSOR SHALL BE PROTECTED FROM EXCESSIVE MOTOR TEMPERATURE AND CURRENT BY MEANS OF AN INTERNAL OVERLOAD PROTECTOR. .2 A HIGH-PRESSURE SWITCH WILL DISABLE THE COMPRESSOR IF EXCESSIVE SYSTEM PRESSURE IS ACHIEVED. A LOW PRESSURE CUT OUT IS ALSO PROVIDED TO DISABLE THE COMPRESSOR IF REFRIGERANT PRESSURE IS BELOW AN ACCEPTABLE THRESHOLD. EACH UNIT SHALL BE EQUIPPED WITH A 'COMPRESSOR CRANKCASE HEATER' TO PREVENT MIGRATION AND MIXING OF REFRIGERATION WITH THE OIL IN THE CRANKCASE THE COMPRESSOR SHALL OPERATE IN A TWO-STAGE COOLING SEQUENCE. THE FIRST STAGE WILL BE MECHANICAL COOLING - 2/3 OF COMPRESSOR CAPACITY (67%) AND THE SECOND STAGE WILL BE MECHANICAL COOLING -FULL COMPRESSOR CAPACITY (100%). SPLIT SYSTEM DX COOLING (UV-1) A PRIMARY DIRECT EXPANSION (DX) COIL SHALL BE PROVIDED IN THE EVAPORATOR COIL SECTION MOUNTED INTO PLACE WITH CONDENSATE DRAIN PAN AND LINES. THE COIL SHALL BE CONSTRUCTED OF COPPER TUBES MECHANICALLY BURRED TO .006" WITH CORRUGATED ALUMINUM FINS PERMANENTLY BONDED TO THE TUBES TO PREVENT ELECTROLYTIC ACTION. THE COIL SHALL BE INSTALLED WITH A THERMAL EXPANSION VALVE CORRECTLY SIZED TO MATCH THE REMOTE CONDENSING UNIT TOGETHER PROVIDING THE COOLING CAPACITY REQUIRED BY THE SCHEDULE AT THE MAXIMUM EFFICIENCY FOR THE SYSTEM. UNLESS SPECIFIED THE REMOTE CONDENSING UNIT AND WARRANTY FOR AIR CONDITIONING PERFORMANCE ARE THE RESPONSIBILITY OF THE MECHANICAL ENGINEER AND/OR CONTRACTOR. DRAIN PAN INSULATED DRAIN PAN: THE STAINLESS-STEEL METAL INSULATED DRAIN PAN SHALL BE DESIGNED WITH BOTH FRONT TO BACK AND SIDE TO SIDE SLOPE TO THE PRIMARY DRAIN OUTLET ELIMINATING ANY STANDING WATER IN THE PAN. THE DRAIN PAN SHALL BE COATED WITH CLOSED-CELL INSULATION. DAMPERS THE VENTILATION DAMPER SHALL BE AN INSULATED GALVANIZED DAMPER OPERATED BY ZERO MAINTENANCE AND CONCEALED LINKAGE. THE OUTSIDE BLADE EDGE AND JAMB SEALS SHALL BE OF THE PRESSURE-SENSITIVE YPE FOR LOW LEAKAGE THE DAMPER SHALL BE EQUIPPED WITH A BELIMO SPRING RETURN DAMPER ACTUATOR WITH A MINIMUM TORQUE OF 18 IN/LB. THE ACTUATOR MUST PROVIDE PROPORTIONAL DAMPER CONTROL IN RESPONSE TO INPUT OF 2 TO 10 VDC. ACTUATORS SHALL USE A BRUSHLESS DC MOTOR CONTROLLED BY A MICROPROCESSOR AND BE PROTECTED FROM OVERLOAD AT ALL ANGLES OF ROTATION. THE DAMPER ACTUATOR SHALL MODULATE DAMPERS TO ALLOW OUTSIDE AIR TO MIX WITH RETURN AIR, THE VOLUME OF OUTSIDE AIR DURING THE OCCUPIED PERIOD TO BE FIXED TO A MINIMUM OUTSIDE AIR OF 450 CFM. IT SHALL HAVE THE CAPABILITY OF OPENING DURING AN ECONOMIZER CYCLE TO ALLOW UP TO 100% OF THE TOTAL SUPPLY AIR THROUGH THE OUTSIDE AIR DAMPER. M. SUPPLY FAN SUPPLY MOTOR AND FAN ASSEMBLY SHALL CONSIST OF TWO FAN BODIES TO SUPPLY THE SPECIFIED AIRFLOW. EACH FAN BODY SHALL BE A DOUBLI INLET CENTRIFUGAL TYPE BLOWER WITH BOTH FANS DRIVEN BY ONE ELECTRONICALLY COMMUTATED MOTOR (ECM) CAPABLE OF VARIABLE SPEED OPERATION. THE EC MOTOR SHALL BE PROGRAMMABLE TO DELIVER THE SPECIFIED AIRFLOW AT THE RATED EXTERNAL STATIC PRESSURE, THIS PROVIDES EFFICIENT FAN OPERATION. PERMANENT SPLIT CAPACITOR (PSC) MOTORS WILL NOT BE ACCEPTABLE. THE SUPPLY FAN SHALL BE ORIENTATED IN A WAY SUCH THAT THE MIXED .2 AIR WILL BE DRAWN THROUGH BOTH THE HEATING AND COOLING COILS. THE SUPPLY FAN MOTOR SHALL BE ISOLATED FROM THE SUPPLY FANS B USING ZINC-PLATED DOUBLE WIRE MOUNTING BRACKETS AND RUBBER ANTI-VIBRATION MOUNTS TO REDUCE THE SOUND-INDUCED VIBRATIONS. FAN ASSEMBLY SLIDER SHALL SIT ON FELT INSULATION. CONDENSING FAN (UV-2)THE CONDENSING MOTOR AND FAN ASSEMBLY SHALL COOL THE CONDENSING COIL AND ALSO BE DESIGNED IN SUCH A WAY AS TO RELIEVE STALE ROOM AIR AT THE SAME RATE AT WHICH OUTSIDE AIR IS ENTERING THE ROOM. THE ASSEMBLY SHALL HAVE TWO BACKWARD CURVED CENTRIFUGAL FANS DRIVEN BY INTEGRAL ELECTRONICALLY COMMUTATED MOTORS (ECM) CAPABLE OF VARIABLE SPEED OPERATION. PERMANENT SPLIT CAPACITOR (PSC) MOTORS WILL NOT BE ACCEPTABLE. THE FAN ASSEMBLY SHALL BE CAPABLE OF EXHAUSTING UP TO 100% AIRFLOW EQUAL TO INCOMING OUTDOOR AIR. GENERAL ELECTRICAL THE MAIN POWER SUPPLY SHALL CONNECT TO THE UNIT THROUGH A WIRE RACEWAY DIRECTLY TO EITHER A TERMINAL BLOCK OR TO THE UNFUSED DISCONNECT PROVIDED BY THE UNIT MANUFACTURER. STANDARD ELECTRICAL SUPPLY VOLTAGE SHALL BE 208 VAC 3 PHASE 60 HZ FOR UV-2. STANDARD ELECTRICAL SUPPLY VOLTAGE SHALL BE 208 VAC 1 PHASE 60 HZ FOR UV-1 SERVICE DISCONNECT EACH UNIT SHALL BE SUPPLIED WITH A LINE VOLTAGE SERVICE DISCONNECT (MAXIMUM 80 AMPS) AND A DOOR SWITCH FOR CONTROL VOLTAGE INTERRUPT TO DISABLE THE MECHANICAL COMPONENTS WHEN THE SERVICE PANEL IS REMOVED. THE DISCONNECT SWITCH IS LOCKABLE IN THE OFF POSITION. ALL INTERNAL FUNCTIONS MUST BE FUSE PROTECTED BY A TIME DELAY .2 FUSE PROPERLY RATED FOR THE AMPERAGE LOAD. Q. START-UP AND IOM INSTALLATION SHALL BE IN FULL ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS MANUAL, GENERALLY ACCEPTED PRACTICE AND ALL APPLICABLE CODES. IMPROPER INSTALLATION OF THE UNITS MAY VOID T WARRANTY. FIELD ASSEMBLED ACCESSORIES SHALL BE FABRICATED AS MENTIONED IN THE INSTRUCTION MANUALS AND DRAWINGS. STORAGE AND HANDLING OF THE EQUIPMENT SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS. THE FILTERS SHALL BE CLEAN OR REPLACED PRIOR TO TURNING THE BUILDING OVER TO THE OWNER. ON-SITE STARTUP: THE MANUFACTURER'S AGENT THAT SUPPLIES THE EQUIPMENT SHALL BE RESPONSIBLE FOR OVERSEEING OR REVIEWING THE INSTALLATION AT THE INITIAL START-UP OR SOON THEREAFTER. THE AGENT WILL ALSO DEMONSTRATE TO THE BUILDING MAINTENANCE PERSONNEL THE OPERATION OF THE UNIT(S) AND EXPLAIN WARRANTY PROCEDURES. AT THE COMPLETION OF THE INSTALLATION, THE MANUFACTURER WILL PROVIDE THE OWNER WITH 2 SETS OF INSTALLATION, OPERATION AND SERVICE MANUALS WITH SHOP DRAWINGS AND ELECTRICAL DIAGRAMS.

R. WARRANTY

## HVAC SPECIFICATIONS

	.1	THE	MANUFACTURER SHALL SUPPLY A LIMITED 14-MONTH WARRANTY ON PARTS AND A THREE-YEAR WARRANTY ON THE DAMPER ACTUATOR
	.2	PART	S AND LABOR WARRANTY: TOGETHER WITH PARTS ONLY WARRANTY TH JFACTURE SHALL COVER LABOR FOR REPLACEMENT OF APPROVED
	001	TIME	CHART SUPPLIED BY THE MANUFACTURER. THIS PARTS AND LABOR RANTY SHALL BE FOR A PERIOD OF ONE YEAR.
	.1	UNIT OTHE	VENTILATOR SHALL HAVE DDC READY CONTROLS (CONTROLLER BY RS)
	.2	A DII THE SHAL	RECT DIGITAL CONTROLLER SHALL BE SUPPLIED AND INSTALLED BY CONTROLS CONTRACTOR ON SITE. THE EQUIPMENT MANUFACTURE L PREPARE THE ELECTRICAL BOX WITH ALL REQUIRED RELAYS AND
		TRAN WIRIN COMI	ISFORMER FOR THE CONTROLLER TO OPERATE. ALL CONTROLLER IG INTERFACE, PROGRAMMING, SEQUENCE OF OPERATIONS, MISSIONING OF CONTROLS AND DOCUMENTATION ARE THE
	ACCE	RESF SSOF AN E	PONSIBILITY OF THE CONTROLS CONTRACTOR. RIES EXTERIOR, WEATHER-RESISTANT VENTEX 2415 LOUVER SHALL BE (4"
		DEEP	) ALUMINUM WITH A STANDARD POWDER COAT PAINT FINISH FROM TH JFACTURE'S STANDARD COLOR LIST (BRONZE OR GRAY) LOUVER SHAL
			INED WITH 22 GALVANIZED BIRD SCREEN MESH. LOUVER SIZE AND GN SHALL BE MATCHED TO THE MODEL TO PROVIDE PROPER ILATION AIR INTAKE ENSURING NO WATER INGRESS AND ROOM AIR
	.2	A 22 SHAL	2-GAUGE METAL WALL SLEEVE SUITED TO MATCH THE 12" DEEP WALL L. BE INCLUDED WITH THE STANDARD LOUVER WITH APPROPRIATE
	.3	SILL A 5-	HEIGHT. -SIDED, DOUBLE INSULATED SOUND ATTENUATING PLENUM OR DUCT
)	BOILI	ERS	BE PROVIDED AS REQUIRED.
	.1	JFACT FURN	URERS IISH AND INSTALL FACTORY "PACKAGED" LOW PRESSURE HOT WATER
		APPF MECH	ROVED AND ACCEPTED BY PATTERSON_KELLEY, LLC OR AS ROVED AND ACCEPTED BY THE ENGINEER AS DEFINED IN THE HANICAL SCHEDULES.
	.2 COMI OPEF	EACH PONEI RABLE	I FACTORY "PACKAGED" BOILER MUST BE COMPLETE WITH ALL NTS AND ACCESSORIES NECESSARY FOR A COMPLETE AND BOILER AS HEREINAFTER SPECIFIED. EACH BOILER MUST BE
	FURN AS A TRAN	NISHEI SEL ISPOR	D FACTORY ASSEMBLED WITH THE REQUIRED WIRING AND PIPING F_CONTAINED UNIT. EACH BOILER MUST BE READILY RTED AND READY FOR INSTALLATION.
	.3	ALL DEMO SPEC	APPROVED EQUAL OR APPROVED ALTERNATE BOILERS MUST DNSTRATE COMPLIANCE WITH THE REQUIREMENTS OF THIS CIFICATION.
	COMI .1 C	PONEI ABINE .1	NTS T ENCLOSURE EACH BOILER MUST FEATURE A FULLY ASSEMBLED CABINET
		.2	ENCLOSURE FABRICATED FROM CARBON STEEL OR ALUMINUM SHEET METAL (MINIMUM 16 GAUGE) WITH POWDER COAT FINISH. THE BOILER'S CABINET ENCLOSURE MUST NOT EXCEED 35" IN WIDTH
		.3	AND THE COMPLETED BOILER MUST FIT THROUGH A STANDARD DOUBLE DOORWAY. THE BOILER'S CABINET ENCLOSURE MUST FEATURE REMOVABLE
		.4	ACCESS PANELS / DOORS THAT CAN BE EASILY OPENED. THE BOILER'S CABINET ENCLOSURE MUST ELIMINATE THE USE OF
			COMBUSTION AIR AROUND THE HEAT EXCHANGER AND THE OUTER SURFACE TEMPERATURE MUST NOT EXCEED 20°F ABOVE AMBIENT
		.5	THE BOILER'S CABINET ENCLOSURE MUST PROMINENTLY DISPLAY ALL REQUIRED SAFETY, INSTRUCTION, COMPLIANCE AND FACTORY RUNOUT
	.2	HEAT .1	LABELS. EXCHANGER EACH FIRE-TUBE BOILER MUST CONTAIN AN ASME SECTION IV HEAT
			ALLOWABLE WORKING PRESSURE OF 160 PSIG AND A MAXIMUM ALLOWABLE TEMPERATURE OF 210°F.
		.2	THE COMPLETED HEAT EXCHANGER MUST CONSIST OF WELDED 316L SS HELICAL FIRED TUBES AND PROVIDE NO LESS THAN THE TOTAL FIRESIDE HEATING SURFACE AREA OF 181.50 FT2.
		.3	EACH COMPLETED HEAT EXCHANGER MUST INCLUDE AN INTEGRAL STAINLESS-STEEL CONDENSATE PAN/COLLECTOR, CONDENSATE DRAIN REMOVABLE BURNER ASSEMBLY, INLET TEMPERATURE SENSOR, OUTLE
			TEMPERATURE SENSOR, FLUE GAS TEMPERATURE SENSOR, HEAT EXCHANGER TEMPERATURE SENSOR, AUTOMATIC AIR VENT, THERMOWELL FOR HIGH TEMPERATURE LIMIT CAPILLARY, LOW WATER
		.4	CUTOFF PROBE OR FLOW SWITCH, AND ALL NECESSARY ASSEMBLY HARDWARE. EACH STAINLESS-STEEL HEAT EXCHANGER MUST BE DESIGNED TO
			MAINTAIN WATER TURBULENCE AT THE FULL PUBLISHED RANGE OF ACCEPTABLE FLOW RATES AT VARIOUS BOILER CONDITIONS AS DESCRIBED BELOW:
			.1 THE MAXIMUM ALLOWABLE FLOW RATE WILL GENERATE A 20°F ΔT WHEN THE BOILER IS OPERATING AT FULL CAPACITY.
			.2 THE MINIMUM ALLOWABLE FLOW RATE WILL GENERATE A 70°F ΔT WHEN THE BOILER IS OPERATING AT FULL CAPACITY.
		.5 .6	THE BOILER'S COMPLETED HEAT EXCHANGER MUST BE CAPABLE OF OPERATING WITH A MINIMUM OUTLET WATER TEMPERATURE OF 42°F. EACH HEAT EXCHANGER MUST BE HYDROSTATICALLY TESTED BY THE
			MANUFACTURER TO A MINIMUM OF 1–1/2 TIMES THE MAXIMUM ALLOWABLE WORKING PRESSURE FOR A MINIMUM OF 5 MINUTES. DURING THIS HYDROSTATIC PRESSURE TEST, THE OPERATOR WILL
	.3 M	AIN G	INSPECT THE PRESSURE GAUGE AND VISUALLY VERIFY THERE ARE N WATER LEAKS. CAS TRAINS
		.1	BOILERS CONFIGURED FOR SINGLE FUEL OPERATION MUST BE EQUIPPED WITH AN INTEGRAL MAIN GAS VALVE TRAIN CAPABLE OF BURNING NATURAL GAS.
		.2	EACH GAS VALVE TRAIN MUST INCLUDE AT LEAST THE FOLLOWING: .1 ONE (1) UPSTREAM MANUAL SHUTOFF VALVE FOR FIELD-CONNECTION.
			.2 ONE (1) COMBINATION AIR-GAS RATIO CONTROL AND SAFETY SHUTOFF VALVE WITH DUAL SOLENOIDS (IN-SERIES) THAT CAN BE INDEPENDENTLY ENERGIZED FOR LEAK TESTING AND
			INTEGRATED INTO A SINGLE BODY DESIGN. THE COMBINATION GAS VALVE MUST OPERATE AS A "ZERO GOVERNOR" AND CONTROL TO A NEUTRAL GAS PRESSURE INSIDE THE GAS VALVE
			.3 ONE (1) LOW GAS PRESSURE SWITCH (MANUAL RESET). .4 ONE (1) HIGH GAS PRESSURE SWITCH (MANUAL RESET).
		.3	.5 INU (2) GAS PRESSURE TEST PORTS. .6 ONE (1) DOWNSTREAM MANUAL SHUTOFF VALVE. EACH GAS TRAIN MUST BE COMPLETELY INDEPENDENT AND INCLUDE
			DEDICATED SAFETY DEVICES, SHUTOFF VALVES, ETC. EACH GAS TRA MUST BE INDIVIDUALLY IDENTIFIED BY THE MANUFACTURER WITH LABELS AND DEDICATED PAINT COLORS (YELLOW = NATURAL GAS).
		.4	THE MAIN GAS VALVE TRAIN(S) MUST BE FACTORY ASSEMBLED, PIPE AND WIRED AND ALLOW FOR OPERATION AT FULL RATED BOILER CAPACITY FROM $3.5 - 4.0$ " W.C. UP TO THE MAXIMUM INLET GAS
		.5	PRESSURE OF 14.0" W.C. IF THE SUPPLIED GAS PRESSURE EXCEEDS 14" W.C., THE CONTRACTO MUST SUPPLY A SUITABLE INTERMEDIATE GAS PRESSURE REGULATOR
	.4	POWE	OF THE LOCK—UP TYPE TO REDUCE THE GAS PRESSURE TO ACCEPTABLE LEVELS. ER BURNER
		.1	THE BOILER MANUFACTURER MUST FURNISH AN INTEGRAL POWER TYPE FUEL BURNER WITH EACH BOILER. THE COMPLETE POWER FU BURNER ASSEMBLY MUST CONSIST OF A GAS BURNER, COMBUSTION
			AIR BLOWER, MAIN GAS VALVE TRAIN, AND IGNITION SYSTEM. THE BURNER MANUFACTURER MUST FULLY COORDINATE THE BURNER DESIGN WITH THE BOILER'S HEAT EXCHANGER AND THE BOILER
			CONTROL SYSTEM IN ORDER TO PROVIDE THE REQUIRED CAPACITIES, EFFICIENCIES, AND PERFORMANCE SPECIFIED. BOILERS SHIPPED WITHOUT A POWER BURNER AND FIELD-EQUIPPED WITH A 3RD/
		.2	PARTY POWER BURNER ARE NOT ACCEPTABLE. BURNER MUST BE SINGLE BURNER, FULLY MODULATING, WITH DYNAM AIR DENSITY COMPENSATION CONTROL.
		.3	THE BURNER MUST INCORPORATE FUEL/AIR RATIO CONTROL SYSTEM TO PRESERVE EXHAUST OXYGEN LEVELS AS PER BOILER SCHEDULE, MAINTAINING CONSISTENT FLUE DEW POINT.
		.4	THE SYSTEM MUST BE LINKAGE-LESS WITHOUT THE USE OF ELECTRONIC CONTROL LOOPS AND ELECTRONIC OXYGEN SENSORS REQUIRING CALIBRATION AND RENEWAL
		.5	LOW NOX BURNER MUST BE CERTIFIED BY SCAQMD FOR NOX LEVEL LISTED ON SCHEDULE WHEN 02 IS CORRECTED TO 3%. NO ADDITIONAL SETUP OR ADJUSTMENT SLICH AS INCREASING EXCESS
		F	AIR, WILL BE NECESSARY TO ACHIEVE LEVEL LISTED

COMBUSTION CHAMBER WITH COMBUSTION GASES FLOWING DOWNWARD THROUGH THE HEAT EXCHANGER. THE BURNER MUST CONSIST OF A STAINLESS STEEL FLANGE AND PERFORATED STAINLESS STEEL CYLINDER.

