HVAC SPECIFICATIONS

DIVISION 23 HVAC

23 05 00 BASIC HVAC REQUIREMENTS

A. SEE DIVISION 00 PROCUREMENT AND CONTRACTING AND DIVISION 01 GENERAL REQUIREMENT FOR ADDITIONAL REQUIREMENTS.
B. SUBSTITUTIONS
1. SEE DIVISION 01 25 13 PRODUCT SUBSTITUTION PROCEDURES FOR ADDITIONAL REQUIREMENTS.
2. CONTRACTOR SHALL PROVIDE ALL SUPPORTING DATA AND ASSUME THE BURDEN OF PROOF THAT ANY SUBSTITUTE IS EQUIVALENT AS TO APPEARANCE, CONSTRUCTION, CAPACITY, AND PERFORMANCE. THE JUDGMENT OF EQUIVALENCY SHALL BE MADE BY THE ENGINEER AT THE TIME OF SHOP DRAWING REVIEW, NOT DURING BIDDING.
3. WHERE SUBSTITUTE EQUIPMENT REQUIRES REDESIGN OF ANY PART OF THE PROJECT, THE COST OF REDESIGN AND ADDITIONAL COSTS OF THE WORK SHALL BE PAID BY THE CONTRACTOR. REDESIGN SHALL BE SUBJECT TO THE APPROVAL OF ALL AUTHORITIES HAVING JURISDICTION OVER THE WORK INCLUDING THE ARCHITECT/ENGINEER.
4. CONTRACTOR SHALL ASSUME ALL COORDINATION RESPONSIBILITIES FOR SUBSTITUTE EQUIPMENT INCLUDING COORDINATION ACROSS TRADES AND COORDINATION OF PREVIOUSLY REVIEWED AND APPROVED SHOP DRAWING SUBMITTALS, SHOULD THESE SHOP DRAWINGS BE AFFECTED BY THE SUBSTITUTED EQUIPMENT.
C. SHOP DRAWINGS, PRODUCT DATA, TEST RESULTS, PROJECT CLOSEOUT DOCUMENTS:
1. SEE DIVISION 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES FOR ADDITIONAL REQUIREMENTS
2. CONSTRUCTION ADMINISTRATION SUBMITTAL LIST:
a. DUCTWORK
b. DUCTWORK ACCESSORIES
c. INSULATION
d. PIPING
e. PIPE HANGERS
f. VALVES
g. GRILLES
h. ROOF HOODS
i. FANS
j. ROOF EXHAUSTERS
k. ELECTRIC WALL UNIT HEATERS
l. GAS PRESSURE REGULATORS
m. GAS UNIT HEATERS
n. RADIANT GAS UNIT HEATERS
o. ROOM AIR CONDITIONING AND ASSOCIATED CONDENSING UNITS
p. TEMPERATURE CONTROLS
q. TEST AND BALANCE REPORT
3. PROJECT CLOSEOUT
a. DOCUMENTATION: PROVIDE VENTILATION SYSTEM DOCUMENTATION PER ASHRAE 62.1-2007, SECTION 7.2.6.
b. AS-BUILT DRAWINGS SHALL BE MARKED ON A FINAL SET OF DRAWINGS WHICH INCLUDES ALL REVISIONS.
c. PROVIDE HVAC EQUIPMENT OPERATING AND MAINTENANCE MANUALS TO THE OWNER PER SPS 364.0313(3).
D. FINISHING AND PAINTING
1. IF FINISH BECOMES RUSTED, CORRODED, SCRATCHED, OR FLAKED DURING STORAGE OR INSTALLATION, REFINISH THE EQUIPMENT TO THE SATISFACTION OF THE OWNER.
E. DETAILS AND SCHEDULES ARE SHOWN TO AID THE CONTRACTOR AND ARE NOT MEANT TO BE INCLUSIVE OF ALL DEVICES. PROVIDE REQUIRED EQUIPMENT AND ACCESSORIES FOR A COMPLETE INSTALLATION.
F. INSTALL ALL EQUIPMENT PER MANUFACTURER'S INSTALLATION INSTRUCTIONS AND REQUIREMENTS. PROVIDE ADDITIONAL WORK AND MATERIALS AS REQUIRED.
G. COORDINATE INSTALLATION OF HVAC WORK WITH THE OTHER CONTRACTORS TO AVOID CONFLICTS WITH OTHER WORK.
H. VERIFY CONNECTION REQUIREMENTS FOR EQUIPMENT FURNISHED BY OTHERS WITH FINAL SHOP DRAWINGS.
I. STRUCTURAL PENETRATIONS
1. OPENINGS THRU BEAMS OR COLUMNS OR ANY OTHER STRUCTURAL MEMBER ARE NOT PERMITTED UNLESS APPROVED BY STRUCTURAL ENGINEER