## HVAC SPECIFICATIONS

-	7	EACH	BOILER MUST BE EQUIPPED WITH DIRECT SPARK IGNITION.	
.5 B	BOILE	ROD/ ER SA	VIONIZATION PROBE (RECTIFICATION) SYSTEM.	
•	1	THE SAFE	BOILER MANUFACTURER MUST FURNISH AND TEST THE FOLLOWING TY AND TRIM DEVICES WITH EACH BOILER: SAFETY RELIFE VALVE MUST BE PROVIDED IN COMPLIANCE WITH	
			THE ASME CODE. CONTRACTOR IS REQUIRED TO PIPE THE RELIEF VALVE DISCHARGE PIPING TO AN ACCEPTABLE DRAIN.	
		.2 .3 .4	WATER PRESSURE/TEMPERATURE GAUGE. LOW WATER / FLOW CUTOFF. MANUAL RESET HIGH LIMIT WATER TEMPERATURE CONTROLLER.	
		.5	OPERATING TEMPERATURE CONTROL TO CONTROL THE SEQUENTIAL OPERATION OF THE BURNER.	
	2	.6 .7 THE	FLAME ROD / IONIZATION PROBE FLAME DETECTION. BOILER MANUFACTURER MUST PROVIDE A CSD-1 FORM	
	3	IDENT THE	TIFYING EACH SAFETY AND TRIM DEVICE. BOILER MUST BE CAPABLE OF INTERFACING WITH THE FOLLOWING RNAL SAFETY DEVICES:	
		.1	AUXILIARY LOW WATER CUTOFF DEVICE. COMBUSTION AIR DAMPER END LIMIT SWITCH.	
.6 B	BOILE	.3 .4 ER CO	EMERGENCY STOP (E-STOP) SWITCH. EXTERNAL SAFETY DEVICE W/ CONTACT CLOSURE. DNTROL SYSTEM	
	1	EACH ALL	BOILER MUST BE PROVIDED WITH ALL NECESSARY CONTROLS, NECESSARY PROGRAMMING SEQUENCES, AND ALL SAFETY	
.2	2	INTER	RLOCKED WITH ALL SAFETIES.	
		CONT PROF FIRE	ROL SYSTEM WHEREBY THE FIRING RATE IS INFINITELY PORTIONAL AT ANY FIRING RATE BETWEEN LOW FIRE AND HIGH AS DETERMINED BY THE PULSE WIDTH MODULATION INPUT	
		CONT SEQU THF	ROL SIGNAL. BOTH FUEL INPUT AND AIR INPUT MUST BE JENCED IN UNISON TO THE APPROPRIATE FIRING RATE WITHOUT USE OF MECHANICAL LINKAGE	
	3	THE CAPA	BOILER'S CONTROL SYSTEM MUST PROVIDE THE MINIMUM BILITIES:	
		.1 .2	PORTS. STANDARD ON-BOARD ETHERNET PORT FOR WIRED INTERNET	
		.3	CONNECTIVITY. PARAMETER UPLOADS AND DOWNLOADS VIA EXTERNAL USB FLASH DRIVE.	
		.4 .5	SOFTWARE UPDATES VIA EXTERNAL USB FLASH DRIVE. CAPTURE SCREEN SHOTS FROM THE CONTROL'S DISPLAY BY	
		.6	LOCAL REPRESENTATIVE SCREEN CAN BE PROGRAMMED TO PROVIDE CONTACT INFORMATION FOR THE LOCAL BOILER	
		.7	MANUFACIURER'S REPRESENTATIVE. PROGRAMMABLE RELAY OUTPUTS FOR DIRECT CONTROL OF PUMPS, CONTROL VALVES, DAMPERS AND OTHER AUXILIARY	
		.8	DEVICES. MULTIPLE BOILER "CASCADE" NETWORK UP TO 32 BOILERS WITHOUT ANY EXTERNAL CONTROL PANEL THE INSTALLATION OF	
		.9	EXTERNAL SEQUENCING CONTROL PANELS IS NOT ACCEPTABLE. AUTOMATIC HYBRID SYSTEM CONTROL FOR MULTIPLE BOILER	
			NON-CONDENSING BOILERS. THIS CONTROL LOGIC PRIORITIZES CONDENSING BOILERS AT LOW WATER TEMPERATURES AND	
		.10	PRIORITIZES NON-CONDENSING BOILERS AT HIGH WATER TEMPERATURES. AUXILIARY BOILER RELAY FOR MULTIPLE BOILER "CASCADE"	
			SYSTEMS WHICH CAN BE USED TO ENABLE A 3RD/ PARTY BOILER PLATFORM IN THE EVENT THE "CASCADE" SYSTEM IS UNABLE TO SATISFY THE HEATING LOAD	
		.11	PROGRAMMABLE BOILER AND SYSTEM PUMP CONTROL WITH MODULATING CAPABILITIES FOR MULTIPLE BOILER "CASCADE"	
		.12	ARRANGEMENT. PROGRAMMABLE CONTROL VALVE LOGIC WITH MODULATING	
		.13	CAPABILITIES FOR MULTIPLE BOILER "CASCADE" SYSTEMS INSTALLED IN A PRIMARY-ONLY PIPING ARRANGEMENT. PROGRAMMABLE SYNCHRONIZATION OF EXHAUST FAN TIMING TO	
		.14	EQUAL THE REAL-TIME BURNER FIRING RATE. 5 PRE-INSTALLED PID CONTROL SPEEDS FOR SYSTEM OPTIMIZATION IN ADDITION TO A USER-DEFINED PID FUNCTION	
		.15	CAPABILITY. INTEGRATION WITH EXTERNAL BUILDING MANAGEMENT SYSTEMS (BMS) VIA MODBUS®/ BTU PROTOCOL NOTE: OPTIONAL	
			PROTOCOL CONVERTER FOR COMMUNICATION VIA LONWORKS®/ AND BACNET®/ MUST BE AVAILABLE FOR PURCHASE FROM THE	
		.16	HARDWIRE INTEGRATION WITH BUILDING MANAGEMENT SYSTEMS (BMS) VIA 4–20MA ANALOG CONTROL SIGNAL FOR TEMPERATURE	
		.17	OR FIRING RATE CONTROL. INTUITIVE "SETUP WIZARDS" ASK THE USER A SERIES OF QUESTIONS AND ALLOW FOR STEP-BY-STEP CONFIGURATION OF	
		.18	THE BOILER OPERATION, CONTROL, AND CONNECTIVITY. ON-SCREEN ERROR NOTIFICATIONS WITH A COMPREHENSIVE DESCRIPTION OF ALL ALARM CONDITIONS AND SEVERAL	
		.19	TROUBLESHOOTING STEPS. AUTOMATIC FLUE GAS TEMPERATURE AND OUTLET (SUPPLY)	
		.20	BOILER EQUIPMENT. AUTOMATIC DIFFERENTIAL TEMPERATURE COMPENSATION TO	
		.21	FREVENT OVER-FIRING OF THE BOILER EQUIPMENT IN A LOW FLOW CONDITION. AUTOMATICALLY ADJUST THE TEMPERATURE SET POINT AND	
		.22	SHUTDOWN THE BOILER BASED ON THE OUTDOOR AIR TEMPERATURE CONDITIONS. NIGHT SETBACK FUNCTIONALITY VIA EXTERNAL POINT OF CLOSURE	
			(OR BMS INTEGRATION) FOR UNIQUE "OCCUPIED" AND "UNOCCUPIED" TEMPERATURE SETPOINT VALUES. SETBACK "EATURE WILL INCLUDE THE APPLIED TO COULD IN THE APPLIED TO COULD INCLUDE THE APPLIED TO COULD INTEGRATION OF	
		<u> </u>	ADJUSTMENTS WITHIN A 24-HOUR PERIOD FOR BUILDING OPTIMIZATION.	
		.25	TIMED, INCREASE IN BOILER TEMPERATURE SETTING IN AN UNEXPECTED OCCUPIED MODE.	
		.24	MAINTAIN SINGLE TEMPERATURE SET POINT WITH A MINIMUM OUTLET (SUPPLY) WATER TEMPERATURE OF 42°F UP TO A MAXIMUM OUTLET (SUPPLY) WATER TEMPERATURE OF 194°F	
		.25	ON-BOARD DHW PRIORITY CAPABLE OF SEAMLESS TRANSITION BETWEEN COMFORT HEAT (CH) AND DOMESTIC HOT WATER (DHW)	
		.26	OPERATION. ON-BOARD CH&DHW OPERATION FOR SIMULTANEOUS COMFORT HEAT (CH) AND DOMESTIC HOT WATER (DHW) OPERATION.	
		.27	ALARM RELAY OUTPUT TO ANNOUNCE ALARM CONDITIONS WHICH REQUIRE MANUAL RESET ON MASTER OR ANY MEMBER BOILER FROM A SINGLE BOILER SOURCE.	
		.28 .29	PROGRAMMABLE LOW FIRE DELAY TO PREVENT EXCESSIVE SHORT-CYCLING OF THE BOILER EQUIPMENT.	
	2	THE	BOILER CONTROL SYSTEM MUST BE CAPABLE OF INTERFACING THE FOLLOWING EXTERNAL CONTROL DEVICES:	
		.1	BUILDING MANAGEMENT SYSTEM (MODBUS®/). NOTE: OPTIONAL PROTOCOL CONVERTER FOR COMMUNICATION VIA LONWORKS®/ AND BACNET®/ MUST BE AVAILABLE FOR PURCHASE FROM THF	
		.2	BOILER MANUFACTURER. DOMESTIC HOT WATER BREAK-ON-RISE AQUASTAT (NORMALLY CLOSED)	
		.3 .4	DOMESTIC HOT WATER TANK TEMPERATURE SENSOR ( $12K\Omega$ ). EXTERNAL HEADER TEMPERATURE SENSOR ( $12K\Omega$ ).	
EXECU	TION	.5 I	OUTDOOR AIR TEMPERATURE SENSOR ( $12K\Omega$ ) BOTH WIRED AND WIRELESS.	
.1	NSTA 1	INSTA	ON ALLATION MUST BE PERFORMED BY THE CONTRACTOR IN DRDANCE WITH THE REQUIREMENTS OF THE APPLICABLE CODES	
		CONT	RACTOR MUST REVIEW THE BOILER AND INSTALLATION FOR PLIANCE WITH REQUIREMENTS AND/OR ISSUES THAT MAY AFFECT	
.2	2		TISFACTOR MANCE. INSTALLATION SHOULD NOT PROCEED UNTIL TISFACTORY CONDITIONS HAVE BEEN CORRECTED. CONTRACTOR MUST MOUNT THE EQUIPMENT AS DESCRIBED	
		BELO .1	W: INSTALL BOILERS ON CAST-IN-PLACE CONCRETE EQUIPMENT BASE	
-	3	.2 THF	IF REQUIRED BY THE LOCAL CODE, INSTALL VIBRATION ISOLATION DEVICES CONTRACTOR MUST INSTALL GAS-FIRED BOILERS IN ACCORDANCE	
		WITH	NFPA 54/ANSI Z223.1 (UNITED STATES), OR CAN/CSA B/149.1	

.4 THE CONTRACTOR MUST INSTALL GAS-FIRED BOILERS IN ACCORDANCE

WITH NBIC - PART 1 (INSTALLATION), OR ANOTHER INSTALLATION

.5 THE CONTRACTOR MUST ASSEMBLE AND INSTALL ANY EXTERNAL

CODE HAVING LOCAL JURISDICTION

## HVAC SPECIFICATIONS

- BOILER SAFETY/TRIM DEVICES.
  .6 THE CONTRACTOR MUST INSTALL ANY ELECTRICAL DEVICES FURNISHED WITH THE BOILER, BUT NOT SPECIFIED TO BE FACTORY-MOUNTED.
  .7 THE CONTRACTOR MUST INSTALL CONTROL WIRING TO FIELD MOUNTED ELECTRICAL DEVICES IN ACCORDANCE WITH THE REQUIREMENTS OF NFPA 70.
  .8 THE CONTRACTOR MUST INSTALL ELECTRICAL (POWER) WIRING TO THE BOILER IN ACCORDANCE WITH THE REQUIREMENTS OF NFPA 70.
  .2 GAS PIPING
- .1 EACH BOILER MUST BE PROVIDED WITH ALL NECESSARY GAS CONNECTIONS. REFER TO THE BOILER'S SPECIFICATION SHEET OR MANUAL FOR CONNECTION SIZES.
  .2 INSTALL GAS PIPING IN ACCORDANCE WITH NFPA 54/CAN/CSA B/149.1 (CANADA).
- HYDRONIC PIPING .1 EACH BOILER MUST BE PROVIDED WITH ALL NECESSARY INLET (SUPPLY) AND OUTLET (RETURN) CONNECTIONS. REFER TO THE BOILER'S SPECIFICATION SHEET OR MANUAL FOR CONNECTION SIZES.
- .2 CHECK MANUFACTURER'S INSTALLATION MANUAL FOR CLEARANCE DIMENSIONS AND INSTALL PIPING THAT WILL ALLOW FOR SERVICE AND EASE OF MAINTENANCE.
- .3 INSTALL PIPING FROM EQUIPMENT DRAIN CONNECTION TO NEAREST FLOOR DRAIN. PIPING MUST BE AT LEAST FULL SIZE OF CONNECTION AND ADHERE TO PROPER CODES FOR NEUTRALIZATION. .4 EXHAUST VENTING
- .1 THE BOILERS MUST BE DUAL CERTIFIED AS CATEGORY II OR IV APPLIANCES AND ARE CAPABLE OF OPERATING WITH SLIGHTLY NEGATIVE TO SLIGHTLY POSITIVE EXHAUST VENT PRESSURE, AND THE VENT GAS TEMPERATURE IS LIKELY TO CAUSE CONDENSATE PRODUCTION IN THE VENT. .2 INSTALL THE EXHAUST/FLUE VENTING SYSTEM IN
  - ACCORDANCE WITH NFPA 54/CAN/CSA B/149.1 (CANADA) AND PER THE MANUFACTURER'S RECOMMENDATIONS IN THE INSTALLATION MANUAL.
- .5 AIR INLET
   .1 THE BOILERS MUST BE CERTIFIED FOR DIRECT VENT / SEALED COMBUSTION INSTALLATIONS WHERE THE COMBUSTION AIR IS SUPPLIED DIRECTLY TO THE BOILER THROUGH DUCTWORK.
   .2 INSTALL THE AIR INLET SYSTEM IN ACCORDANCE WITH NFPA
- 54/CAN/CSA B/149.1 (CANADA) AND PER THE MANUFACTURER'S RECOMMENDATIONS IN THE INSTALLATION MANUAL. .6 ELECTRICAL
- .1 INSTALL AN EXTERNAL DISCONNECT AND OVERLOAD PROTECTION FOR EACH BOILER IN ACCORDANCE WITH THE REQUIREMENTS OF NFPA 70.
   .2 THE VOLTAGE REQUIREMENTS FOR EACH BOILER MUST BE CONFIGURED FOR 208–240VAC OR 480VAC, THREE–PHASE (W/ NEUTRAL), 60HZ.
   10.2 BOILER VENTING A. POSITIVE PRESSURE VENT
- .1 THE VENT SHALL BE OF DOUBLE WALL, FACTORY BUILT TYPE, DESIGNED FOR USE IN CONJUNCTION WITH CATEGORY I, II, III OR IV CONDENSING OR NON-CONDENSING GAS FIRED APPLIANCES OR AS SPECIFIED BY THE HEATING EQUIPMENT MANUFACTURER.
- .2 MAXIMUM CONTINUOUS FLUE GAS TEMPERATURE SHALL NOT EXCEED 480°F (249°C).
   .3 VENT SHALL BE LISTED FOR A MINIMUM POSITIVE PRESSURE RATING OF 6"
- W.C. AND SHALL HAVE PASSED AT 35" W.C.
  .4 THE VENT SYSTEM SHALL BE CONTINUOUS FROM THE APPLIANCE'S FLUE OUTLET TO THE VENT TERMINATION OUTSIDE THE BUILDING. ALL SYSTEM
- COMPONENTS SHALL BE INTERTEK ETL AND SUPPLIED FROM THE SAME MANUFACTURER. .5 THE VENT SHALL BE CONSTRUCTED WITH AN INNER AND OUTER TUBE, WHERE THE ANNULAR SPACE BETWEEN THE TUBES IS 1–INCH INDOORS
- AND 2-INCH INSULATION OUTDOORS.
  .1 THE INNER TUBE (FLUE GAS CONDUIT) SHALL BE CONSTRUCTED FROM EITHER AL29-4C® OR 316L STAINLESS STEEL. THE AL29-4C STAINLESS STEEL WILL HAVE A WALL THICKNESS OF .015" FOR 3" THROUGH 9" DIAMETER VENTS, .020" FOR 10" THROUGH 16" AND .024" FOR 18" THROUGH 24" DIAMETER VENTS. THE 316L STAINLESS STEEL WILL HAVE A MINIMUM WALL THICKNESS OF .015" FOR 3"-9" DIAMETER VENTS, .019" FOR 10"-16" DIAMETER VENTS AND .024" FOR 18"-24" DIAMETER VENTS.
- .2 THE OUTER TUBE (JACKET) SHALL BE CONSTRUCTED FROM 441 STAINLESS STEEL WITH A MINIMUM WALL THICKNESS OF .015" FOR 3" THROUGH 9" DIAMETER VENTS, .020" FOR 10" THROUGH 16" AND .024" FOR 18" THROUGH 24" DIAMETER VENTS.
- .6 ALL SYSTEM COMPONENTS SUCH AS VENT SUPPORTS, ROOF OR WALL PENETRATIONS, TERMINATIONS, APPLIANCE CONNECTORS AND DRAIN FITTINGS REQUIRE TO INSTALL THE VENT SYSTEM SHALL BE INTERTEK ETL LISTED AND PROVIDED BY THE VENT MANUFACTURER.
- .7 VENT LAYOUT SHALL BE DESIGNED AND INSTALLED IN COMPLIANCE WITH MANUFACTURER'S INSTALLATION INSTRUCTIONS AND ALL APPLICABLE LOCAL CODES.
   B. EXECUTION
- .1 VENT SYSTEM LAYOUT .1 VENT SYSTEM LAYOUT
  - .1 THE VENT SYSTEM SHALL BE ROUTED TO MAINTAIN MINIMUM CLEARANCE TO COMBUSTIBLES AS SPECIFIED BY THE MANUFACTURER.
  - .2 VENT INSTALLATION SHALL CONFORM TO THE MANUFACTURER'S
  - INSTALLATION INSTRUCTIONS, ITS LISTING AND STATE / LOCAL CODES. .3 THE VENT SYSTEM AND BREECHINGS SHALL BE INSPECTED AND
- .3 THE VENT STSTEM AND BREECHINGS SHALL BE INSPECTED AND CLEANED BEFORE THE FINAL CONNECTION TO THE APPLIANCES. .2 MECHANICAL EQUIPMENT
- .1 KW ADJUSTABLE DAMPERS MUST BE INCLUDED AND INSTALLED FOR EACH INITIAL VERTICAL VENTING BRANCH.
   .2 IF DAMPERS OR FANS ARE INSTALLED IN CONJUNCTION OF THE VENT SYSTEM, SUCH EQUIPMENT SHALL BE SUPPORTED INDEPENDENTLY FROM THE VENT SYSTEM. PROTECT THE VENT SYSTEM FROM TWISTING OR MOVEMENT DUE TO FAN TORQUE OR VIBRATION.
- 1. THE MANUFACTURER SHALL BE RESPONSIBLE FOR PROVIDING VENTING SHOP DRAWINGS OUTING THE VENTING MATERIAL, FITTINGS AND COMPONENTS IN THE FORM OF AN ISOMETRIC VENTING DIAGRAM. THIS SHOP DRAWING SHALL BE ACCOMPANIED BY VENTING PRESSURE DROP CALCULATIONS AND SHALL BE SEALED BY A LISCENSED PROFESSIONAL ENGINEER IN THE PROVICE ON ONTARIO WITH MINIMUM TEN (10) YEARS OF RELAVENT EXPERIENCE.
- .2 SPECIFICATION REQUIREMENTS SHALL BE MET BY USING SECURITY CHIMNEYS SECURE SEAL SSD DOUBLE-WALL INDOORS AND SSID OUTDOORS, EXHAUST FLUE OR EQUIVALENT AS APPROVED BY THE ENGINEER. EQUIVALENT SUBMITTALS SHALL DEMONSTRATE THAT THE ALTERNATE MATERIAL IS IN COMPLIANCE WITH ALL SPECIFICATION REQUIREMENTS. PLEASE CONTACT SMITH ENERGY – PERRY LAM (647–660–4322, EXT. 3307) FOR ANY QUESTIONS.

#### 11 HVAC PUMPS

- 11.1 <u>VARIABLE SPEED PACKAGED PUMP SYSTEM (P-1, P-2, P-3, P-4, P-5, P-6)</u> A. GENERAL
- .1 FURNISH AND INSTALL A PRE-FABRICATED AND TESTED VARIABLE SPEED PACKAGED PUMPING SYSTEM TO MAINTAIN CONSTANT WATER DELIVERY PRESSURE.
- .2 THE PACKAGED PUMP SYSTEM SHALL BE A STANDARD PRODUCT OF A SINGLE PUMP MANUFACTURER. THE ENTIRE PUMP SYSTEM INCLUDING PUMPS AND PUMP LOGIC CONTROLLER, SHALL BE DESIGNED, BUILT, AND TESTED BY THE SAME MANUFACTURER.
- .3 THE COMPLETE PACKAGED WATER BOOSTER PUMP SYSTEM SHALL BE CERTIFIED AND LISTED BY UL (CATEGORY QCZJ – PACKAGED PUMPING SYSTEMS) FOR CONFORMANCE TO U.S. AND CANADIAN STANDARDS.
- .4 THE COMPLETE PACKAGED PUMPING SYSTEM SHALL BE NSF61 / NSF372 LISTED FOR DRINKING WATER AND LOW LEAD REQUIREMENTS. B. PUMPS
- .1 ALL PUMPS SHALL BE ANSI NSF 61 / NSF372 LISTED FOR DRINKING WATER AND LOW LEAD REQUIREMENTS.
- .2 THE PUMPS SHALL BE OF THE IN-LINE VERTICAL MULTI-STAGE DESIGN.
   .3 THE HEAD-CAPACITY CURVE SHALL HAVE A STEADY RISE IN HEAD FROM MAXIMUM TO MINIMUM FLOW WITHIN THE PREFERRED OPERATING REGION. THE SHUT-OFF HEAD SHALL BE A MINIMUM OF 20% HIGHER THAN THE HEAD AT THE BEST EFFICIENCY POINT.
- .4 SMALL VERTICAL IN-LINE MULTI-STAGE PUMPS (NOMINAL FLOW FROM 3 TO 125 GALLONS PER MINUTE) SHALL HAVE THE FOLLOWING FEATURES: .1 THE PUMP IMPELLERS SHALL BE SECURED DIRECTLY TO THE PUMP
- SHAFT BY MEANS OF A SPLINED SHAFT ARRANGEMENT. .2 THE SUCTION/DISCHARGE BASE SHALL HAVE ANSI CLASS 250 FLANGE OR INTERNAL PIPE THREAD (NPT) CONNECTIONS AS DETERMINED BY THE PUMP STATION MANUFACTURER.
- .3 PUMP CONSTRUCTION.
- .1 SUCTION/DISCHARGE BASE, PUMP HEAD, MOTOR STOOL: CAST IRON (CLASS 30)
- .2 IMPELLERS, DIFFUSER CHAMBERS, OUTER SLEEVE: 304 STAINLESS STEEL
- .3 SHAFT: 316 OR 431 STAINLESS STEEL

## 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 184TC AND SMALLER SHALL BE MADE OF CAST IRON OR SINTERED STEEL, SHAFT COUPLINGS FOR MOTOR FLANGE SIZES LARGER THAN 184TC SHALL BE MADE OF DUCTILE IRON (ASTM 60-40-18). OPTIONAL MATERIALS FOR THE SUCTION/DISCHARGE BASE AND PUMP HEAD SHALL BE CAST 316 STAINLESS STEEL (ASTM CF-8M) RESULTING IN ALL WETTED PARTS OF STAINLESS STEEL. .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 PLATE: 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. THE ENTIRE CARTRIDGE SHAFT SEAL SHALL BE REMOVABLE AS A ONE PIECE COMPONENT. PUMPS WITH MOTORS EQUAL TO OR LARGER THAN 15 HP (FIFTEEN HORSEPOWER) SHALL HAVE ADEQUATE SPACE WITHIN THE MOTOR STOOL SO THAT SHAFT SEAL REPLACEMENT IS POSSIBLE WITHOUT MOTOR REMOVAL.
- .5 LARGE IN-LINE VERTICAL MULTI-STAGE PUMPS (NOMINAL FLOWS 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 SPLIT CONE AND NUT DESIGN. .2 THE SUCTION/DISCHARGE BASE SHALL HAVE ANSI CLASS 125 OR CLASS 250 FLANGE CONNECTIONS IN A SLIP 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 SHAFT 431 STAINLESS STEEL
- .4 MOTOR STOOL 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 PTFE .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 PLATE: 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, MOTOR COUPLINGS, MOTOR AND SEAL COVER. THE ENTIRE CARTRIDGE SHAFT SEAL SHALL BE REMOVABLE AS A ONE PIECE COMPONENT. PUMPS WITH MOTORS EQUAL TO OR LARGER THAN 15 HP (FIFTEEN HORSEPOWER) SHALL HAVE ADEQUATE SPACE WITHIN THE MOTOR STOOL SO THAT SHAFT SEAL REPLACEMENT IS VARIABLE FREQUENCY DRIVE MOTORS
- .1 EACH MOTOR SHALL HAVE A VARIABLE FREQUENCY DRIVE SHIPPED LOOSE .2 THE VFD SHALL BE OF THE PWM (PULSE WIDTH MODULATION) DESIGN
- .2 THE VED SHALL BE OF THE PWM (PULSE WIDTH MODULATION) DESIGN USING CURRENT IGBT (INSULATED GATE BIPOLAR TRANSISTOR) TECHNOLOGY.
   .3 THE VED SHALL CONVERT INCOMING FIXED FREQUENCY THREE—PHASE AC POWER INTO A VARIABLE FREQUENCY AND VOLTAGE FOR CONTROLLING THE SPEED OF MOTOR. THE MOTOR CURRENT SHALL CLOSELY APPROXIMATE A SINE WAVE. MOTOR VOLTAGE SHALL BE VARIED WITH FREQUENCY TO MAINTAIN DESIRED MOTOR MAGNETIZATION CURRENT SUITABLE FOR
- CENTRIFUGAL PUMP CONTROL AND TO ELIMINATE THE NEED FOR MOTOR DE-RATING. .4 THE VFD SHALL UTILIZE AN ENERGY OPTIMIZATION ALGORITHM TO MINIMIZE ENERGY CONSUMPTION. THE OUTPUT VOLTAGE SHALL BE ADJUSTED IN
- RESPONSE TO THE LOAD, INDEPENDENT OF SPEED. .5 THE VFD SHALL AUTOMATICALLY REDUCE 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. THE SWITCHING FREQUENCY SHALL BE REDUCED BEFORE MOTOR SPEED IS REDUCED. .6 AN INTEGRAL 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 TRIP WITHIN THE RANGE OF 125-150% OF RATED CURRENT.
  .9 THE INTEGRATED VFD MOTOR SHALL INCLUDE PROTECTION AGAINST INPUT TRANSIENTS, PHASE IMBALANCE, LOSS OF AC LINE PHASE, OVER-VOLTAGE, UNDED VOLTAGE VFD MOTOR SHALL INCLUDE MOTOR OF ACTION AGAINST INPUT TRANSIENTS, PHASE IMBALANCE, LOSS OF AC LINE PHASE, OVER-VOLTAGE,
- UNDER-VOLTAGE, VFD OVER-TEMPERATURE, AND MOTOR OVER-TEMPERATURE. THREE-PHASE INTEGRATED VFD MOTORS SHALL BE CAPABLE OF PROVIDING FULL OUTPUT VOLTAGE AND FREQUENCY WITH A VOLTAGE IMBALANCE OF UP TO 10%. .10 THE VFD MOTOR SHALL HAVE, AS A MINIMUM, THE FOLLOWING
- INPUT/OUTPUT CAPABILITIES:
- .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 FLOW RATE FOR THE PUMP AT FULL RATED SPEED. SWITCHED TO THE "OFF" POSITION BUT WITH ELECTRICITY SUPPLY STILL CONNECTED). THE INOPERATIVE PUMPS SHALL BE SWITCHED ON FOR
- PERIOD OF TWO TO THREE (3-4) SECONDS EVERY 24 HOURS, 48 HOURS OR ONCE PER WEEK AND AT SPECIFIC TIME OF DAY (USER SELECTABLE). .18 THE CONTROLLER SHALL BE CAPABLE OF CHANGING THE NUMBER OF PUMPS AVAILABLE TO OPERATE OR HAVE THE ABILITY LIMIT THE MAXIMUM POWER CONSUMPTION BY ACTIVATION OF A DIGITAL INPUT FOR PURPOSES
- OF LIMITED GENERATOR SUPPLIED POWER. .19 THE CONTROLLER SHALL BE CAPABLE OF DISPLAYING INSTANTANEOUS POWER CONSUMPTION (WATTS 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
- .2 PROPORTIONAL PRESSURE CONTROL
- .3 PUMP OUTSIDE OF DUTY RANGE 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 LOWER FLOW-RATES AND INCREASING PRESSURE SET-POINT AT HIGHER 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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IVA	٩C	SPECIFICATIONS
	.24	FLOPORTIONAL PRESSURE CONTROL THAT USES ACTUAL OR CALCULATED FLOW RATE. THE CONTROLLER SHALL HAVE THE ABILITY TO COMMUNICATE COMMON FIELD-BUS PROTOCOLS, (BACNET, MODBUS, PROFIBUS, AND LON), VIA
	.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.
٨.	.26 SYST	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. EM 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
	.2	BACTERIA GROWTH INSIDE MANIFOLD. THE SUCTION AND DISCHARGE MANIFOLDS MATERIAL SHALL BE 316 STAINLESS STEEL. MANIFOLD CONNECTION SIZES SHALL BE AS FOLLOWS: .1 3 INCH AND SMALLER: MALE NPT THREADED .2 4 INCH THROUGH 8 INCH: ANSI CLASS 150 .3 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 OR EFOXY COATED IRON (FUSION BONDED) WITH AN
	.5	FOR SYSTEMS THAT REQUIRE A DIAPHRAGM TANK, A CONNECTION OF NO
	.6	SMALLER THAN <sup>3</sup> / <sub>4</sub> " SHALL BE PROVIDED ON THE DISCHARGE MANIFOLD. 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%
	.7	FULL SCALE. THE OUTPUT SIGNAL SHALL BE 4-20 MA WITH A SUPPLY VOLTAGE RANGE OF 9-32 VDC. 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
	.8 .9	SPAN WITHOUT REQUIRING RECALIBRATION. SYSTEMS WITH A FLOODED SUCTION INLET OR SUCTION LIFT CONFIGURATION SHALL HAVE A FACTORY INSTALLED WATER SHORTAGE PROTECTION DEVICE ON THE SUCTION MANIFOLD. THE BASE FRAME SHALL BE CONSTRUCTED OF CORROSION RESISTANT 304 STAINLESS STEEL PURPER VIRPATION DAMPERS SHALL BE FITTED BETWEEN
	.10	EACH PUMPS AND BASEFRAME TO MINIMIZE VIBRATION.
	TECT	ANEL SHALL BE MOUNTED IN ONE OF THE FOLLOWING WATS: .1 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)
	.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.
	.Z	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.
1.2	.1 CLOS	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. SE COUPLED IN-LINE PUMP (P-9, P-10, P-11)
А. 1	GENE FURN	RAL IISH AND INSTALL CLOSE COUPLED IN-LINE PUMPS AS PER PLANS
2	THE PUMF	PUMP SCHEDULE. PUMP AND ELECTRIC MOTOR SHALL BE FACTORY ASSEMBLED AT THE P MANUFACTURER'S FACILITY. THE PUMP MANUFACTURER SHALL HAVE
3.	COMF PUMF	PLETE UNIT RESPONSIBILITY. PS
1	THE CAST	PUMPS SHALL BE CLOSE COUPLED, SINGLE STAGE, IN-LINE DESIGN, IRON BRONZE FITTED CONSTRUCTION.
Z	.1	ALL 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 SUMUL HAVE INTEGRALY CAST
		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
	.2	DESIGN SPEED. PUMPS SHALL BE FITTED WITH BRONZE RENEWABLE CASE WEAR
	.3	RINGS. SUCTION AND DISCHARGE FLANGES SHALL BE DRILLED TO ANSI CLASS
	.4	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
	.5	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
	.6	RECIRCULATION LINE OF NYLON TUBING WITH BRASS FITTING SHALL BE PROVIDED TO VENT THE MECHANICAL SEAL
	.7	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 KEYED TO THE SHAFT. THE IMPELLER SHALL BE TRIMMED TO MEET THE SPECIFIC HYDRAULIC REQUIREMENTS.

HVAC SPECIFICATIONS

### CLASS 65

.1

- 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 III932 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
- MOTORS SHALL MEET SCHEDULED HORSEPOWER, SPEED, VOLTAGE, AND .1
- 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
- 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.

.8 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-



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.
<ol> <li>ISSUED FOR REVIEW 10.10.23</li> <li>ISSUED FOR PERMIT 14.11.23</li> <li>ISSUED FOR TENDER 14.02.24</li> </ol>
HVAC Renovations
Glendale Secondary School
145 Rainbow Dr, Hamilton, ON For the HWDSB
SEAL:
EXP Services Inc. t: 905.525.6069   f: 905.528.7310 1266 South Service Road, Suite C1-1, Stoney Creek, ON, L8E 5R9 Canada
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TRUE NORTH:
Mechanical Specifications
SCALE: AS NOTED
DRAWN: C.M. / J.L. DATE:
SEPTEMBER 2023 PROJECT #: ALL-23010629-40
DRAWING #:
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### 1. <u>GENERAL</u>

- 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. . 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 TRADE CERTIFIED ELECTRICIANS REGULARLY EMPLOYED
- BY THE CONTROL SUB-CONTRACTOR. D. THE CONTROLS CONTRACTOR WILL SPECIFICALLY READ ALL MECHANICAL AND ELECTRICAL DRAWINGS, SPECIFICATIONS, AND ADDENDA 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 (BACS) 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 BACS 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 BACS CONTRACTOR RESPONSIBLE FOR EXAMINING THE SPECIFICATIONS FOR
- CONTRADICTIONS AND OVERLAP. E. THE BACS 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. 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. <u>SCOPE OF WORK</u>

- A. THIS PROJECT SCOPE SHALL INCLUDE, BUT NOT BE LIMITED TO, THE FOLLOWING 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 BACS CONTRACT WILL ONLY BE ACCEPTED FROM AUTHORIZED VENDORS/INSTALLERS OF THE FOLLOWING MANUFACTURERS: - CONVERGINT TECHNOLOGIES
- 4. <u>SYSTEM PERFORMANCE</u>
- 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.
- 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. <u>SUBMITTAL REQUIREMENTS</u>

- 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 PRODUCT, THE DATA SPECIFICALLY APPLICABLE TO THE PROJECT 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.
- 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. WARRANT 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 ONSITE PREVENTATIVE MAINTENANCE DURING WARRANTY PERIOD. EIGHT (8) HOURS AT SIX (6) MONTHS, AND EIGHT (8) HOURS AT TEN (10) MONTHS AFTER SUBSTANTIAL COMPLETION OF ONSITE 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 CERTIFICATES 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-COMPLAINT 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.
- .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 USER 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 ADDITIONAL SOFTWARE TO BE INSTALLED ON THE CLIENT DEVICE (I.E. VPN CLIENT) SECURE REMOTE ACCESS TO THE BAS SHALL NOT REQUIRE ANY INBOUND
- PORTS ON A FIREWALL TO BE "EXPOSED" OR "FORWARDED". D. SECURE REMOTE ACCESS TO THE BAS SHALL BE AVAILABLE ANYWHERE, ANYTIME
- USING A COMPATIBLE CLIENT DEVICE (PC/TABLET/PHONE) E. THIS PROJECT SHALL BE COMPRISED OF A HIGH SPEED ETHERNET NETWORK UTILIZING BACNET/IP COMMUNICATIONS BETWEEN SYSTEM CONTROLLERS. EACH SYSTEM CONTROLLER SHALL FUNCTION AS A BACNET ROUTER TO EACH UNIT CONTROLLER PROVIDING A UNIQUE BACNET DEVICE ID FOR ALL CONTROLLERS WITHIN THE SYSTEM. COMMUNICATIONS BETWEEN SYSTEM CONTROLLERS AND
- SUB-NETWORKS OF CUSTOM APPLICATION CONTROLLERS AND/OR APPLICATION SPECIFIC CONTROLLERS SHALL BE AS DEFINED BELOW. F. EACH SYSTEM CONTROLLER SHALL PERFORM COMMUNICATIONS TO A NETWORK OF CUSTOM APPLICATION AND APPLICATION SPECIFIC CONTROLLERS USING BACNET/ZIGBEE (802.15.4) AS DEFINED BY THE ZIGBEE STANDARD.
- .1 EACH COMMUNICATION INTERFACE SHALL BE ZIGBEE BUILDING AUTOMATION CERTIFIED PRODUCT AS DEFINED BY THE BACNET STANDARD AND THE ZIGBEE ALLIANCE.
- .2 EACH SYSTEM CONTROLLER SHALL FUNCTION AS A BACNET ROUTER TO EACH UNIT CONTROLLER PROVIDING A UNIQUE BACNET DEVICE ID FOR ALL CONTROLLERS WITHIN THE SYSTEM. .3 WIRELESS EQUIPMENT CONTROLLERS AND AUXILIARY CONTROL DEVICES SHAL
- CONFORM TO: .1 IEEE 802.15.4 RADIOS TO MINIMIZE RISK OF INTERFERENCE AND MAXIMIZE BATTERY LIFE, RELIABILITY, AND RANGE.
- .2 COMMUNICATION BETWEEN EQUIPMENT CONTROLLERS SHALL CONFORM TO ZIGBEE BUILDING AUTOMATION (ZBA) STANDARD AS BACNET TUNNELING DEVICES TO ENSURE FUTURE INTEGRATION OF OTHER ZBA CERTIFIED
- .3 OPERATING RANGE SHALL BE A MINIMUM OF 200 FEET (60 M); OPEN RANGE SHALL BE 2,500 FT. (762 M) WITH LESS THAN 2% PACKET ERROR RATE
- .4 TO MAINTAIN ROBUST COMMUNICATION, MESH NETWORKING AND TWO-WAY COMMUNICATIONS SHALL BE USED TO OPTIMIZE THE WIRELESS NETWORK HEALTH.
- SENSORS PER CONTROLLER TO SUPPORT AVERAGING, MONITORING, AND

- .5 WIRELESS COMMUNICATION SHALL BE CAPABLE OF MANY-TO-ONE
- MULTIPLE ZONE APPLICATIONS. .6 CERTIFICATIONS SHALL INCLUDE FCC CFR47 - RADIO FREQUENCY

## CONTROLS & INSTRUMENTATION SPEC.

- DEVICES SECTION 15.247 & SUBPART E G. EACH SYSTEM CONTROLLER SHALL PERFORM COMMUNICATIONS TO A NETWORK OF CUSTOMAPPLICATION 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 TRENDING, 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, NCLUDING AT A MINIMUM: GENERAL FACILITY PERFORMANCE METRICS,
- AUTOMATED FAULT DETECTION AND DIAGNOSTICS, BUILDING 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). 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, 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.
- .3 THE SYSTEM SHALL INCLUDE AN EMBEDDED AUTOMATED WEATHER FEED. .4 DATA SHALL BE STORED IN A CLASS 5 SECURE HOSTING LOCATION PROTECTED BY ISO 5001-COMPLAINT FIREWALL AND INTRUSION DETECTION SYSTEMS WITH SUPPORT FOR MAJOR NETWORK SECURITY PROTOCOLS SUCH AS HTTPS AND SFTP TO SECURELY ACCESS AND STORE DATA.
- 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 FOUIPMENT 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 ESTIMATÉS
- 3 PERFORMANCE ANALYTICS AND REPORTS ARE TO BE DEVELOPED AND REVIEWED WITH BUILDING OWNER DURING SCHEDULED PERFORMANCE REVIEW
- MFFTINGS. .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 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. .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.
- . 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 REMOTE 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 REQUIREMENT. THIS WILL PREVENT XYZ FROM PLACING ANY SERVICE CALLS THAT ARE NOT 100% 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 CORRECT 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 ALLOWS FOR SMARTER AND MORE EFFICIENT SERVICE THAT ENSURES ACCURATE CALLS IN CASES WHERE THIS TYPE OF MAINTENANCE IS RFOUIRFD.
- .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 REPORTING, XYZ MAY TRIP AN ALARM TO DEMONSTRATE REMOTE CAPABILITY PRIOR TO ACCEPTANCE.
- 10. <u>OPERATOR INTERFACE</u>
- A. FURNISH [1] PC BASED OPERATOR WEB INTERFACE AS SHOWN ON THE SYSTEM DRAWINGS. ÉACH 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 15 OR BETTER
- .2 8 GB RAM .3 500 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+ 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
- .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 USE 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 BE AVAILABLE FOR ALL SYSTEM FUNCTIONS 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 POINT.
- .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 OPFRATORS
- .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 VIEWER.
- .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. POINTS REPORT: PROVIDE A REPORT THAT LISTS THE CURRENT VALUE OF ALL

- 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 B 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" 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 Schoo 145 Rainbow Dr. Hamilton, ON For the HWDSB SEAL: **EXP** Services Inc. : 905.525.6069 | f: 905.528.7310 1266 South Service Road, Suite C1-1, Stoney Creek, ON, L8E 5R9 Canada www.exp.com BUILDINGS EARTH & ENVIRONMENT ENERGY INDUSTRIAL 
  INFRASTRUCTURE 
  SUSTAINABILITY TRUE NORTH: DRAWING TITLE: Mechanical Specifications
- SCALE: AS NOTED
- DRAWN C.M. / J.L.
- DATE: SEPTEMBER 2023
- PROJECT #:
- ALL-23010629-A0 DRAWING #:
- M0.8

POINTS

## 13. <u>CONTROLLER SOFTWARE</u>

- A. FURNISH THE FOLLOWING APPLICATIONS SOFTWARE FOR BUILDING AND ENERGY MANAGEMENT. ALL SOFTWARE APPLICATIONS SHALL RESIDE 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 ADVANCES 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 EXECUTED 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 THEN AND GREATER THAN 24 HOURS. PROVIDE THE ABILITY TO MODIFY THE START ALGORITHM BASED ON OUTDOOR AIR TEMPERATURE. PROVIDE 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
- .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. TIMED 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

## 14. <u>BUILDING CONTROLLERS</u>

- A. THERE SHALL BE ONE OR MORE INDEPENDENT, STANDALONE MICROPROCESSOR BASED SYSTEM CONTROLLERS TO MANAGE THE GLOBAL STRATEGIES DESCRIBED IN APPLICATION AND CONTROL SOFTWARE SECTION.
- B. THE SYSTEM CONTROLLER SHALL HAVE SUFFICIENT MEMORY TO SUPPORT ITS OPERATING SYSTEM, DATABASE, AND PROGRAMMING REQUIREMENTS.
- C. THE CONTROLLER SHALL PROVIDE A USB COMMUNICATIONS PORT FOR CONNECTION TO A PC.
- D. THE OPERATING SYSTEM OF THE CONTROLLER SHALL MANAGE THE INPUT AND OUTPUT COMMUNICATIONS SIGNALS TO ALLOW DISTRIBUTED CONTROLLERS TO SHARE REAL AND VIRTUAL POINT INFORMATION AND ALLOW CENTRAL MONITORING AND ALARMS.
- E. ALL SYSTEM CONTROLLERS SHALL HAVE A REAL TIME CLOCK.
- F. DATA SHALL BE SHARED BETWEEN NETWORKED SYSTEM CONTROLLERS. G. THE SYSTEM CONTROLLER SHALL CONTINUALLY CHECK THE STATUS OF ITS PROCESSOR AND MEMORY CIRCUITS. IF AN ABNORMAL OPERATION IS DETECTED, THE CONTROLLER SHALL
- .1 ASSUME A PREDETERMINED FAILURE MODE.
- .2 GENERATE AN ALARM NOTIFICATION. .3 CREATE A RETRIEVABLE FILE OF THE STATE OF ALL APPLICABLE MEMORY
- LOCATIONS AT THE TIME OF THE FAILURE. .4 AUTOMATICALLY RESET THE SYSTEM CONTROLLER TO RETURN TO A NORMAL OPERATING MODE.
- H. ENVIRONMENT. CONTROLLER HARDWARE SHALL BE SUITABLE FOR THE ANTICIPATED AMBIENT CONDITIONS. CONTROLLER USED IN CONDITIONED AMBIENT SHALL BE MOUNTED IN AN ENCLOSURE, AND SHALL BE RATED FOR OPERATION AT -40° C TO 50° C [-40° F TO 122° F].
- I. CLOCK SYNCHRONIZATION.
- .1 ALL SYSTEM CONTROLLERS SHALL BE ABLE TO SYNCHRONIZE WITH A NTP SERVER FOR AUTOMATIC TIME SYNCHRONIZATION.
- .2 ALL SYSTEM CONTROLLERS SHALL BE ABLE TO ACCEPT A BACNET TIME SYNCHRONIZATION COMMAND FOR AUTOMATIC TIME SYNCHRONIZATION.
- .3 ALL SYSTEM CONTROLLERS SHALL AUTOMATICALLY ADJUST FOR DAYLIGHT
- SAVINGS TIME IF APPLICABLE. J. SERVICEABILITY
- .1 PROVIDE DIAGNOSTIC LEDS FOR POWER, COMMUNICATIONS, AND PROCESSOR.
- .2 THE SYSTEM CONTROLLER SHALL HAVE A DISPLAY ON THE MAIN BOARD THAT INDICATES THE CURRENT OPERATING MODE OF THE CONTROLLER.
- .3 SD CARD SHOULD BE PROVIDED AND USED FOR LOCAL BACKUP. IF LOCAL BACKUP THROUGH SD CARD OR SIMILAR DEVICE IS NOT AVAILABLE THEN PROVIDE OPERATOR WORKSTATION WITH SUFFICIENT MEMORY PROVIDE SCHEDULED BACKUPS OF THE SYSTEM. BAS SERVICE PROVIDER SHALL BE RESPONSIBLE FOR BAS BACKUPS DURING THE WARRANTY PERIOD.
- .4 ALL WIRING CONNECTIONS SHALL BE MADE TO FIELD REMOVABLE, MODULAR TERMINAL CONNECTORS. .5 THE SYSTEM CONTROLLER SHALL UTILIZE STANDARD DIN MOUNTING METHODS FOR INSTALLATION AND REPLACEMENT.
- .6 MEMORY. THE SYSTEM CONTROLLER SHALL MAINTAIN ALL BIOS AND PROGRAMMING INFORMATION INDEFINITELY WITHOUT POWER TO THE SYSTEM CONTROLLER.
- IMMUNITY TO POWER AND NOISE. CONTROLLER SHALL BE ABLE TO OPERATE AT 90% TO 110% OF NOMINAL VOLTAGE RATING AND SHALL PERFORM AN ORDERLY SHUT-DOWN BELOW 80% NOMINAL VOLTAGE.
- .8 BACNET TEST LABS (BTL) LISTING. EACH SYSTEM CONTROLLER SHALL BE LISTED AS A BUILDING CONTROLLER (B-BC) BY THE BACNET TEST LABS WITH A MINIMUM BACNET PROTOCOL REVISION OF 14.

## CONTROLS & INSTRUMENTATION SPEC.

## 15. <u>AUXILLARY CONTROL DEVICES</u>

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, 13°C TO 30°C (55°F TO 85°F) SETPOINT RANGE, 1°C (2°F) 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, 13°C TO 30°C (55°F TO 85°F) SETPOINT RANGE, 1°C (2°F) 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 SENSED BY ANY 30 CM (1 FT) SECTION. THE LOW-LIMIT THERMOSTAT SHALL BE MANUAL RESET ONLY.

#### 16. <u>COORDINATION</u> A. SITE

- 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 INTERFACE 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 "COMMUNICATION" 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 THI 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. ). 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 CRIMPED 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.
- . ALL CONTROL WIRING SHALL BE INSTALLED AS CONTINUOUS LENGTHS, WHERE POSSIBLE. ANY REQUIRED SPLICES SHALL BE MADE ONLY WITHIN AN 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.
- . 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. <u>SUPPLY OF CONTROL DEVICES</u>

## CONTROLS & INSTRUMENTATION SPEC.

A. UNLESS OTHERWISE SPECIFIED, SUPPLY ALL REQUIRED CONTROL DAMPERS.	ALARN
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	• 0
B. PROVIDE LINKAGE AND OPERATORS FOR THE DAMPERS. WHEREVER POSSIBLE	• 0
LOCATE DAMPER OPERATORS SO THAT THEY ARE ACCESSIBLE FROM OUTSIDE DUCT, PLENUM, AND EQUIPMENT CASINGS, BRACKET MOUNT OPERATORS ON	• C
C. WHERE SEQUENCE OPERATION IS INDICATED, OR WHERE MULTIPLE OPERATORS	• E
DRIVE A SERIES OF DAMPERS, PROVIDE PILOT POSITIONERS TO COUPLE THEIR ACTION.	• E)
D. ENSURE THAT DAMPERS LOCATED IN DUCTWORK OTHER THAN GALVANIZED STEEL ARE CONSTRUCTED OF TYPE 316 STAINLESS STEEL.	• S
E. UNLESS OTHERWISE SPECIFIED, SUPPLY ALL REQUIRED AUTOMATIC CONTROL VALVES, HAND THE VALVES TO THE APPROPRIATE PIPING TRADES AT THE SITE IN	• S
THE LOCATIONS THEY ARE REQUIRED FOR INSTALLATION AS PART OF THE PIPING WORK. ENSURE THAT EACH VALVE IS PROPERLY SIZED, LOCATED AND INSTALLED.	• S LI
F. PROVIDE AN OPERATOR FOR EACH VALVE WITH ON/OFF CONTROL FOR 2 POSITION 0-10VDC OR 4-20MA FOR MODULATING FOR CONTROL SPRING	• E
RETURN ACTUATORS ARE REQUIRED ON AS DEFINED ON THE DRAWINGS FOR FAIL SAFE OPERATION, OR AS NEEDED TO PROTECT THE EQUIPMENT, SUCH AS	• E)
NORMAL CLOSED POSITION FOR OUTSIDE AIR DAMPERS.	• E) Ll
	• P
19. <u>TRAINING</u> A PROVIDE MINIMUM OF (4) TRAINING SESSIONS AND (4) HOURS FOR EACH	• FI
SESSION, THROUGHOUT THE CONTRACT PERIOD. THE TRAINING WILL BE PROVIDED FOR PERSONNEL DESIGNATED BY THE OWNER.	A
B. THESE OBJECTIVES WILL BE DIVIDED INTO LOGICAL GROUPINGS; PARTICIPANTS MAY ATTEND ONE OR MORE OF THESE, DEPENDING ON LEVEL OF KNOWLEDGE	• C, E)
REQUIRED:	• R
.2 BAS TROUBLESHOOTING & MAINTENANCE	• H
C. THE INSTRUCTOR(S) SHALL BE FACTORY-TRAINED AND EXPERIENCED IN TEACHING THIS TECHNICAL MATERIAL.	1:
D. TRAINING WILL BEGIN WHEN THE OPERATING AND MAINTENANCE MANUALS HAVE BEEN_DELIVERED TO THE OWNER OR REVIEWED BY THE ENGINEER'S	• L( (A
REPRESENTATIVE. E. BUILDING WALK THROUGH AND LOCATION OF CONTROL DEVICES	
F. OPERATING PROCEDURES	A. I THE U
G. MAINTENANCE PROCEDURES H. TROUBLE-SHOOTING PROCEDURES	FOLLO
I. SPARE PARTS REQUIRED	OCCU
AN ELECTRONIC COPY. THE DOCUMENTS SHALL BE SUBMITTED FOR APPROVAL PRIOR TO FINAL COMPLETION AND INCLUDE:	• A • A
.1 PROJECT RECORD DRAWINGS – THESE SHALL BE AS-BUILT VERSIONS OF THE SUBMITTAL SHOP DRAWINGS ONE SET OF ELECTRONIC MEDIA PDF	• U
DRAWING FILES SHALL BE PROVIDED.	• A
TRAINED FACTORY (EQUIPMENT MANUFACTURERS) AND FIELD (BAS) COMMISSIONING PERSONNEL.	• A
	THE U FRE
20. <u>OPERATING AND MAINTENANCE (O &amp; M) MANUALS</u>	<b>D</b> 1
A. THESE SHALL BE AS-BUILT VERSIONS OF THE SUBMITTAL PRODUCT DATA. IN ADDITION TO THE INFORMATION REQUIRED FOR THE SUBMITTALS. OPERATING &	THE U
MAINTENANCE MANUAL SHALL INCLUDE:	ALGOI WHILE
CONTRACTOR SERVICE DEPARTMENT ALONG WITH NAMES, ADDRESS OF SERVICE PERSONNEL RESPONSIBLE FOR SUPPORTING THE ONGOING	OCCU
WARRANTY AND SERVICES OF THE CONTROL SYSTEM.	THE S
TROUBLESHOOTING; AND HARDWARE REPAIR AND/OR REPLACEMENT PROCEDURES.	SHUTI HAVE
.3 ONE SET OF ELECTRONIC MEDIA CONTAINING FILES OF ALL OPERATOR COLOR GRAPHIC SCREENS FOR THE PROJECT.	THE I
.4 LOCAL SUPPLY STORE SHOULD HAVE A MINIMUM 3 UNIT CONTROLLERS, SYSTEM CONTROLLERS, AND ROOM SENSORS AVAILABLE FOR SAME DAY	DEFIN
PURCHASE. 5 DOCUMENTATION, INSTALLATION, AND MAINTENANCE INFORMATION FOR ALL	D. I
THIRD PARTY HARDWARE/SOFTWARE PRODUCTS PROVIDED INCLUDING PERSONAL COMPUTERS, PRINTERS, HUBS, SENSORS, VALVES, ETC.	FOLLO
.6 ORIGINAL ISSUE MEDIA FOR ALL SOFTWARE PROVIDED, INCLUDING OPERATING SYSTEMS, PROGRAMMING LANGUAGE, OPERATOR WORKSTATION SOFTWARE,	COOLI
AND GRAPHICS SOFTWARE. .7 LICENSES, GUARANTEE, AND WARRANTY DOCUMENTS FOR ALL EQUIPMENT	• TI
AND SYSTEMS. .8 RECOMMENDED PREVENTIVE MAINTENANCE PROCEDURES FOR ALL SYSTEM	• A
COMPONENTS INCLUDING A SCHEDULE OF TASKS (INSPECTION, CLEANING, CALIBRATION, ETC.) AND TASK DESCRIPTIONS.	• Al
	• Ti
21. <u>SEQUENCE OF OEPRATIONS</u> 21.1 <u>ENERGY RECOVERY VENTILATOR (ERV-1)</u>	• A
A. RUN CONDITIONS - CONTINUOUS:	۱۱ A •
THE UNIT SHALL SHUT DOWN AND GENERATE AN ALARM UPON RECEIVING SMOKE	W
DETECTOR STATUS.	• A
THE OUTSIDE AIR DAMPER SHALL OPEN ANYTIME THE UNIT RUNS AND SHALL CLOSE	HEATI
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	THE E
4SEC (ADJ.) AFTER THE SUPPLY FAN STOPS.	• 0 • A
ANYTIME THE UNIT STOPS. THE SUPPLY FAN SHALL START ONLY AFTER THE DAMPER	ΤI
4SEC (ADJ.) AFTER THE SUPPLY FAN STOPS.	• A
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	PERIO
STATUS HAS PROVEN THE DAMPER IS OPEN. THE OUTSIDE AIR DAMPER SHALL CLOSE 4SEC (ADJ.) AFTER THE EXHAUST FAN STOPS	THE E RUNS
C. FAN OPERATION:	FROS
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.)	THE E
MINIMUM RUNTIME, UNLESS SHUTDOWN ON SAFETIES. THE EXHAUST FAN SHALL RUN WHENEVER THE SUPPLY FAN RUNS. UNLESS	F. •
SHUTDOWN ON SAFETIES. SUPPLY AIR TEMPERATURE:	TO M
THE CONTROLLER SHALL MONITOR THE SUPPLY AIR TEMPERATURE. DURING WINTER	A US USER
AIR TEMPERATURE SETPOINT OF 72°F (ADJ.)	THE (
D. GAS HEATING STAGE:	• 0
HEATING TO MAINTAIN ITS HEATING SETPOINT. TO PREVENT SHORT CYCLING, THE	• A
THE HEATING SHALL BE ENABLED WHENEVER:	• A • ^
• OUTSIDE AIR TEMPERATURE IS LESS THAN 65°F (ADJ.).	• A
AND THE SUPPLY AIR TEMPERATURE IS BELOW HEATING SETPOINT.	J.

## CONTROLS & INSTRUMENTATION SPEC.

### MS SHALL BE PROVIDED AS FOLLOWS:

- UTSIDE AIR DAMPER FAILURE: COMMANDED OPEN, BUT THE STATUS IS CLOSED. UTSIDE AIR DAMPER IN HAND: COMMANDED CLOSED, BUT THE STATUS IS OPEN.
- ORE DAMPER FAILURE: COMMANDED OPEN, BUT THE STATUS IS CLOSED.
- ORE DAMPER IN HAND: COMMANDED CLOSED, BUT THE STATUS IS OPEN.
- XHAUST AIR DAMPER FAILURE: COMMANDED OPEN, BUT THE STATUS IS CLOSED.
- XHAUST AIR DAMPER IN HAND: COMMANDED CLOSED, BUT THE STATUS IS OPEN.
- UPPLY FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- UPPLY FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON. UPPLY FAN RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE IMIT (ADJ.).
- XHAUST FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- XHAUST FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
- XHAUST FAN RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE IMIT (ADJ.).
- REFILTER CHANGE REQUIRED: PREFILTER DIFFERENTIAL PRESSURE EXCEEDS A SER DEFINABLE LIMIT (ADJ.).
- INAL FILTER CHANGE REQUIRED: FINAL FILTER DIFFERENTIAL PRESSURE EXCEEDS USER DEFINABLE LIMIT (ADJ.)
- ARBON FILTER CHANGE REQUIRED: CARBON FILTER DIFFERENTIAL PRESSURE EXCEEDS A USER DEFINABLE LIMIT (ADJ.). ETURN 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 20°F (ADJ.).
- OW SUPPLY AIR TEMP: IF THE SUPPLY AIR TEMPERATURE IS LESS THAN 45'F ADJ.).

#### 21.2 <u>AIRHANDLING UNIT WITH ENTHALPY WHEEL (RTU-1)</u> RUN CONDITIONS:

UNIT SHALL RUN ACCORDING TO A USER DEFINABLE TIME SCHEDULE IN THE DWING MODES:

PIED MODE: THE UNIT SHALL MAINTAIN

- 75°F (ADJ.) COOLING SETPOINT
- 70°F (ADJ.) HEATING SETPOINT.
- NOCCUPIED MODE (NIGHT SETBACK): THE UNIT SHALL MAINTAIN
- 80°F (ADJ.) COOLING SETPOINT.
- 65°F (ADJ.) HEATING SETPOINT.
- UNIT SHALL SHUT DOWN AND GENERATE AN ALARM UPON RECEIVING A EEZESTAT STATUS.

#### ZONE OPTIMAL START:

UNIT SHALL USE AN OPTIMAL START ALGORITHM FOR MORNING START-UP. THIS RITHM SHALL MINIMIZE THE UNOCCUPIED WARM-UP OR COOL-DOWN PERIOD STILL ACHIEVING COMFORT CONDITIONS BY THE START OF A SCHEDULED JPIED PERIOD.

#### FAN OPRATION

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

RETURN FAN SHALL RUN WHENEVER THE SUPPLY FAN RUNS, UNLESS SHUTDOWN

AFETIES. TO PREVENT SHORT CYCLING, THE RETURN FAN SHALL HAVE A USER IABLE (ADJ.) MINIMUM RUNTIME.

ENTHALPY WHEEI CONTROLLER SHALL RUN THE ENTHALPY WHEEL FOR ENERGY RECOVERY AS DWS.

ING MODE:

- ENTHALPY WHEEL SHALL RUN FOR FULL COOL RECOVERY WHENEVER:
- HE OUTSIDE AIR ENTHALPY IS GREATER THAN THE RETURN AIR ENTHALPY.
- ND THE ZONE TEMPERATURE IS ABOVE COOLING SETPOINT.
- AND THE SUPPLY FAN IS ON. ENTHALPY WHEEL SHALL RUN FOR PARTIAL COOL RECOVERY WHENEVER:
- HE OUTSIDE AIR HUMIDITY RATIO IS LESS THAN THE RETURN AIR HUMIDITY RATIO
- ND THE OUTSIDE AIR TEMPERATURE IS GREATER THAN THE RETURN AIR
- EMPERATURE
- AND THE UNIT DISCHARGE AIR DRYBULB DOES NOT DROP BELOW THE ENTHALPY
- HEEL SUPPLY AIR DEWPOINT
- AND THE ZONE TEMPERATURE IS ABOVE COOLING SETPOINT
- AND THE SUPPLY FAN IS ON.

NG MODE:

- ENTHALPY WHEEL SHALL RUN FOR FULL HEAT RECOVERY WHENEVER:
- DUTSIDE AIR ENTHALPY IS LESS THAN RETURN AIR ENTHALPY ND THE OUTSIDE AIR TEMPERATURE IS LESS THAN THE RETURN AIR
- EMPERATURE
- AND THE ZONE TEMPERATURE IS BELOW HEATING SETPOINT.
- AND THE SUPPLY FAN IS ON.

DIC SELF-CLEANING: ENTHALPY WHEEL SHALL RUN FOR 10SEC (ADJ.) EVERY 4HR (ADJ.) THE UNIT

PROTECTION: ENTHALPY WHEEL FROST PROTECTION CONTROLS SHALL BE SUPPLIED AND ATED AS PER THE MANUFACTURERS INSTRUCTIONS.

COOLING STAGES:

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

- COOLING SHALL BE ENABLED WHENEVER: UTSIDE AIR TEMPERATURE IS GREATER THAN 60°F (ADJ.).
- ND THE ECONOMIZER (IF PRESENT) IS DISABLED OR FULLY OPEN.
- ND THE ZONE TEMPERATURE IS ABOVE COOLING SETPOINT.
- ND THE SUPPLY FAN STATUS IS ON.
- AND THE HEATING IS NOT ACTIVE.
- 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 65°F (ADJ.).
- AND THE ZONE TEMPERATURE IS BELOW HEATING SETPOINT.
- AND THE SUPPLY FAN STATUS IS ON.
- AND THE COOLING IS NOT ACTIVE.

THE CONTROLLER SHALL MONITOR THE DIFFERENTIAL PRESSURE ACROSS THE:

- PREFILTER.
- FINAL FILTER. RETURN FILTER
- CARBON FILTER

- E. FILTER MONITOR:
- AND THE FAN STATUS IS ON.

CONTROLS & INSTRUMENTATION SPEC.
K. 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:
<ul> <li>OUTSIDE AIR TEMPERATURE IS LESS THAN 65°F (ADJ.).</li> <li>AND THE OUTSIDE AIR ENTHALPY IS LESS THAN 22BTU/LB (ADJ.).</li> </ul>
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 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
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.).
DURING DEHUMIDIFICATION, THE MODULATING CONDENSER REHEAT SHALL MODULATE
DEHUMIDIFICATION SHALL BE ENABLED WHENEVER:
• THE SUPPLY FAN STATUS IS ON.
<ul> <li>AND ZONE TEMPERATURE IS GREATER THAN THE COOLING SETPOINT.</li> <li>N. MISCELLEANOUS MONITORING:</li> </ul>
THE CONTROLLER SHALL MONITOR THE DIFFERENTIAL PRESSURE ACROSS THE PREFILTER.
THE CONTROLLER SHALL MONITOR THE DIFFERENTIAL PRESSURE ACROSS THE FINAL
THE CONTROLLER SHALL MONITOR THE MIXED AIR TEMPERATURE AND USE AS
O. RETURN AIR CARBON DIOXIDE (CO2) CONCENTRATION MONITORING:
THE CONTROLLER SHALL MEASURE THE RETURN AIR CO2 CONCENTRATION.
FOR ECONOMIZER CONTROL.
REQUIRED FOR ECONOMIZER CONTROL.
THE CONTROLLER SHALL MONITOR THE SUPPLY AIR TEMPERATURE.
• HIGH ZONE TEMP: IF THE ZONE TEMPERATURE IS GREATER THAN THE COOLING
• 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.
<ul> <li>SUPPLY FAN RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT (ADJ.).</li> </ul>
• RETURN FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
<ul> <li>RETURN FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.</li> <li>RETURN FAN RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE</li> </ul>
LIMIT (ADJ.).
• ENTHALPY WHEEL ROTATION FAILURE: COMMANDED ON, BUT THE STATUS IS OFF. • ENTHALPY WHEEL IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
<ul> <li>ENTHALPY WHEEL RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT (ADJ.).</li> </ul>
PREFILTER CHANGE REQUIRED: PREFILTER DIFFERENTIAL PRESSURE EXCEEDS A
• FINAL FILTER CHANGE REQUIRED: FINAL FILTER DIFFERENTIAL PRESSURE EXCEEDS
A USER DEFINABLE LIMIT (ADJ.). • HIGH MIXED AIR TEMP: IF THE MIXED AIR TEMPERATURE IS CREATER THAN 90°E
(ADJ.).
• LOW MIXED AIR TEMP: IF THE MIXED AIR TEMPERATURE IS LESS THAN 45°F (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 CREATER THAN
70% (ADJ.).
• LOW RETURN AIR HUMIDITY: IF THE RETURN AIR HUMIDITY IS LESS THAN 35% (ADJ.).
<ul> <li>HIGH RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS GREATER THAN 90°F (ADJ.).</li> </ul>
<ul> <li>LOW RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS LESS THAN 45*F (ADJ.).</li> </ul>
HIGH SUPPLY AIR TEMP: IF THE SUPPLY AIR TEMPERATURE IS GREATER THAN
1201 (ADJ.). • LOW SUPPLY AIR TEMP: IF THE SUPPLY AIR TEMPERATURE IS LESS THAN 45°F
(ADJ.).

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#### 21.3 <u>AIRHANDLING UNIT (RTU-2)</u> 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 75°F (ADJ.) COOLING SETPOINT

- A 70°F (ADJ.) HEATING SETPOINT.
- UNOCCUPIED MODE (NIGHT SETBACK): THE UNIT SHALL MAINTAIN
- A 80°F (ADJ.) COOLING SETPOINT.
- A 65°F (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 60°F (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 65°F (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 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 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 45°F TO 40°F (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. MISCELLENOUS 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.).

## CONTROLS & INSTRUMENTATION SPEC.

• 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 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 90°F (ADJ.). • LOW RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS LESS THAN
- 45°F (ADJ.). • HIGH SUPPLY AIR TEMP: IF THE SUPPLY AIR TEMPERATURE IS GREATER
- THAN 120°F (ADJ.).
  LOW SUPPLY AIR TEMP: IF THE SUPPLY AIR TEMPERATURE IS LESS THAN 45°F (ADJ.).
- 21.4 <u>UNIT\_VENTILATOR (UV-1, UV-2)</u>

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: 28°C (ADJ.)
- COOLING OCCUPIED: 24°C (ADJ.)
- HEATING UNOCCUPIED: 18<sup>•</sup>C (ADJ.)
- HEATING OCCUPIED: 21°C (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.

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 60°F (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 65°F (ADJ.).
- AND THE ZONE TEMPERATURE IS BELOW HEATING SETPOINT.
- AND THE FAN IS ON.

TEMPERATURE.

THE RETURN DAMPER

RISE ABOVE 750PPM (ADJ.).

STATUS

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:

• AND THE OUTSIDE AIR TEMPERATURE IS LESS THAN 75°F (ADJ.)

THE OUTSIDE AIR DAMPERS SHALL CLOSE AND THE RETURN AIR DAMPER SHALL

THE CONTROLLER SHALL MONITOR THE DISCHARGE AIR TEMPERATURE. SHOULD

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

DISCHARGE TEMPERATURE DROP BELOW A USER DEFINABLE TEMPERATURE (ADJ.), THE

CONTROLLER SHALL ENABLE THE HEATING, CLOSE THE OUTSIDE DAMPER AND OPEN

WHEN IN THE OCCUPIED MODE, THE CONTROLLER SHALL MEASURE THE ZONE CO2

CONCENTRATIONS, OVERRIDING NORMAL DAMPER OPERATION AS CO2 CONCENTRATIONS

THE CONTROLLER SHALL MONITOR THE DIFFERENTIAL PRESSURE ACROSS THE FILTER.

• HIGH ZONE TEMP: IF THE ZONE TEMPERATURE IS GREATER THAN THE

• FILTER CHANGE REQUIRED: FILTER DIFFERENTIAL PRESSURE EXCEEDS A

· HIGH DISCHARGE AIR TEMP: IF THE DISCHARGE AIR TEMPERATURE IS

• LOW DISCHARGE AIR TEMP: IF THE DISCHARGE AIR TEMPERATURE IS LESS

• LOW ZONE TEMP: IF THE ZONE TEMPERATURE IS LESS THAN THE HEATING

COOLING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).

CONCENTRATION AND OPEN THE OUTSIDE AIR DAMPERS ON RISING CO2

THE CONTROLLER SHALL MONITOR THE DISCHARGE AIR TEMPERATURE.

THE CONTROLLER SHALL MEASURE THE ZONE CO2 CONCENTRATION.

SETPOINT BY A USER DEFINABLE AMOUNT (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

• HIGH ZONE CARBON DIOXIDE CONCENTRATION: IF THE ZONE CO2

THE CONTROLLER SHALL MONITOR THE FAN STATUS.

ALARMS SHALL BE PROVIDED AS FOLLOWS:

USER DEFINABLE LIMIT (ADJ.).

GREATER THAN 120°F (ADJ.).

THAN 40°F (ADJ.).

DEFINABLE LIMIT (ADJ.).

THE ECONOMIZER SHALL CLOSE WHENEVER THE FREEZESTAT IS ON.

AIR DAMPER SHALL MODULATE TO FULLY CLOSED.

H. CARBON DIOXIDE (CO2) CONTROL:

• OUTSIDE AIR TEMPERATURE IS AT LEAST 3°F (ADJ.) LESS THAN THE ZONE

## CONTROLS & INSTRUMENTATION SPEC.

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

OCCUPIED MODE. 21.5 <u>PERIMETER RADIATORS</u>

A. RUN CONDITIONS:

THE UNIT SHALL RUN CONTINUOUSLY AND SHALL MAINTAIN A HEATING SETPOINT OF 70°F (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 65°F (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 65°F (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 38°F (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 0°F (ADJ.) TO 70°F (ADJ.) THE HOT WATER SUPPLY TEMPERATURE SETPOINT SHALL RESET DOWNWARDS BY SUBTRACTING FROM 0°F (ADJ.) UP TO 20°F (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

10°F (ADJ.) STAGE OFF IF HOT WATER SUPPLY TEMPERATURE RISES ABOVE SETPOINT BY 20°F (ADJ.)

THIRD BOILER:

H. STAGE ON IF HOT WATER SUPPLY TEMPERATURE DROPS BELOW SETPOINT BY 10°F (ADJ.)
 STAGE OFF IF HOT WATER SUPPLY TEMPERATURE RISES ABOVE SETPOINT BY 20°F

(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
- WEEKLYMONTHLY

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

21.7 <u>AIR HANDLING UNIT (AHU-10, AHU-11)</u>

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

## CONTROLS & INSTRUMENTATION SPEC.

• A 80°F (ADJ.) COOLING SETPOINT.

• A 65°F (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 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. 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 60°F (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 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 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 45°F TO 40°F (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. H. 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.).

THE CONTROLLER SHALL MONITOR THE RETURN AIR HUMIDITY AND USE AS REQUIRED

• HIGH ZONE TEMP: IF THE ZONE TEMPERATURE IS GREATER THAN THE COOLING

• LOW ZONE TEMP: IF THE ZONE TEMPERATURE IS LESS THAN THE HEATING

• SUPPLY FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.

• SUPPLY FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.

• 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

• FILTER CHANGE REQUIRED: PREFILTER DIFFERENTIAL PRESSURE EXCEEDS A

• LOW MIXED AIR TEMP: IF THE MIXED AIR TEMPERATURE IS LESS THAN 45°F

• HIGH RETURN AIR CARBON DIOXIDE CONCENTRATION: IF THE RETURN AIR CO2

• HIGH RETURN AIR HUMIDITY: IF THE RETURN AIR HUMIDITY IS GREATER THAN

• LOW RETURN AIR HUMIDITY: IF THE RETURN AIR HUMIDITY IS LESS THAN 35%

• HIGH RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS GREATER THAN

• LOW RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS LESS THAN 45°F

• HIGH SUPPLY AIR TEMP: IF THE SUPPLY AIR TEMPERATURE IS GREATER THAN

• LOW SUPPLY AIR TEMP: IF THE SUPPLY AIR TEMPERATURE IS LESS THAN 45'F

THE HOT WATER PUMPS SHALL BE ENABLED WHENEVER OUTSIDE AIR TEMPERATURE IS

21.8 <u>SYSTEM PUMPS (P-1, P-2, P-3, P-4, P-5, P-6)</u>

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

• HIGH MIXED AIR TEMP: IF THE MIXED AIR TEMPERATURE IS GREATER THAN 90°F

• SUPPLY FAN RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER

. MISCELLENOUS MONITORING:

REQUIRED FOR ECONOMIZER CONTROL

REQUIRED FOR ECONOMIZER CONTROL

DEFINABLE LIMIT (ADJ.).

DEFINABLE LIMIT (ADJ.).

(ADJ.).

(ADJ.).

70% (ADJ.).

90°F (ADJ.).

120°F (ADJ.)

A. RUN CONDITIONS:

LESS THAN 54°F (ADJ.).

(ADJ.).

(ADJ.).

(ADJ.).

USER DEFINABLE LIMIT (ADJ.).

ALARMS SHALL BE PROVIDED AS FOLLOWS:

FOR ECONOMIZER CONTROL

THE CONTROLLER SHALL MONITOR THE DIFFERENTIAL PRESSURE ACROSS THE PREFILTER. THE CONTROLLER SHALL MONITOR THE MIXED AIR TEMPERATURE AND USE AS

THE CONTROLLER SHALL MEASURE THE RETURN AIR CO2 CONCENTRATION.

THE CONTROLLER SHALL MONITOR THE SUPPLY AIR TEMPERATURE.

SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).

SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).

THE CONTROLLER SHALL MONITOR THE RETURN AIR TEMPERATURE AND USE AS

CONTROLS & INSTRUMENTATION SPEC.		١
THE PUMPS SHALL RUN FOR FREEZE PROTECTION ANYTIME OUTSIDE AIR		
TEMPERATURE IS LESS THAN 38°F (ADJ.). TO PREVENT SHORT CYCLING, THE PUMPS SHALL RUN FOR AND BE OFF FOR MINIMUM ADJUSTABLE TIMES (BOTH USER DEFINABLE). B I FAD/LAG OPFRATION:		
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	· · · · · · · · · · · · · · · · · · ·	THESE DRAWINGS ARE NOT TO BE SCALED
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		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.
PUMP SHALL TURN OFF. <ul> <li>ON DECREASING HOT WATER DIFFERENTIAL PRESSURE, THE LAG PUMP SHALL</li> <li>STAGE ON AND RUN IN UNISON WITH THE LEAD PUMP TO MAINTAIN HOT WATER</li> </ul>		THE CONTRACTOR MUST FIELD VERIFY ALL DIMENSIONS AND MUST CONFIRM & CORRELATE ALL DETAILS WITHIN THE FULL DRAWING DACK OF DETAILS PROVIDED
DIFFERENTIAL PRESSURE SETPOINT. THE DESIGNATED LEAD PUMP SHALL ROTATE UPON ONE OF THE FOLLOWING		FOR SAME THROUGHOUT CONSTRUCTION, REPORTING ANY DISCREPANCIES TO THE ARCHITECT PRIOR TO COMMENCING THE RELEVANT WORK
CONDITIONS (USER SELECTABLE): • MANUALLY THROUGH A SOFTWARE SWITCH • IF PLIMP PLINTIME (ADL) IS EXCEEDED		ALL DRAWINGS, DETAILS & SPECIFICATIONS REPRESENTED IN THE DRAWINGS ARE TO BE USED FOR CONSTRUCTION ONLY WHEN
• DAILY		ISSUED BY THE ARCHITECT AND NOTED ACCORDINGLY IN THE "ISSUE/REVISIONS" BOX HEREON.
• WEEKLY • MONTHLY		<ol> <li>ISSUED FOR REVIEW 22.09.23</li> <li>ISSUED FOR REVIEW 10.10.23</li> </ol>
(P-1, P-2) HOT WATER DIFFERENTIAL PRESSURE CONTROL: THE CONTROLLER SHALL MEASURE HOT WATER DIFFERENTIAL PRESSURE AND	-	<ol> <li>3. ISSUED FOR PERMIT 14.11.23</li> <li>4. ISSUED FOR TENDER 14.02.24</li> </ol>
MODULATE THE HOT WATER PUMP VEDS 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:	-	
<ul> <li>THE CONTROLLER SHALL MODULATE THE LEAD VFD TO MAINTAIN SETPOINT.</li> <li>IF THE LEAD VFD SPEED IS GREATER THAN A SETPOINT OF 90% (ADJ.), THE</li> </ul>		PROJECT:
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 VED TO MAINTAIN STRONG		HVAC Renovations
NUN IN UNISON WITH THE LEAD VED TO MAINTAIN SETPOINT. ON RISING HOT WATER DIFFERENTIAL PRESSURE, THE VEDS SHALL STAGE OFF AS FOLLOWS:		Glendale
<ul> <li>IF THE VFDS SPEEDS DROPS BACK TO 60% (ADJ.) BELOW SETPOINT, THE LAG VFD SHALL STAGE OFF.</li> </ul>		Secondary
• THE LEAD VFD SHALL CONTINUE TO RUN TO MAINTAIN SETPOINT. P $-3/P-4$ AND P $-5/P-6$ OPERATION:		School
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.		145 Rainbow Dr, Hamilton. ON
C. HOT WATER TEMPERATURE MONITORING: THE FOLLOWING TEMPERATURES SHALL BE MONITORED: • HOT WATER SUPPLY.		For the HWDSB
HOT WATER RETURN.		SEAL:
<ul> <li>ALARMS SHALL BE PROVIDED AS FOLLOWS:</li> <li>HOT WATER PUMP (P-1, P-3, P-5)</li> </ul>		
FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.		
RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT.		
<ul> <li>VFD FAULT.</li> <li>HOT WATER PUMP (P-2, P-4, P-6)</li> </ul>		
• FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.		
<ul> <li>RUNNING IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.</li> <li>RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT.</li> </ul>	-	
• VFD FAULT.	E	EXP Services Inc.
<ul> <li>HIGH HOT WATER DIFFERENTIAL PRESSURE: IF 25% (ADJ.) GREATER THAN SETPOINT.</li> </ul>	t: 1 S	: 905.525.6069   f: 905.528.7310 266 South Service Road, Suite C1-1, Stoney Creek,
<ul> <li>LOW HOT WATER DIFFERENTIAL PRESSURE: IF 25% (ADJ.) LESS THAN SETPOINT.</li> <li>HIGH HOT WATER SUPPLY TEMP: IF THE HOT WATER SUPPLY TEMPERATURE IS GREATER THAN 200°F (ADJ.).</li> </ul>	C C	DN, L8E 5R9 Canada vww.exp.com
<ul> <li>LOW HOT WATER SUPPLY TEMP: IF THE HOT WATER SUPPLY TEMPERATURE IS LESS THAN 120°F (ADJ.).</li> </ul>		
21.9 <u>PACKAGED AIR HANDLING UNIT (AHU-9, AHU-12)</u> A. RUN CONDITIONS:		
THE UNIT SHALL KUN ACCORDING TO A USER DEFINABLE TIME SCHEDULE IN THE FOLLOWING MODES: • OCCUPIED MODE: THE LINIT SHALL MAINTAIN		
A 75'F (ADJ.) COOLING SETPOINT	=	
• A 72°F (ADJ.) HEATING SETPOINT UNOCCUPIED MODE (NIGHT SETBACK): THE UNIT SHALL MAINTAIN	•	INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY
<ul> <li>A 85°F (ADJ.) COOLING SETPOINT</li> <li>A 60°F (ADJ.) HEATING SETPOINT</li> </ul>		TRUE NORTH:
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 LIDON DECENTING 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 AND SMOKE DETECTOR STATUS		DRAWING TITLE:
C. SUPPLY FAN: THE SUPPLY FAN SHALL RUN ANYTIME THE LINIT IS COMMANDED TO RUN UNLESS		Mechanical
SHUTDOWN ON SAFETIES. TO PREVENT SHORT CYCLING, THE SUPPLY FAN SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.		Specifications
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:	.	SCALE:
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	.	AS NOTED
• OUTSIDE AIR TEMPERATURE IS GREATER THAN 60°F (AD.1.)		C.M. / J.L.
		SEPTEMBER 2023
		PROJECT #: ALL-23010629-A0

DRAWING #:

- 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. MISCELLEANOUS 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.).

	HESE DRAWINGS ARE NOT TO BE SCALED ALL DRAWINGS, THE DESIGN, AND THE VETAILS THEREON REMAIN THE PROPERTY F THE CONSULTANT AND ARE NOT TO BE ALTERED, RE-USED OR REPRODUCEL WITHOUT THE CONSULTANT'S EXPRESS WRITTEN CONSENT. THE CONTRACTOR MUST FIELD VERIFY ALL DIMENSIONS AND MUST CONFIRM & CORRELATE ALL DETAILS WITHIN THE FULL OR SAME THROUGHOUT CONSTRUCTION REAWING PACKAGE BEING RESPONSIBLE OR SAME THROUGHOUT CONSTRUCTION REPORTING ANY DISCREPANCIES TO THE RECHITECT PRIOR TO COMMENCING THE RELEVANT WORK ALL DRAWINGS, DETAILS & SPECIFICATIONS REPRESENTED IN THE DRAWINGS ARE TO SEVEND FOR CONSTRUCTION ONLY WHEN SSUED BY THE ARCHITECT AND NOTED ACCORDINGLY IN THE "ISSUE/REVISIONS"
	ISSUED FOR REVIEW 22.09.23 ISSUED FOR REVIEW 10.10.23 ISSUED FOR PERMIT 14.11.23 ISSUED FOR TENDER 14.02.24
	HVAC Renovations
	Glendale Secondary School 145 Rainbow Dr,
f S	Tamilton, ON For the HWDSB
E	<b>XP</b> Services Inc.
t: 9 12 SL Of Ca	205.525.6069   f: 905.528.7310 66 South Service Road, lite C1-1, Stoney Creek, N, L8E 5R9 Inada
-	BUILDINGS • EARTH & ENVIRONMENT • ENER
● IN	DUSTRIAL • INFRASTRUCTURE • SUSTAINABIL
	Mechanical Specifications
5	SCALE: AS NOTED DRAWN:
	C.M. / J.L.



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	
2 DEMOLISH AND DISPOSE OF EXISTING HORIZONTAL BOILER SYSTEM PUMPS. PROVIDE CAPPED CONNECTION AND PREPARE PIPING FOR INSTALLATION OF NEW VERTICAL INLINE SYSTEM	
3 EXISTING EXPANSION TANKS ON MEZZANINE LEVEL TO REMAIN.	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 STORES
4 EXISTING AIR COMPRESSOR TO REMAIN.	WRITTEN CONSENT. WRITTEN CONSENT. THE CONTRACTOR MUST FIELD VERIFY ALL DIMENSIONS AND MUST CONFIRM &
5 EXISTING DOMESTIC HOT WATER HEATER TO REMAIN	CORRELATE ALL DETAILS WITHIN THE FULL DRAWING PACKAGE BEING RESPONSIBLE FOR SAME THROUGHOUT CONSTRUCTION, REPORTING ANY DISCREPANCIES TO THE
6 EXISTING HOT WATER SUPPLY AND RETURN HEADERS TO REMAIN AND BE REUSED.	ARCHITECT PRIOR TO COMMENCING THE RELEVANT WORK ALL DRAWINGS, DETAILS & SPECIFICATIONS REPRESENTED IN THE DRAWINGS ARE TO
7 EXISTING STAINLESS STEEL LINED CHIMNEY SERVING BOILERS IS TO BE REMOVED AND DISPOSED OF.	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
8 EXISTING GAS METER ON BUILDING EXTERIOR. CONTRACTOR IS TO COORDINATE WITH THE UTILITY AND OWNER FOR ALL SERVICE INTERRUPTIONS.	2. ISSUED FOR REVIEW 10.10.23           3. ISSUED FOR PERMIT 14.11.23           4. ISSUED FOR TENDER 14.02.24
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.	
$\begin{array}{c} \hline 12 \end{array}  \text{EXISTING PIPING TO REMAIN SIZE AND SERVICE AS} \\ \hline \text{INDICATED.} \end{array}$	PROJECT: HVAC Renovations
13 DEMOLISH EXISTING AIR SEPARATOR PROVIDE TEMPORARY TAPPED CONNECTIONS.	Glendale
14 DEMOLISH EXISTING HYDRONIC PIPING TO EXTENT SHOWN. PROVIDE TEMPORARY CAPPED CONNECTION AT MAINS.	Secondary School
15 DISCONNECT NATURAL GAS PIPING BACK TO MAIN DISTRIBUTION HEADER WITHIN MECHANICAL ROOM.	145 Rainbow Dr,
(16) EXISTING TRENCH DRAIN TO REMAIN.	Hamilton, ON For the HWDSB
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.	SEAL:
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.	
	EXP Services Inc. t: 905.525.6069   f: 905.528.7310 1266 South Service Road, Suite C1-1, Stoney Creek, ON, L8E 5R9 Canada www.exp.com
	<b>I</b>
	● BUILDINGS ● EARTH & ENVIRONMENT ● ENERGY     ● INDUSTRIAL ● INFRASTRUCTURE ● SUSTAINABILITY
	TRUE NORTH:
	Demolition Boiler Room
A) THE EXISTING SERVICES SHOWN ON THIS DRAWING	Plan
<ul> <li>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.</li> <li>B) ALL DISCONNECTED DUCTWORK AND PIPING TO BE CAPPED OFF UNLESS OTHERWISE NOTED</li> <li>C) ALL CUTTING AND PATCHING OF EXISTING ROOF, FLOORS AND WALLS TO BE BY MECHANICAL</li> </ul>	SCALE: AS NOTED DRAWN: C.M. / J.L. DATE: SEPTEMBER 2023
CONTRACTOR D) FOR DRAWING LEGENDS SEE DRAWING MO.0	PROJECT #: ALL-23010629-A0
E) ALL DEMOLITION WORK SHALL BE DONE VIA PIPE FREEZING. THE EXISTING HEATING SYSTEM SHALL NOT BE DRAINED DOWN.	DRAWING #: $M1.0$



DRAWING NOTES	
1 EXISTING SUPPLY AIR DUCTWORK DOWN TO BELOW GRADE. BELOW GRADE DUCT IS TO BE ABANDONED. DEMOLISH EXPOSED SECTION. CAP AT	
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.	THESE DRAWINGS ARE NOT TO BE SCALED ALL DRAWINGS, THE DESIGN, AND THE
4 EXISTING GRILLE C/W FIRE DAMPERS TO REMAIN.	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.
5 DEMOLISH AND DISPOSE OF EXISTING CEILING HUNG COOLING UNIT. CONTRACTOR TO DEMOLISH ASSOCIATED REMOTE CONDENSING UNIT AND PIPING.	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 DISCRETANCIES TO THE
6 DISCONNECT EXISTING SUPPLY AIR DUCTWORK FROM SUPPLY FAN THROUGH CEILING SLAB ABOVE.	REPORTING ANY DISCREPANCIES TO THE ARCHITECT PRIOR TO COMMENCING THE RELEVANT WORK ALL DRAWINGS, DETAILS & SPECIFICATIONS REPRESENTED IN THE DRAWINGS ARE TO
(7) EXISTING DUCTWORK TO BE DEMOLISHED TO EXTENT SHOWN.	BE USED FOR CONSTRUCTION ONLY WHEN ISSUED BY THE ARCHITECT AND NOTED ACCORDINGLY IN THE "ISSUE/REVISIONS" BOX HEREON.
8 EXISTING SUPPLY AIR REGISTER TO BE DEMOLISHED AND DISPOSED OF.	1. ISSUED FOR REVIEW 22.09.23           2. ISSUED FOR REVIEW 10.10.23
(10) EXISTING DUCT DOWN FROM ABOVE TO REMAIN	3. ISSUED FOR PERMIT 14.11.23           4. ISSUED FOR TENDER 14.02.24
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.	HVAC Renovations
<ul> <li>DEMOLISH AND DISPOSE OF EXISTING PERIMETER RADIATOR. REMOVE ALL ASSOCIATED VALVES AND FITTINGS CUT PIPE BACK TO MAIN AND PROVIDE TEMPORARY CAPPED CONNECTION</li> </ul>	Glendale Secondary
17 EXISTING HOT WATER SUPPLY AND RETURN PIPING	School
18 EXISTING PERIMETER RADIATOR TO REMAIN.	145 Rainbow Dr, Hamilton, ON
(19) REMOVE AND DISPOSE OF EXISTING DUCT MOUNTED AIR GRILLE. BLANK OFF THE EXISTING OPENING AND SEAL DUCTWORK.	For the HWDSB
20 EXISTING DUST COLLECTER AND ALL ASSOCIATED PIPING AND DUCTWORK TO REMAIN.	SEAL:
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.	<b>EXP</b> Services Inc. t: 905.525.6069   f: 905.528.7310 1266 South Service Road
25 DEMOLISH AND DISPOSE OF ABANDONED EXHAUST FAN AND ASSOCIATED DUCTWORK.	Suite C1-1, Stoney Creek, ON, L8E 5R9 Canada
26 EXISTING REFRIGERANT PIPING RUNNING UP TO ROOF LEVEL TO BE DEMOLISHED AND DISPOSED OF.	www.exp.com
	$  -\lambda p$
	● BUILDINGS ● EARTH & ENVIRONMENT ● ENERGY     ● INDUSTRIAL ● INFRASTRUCTURE ● SUSTAINABILIT
	TRUE NORTH:
	DRAWING TITLE: Demolition
	HVAC Ground Floor Plan
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	SCALE: AS NOTED
MECHANICAL CONTRACTOR SHALL CARRY OUT A FULL SURVEY OF ALL EXISTING SERVICES AND STRUCTURE TO CONFIRM THE SIZE AND LOCATION OF THESE	D R A W N : C.M. / J.L.
SERVICES, BEFORE THE COMMENCEMENT OF ANY WORK. B) ALL DISCONNECTED DUCTWORK AND PIPING	DATE: SEPTEMBER 2023
TO BE CAPPED OFF UNLESS OTHERWISE NOTED C) ALL CUTTING AND PATCHING OF EXISTING	PROJECT #: ALL-23010629-A0
ROOF, FLOORS AND WALLS TO BE BY MECHANICAL CONTRACTOR D) FOR DRAWING LEGENDS SEE DRAWING MO.0	DRAWING #:
, S LOLINDO SEL DIAMING MU.U	



<ul> <li>DRAWING NOTES</li> <li>DEMOLISH AND DISPOSE OF EXISTING AIR HANDLING UNIT. CUTBACK HYDRONIC LINES TO HANDLING UNIT. CUTBACK HYDRONIC LINES TO ANDLING AND PROVIDE CAPPED CONNECTION.</li> <li>DEMOLISH AND DISPOSE OF EXISTING RETURN FAN.</li> <li>DEMOLISH EXISTING WALL DOUVRE. REFER TO APTCHING OF WALL OPENING.</li> <li>DEMOLISH AND DISPOSE OF DELOW IS TO BE REUSED.</li> <li>RETURN AIR CRILLE TO BE DEMOLISHED. EXISTING OPENING TO BE FILLED IN, REFER TO ARCHITECTURAL AND STRUCTURAL DRAWINGS.</li> <li>RETURN AIR CRILLE TO BE DEMOLISHED. EXISTING OPENING TO BE FILLED IN, REFER TO ARCHITECTURAL AND STRUCTURAL DRAWINGS.</li> <li>DEMOLISH AND DISPOSE OF DUCT WORK TO EXTENT SHOWN.</li> <li>EXISTING DUCT BELOW TO ROOF ABOVE TO BE DEMOLISHED.</li> <li>DEMOLISH EXISTING DUCTWORK, DUCTWORK IS INSTALLED BETWEEN EXISTING ROOF STRUCTURE.</li> <li>EXISTING DUCT RISER TO DOWN TO FLOOR BELOW TO REMAIN.</li> <li>EXISTING DUCTWORK TO REMAIN.</li> <li>EXISTING DUCTWORK TO REMAIN.</li> <li>EXISTING DUCTWORK TO REMAIN.</li> <li>BEXISTING DUCTWORK TO REMAIN.</li> <li>CIT CONTINUES UP TO AHU-10 ON ROOF ABOVE.</li> <li>EXISTING DUCTWORK TO REMAIN.</li> <li>DUCT CONTINUES UP TO AHU-10 ON ROOF ABOVE.</li> <li>EXISTING DUCTWORK TO REMAIN.</li> <li>DUCT DROP TO BELOW TO BE DEMOLISHED AND DISPOSED OF. DISTRUCTURAL AND ARCHITECTURAL DRAWINGS.</li> </ul>	THESE DRAWINGS ARE NOT TO BE SCALED         ALL DRAWINGS, THE DESIGN, AND THE DETAILS THEREON REMAIN THE PROPERTY OF THE CONSULTANTS EXPRESS         THE CONTRACTOR WUST FIELD VERIFY ALL DIMENSIONS AND MUST CONFIRM.         DREADED THE CONSULTANT'S EXPRESS         THE CONTRACTOR WUST FIELD VERIFY ALL DIMENSIONS AND DISCUSTRUCTION, REPORTED IN THE DRAWINGS FARE TO BE SCHED FOR DESORDED ON THE CONTRACTOR DESORDED TO COMMENSIONS THE REPORT OF DESORDED ON THE REPORT OF THE REPORT OF DESORDED ON THE REPORT OF THE
CENERAL 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 MO.0	EXP Services Inc. T: 905.525.6069   f: 905.528.7310 T266 South Service Road, Suite C1-1, Stoney Creek, ON, LBE SR9 Canada www.exp.com • BUILDINGS • EARTH & ENVIRONMENT • ENERGY • NDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY TRUE NORTH: DEMOISTION DRAWING TITLE: DEMOISTION HVAC Second FLOOR PLON SCALE: AS NOTED DRAWN: C.M. / J.L. DATE: SEPTEMBER 2023 PROJECT #: ALL-23010629-A0 DRAWING #: M1.2



<ul> <li>DEROLISH AND DISPOSE OF EXISTING EXHAUST AR VERT, REFER TO ARCHITECTURAL AND STRUCTURAL VERT, REFER TO ARCHITECTURAL AND STRUCTURAL AND DUCT CONNECTIONS.</li> <li>(2) DEMOLISH AND DISPOSE OF EXISTING ROOF TOP UNIT. TEMPORARILY CAP NATURAL GAS SERVICE AND DUCT CONNECTIONS.</li> <li>(3) DEMOLISH EXISTING ROOFTOP DUCT WORK TO EXISTING PRETERTION THROUGH ROOF. EXISTING FIRE DAMPERS TO REMAIN.</li> <li>(4) EXISTING NATURAL GAS PIPE DROPS THROUGH ROOF TO BELOW.</li> <li>(5) EXISTING NATURAL GAS PIPING CONTINUES ALONG ROOF</li> <li>(6) EXISTING REFRIGERANT PIPING TO BE DEMOLISHED AND DISPOSED OF.</li> <li>(7) EXISTING REFRIGERANT PIPING TO BE DEMOLISHED AND DISPOSED OF.</li> <li>(8) DEMOLISH AND DISPOSE OF EXISTING ROOFTOP CONDENSER UNIT ASSOCIATED WITH CELLING HUNG ASSOCIATED PIPING AND FITTINGS.</li> </ul>	THESE DRAWINGS ARE NOT TO BE SCALED         ALTER DRAWINGS, THE DESIGN, AND THE DETAILS THEREON REMAIN THE PROPERTY OF THE CONSULTANT AND ARE NOT TO BE ALTERO, RE-USED OR REPRODUCED WITTEN CONSULTANT SERVICES WITTEN CONSULTANT SERVICES TO THE ACCHITECT CONSULTANT SERVICES TO THE ARCHITECT PRIOR TO COMMENCING THE RESULT ON STRUCTION ONLY WERN SERVICES TO THE ARCHITECT PRIOR TO COMMENCING THE RESULT OF THE ARCHITECT AND NOTES ASOL HEREON.         1. ISSUED FOR REVIEW 22.09.23         2. ISSUED FOR REVIEW 10.10.23         3. ISSUED FOR TENDER 14.10.24         DESULT FOR TENDER 14.02.24         DESULT FOR CONSTRUCTION ONLY WEREN         A. ISSUED FOR TENDER 14.02.24         DESULT FOR TENDER 14.02.25         DESULT FOR TENDER 14.02.24 <td< td=""></td<>
<ul> <li>ALL DISCONNECTED DUCTWORK AND PIPING TO BE CAPPED OFF UNLESS OTHERWISE</li> <li>ALL DISCONNECTED DUCTWORK AND PIPING TO BE CAPPED OFF UNLESS OTHERWISE NOTED</li> <li>ALL DISCONNECTED DUCTWORK AND PIPING TO BE CAPPED OFF UNLESS OTHERWISE</li> <li>ALL DISCONNECTED DUCTWORK AND PIPING TO BE CAPPED OFF UNLESS OTHERWISE NOTED</li> <li>ALL DISCONNECTED DUCTWORK AND PIPING TO BE CAPPED OFF UNLESS OTHERWISE NOTED</li> <li>ALL DISCONNECTED DUCTWORK AND PIPING TO BE CAPPED OFF UNLESS OTHERWISE NOTED</li> <li>ALL DISCONNECTED DUCTWORK AND PIPING TO BE CAPPED OFF UNLESS OTHERWISE</li> <li>ALL DISCONNECTED DUCTWORK AND PIPING TO BE CAPPED OFF UNLESS OTHERWISE</li> <li>FOR DRAWING LEGENDS SEE DRAWING MO.0</li> </ul>	EXP Services Inc. T: 905.525.6069 [ f: 905.528.7310 1266 South Service Road, Suite C1-1, Stoney Creek, ON, L&E 5R9 Canada www.exp.com • BUILDINGS • EARTH & ENVIRONMENT • ENERGY • NDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY TRUE NORTH: DEMOISTION DRAWING TITLE: DemOISTION HVAC ROOF Plan SCALE: AS NOTED DRAWN: C.M. / J.L. DATE: SEPTEMBER 2023 PROJECT #: ALL-23010629-A0 DRAWING #: M1.33



<section-header><ul> <li>DRAWING NOTES</li> <li>existing EXPANSION TANKS TO REMAIN.</li> <li>existing GAS METER ON BUILDING EXTERIOR. CONTRACTOR IS TO COORDINATE WITH THE UTILITY AND OWNER FOR ALL SERVICE INTERRUPTIONS.</li> <li>CONNECT TO EXISTING GAS LINE AT APPROXIMATE LOCATION INDICATED. PROVIDE GAS VALVE AND SUPPLY HEADERS. PROVIDE ALL INCESSARY PIPE TRANSITIONS TO CONNECT FROM NEW 4% BOILER.</li> <li>INSTALL NEW ANTROL 6-ASL HYRDRONIC AIR SEPARATOR OR EQUIVALENT WITHIN EXISTING INSTRUCTIONS. EQUIPMENT TO BE MOUNTED ON NEW 4° CONCRETE HOUSE KEEPING PAD. REFER INSTRUCTIONS. EQUIPMENT TO BE MOUNTED ON NEW 4° CONCRETE HOUSE KEEPING PAD. REFER INSTRUCTIONS. EQUIPMENT TO BE MOUNTED ON NEW 4° CONCRETE HOUSE KEEPING PAD. REFER INSTRUCTIONS. EQUIPMENT TO BE MOUNTED ON NEW 4° CONCRETE HOUSE KEEPING PAD. REFER INSTRUCTIONS. EQUIPMENT TO BE MOUNTED ON NEW 4° CONCRETE HOUSE KEEPING PAD. REFER INSTRUCTIONS. EQUIPMENT TO BE MOUNTED ON NEW 4° CONCRETE HOUSE KEEPING PAD. REFER INSTRUCTIONS. PROVIDE ALL PIPE TRANSITIONS NEEDED TO SKID AS PER MINUFACTURERS INSTRUCTION ON NEW HOUSEKEEPING PAD. PROVIDE ALL PIPE TRANSITIONS NEEDED TO SKID MAINFOLD. CORRESPONDING VFD. REFER TO M3.0 FOR PIPING SCHEMATIC.</li> <li>INSTALL NEW PUWP VFD ON WALL SECURED TIGHT AS REQUIRED. PROVIDE ALL REQUIRED WIRING BACK TO MAIN PUWP INDICATED.</li> <li>ONNECT TO EXISTING PIPE AT APPROXIMATE.</li> <li>INSTALL NEW PUWP VED ON WALL SECURED TIGHT AS REQUIRED. PROVIDE ALL REQUIRED WIRING BACK TO MAIN PUWP INDICATED.</li> <li>CONNECT TO EXISTING PIPE AT APPROXIMATE.</li> <li>MISTALL NEW PUWP VED ON WALL SECURED TIGHT AS REQUIRED. PROVIDE ALL REQUIRED WIRING BACK TO MAIN PUWF INDICATED.</li> <li>CONNECT TO EXISTING PIPE AT APPROXIMATE.</li> <li>CONNECT TO EXISTING PIPE AT APPROXIMATE.</li> <li>CONNECT TO EXISTING PIPE AT APPROXIMATE.</li> <li>CONNECT NEW GAS PIPE SERVING NEW ERV AND MUX AD TO EXISTING C</li></ul></section-header>	THESE DRAWINGS ARE NOT TO BE SCALED         ALL DRAWINGS, THE DESIGN, AND THE         DETAILS THREECON REMAIN THE AROPERTY         OF THE DOWNED THE CONSULTANT'S EXPRESS         WITTED. ON REJIGN WIST FIELD VENIFY ALL         DIMENSIONS AND MUST CONFIRM &         CONTRACTOR WUST FIELD VENIFY ALL         DIMENSIONS AND MUST CONFIRM &         CONTRACTOR WUST FIELD VENIFY ALL         DIMENSIONS AND MUST CONFIRM &         CONTRACTOR TO COMMENCING THE         REPORTING ANY DISCREPANCES TO THE         REPORTING ANY DISCREPANCES TO THE         RELEVANT WORK         ALL DRAWINGS PARAGE         SEDE FOR CONSTRUCTION ONLY WHEN         SECORDINGLY IN THE "ISSUE/REVISIONS"         BOX HEREON.         1. ISSUED FOR REVIEW 10.10.23         3. ISSUED FOR TENDER 14.02.24         DIMENSIONE FOR TENDER 14.02.24         DIMENSIONE         DIMENSIONE         P R 0 J E C T :         HVAC Renovations         Glendale         Secondary         School         145 Rainbow Dr,         Hort the HWDSB
<ul> <li>(20) INSTALL NEW PUMP VFD ON WALL. COMPLETE ALL REQUIRED WIRING BACK TO MAIN PUMP SKID INDICATED.</li> <li>(21) (N O T U S E D)</li> <li>(22) EXISTING AIR COMPRESSOR TO REMAIN.</li> <li>(23) CONNECT NEW HOT WATER SUPPLY AND RETURN TO EXISTING MAIN HEADER.</li> <li>(24) EXISTING HYDRONIC SYSTEM IS TO BE FLUSHED PRIOR TO COMMISSIONING. CONTRACTOR IS RESPONSIBLE FOR COORDINATING WITH AQUARIAN CHEMICALS. INC FOR WATER CHEMICAL TREATMENT. (MCESA@AQUARIANCHEMICALS.COM, P: 416–540–1883) PROVIDE PRE-START UP AND START UP REPORT.</li> <li>(DECENCENCE) DECENT OF COMMUNICATION OF TREATMENT. (MCESA@AQUARIANCHEMICALS.COM, P: 416–540–1883) PROVIDE PRE-START UP AND START UP REPORT.</li> </ul>	EXP Services Inc. I: 905.525.6069   f: 905.528.7310 1266 South Service Road, Suite C1-1, Stoney Creek, ON, L8E 5R9 Canada www.exp.com • BUILDINGS • EARTH & ENVIRONMENT • ENERGY • BUILDINGS • EARTH & ENVIRONMENT • ENERGY • INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY TRUE NORTH: • DRAWING TITLE: Proposed Boiler Room Ground Floor Plan S CALE: AS NOTED
<ul> <li>C) DUCT KUNUUTS TO MATCH GRILLE/DIFFUSER SIZE UNLESS OTHERWISE NOTED.</li> <li>D) DUCTWORK LOCATIONS TO BE FULLY CO-ORDINATED WITH GENERAL, PLUMBING, SPRINKLER AND ELECTRICAL CONTRACTORS PRIOR TO FABRICATION OR INSTALLATION.</li> <li>E) FOR DRAWING LEGENDS SEE DRAWING M-1.</li> <li>F) ALL DEMOLITION WORK SHALL BE DONE VIA PIPE FREEZING. THE EXISTING HEATING SYSTEM SHALL NOT BE DRAINED DOWN.</li> </ul>	C.M. / J.L. D A T E : SEPTEMBER 2023 P R O JE C T # : ALL-23010629-A0 D R A W IN G # : M 2.0



DRAWING NOTES	
1 DUCTWORK CONTINUES UP TO FLOOR ABOVE. PROVIDE FIRE DAMPERS AS INDICATED.	
2 INSTALL NEW UNIT VENTILATOR AS PER MANUFACTURERS INSTRUCTIONS. CONNECT TO EXISTING HOT WATER SUPPLY AND RETURN AS PER MECHANICAL DETAILS. CONTRACTOR TO PROVIDE LOUVRE BASED ON FINAL SHOP DRAWING DIMENSIONS. DRAIN CONDENSATE THROUGH EXTERIOR WALL.	
3 DROP AIR GRILLE DOWN TO ROOM BELOW COMPLETE WITH BALANCING DAMPER.	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
4 REUSE EXISTING WALL OPENING FOR NEW GRILLE. GAPS AROUND NEW GRILLES TO BE PATCHED AND	ALTERED, RE-USED OR REPRODUCED WITHOUT THE CONSULTANT'S EXPRESS WRITTEN CONSENT. THE CONTRACTOR MUST FIELD VERIEY ALL
5 EXISTING RETURN GRILLE C/W FIRE DAMPERS.	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
<ul> <li>AIRFLOW TO VALUES INDICATED.</li> <li>REMOVE TEMPORARY CAPS AND CONNECT TO</li> </ul>	ALL DRAWINGS, DETAILS & SPECIFICATIONS REPRESENTED IN THE DRAWINGS ARE TO BE USED FOR CONSTRUCTION ONLY WHEN
EXISTING HOT WATER SUPPLY AND RETURN PIPING.	ISSUED BY THE ARCHITECT AND NOTED ACCORDINGLY IN THE "ISSUE/REVISIONS" BOX HEREON.
	2. ISSUED FOR REVIEW 10.10.23
9 REFRIGERANT LINES CONTINUE UP TO CONDENSER ON ROOF ABOVE.	3. ISSUED FOR PERMIT 14.11.23           4. ISSUED FOR TENDER 14.02.24
<ul> <li>(10) EXISTING PERIMETER RADIATOR TO REMAIN.</li> <li>(11) CONNECT TO EXISTING DUCTWORK.SIZE IS TO MATCH EXISTING ROUND DUCT. PROVIDE ALL NECESSARY TRANSITION PIECES TO MAKE CONNECTION TO NEW UV.</li> </ul>	
12 BALANCE EXISTING SUPPLY DIFFUSER/GRILLE TO	
13 EXISTING DUST COLLECTOR TO REMAIN.	
14 EXISTING DUCT RISER FROM ABOVE TO REMAIN.	PROJECT: HVAC Renovations
15) RUN DUCT DOWN TIGHT AGAINST WALL.	Glendale
(16) EXISTING DUCTWORK TO REMAIN	Secondary
<ul> <li>INSTALL NEW SOLENOID CONTROL VALVE ON EXISTING PERIMETER RADIATORS. WIRE CONTROL VALVES AND THERMOSTATS TO NEW CONTROLLER IN STORAGE ROOM 1057.</li> </ul>	School
(18) PROVIDE NEW CONTROLLER FOR RADIATOR CONTROL VALVES AND THERMOSTATS. PROVIDE WIRING BACK TO MAIN CONTROLLER IN BOILER ROOM.	145 Rainbow Dr, Hamilton, ON For the HWDSB
(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.	SEAL:
(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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	TRUE NORTH:
	PRAWING TITLE: Proposed HVAC Ground Floor Plan
A) FOR EVACT LOCATION OF OPHILES AND DIFFUSEDS	
B) ALL DUCTWORK AND EQUIPMENT TO BE CONCEALED IN	SCALE:
CEILING SPACE UNLESS NOTED OTHERWISE. C) DUCT RUNOUTS TO MATCH GRILLE/DIFFUSER SIZE	AS NOTED D R A W N :
UNLESS OTHERWISE NOTED. D) DUCTWORK LOCATIONS TO BE FULLY CO-ORDINATED	C.M. / J.L.
WITH GENERAL, PLUMBING, SPRINKLER AND ELECTRICAL CONTRACTORS PRIOR TO FABRICATION OR INSTALLATION.	SEPTEMBER 2023
LJ FUR URAWING LEGENUS SEE DRAWING M-1.	PROJECT #: ALL-23010629-A0
	DRAWING #:
	M2.1



# 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.



DATE: SEPTEMBER 2023

PROJECT #:

DRAWING #:

M2.2

ALL-23010629-A0

	UNLESS UTHERWISE NUTED.
)	DUCTWORK LOCATIONS TO BE FULLY CO-ORDINATED WITH GENERAL, PLUMBING, SPRINKLER AND ELECTRICAL CONTRACTORS PRIOR TO FABRICATION OR INSTALLATION

GENERAL NOTES

A) FOR EXACT LOCATION OF GRILLES AND DIFFUSERS

C) DUCT RUNOUTS TO MATCH GRILLE/DIFFUSER SIZE

REFER TO ARCHITECTURAL REFLECTED CEILING PLAN.

E) FOR DRAWING LEGENDS SEE DRAWING M-1.



DRAWING NOTES	
<ul> <li>DUCTWORK CONTINUES DOWN THROUGH ROOF TO BELOW. REFER TO M2.2 FOR CONTINUATION.</li> </ul>	
3 RECONNECT NATURAL GAS PIPING TO NEW AHU	
4 OFFSET NATURAL GAS PIPING AS REQUIRED TO ACCOMMODATE EXISTING ROOF.	THESE DRAWINGS ARE NOT TO BE SCALED ALL DRAWINGS, THE DESIGN, AND THE
5 RUN NEW GAS PIPING ALONG ROOF.	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.
6 RECONNECT TO EXISTING DUCT DROPS THROUGH ROOF. FULLY SEAL INSULATION AND PROVIDE NEW FLASHING AT ROOF PENETRATIONS.	THE CONTRACTOR MUST FIELD VERIFY ALL DIMENSIONS AND MUST CONFIRM & CORRELATE ALL DETAILS WITHIN THE FULL DRAWING PACKAGE BEING RESPONSIBLE FOR SAME THEOLICHOUT CONSTRUCTION
7 INSTALL ROOF TOP UNIT ON EXISTING STRUCTURAL PLATFORM.	REPORTING ANY DISCREPANCIES TO THE ARCHITECT PRIOR TO COMMENCING THE RELEVANT WORK
(8) INSTALL ROOF TOP UNIT ON EXISTING ROOF CURB. PROVIDE CURB ADAPTER FROM MANUFACTURER.	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.
9 INSTALL ROOF TOP UNIT ON NEW STRUCTURAL PLATFORM.	1. ISSUED FOR REVIEW 22.09.23           2. ISSUED FOR REVIEW 10.10.23
10 CONNECT NEW HVAC EQUIPMENT TO NATURAL GAS PIPING.	3. ISSUED FOR PERMIT 14.11.234. ISSUED FOR TENDER 14.02.24
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.	PROJECT:
14 SUPPORT NATURAL GAS PIPING AS PER MECHANICAL DETAILS.	HVAC Renovations
(15) GAS PIPE CONTINUES ALONG ROOF. REFER TO MO.1 FOR CONTINUATION ON OVERALL ROOF PLAN.	Glendale Secondary
16 PROVIDE EXPANSION LOOP IN NATURAL GAS PIPE RUN.	School
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 BTU-2	145 Rainbow Dr, Hamilton ON
18 REFER TO DRAWING MO.1 FOR CONTINUATION OF GAS PIPE.	For the HWDSB
	SEAL:
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	● BUILDINGS ● EARTH & ENVIRONMENT ● ENERGY     ● INDUSTRIAL ● INFRASTRUCTURE ● SUSTAINABILITY
	TRUE NORTH:
	DRAWING TITLE: Proposed
	HVAC Roof
GENERAL NOTES	
<ul><li>A) FOR EXACT LOCATION OF GRILLES AND DIFFUSERS REFER TO ARCHITECTURAL REFLECTED CEILING PLAN.</li><li>B) ALL DUCTWORK AND EQUIPMENT TO BE CONCEALED IN</li></ul>	SCALE:
CEILING SPACE UNLESS NOTED OTHERWISE. C) DUCT RUNOUTS TO MATCH GRILLE/DIFFUSER SIZE UNLESS OTHERWISE NOTED.	AS NOIED DRAWN: C.M. / J.L.
D) DUCTWORK LOCATIONS TO BE FULLY CO-ORDINATED WITH GENERAL, PLUMBING, SPRINKLER AND ELECTRICAL CONTRACTORS PRIOR TO FABRICATION OR INSTALLATION.	D A T E : SEPTEMBER 2023
E) FOR DRAWING LEGENDS SEE DRAWING M-1.	PROJECT #: ALL-23010629-A0
	DRAWING #: $\sqrt{2}$













AI - Zone Temp

AO - Heating Valve

POINT NAME	HARDWARE POINTS	SOFTWARE POINTS	TREND	ALARM	SHOV GRAI
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	-	<u>.</u>	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 CONCEN- TRATION	-	-	N	Y	N
HIGH ZONE TEMP	u	u	N	Y	N
LOW DISCHARGE AIR TEMP	-	-	N	Y	N
LOW ZONE TEMP	-	-	N	Y	N

# UNIT VENTILATOR CONTROL SCHEMATIC



DA



Point Name	HARDWARE POINTS	SOFTWARE POINTS	Trend	Alarm	Show On Graphic
Exhaust Air Temp	Al	-	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	Al	-	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	Ŷ	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	Ŷ	N
Exhaust Fan in Hand	-	-	N	Ŷ	N
Exhaust Fan Runtime Exceeded	-	-	N	Ŷ	N
Final Filter Change Required	~	-	N	Y	Y
Prefilter Change Required	<u>.</u>	-	N	Y	Y
Carbon Filter Change Required	-	-	N	Ŷ	Y
Return Filter Change Required	-	-	N	Ŷ	Y
High Supply Air Temp	-		N	Ŷ	N
Low Supply Air Temp	-	-	N	Ŷ	N
Outside Air Damper Failure	-	-	N	Y	N
Outside Air Damper in Hand	-	-	N	Ŷ	N
Supply Fan Failure	-	-	N	Y	N
Supply Fan in Hand	-	-	N	Y	N
Supply Fan Runtime Exceeded	•	-	N	Y	N



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

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. 1. ISSUED FOR REVIEW 22.09.23 2. ISSUED FOR REVIEW 10.10.23 3. ISSUED FOR TENDER 14.02.24
PROJECT: HVAC Renovations Glendale Secondary School 145 Rainbow Dr, Hamilton, ON For the HWDSB
EXP Services Inc. I: 905.525.6069   f: 905.528.7310 1266 South Service Road, Suite C1-1, Stoney Creek, ON, L8E 5R9 Canada www.exp.com
<ul> <li>BUILDINGS • EARTH &amp; ENVIRONMENT • ENERGY</li> <li>INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY</li> <li>TRUE NORTH:</li> <li>DRAWING THTLE:</li> <li>Control</li> <li>Schematics</li> </ul>
S C A L E : AS NOTED D R A W N : C.M. / J.L. D A T E : SEPTEMBER 2023 P R O J E C T # : ALL-23010629-A0 D R A W IN G # : ALL - 23010629-A0



BI - Cooling Status Stage 1 BI - Cooling Status Stage 2

AO - Modulating Condenser Stage

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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	ECONOMIZER ZONE TEMP SET- POINT
ENTHALPY WHEEL DISCHARGE AIR HUMIDITY	AI	-		Y	N	Y	ENTHALPY WHEEL DISCHARGE AIR DEWPOINT
ENTHALPY WHEEL DISCHARGE AIR TEMP	AI	-	-	Y	N	Y	ENTHALPY WHEEL DISCHARGE AIR ENTHALPY
ENTHALPY WHEEL RETURN AIR HUMIDITY	AI	-	-	Y	N	Y	ENTHALPY WHEEL RETURN AIR DEWPOINT
ENTHALPY WHEEL RETURN AIR TEMP	AI	-	-	Y	N	Y	ENTHALPY WHEEL RETURN AIR EN- THALPY
EXHAUST AIR TEMP	AI	-	-	Y	N	Y	HEATING SETPOINT
FINAL FILTER DIFFERENTIAL PRES- SURE	AI	-	-	Y	N	N	
MIXED AIR TEMP	AI	-	-	Y	N	Y	
OUTSIDE AIR HUMIDITY	AI	-	-	Y	N	Y	SETPOINT
OUTSIDE AIR HUMIDITY	AI	-	-	Y	N	Y	SCHEDULE
OUTSIDE AIR TEMP	AI	-	-	Y	N	Y	COMPRESSOR RUNTIME EX-
OUTSIDE AIR TEMP	AI	-	-	Y	N	Y	
PREFILTER DIFFERENTIAL PRES- SURE	AI	-	-	Y	N	N	ENTHALPY WHEEL IN HAND
RETURN AIR CARBON DIOXIDE PPM	AI	-	-	Y	N	Y	URE
RETURN AIR HUMIDITY	AI	-	-	Y	N	Y	ENTHALPY WHEEL RUNTIME EX- CEEDED
RETURN AIR TEMP	AI	_	-	Y	N	Y	FINAL FILTER CHANGE REQUIRED
SUPPLY AIR TEMP	AI	-	-	Y	N	Y	HIGH MIXED AIR TEMP
ZONE TEMP	AI	-	-	Y	N	Y	HIGH RETURN AIR CARBON DIOX-
MIXED AIR DAMPERS	AO	-	-	Y	N	Y	IDE CONCENTRATION
ENTHALPY WHEEL STATUS	BI	-	-	Y	N	Y	HIGH RETURN AIR HUMIDITY
FREEZESTAT	BI	-	-	Y	Y	Y	HIGH RETURN AIR TEMP
RETURN FAN STATUS	BI	-	-	Y	N	Y	HIGH SUPPLY AIR TEMP
SUPPLY FAN STATUS	BI	-	-	Y	N	Y	HIGH ZONE TEMP
ZONE OVERRIDE	BI	-	-	Y	N	Y	LOW MIXED AIR TEMP
COOLING STAGE	BO	-	-	Y	N	Y	LOW RETURN AIR HUMIDITY
COOLING STAGE 2	во	-	-	Y	N	Y	LOW RETURN AIR TEMP
COOLING STAGE 1 STATUS	BI	-	-	Y	N	Y	LOW SUPPLY AIR TEMP
COOLING STAGE 2 STATUS	BI	-	-	Y	N	Y	LOW ZONE TEMP
ENTHALPY WHEEL BYPASS DAMP- ERS	во	-	-	Y	N	Y	PREFILTER CHANGE REQUIRED
ENTHALPY WHEEL PREHEATER	во	-	-	Y	N	Y	RETURN FAN IN HAND
ENTHALPY WHEEL START/STOP	BO	-	-	Y	N	Y	RETURN FAN RUNTIME EXCEEDED
HEATING VALVE	AO	-	-	Y	N	Y	SUPPLY FAN FAILURE
MODULATING CONDENSER	AO	-	-	Y	N	Y	SUPPLY FAN IN HAND
RETURN FAN START/STOP	BO	-	-	Y	N	Y	SUPPLY FAN RUNTIME EXCEEDED
SUPPLY FAN START/STOP	во	-	-	Y	N	Y	
COOLING SETPOINT		AV	_	Y	N	Y	
DEHUMIDIFICATION SETPOINT		AV	-	Y	N	Y	
	-						

RTU-1 CONTROL SCHEMATIC

N.T.S.

![](_page_24_Figure_7.jpeg)

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![](_page_24_Figure_8.jpeg)

POINT NAME	HARDWARE POINTS	SOFTWARE POINTS	SCHED	TREN D	ALARM	SHOW ON GRAPHIC
FINAL FILTER DIFFERENTIAL PRES- SURE	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 PRES- SURE	AI	-	-	Y	N	Ν
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	Υ
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	во	-	-	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	во		-	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 SET- POINT	-	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 EX- CEEDED	-	-	-	N	Y	N
FINAL FILTER CHANGE REQUIRED	-	-	-	N	Y	Y
HIGH MIXED AIR TEMP	-	-	-	Y	Y	N
HIGH RETURN AIR CARBON DIOX- IDE CONCENTRATION	-		-	Υ	Y	N
HIGH RETURN AIR HUMIDITY		-	-	Y	Y	N
HIGH RETURN AIR TEMP	-	-	-	Y	Y	N
LOW MIXED AIR TEMP	-	-	-	Y	Y	N
LOW RETURN AIR HUMIDITY	-	-	_	Y	Y	N
LOW RETURN AIR TEMP	-	-	-	Y	Y	N
LOW SUPPLY AIR TEMP	-	-	-	Y	Y	N
LOW ZONE TEMP		-	-	Y	Y	N
PREFILTER CHANGE REQUIRED	-	-	-	Y	Y	Y
POWER EXHAUST FAN FAILURE	-	-		Y	Y	N
POWER EXHAUST FAN IN HAND			-	Y	Y	N
POWER EXHAUST 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

![](_page_24_Picture_10.jpeg)

![](_page_24_Figure_12.jpeg)

![](_page_24_Picture_14.jpeg)

![](_page_25_Figure_0.jpeg)

POINT NAME	HARD- WARE POINTS	SOFT- WARE 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	Ŷ
BOILER ENABLE (TYP. OF 3)	BO	-	N	N	Y
HOT WATER PUMP START/STOP (TYP. OF 3)	во	-	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	-	-	Ν	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	TREN D	ALARM	SHOW ON GRAPHIC
FINAL FILTER DIFFERENTIAL PRES- SURE	AI	-	-	Y	N	N
MIXED AIR TEMP	Al	-	-	Y	N	Y
OUTSIDE AIR HUMIDITY	AI	_	-	Y	N	Y
OUTSIDE AIR TEMP	AI	-	-	Y	N	Y
PREFILTER DIFFERENTIAL PRES- SURE	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 SET- POINT	-	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 EX- CEEDED	-	-	-	N	Y	N
FINAL FILTER CHANGE REQUIRED	-	-	-	N	Y	Y
HIGH MIXED AIR TEMP	_	_	_	Y	Y	N
HIGH RETURN AIR CARBON DIOX- IDE 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

![](_page_25_Figure_5.jpeg)

AV - Motor Speed RPM BV - VFD Status 1. VARIABLE FREQUENCY DRIVE INTERFACE (TYPICAL FOR ERVS, RTUS, VFD PUMPS)VFD INTERFACE MONITOR: AV - Motor Frequency Hz BV - In Fault Condition CURRENT VFD STATUS AND OPERATING CONDITIONS SHALL BE MONITORED AV - Motor Current Amps BV - In Bypass THROUGH ITS COMMUNICATIONS INTERFACE PORT. THE INTERFACE SHALL AV - Motor Runtime MONITOR AND TREND THE POINTS AS SHOWN ON THE POINTS LIST. 2. 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. SOFTWARE POINT NAME TREND ALARM SHOW ON GRAPHIC POINTS MOTOR CURRENT AMPS AV Y N Y MOTOR FREQUENCY HERTZ AV N Y Y MOTOR RUNTIME AV Ν Ν Y MOTOR SPEED RPM AV Y N Y IN BYPASS ΒV Υ Y Y IN FAULT CONDITION BV Y Y Y VFD STATUS BV Ν Y Y |

## VARIABLE SPEED DRIVE SCHEMATIC N.T.S.

![](_page_26_Figure_0.jpeg)

![](_page_26_Figure_1.jpeg)

# SYSTEM PUMP CONTROL SCHEMATIC

	N.C.	
EA		
	BI - Power Exhaust Fan Status	
	Starter	
	BO - Power Exhaust Fan Start/Stop	
	AO - Mixed Air Dampers	N.O.
		' 🛛
	N.C.	

AI - Final Filter Differential Pressure

POINT NAME
BUILDING STATIC PRESSURE
FILTER DIFFERENTIAL PRES- SURE
MIXED AIR TEMP
OUTSIDE AIR TEMP
RETURN AIR TEMP
ZONE SETPOINT ADJUST
ZONE TEMP
MIXED AIR DAMPERS
FREEZESTAT
SUPPLY FAN STATUS
EXHAUST FAN STATUS
SUPPLY AIR SMOKE DETEC- TOR
COOLING STAGE (AS PER EQUIP. SCHEDULE)
COOLING STATUS (AS PER EQUIP. SCHEDULE)
HEATING STAGE 1
HEATING STAGE 2
SUPPLY FAN START/STOP
EXHAUST FAN START/STOP
BUILDING STATIC PRESSURE SETPOINT
COOLING SETPOINT
ECONOMIZER ZONE TEMP SETPOINT
HEATING SETPOINT
EMERGENCY SHUTDOWN
SCHEDULE
COMPRESSOR RUNTIME EX- CEEDED
FILTER CHANGE REQUIRED
HIGH MIXED AIR TEMP
HIGH RETURN AIR TEMP
HIGH ZONE TEMP
LOW MIXED AIR TEMP
LOW RETURN AIR TEMP
LOW ZONE TEMP
LOW BUILDING STATIC PRES- SURE
HIGH BUILDING STATIC PRES- SURE
SUPPLY FAN IN HAND
SUPPLY FAN RUNTIME EX- CEEDED
EXHAUST FAN FAILURE
EXHALIST FAN IN HAND

	HARDWARE POINTS	SOFTWARE POINTS	TREND	ALARM	SHOW ON GRAPHIC
PRES-	AI	-	Y	N	Y
	AI	-	Y	N	Y
	AI	-	Y	N	Y
<sup>&gt;</sup> -6)	AO		Y	N	Y
<sup>&gt;</sup> -6)	BI	-	Y	N	Y
P-6)	BI	-	N	Y	Y
<sup>6)</sup>	во	-	Y	N	Y
PRES-	_	AV	N	N	Y
	-	AV	N	N	Y
NTIAL	-	-	N	Y	N
ГЕМР	-	-	N	Y	N
<sup>-</sup> -6)	-	-	N	Y	N
<sup>-</sup> -6)	-	-	N	Y	N
<sup>-</sup> -6)	-	-	N	Y	N
ITIAL	_	-	N	Y	N
EMP	-	-	N	Y	N

![](_page_26_Figure_8.jpeg)

															MECH	ANICAL	SCHEDU	JLE - ENER	GY RECOV	ERY VEN	TILATOR	S								
						_	FAN					GAS HE	ATING					ENERGY	RECOVERY						WIRII			UIPMENT SCI	IEDULE	
																SI	UMMER			WIN	TER									
dwg. Designatio	SYSTEM ON and ROOM	MODEL	SPEC TYPE	WEIGHT (LBS)	FUNCTION	SIZE	HORSEPOWER	CFM	ESP (IN W.G.)	RPM	INPUT (MBH)	output (MBH)	TEMPERATU RISE (°F)	JRE EFF.	RECOVER) (MBH)	f EFF (%	EAT (°    DB / W 	PF)     LAT (°F)       /B     DB / WB       B     DB / WB	RECOVER) (MBH)	( EFF (%)	eat (°f) db/wb db/wb	LAT (°F) DB / WB DB/WB	MECHANICAL REMARKS	MOTOR Wor HP	MCA	МСОР	VACIØ	ROOM STARTER TYPE	REMOTE CONTROL DISC. TYPE DEVICE	ELECTRICAL WIRING INSTRUCTIONS
ERV-1	TECH SHOP WING	AIR WISE TB+650/HRP	ERV	7,900	SUPPLY	12-12 FF BT2/T1 DWDI 254T/256T DWDI	10 7.5	7,000 8,300	0.7"	2907 1233	800	648	86	81%	67	59.5	90/73.	0 81.1/70.5 1 82.5/65.1	416702.00	60.40	-5/-5 72/52.9	41.5/29.2 26.3/26.3	PLATE TO PLATE ENERGY RECOVERY VENTILATOR, 15:1 TURNDOWN GAS HEATING, VFD TO 35% SUPPLY AND RETURN FANS, MERV 8 & MERV 13 FILTER, SUPPLY AIR CARBON FILTER. HEAT TRACE DRAIN. FURNISHED BY OWNER & INSTALLED BY CONTRACTOR.	-	21.2	30	575/3	VFD (DIV 23)	BAS TYPE 3R (DIV.23A)	DIV. 26 TO WIRE THROUGH DISCONNECT & VFD SUPPLIED BY MECHANICAL DIVISION. ALL CONTROL WIRING BY THE MECHANICAL DIVISION. SHUTDOWN UPON FIRE ALARM ACTIVIATION BY DIV. 26
			•		8		•		- I	<b>_</b>		1	1		•		<b>I</b>	ł		<b>I</b>	. <u> </u>				,	F		1		•

JOB I	NAME:																			HWDSB GLE	ENDALES	EC SCH BOIL	ER AHU RI	EPLACEME	ENT																J	JOB No.	ALL-23010629-A0
																				MECH	HANICAL	SCHEDU	ILE - AI	R HANDI	LING EQU	JIPMEN	Т																
							SUPPL	Y FAN			RETURN	AN			D	COILS		F	IOT GAS I	REHEAT		GAS	HEATING					ENERGY	RECOVERY		-		F	ILTERS									
							CFM				CFM					EAT	(°F) LAT (°F)		EAT	(°F) LAT	(°F)					s	UMMER EAT (°F	)   LAT (°F)		V	VINTER EAT (°F	)   LAT (°I	=)				WIRING F	OR MECHANIC	al Equipm	ENT SCHE	EDULE		
DV DESIGI	WG. NATION	SYSTEM and ROOM	MODEL	SPEC TYPE	(LBS)	SIZE	TOTAL	ESP (IN W.G.)	RPM	SIZE	TOTAL	ESP (IN N.G.)	RPM	TOTAL CAPACITY (MBH)	SENSIB CAPACI (MBH)	.E TY DB/	WB DB/WB	TOTAL CAPACIT (MBH)	Y DB/	WB DB/V	INI (M	PUT OUT BH) (ME	PUT BH) DII	TEMP FFERNCE (°F)	RECOVE LAT/SEN (MBH)	RY IS (%)	DB/WB	DB/WB	RECOVE LAT/SEN (MBH)	RY NS EFF (%)	DB/WB	DB/WE	SIZE	MERV	MECHANICAL REMARKS	MOTOR Wor HP	MCA FLA		ROOM START TYPE	A RE ER COA E DE	EMOTE INTROL EVICE	DISC. TYPE	ELECTRICAL WIRING INSTRUCTIONS
RT	TU-1	LARGE GYMNASSIUM	AIR WISE TBI 350/HRW/D19/I R	⊢ HG AHU	8800	12-12 T2 DWDI	5400	1 1	1798 1	82T/184 T DWDI	5400	1	1931	225	133	79.0/	67.9 56.2/54.7	113	56.	25 76.3	35 4	00 32	24	56	58.2/48.2	2 54%	88.0/73.0	0 79.7/67.7	53.8/288	.3 63%	-5/-5	44.4/36.	3 2"/4"	8/13	OUTDOOR ROOFTOP UNIT, ENTHALPY WHEEL, GAS HEATER, DX COOLING R-410A REFRIGERANT, SUPPLY & RETURN FAN C/W VFD, 120V GFCI OUTLET. HOT GAS REHEA DEHUMIDIFICATION, ROOF CURI FURNISHED BY OWNER & INSTALLED BY CONTRACTOR	- .Т З.	45.5	50 575/3	3 VFD (DIV.2	3)	BAS T	TY PE 3R C	DIV. 26 TO PROVIDE DISCONECT AND WIRE COMPLETELY THROUGH VFD SUPPLIED BY MECHANICAL DIVISION. DIV. 26 TO PROVIDE A SEPARATE CIRCUIT FOR THE MAINTENANCE RECEPTACLE. ALL CONTROL WIRING BY MECHANICAL DIVISION. SHUTDOWN UPON FIRE ALARM ACTIVATION BY DIV. 26
RT	TU-2	SMALL GYMNASSIUM	TRANE PRECEDENT YHJ210AWSA 00E0A2A1A00	H** AHU D2	2416	BC PLENUM	5300	1.2 1	1267	-	-	-	-	213.35	134.84	80.3/	68.7 58.65/56.62	. 158.5	80.3/	/68.7 56.1 <i>/</i> !	55.6 4	00 32	24	60	-	-	-	-	-	-	-	-	2"	13	OUTDOOR ROOFTOP UNIT, GA HEATER, DX COOLING R410-A REFRIGERANT, C/W POWEREL EXHAUST FAN, MODULATING HOT GAS REHEAT, ROOF CURI ECONOMIZER. FURNISHED BY OWNER & INSTALLED BY CONTRACTOR.	S 3, 18.54 KW	40	50 575/3	BIC		BAS T		DIV. 26 TO PROVIDE DISCONECT AND WIRE COMPLETELY THROUGH VFD SUPPLIED BY MECHANICAL DIVISION. DIV. 26 TO PROVIDE A SEPARATE CIRCUIT FOR THE MAINTENANCE RECEPTACLE. ALL CONTROL WIRING BY MECHANICAL DIVISION. SHUTDOWN UPON FIRE ALARM ACTIVATION BY DIV. 26
AH	-IU-9	SECOND FLOOR CLASSROOM	TRANE Y SJ090AWSO D0E0A1A1	H** AHU	1194	BC PLENUM	3000	0.75 1	185	-	-	-	-	94.42	73.02	80.0/	67.0 58.95/57.38	-	-		2	00 16	52	49.5	-	-	-	-	-	-	-	-	2"	13	OUTDOOR ROOFTOP UNIT, GA HEATER, DX COIL, C/W CURB ADAPTER. FURNISHED BY OWNER & INSTALLED BY CONTRACTOR.	8.69 KW	19	25 575/3	BIC		BAS (	TYPE3R (DIV.23 A)	DIV. 26 TO WIRE COMPLETELY THROUGH BUILT-IN DISCONNECT ALL CONTROL WIRING BY MECHANICAL DIVISION
АН	łU-10	SOUTH WING	A IR WISE PA C500/D30/F	AHU	8600	10HP TEFC	0 11220	1.8 1	1208	5HP TEFC	10320	1	707	356	-	79.5/	68.0 62.0/58.27	-	-		4	40 35	56	29	-	-	-	-	_	-	-	-	2"	13	OUTDOOR ROOFTOP UNIT, GA HEATER, PACKAGED DX COIL, R13 FOAM PANEL INSULATION FURNISHED BY OWNER & INSTALLED BY CONTRACTOR	s , 	64.1	70 575/3	3 VFD (DIV.2	3)	BAS T	IYPE 3R	DIV. 26 TO PROVIDE DISCONECT AND WIRE COMPLETELY THROUGH V FD SUPPLIED BY MECHANICAL DIVISION. ALL CONTROL WIRING BY MECHANICAL DIVISION
АН	łU-11	EAST WING	AIR WISE PAC350/D25/F	RA AHU	6900	10HP TEFO	7800	1.8 1	1307	3HP TEFC	6500	1	725	356	-	79.5/	68.0 59.0/56.41	-	-		3	10 25	50	29	-	-	-	-	_	-	-	-	2"	13	OUTDOOR ROOFTOP UNIT, GA HEATER, PACKAGED DX COIL, R13 FOAM PANEL INSULATION FURNISHED BY OWNER & INSTALLED BY CONTRACTOR	s , 	52.1	60 575/3	3 VFD (DIV.2	3)	BAS T	IYPE 3R	DIV. 26 TO PROVIDE DISCONECT AND WIRE COMPLETELY THROUGH VFD SUPPLIED BY MECHANICAL DIVISION. ALL CONTROL WIRING BY MECHANICAL DIVISION
АН	IU-12	SECOND FLOOR CLASSROOM	TRANE Y SJ090AWSO D0E0A1A1	H** AHU	1194	BC PLENUM	3000	0.75 1	1185	-	-	-	-	94.42	73.02	80.0/	67.0 58.95/57.38	-	-		2	00 16	52	49.5	-	-	-	-	-	-	-	-	2"	13	OUTDOOR ROOFTOP UNIT, GA HEATER, DX COIL, C/W CURB A DAPTER. FURNISHED BY OWNER & INSTALLED BY CONTRACTOR.	8.69 KW	19	25 575/3	BIC	E	BAS (	TYPE3R (DV.23 A)	DIV. 26 TO WIRE COMPLETELY THROUGH BUILT-IN DISCONNECT ALL CONTROL WIRING BY MECHANICAL DIVISION

JOB NAME:						HWE	SB GL	ENDALE SE	EC SCH BOILER AHU REPLACEMENT							JOB No.	ALL-23010629-A0
								n	MECHANICAL SCHEDULE - UNIT VENTIL	ATORS							
514/0				CFM	COOLING	HEATING					WIRING	g for N	ECHAN	CAL EQUIP	MENT SCHEDU	_E	
DWG. DESIGNATION	ROOM	MODEL	TOTAL		CAPACIT Y (BTU/H)	CAPACIT Y (BTU/H)	GPM	PD (FT. H20)	MECHANICAL REMARKS	MOTOR W or HP	MCA FLA	мсор	VAC/ø	ROOM STARTER TYPE	REMOTE CONTROL DEVICE	DISC. TYPE	ELECTRICAL WIRING INSTRUCTIONS
UV-1	DANCE STUDIO	SYSTEM A IR FRESHMAN HRA 36 1200 B C IQ	1200	450	51.4	64.6	3.5	0.46	1 STAGE DX COOLING, HYDRONIC HOT WATER COIL, MERV 13 FILTERS. FURNISHED BY OWNER AND INSTALLED BY CONTRACTOR.	-	5.5	15	208/1	BIC	THERMOSTAT	DV 23	SINGLE POINT CONNECTION WITH BUILT IN DISCONNECT. DIV 26 TO WIRE UNIT THROUGH DISCONNECT. ALL CONTROL WIRING BY MECHANICAL DIVISION.
UV-2	TECH CLASS	SY STEM AIR SOPHMORE HPA 36 1200 O B IQ b	1200	547	36.3	72.7	6.1	1.59	PACAKGED COOLING, 1 STAGE DX COOLING, HYDRONIC HOT WATER COIL, MERV 13 FILTERS. FURNISHED BY OWNER AND INSTALLED BY CONTRACTOR.	-	23.4	30	208/3	вю	THERMOSTAT	DIV 23	SINGLE POINT CONNECTION WITH BUILT IN DISCONNECT. DIV 26 TO WIRE UNIT THROUGH DISCONNECT. ALL CONTROL WIRING BY MECHANICAL DIVISION.

JOB NAME:				HW	DSB GLENDA	ALE SEC SCH	BOILER A HU REPLACEMENT							JOB No.:	ALL-23010629-A0
						MECH	ANICAL SCHEDULE - CONDENSING UN	ITS							
DWG.					coc	DLING			WIRING	FORMECH	NICAL EQU	JIPMENT SC	HEDULE		
DESIGNATIO N	EVAPORATOR UNIT DESIGNATION	SYSTEM and ROOM	MODEL	(LBS)	AM BIENT (°F)	CAPACITY (MBH)	MECHANICAL REMARKS	MOTOR W or HP	MCA FLA	МСОР	VAC/ø	ROOM STARTER TYPE	REMOTE CONTROL DEVICE	DISC. TYPE	ELECTRICAL WIRING INSTRUCTIONS
CU-1	UV-1	DANCE STUDIO	TRANE 4TTA 4036A3	156	95	36	ROOFTOP CONDENSER UNIT. FURNISHED BY OWNER AND INSTALLED BY CONTRACTOR.	-	12	20	208/3	BIC	BAS	TYPE 3R	DIV. 26 TO PROVIDE DISCONECT AND WIRE COMPLETELY. ALL CONTROL WIRING BY MECHANICAL DIVISION

JOB NAME:	HWDSB GLEN	DALE SEC SCH	BOILER A HU REPLACEMENT	JOB No.	ALL-23010629-A0
	MECHA	ANICAL SCH	EDULE - GAS SERVICE	PRESSURE R	EDUCING VALVES
DWG. DESIGNATION	SYSTEM	CAPACTIY (FT <sup>3</sup> /HR)	INLET PRESSURE (PSIG)	OUTLET PRESSURE (IN W.G)	MECHANICAL REMARKS
GPRV-1	RTU-1, RTU-2	400	2	7"-14"	
GPRV-2	ERV-1	800	2	7"-14"	

JOB NAME:		HWDSI	B GLENDALE SEC	C SCH BOILER	AHU REPLA	CEMENT		JOB No.	ALL-23010629-A0
				MECHANIC	AL SCHE	DULE - All	R DIFFUSE	RS	
DWG.	MO	DEL	FACEPLATE	NECK SIZE	C	-M	SP (IN	W.G.)	
DESIGNATION	SERIES	FRAME	SIZE	(IN)	MIN	MAX	MIN	MAX	
D-01	ND	SM	-	12"	300	600	0.07	0.26	SURFACE DUCT MOUNTED NOZZLE DIFFUSER, C/W DAMPER.
FRAME 31 IS FOR	R'TBAR CEILI	NG							

FRAME 31/SPF IS FOR PLASTER CEILING FOR EXPOSED DUCT MULTIPLY THROW BY 0.7

![](_page_27_Picture_7.jpeg)

JOB NAME:								HWDSB GLE	ENDALE SEC	SCH BOILER	RAHU REPLA	CEMENT							JOB No.	ALL-23010629-A0
										MECHA	ANICAL SO	CHEDULE - BOILERS								
									WATER C	ONDITIONS				WIRING	FOR MECH	ANICAL EQU	JIPMENT SC	HEDULE		
DWG. DESIGNATION	SYSTEM and ROOM	MODEL	Туре	WEIGHT (LBS)	OUTPUT (MBH)	INPUT (MBH)	EFFICIENCY (%)	FLOW (GPM)	PD (FT)	EWT (°F)	LWT (°F)	MECHANICAL REMARKS	MOTOR W or HP	MCA	мсор	VAC/ø	ROOM STARTER TYPE	REMOTE CONTROL DEVICE	DISC. TYPE	ELECTRICAL WIRING INSTRUCTIONS
B-1	BOILER ROOM	PA TTERSON KELLY P-K SOLIS SL-2000	CONDENSING	3000	1920	2000	96%	192	5.2	180	160	Condensing firetube Boiler, 10:1 Turndown, Nuro Integral Boiler Controls.	-	15	-	208V/1ø	BIC	BAS	TYPE 1	DIV. 26 TO PROVIDE RED PAINTED DISCONNECT AND WIRE COMPLETELY. DIV. 26 TO PROVIDE EPO SWITCH WITH COVER TO REMOTELY SHUT DOWN BOILER. ALL CONTROL WIRING BY MECHANICAL DIVISION
B-2	BOILER ROOM	PATTERSON KELLY P-K SOLIS SL-2000	CONDENSING	3000	1920	2000	96%	192	5.2	180	160	CONDENSING FIRETUBE BOILER, 10:1 TURNDOWN, NURO INTEGRAL BOILER CONTROLS.	-	15	-	208V/1ø	BIC	BAS	TYPE 1	DIV. 26 TO PROVIDE RED PAINTED DISCONNECT AND WIRE COMPLETELY. DIV. 26 TO PROVIDE EPO SWITCH WITH COVER TO REMOTELY SHUT DOWN BOILER. ALL CONTROL WIRING BY MECHANICAL DIVISION
B-3	BOILER ROOM	PATTERSON KELLY P-K SOLIS SL-2000	CONDENSING	3000	1920	2000	96%	192	5.2	180	160	Condensing firetube Boiler, 10:1 Turndown, Nuro Integral Boiler Controls.	-	15	-	208V/1ø	BIC	BAS	TYPE 1	DIV. 26 TO PROVIDE RED PAINTED DISCONNECT AND WIRE COMPLETELY. DIV. 26 TO PROVIDE EPO SWITCH WITH COVER TO REMOTELY SHUT DOWN BOILER. ALL CONTROL WIRING BY MECHANICAL DIVISION

JOB NAME:					HWI	DSB GLENDA	LE SEC SCH	I BOILER AHU REPLACEMENT							JOB No.	ALL-23010629-A0
								MECHANICAL SCHEDULE - PUMPS								
										WIRING	FOR MECH	ANICAL EQ	UIPMENT SC	HEDULE		
DWG. DESIGNATION	SYSTEM and ROOM	MODEL	SPEC TYPE	FLOW (GPM)	HEAD (FT)	EFF. (%)	VFD	MECHANICAL REMARKS	MOTOR W or HP	MCA FLA	мсор	VAC/ø	ROOM STARTER TYPE	REMOTE CONTROL DEVICE	DISC. TYPE	ELECTRICAL WIRING INSTRUCTIONS
P-1	RADIA TOR LOOP	GRUNDFOS HYDRO NP (ABB) 2CR 125-1	VP	600	105.2	78.10%	YES	PACKAGED PUMP SKID WITH VFD SHIPPED LOOSE. PRESSURE TRANSDUCER FACTORY INSTALLED	25 HP			208/3ø	VFD (DIV.23)	BAS	TYPE 1	DIV. 26 TO PROVIDE DISCONECT AND WIRE COMPLETELY THROUGH VFD SUPPLIED BY MECHANICAL DIVISION. ALL CONTROL WIRING BY MECHANICAL DIVISION
P-2	RADIA TOR LOOP	GRUNDFOS HYDRO NP (ABB) 2CR 125-1	VP	600	105.2	78.10%	YES	PACKAGED PUMP SKID WITH V FD SHIPPED LOOSE. PRESSURE TRANSDUCER FACTORY INSTALLED	25 HP			208/3ø	VFD (DIV.23)	BAS	TYPE 1	DIV. 26 TO PROVIDE DISCONECT AND WIRE COMPLETELY THROUGH VFD SUPPLIED BY MECHANICAL DIVISION. ALL CONTROL WIRING BY MECHANICAL DIVISION
P-3	FAN COIL LOOP	GRUNDFOS HYDRO NP (ABB) 2CR 45-1	VP	250	85.2	73.40%	YES	PACKAGED PUMP SKID WITH VFD SHIPPED LOOSE. PRESSURE TRANSDUCER FACTORY INSTALLED	10 HP			208/3ø	VFD (DIV.23)	BAS	TYPE 1	DIV. 26 TO PROVIDE DISCONECT AND WIRE COMPLETELY THROUGH VFD SUPPLIED BY MECHANICAL DIVISION. ALL CONTROL WIRING BY MECHANICAL DIVISION
P-4	FAN COIL LOOP	GRUNDFOS HY DRO NP (ABB) 2CR 45-1	VP	250	85.2	73.40%	YES	PACKAGED PUMP SKID WITH V FD SHIPPED LOOSE. PRESSURE TRANSDUCER FACTORY INSTALLED	10 HP			208/3ø	VFD (DIV.23)	BAS	TYPE 1	DIV. 26 TO PROVIDE DISCONECT AND WIRE COMPLETELY THROUGH VFD SUPPLIED BY MECHANICAL DIVISION. ALL CONTROL WIRING BY MECHANICAL DIVISION
P-5	TECH WING LOOP	GRUNDFOS HYDRO NP (ABB)(CUE) 2CR 45-1	VP	200	85.2	74.90%	YES	PACKAGED PUMP SKID WITH VFD SHIPPED LOOSE. PRESSURE TRANSDUCER FACTORY INSTALLED	10 HP			208/3ø	VFD (DIV.23)	BAS	TYPE 1	DIV. 26 TO PROVIDE DISCONECT AND WIRE COMPLETELY THROUGH VFD SUPPLIED BY MECHANICAL DIVISION. ALL CONTROL WIRING BY MECHANICAL DIVISION
P-6	TECH WING LOOP	GRUNDFOS HYDRO NP (ABB)(CUE) 2CR 45-1	VP	200	85.2	74.90%	YES	PACKAGED PUMP SKID WITH VFD SHIPPED LOOSE. PRESSURE TRANSDUCER FACTORY INSTALLED	10 HP			208/3ø	VFD (DIV.23)	BAS	TYPE 1	DIV. 26 TO PROVIDE DISCONECT AND WIRE COMPLETELY THROUGH VFD SUPPLIED BY MECHANICAL DIVISION. ALL CONTROL WIRING BY MECHANICAL DIVISION
P-9	BOILER PUMP	GRUNDFOS 40959 VL	СР	192	30	88.70%	NO	BOILER CIRCULA TOR PUMP	3 HP	7.64		208/3ø	BIC	BAS	TYPE 1	DIV. 26 TO PROVIDE DISCONECT AND WIRE COMPLETELY. ALL CONTROL WIRING BY MECHANICAL DIVISION
P-10	BOILER PUMP	GRUNDFOS 40959 VL	СР	192	30	88.70%	NO	BOILER CIRCULA TOR PUMP	3 HP	7.64		208/3ø	BIC	BAS	TYPE 1	DIV. 26 TO PROVIDE DISCONECT AND WIRE COMPLETELY. ALL CONTROL WIRING BY MECHANICAL DIVISION
P-11	BOILER PUMP	GRUNDFOS 40959 VL	СР	192	30	88.70%	NO	BOILER CIRCULA TOR PUM	3 HP	7.64		208/3ø	BIC	BAS	TYPE 1	DIV. 26 TO PROVIDE DISCONECT AND WIRE COMPLETELY. ALL CONTROL WIRING BY MECHANICAL DIVISION

JOB NAME:		HV	VDSB GLEND	ALE SEC SCH	I BOILER AHL	J REPLACEME	ENT		JOB No.	ALL-23010629-A
ľ				1	MECHANIC		DULE - GR		D REGISTI	ERS
DWG.		MODEL		SI	ZE	CI	FM	SP (IN	I W.G.)	MECHANICAL REMARKS
DESIGNATION	CORE	BORDER	FRAME	Length	Width	MIN	MAX	MIN	MAX	
G-01	А	F	630D/L	36	12	1000	1,700	0.044	0.1	EH PRICE, ALUMINUM CONSTRUCTION, RETURN GRILLE
G-02	А	F	630D/S	38	22	1000	1,700	0.011	0.025	EH PRICE, ALUMINUM CONSTRUCTION, RETURN GRILLE
G-03	А	F	630D/L	24	8	400	750	0.025	0.1	EH PRICE, ALUMINUM CONSTRUCTION, RETURN GRILLE
G-04	А	F	630D/L	10	4	50	180	0.011	0.177	EH PRICE, ALUMINUM CONSTRUCTION, RETURN GRILLE
G-05	А	F	99D/L	48	14	1500	3,000	0.038	0.11	EH PRICE, ALUMINUM CONSTRUCTION, RETURN GRILLE
G-06	А	F	620D/L	36	12	900	1,900	0.006	0.03	EH PRICE, ALUMINUM CONSTRUCTION, SUPPLY GRILLE
G-07	А	F	620D/L	18	8	400	750	0.01	0.04	EH PRICE, ALUMINUM CONSTRUCTION, SUPPLY GRILLE
G-08	А	F	620D/L	8	4	50	180	0.006	0.09	EH PRICE, ALUMINUM CONSTRUCTION, SUPPLY GRILLE
G-09	-	-	SDGE	16	6	200	400	0.006	0.09	EH PRICE, ALUMINUM CONSTRUCTION, SPIRAL DUCT SUPPLY GRILLI C/W AIRSCOOP OBD, DOUBLE DEFLECTION PARALLEL TO SHORT DIMENSION.

ALL GRILLES AND DIFFUSERS TO BE COLOUR B15 (ALUMINUM POWDER COAT) ALL GRILLES TO HAVE 'A' FASTENING

## NOTES - ELECTRICAL WIRING INSTRUCTIONS:

- 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.
- 4. USING ONE FACR, INTERLOCK WITH FIRE ALARM SYSTEM SO THAT FAN STARTS/RUNS EITHER AUTOMATICALLY ON FIRE ALARM SYSTEM ALERT OR EVAC SIGNAL, OR BY MANUALLY SELECTING "RUN" POSITION ON THE ASSOCIATED SELECTOR SWITCH AT THE CACF.
- 5. USING SECOND FACR, INTERLOCK WITH FIRE ALARM SYSTEM SO THAT THE FAN STOPS BY MANUALLY SELECTING THE "OFF" POSITION ON THE ASSOCIATED
- SELECTOR SWITCH AT THE CACF.
- 6. USING FAIM INTERLOCK WITH FIRE ALARM SYSTEM TO INDICATE FAN'S RUN/OFF STATUS AT THE CACF. 7. INTERLOCK DIRECTLY WITH DUCT DETECTOR SO THAT FAN SHUTS DOWN WHEN DETECTOR ACTUATES.
- 8. USING FACR, INTERLOCK WITH FIRE ALARM SYSTEM SO THAT FAN SHUTS DOWN ON FIRE ALARM SYSTEM ALERT OR EVAC SIGNAL.
- 9. PROVIDE 120 VOLT CIRCUIT AND LOCAL TOGGLE DISCONNECT SWITCH FOR BUILT-IN PREWIRED SERVICE RECEPTACLES AND/OR LIGHTS.
- 10. PROVIDE 2 FAIMS PER DAMPER. CONNECT ONE TO DAMPER "CLOSED" POSITION END SWITCH(ES) AND ONE TO DAMPER "OPEN" POSITION END SWITCH(ES) TO PROVIDE DAMPER POSITION STATUS SIGNAL TO FA SYSTEM. WHERE THERE ARE MULTIPLE END SWITCHES, WIRE IN SERIES TO FA INPUT MODULE. DAMPER END SWITCHES ARE SUPPLIED AND INSTALLED BY MECHANICAL DIVISION.
- 11. USING FACR, INTERLOCK WITH FIRE ALARM SYSTEM SO THAT NORMALLY CLOSED DAMPER CLOSES ON FIRE ALARM SYSTEM ALERT OR EVAC SIGNAL OR MANUALLY BY SELECTING THE "OPEN" POSITION ON THE ASSOCIATED SELECTOR SWITCH AT THE CACF.
- 12. INTERLOCK DIRECTLY WITH DUCT DETECTOR SO THAT FAN SHUTS DOWN WHEN DETECTOR ACTUATES. 13. MOUNT STARTER AT UNIT AS A DISCONNECT.
- 14. INTERLOCK DISCONNECT SWITCH AUXILIARY CONTACT TO VFD FOR SHUT DOWN WHEN SWITCH IS OPEN.
- 15. USE NEXANS "DRIVERX (CSA)" CABLES OR APPROVED EQUAL FOR POWER WIRING FROM VFD THROUGH DISCONNECT SWITCH AND ONTO MOTOR. ALL
- ASSOCIATED CABLE CONNECTORS SHALL BE RATED FOR CLASS II, GROUPS E, F AND G HAZARDOUS LOCATIONS.
- 16. PROVIDE 120VAC "VAV" JUNCTION BOXES AS INDICATED FOR USE BY MECHANICAL DIVISION TO CONNECT VAV BOX LOW VOLTAGE TRANSFORMER PRIMARY WIRING.
- 17. ALL SUMP PUMP MOTORS CAN OPERATE AT THE SAME TIME. CONNECT FLOAT SWITCHES (FOUR(4) PER PUMP PACKAGE) AND PUMP CABLES TO CONTROL PANEL. INSTALL HORN/LIGHT ALARM SUPPLIED BY MECHANICAL DIVISION AND WIRE TO CONTROL PANEL. CONFIRM EXACT LOCATION WITH OWNER (ALLOW 100 M RUN). 18. FEED FIRE PUMP AUTOMATIC TRANSFER SWITCH/CONTROLLER FROM BOTH NON-ESSENTIAL POWER AND ESSENTIAL POWER SUPPLIES AS INDICATED.
- PROVIDE SIX (6) FAIM'S AND CONNECT EACH FAIM TO ONE OF THE FOLLOWING SWITCHES/CONTACTS WITHIN CONTROLLER:
- a. "LOSS OF EXCESS WATER PRESSURE"
- b. "LOSS OF POWER"
- c. "PUMP MOTOR RUNNING" d. "PHASE LOSS"
- e. "PHASE REVERSAL"
- f. "CONTROLLER CONNECTED TO ESSENTIAL POWER"
- ALL FIRE ALARM CONNECTIONS ARE SUPERVISORY ZONE CONNECTIONS AS INDICATED ON PLANS.
- 19. WIRE PRESSURE SWITCH (PS) (LOCATED WITHIN 6 METERS) SO THAT PUMP STARTS WHEN PS IS ACTIVATED.
- 20. PROVIDE FAIM AND CONNECT TO CONTROLLER FOR "LOSS OF POWER" SIGNAL.
- 21. RUNS Nos 4, 5 AND 6 SHARE A COMMON BREAKER AND A COMMON CONTROL THERMOSTAT.
- 22. RUNS Nos 8, 9, 10 AND 11 SHARE A COMMON BREAKER AND A COMMON CONTROL THERMOSTAT.
- 23. RUNS Nos 13 AND 14 SHARE A COMMON BREAKER A COMMON CONTROLLER AND FAIM.
- 24. RUNS Nos 16 AND 17 SHARE A COMMON BREAKER AND A COMMON CONTROL THERMOSTAT.
- 25. RUNS Nos 18 AND 19 SHARE A COMMON BREAKER AND A COMMON CONTROL THERMOSTAT.
- 26. RUNS Nos 22 AND 23 SHARE A COMMON BREAKER AND A COMMON CONTROL THERMOSTAT.
- 27. RUNS Nos 24 AND 25 SHARE A COMMON BREAKER AND A COMMOM CONTROL THERMOSTAT.
- 28. PROVIDE ONE(1) CAT. 6 CABLE IN CONDUIT AND CONNECT TO NEAREST ROP LAN PATCH PANEL. 29. USING TWO (2) FACR'S, INTERLOCK WITH FIRE ALARM SYSTEM SO THAT DAMPER OPENS BY
- MANUALLY SELECTING THE "OPEN" POSITION ON THE SELECTOR SWITCH AT THE CACF AND THE DAMPER CLOSES BY MANUALLY SELECTING THE "CLOSE" POSITION ON THE ASSOCIATED SELECTOR SWITCH AT THE CACF.
- 30. KITCHEN HOOD "MARVEL" CONTROL PANEL BY KITCHEN CONTRACTOR. INSTALL VFDS SUPPLIED BY KITCHEN CONTRACTOR AND PROVIDE POWER WIRING TO EXHAUST FAN MOTOR THROUGH VFD. INTERLOCK WITH CONTROL PANEL AS INDICATED ON DWG E3.61.
- 31. PROVIDE A FAIM FOR EACH DEVICE AND WIRE TO SAME AND CONNECT FAIM TO FIRE ALARM SYSTEM
- AS INDICATED. CONFIRM EXACT DEVICE LOCATION WITH SPRINKLER SYSTEM CONTRACTOR PRIOR TO ROUGH-IN. ALLOW FOR CHANGE OF LOCATION WITHIN SIX (6) METERS OF WHAT IS INDICATED.
- 32. PROVIDE TWO (2) FACR'S AND CONNECT TO PANEL. PROGRAM FACR'S TO PROVIDE SEPARATE FIRST STAGE AND SECOND STAGE FIRE ALARM SIGNALS TO THE BAS SYSTEM.
- 33. RUNS Nos 30, 31 AND 32 SHARE A COMMON BREAKER AND A COMMON CONTROL THERMOSTAT.

WIRING FOR MECHANICAL

LS – LEVEL SWITCH

MAN – MANUAL STARTER

ODT – OFF DELAY TIMER

COVER

SS – SPEED SWITCH

SV – SOLENOID VALVE

TI – TIMER (INTERVAL)

T7 – TIMER (7–DAY)

TS – THERMOSTAT

VM – VALVE MOTOR

(VSD)

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
C2 – EEMAC-2 TYPE DISC. SWITCH
C3R – EEMAC-3R TYPE DISC. SWITCH
C4 – EEMAC-4 TYPE DISC. SWITCH
C12 – EEMAC-12 TYPE DISC. SWITCH
COMB – COMBINATION MAGNETIC STARTER
CP – CONTROL PANEL
CSR – CURRENT SENSING RELAY
CT – CONTROL TRANSFORMER
CWSV – COLD WATER SOLENOID VALVE
(D23) – ITEM ADJACENT IS SUPPLIED, INSTALLED AND WIRED BY MECHANICAL DIVISION.
(D23A) – ITEM ADJACENT IS SUPPLIED AND INSTALLED BY MECHANICAL DIVISION. ELECTRICAL DIVISION WIRES ITEM.
(D26) – ITEM ADJACENT IS SUPPLIED BY MECHANICAL DIVISION. ELECTRICAL DIVISION INSTALLS AND WIRES ITEM.
(D26A) – ITEM ADJACENT IS SUPPLIED, INSTALLED AND WIRED BY ELECTRICAL
DISC – DISCONNECT
DM – DAMPER MOTOR
DMSW – DAMPER MOTOR SWITCH
DVR – DOUBLE VOLTAGE RELAY
FA - FIRE ALARM SYSTEM CONNECTION
FAIM – ADDRESSABLE FIRE ALARM INPUT MODULE
FACR – ADDRESSABLE FIRE ALARM CONTROL RELAY MODULE
FL – FLOAT SWITCH FLA – FULL LOAD RUNNING AMPERES
FPU - FIFLD PROCESSOR UNIT BY DIV 15900*
FPU/SS - START/STOP CONTROL OUTPUT FROM FPU*
FOLL/ST MOTOR PLINNING STATUS INDUIT TO FOLL*
FP0731 = MOTOR ROMAING STATUS INFUT TO TFUT
FS - FLOW SWITCH
HOA = HAND / OEE / ALITO SWITCH IN STARTED COVER
HUM _ HUMIDISTAT
INSV - NUT WALER SULLINUID VALVE
ING - INFRARED SENSUR
NINGW - KET OPERATED MOMENTARY CONTACT SWITCH
KSW/PL - KEY SWIICH(15A, 120V,SPST, LOCK TYPE

C/W PILOT LIGHT)

## Glendale Secondary School 145 Rainbow Dr, WIRING FOR MECHANICAL Hamilton, ON EQUIPMENT SCHEDULE LEGEND For the HWDSB LWCO - LOW WATER CUT OFF SEAL: MAG – MAGNETIC STARTER MCA – MINIMUM CIRCUIT AMPS MCC - MOTOR CONTROL CENTRE MFA – MAXIMUM FUSE AMPACITY MOCP - MAXIMUM OVER CURRENT PROTECTION MVS – MONITORED VALVE SWITCH PB – PUSHBUTTON ON/OFF SWITCH IN STARTER **EXP** Services Inc. t: 905.525.6069 | f: 905.528.7310 PL – PILOT LIGHT IN STARTER COVER 1266 South Service Road, Suite C1-1, Stoney Creek, PLG – 120V RECEPTACLE BY ELECTRICAL DIVISION ON, L8E 5R9 Canada PS – PRESSURE SWITCH www.exp.com RPB – REMOTE STOP/START PUSHBUTTON RPL – REMOTE PILOT LIGHT SD – SMOKE DETECTOR (DUCT TYPE) SLS & PL – SELECTOR SWITCH AND PILOT LIGHT SW – HP RATED TOGGLE SWITCH BUILDINGS • EARTH & ENVIRONMENT • ENERGY INDUSTRIAL INFRASTRUCTURE SUSTAINABILITY TC – TEMPERATURE CONTROLLER TRUE NORTH: TRS - THERMOSTAT REVERSING SWITCH DRAWING TITLE: T - THERMOSTAT OR TEMPERATURE SENSING UNIT Mechanical & Electrical VFD – VARIABLE FREQUENCY (OR SPEED) DRIVE Schedules TOA - TEST/OFF/AUTO SWITCH IN STARTER COVER. SCALE: AS NOTED DRAWN: C.M. / J.L. DATE: SEPTEMBER 2023 PROJECT #: ALL-23010629-A0 DRAWING #:

ME

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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

HVAC Renovations

RELEVANT WORK

BOX HEREON

PROJECT: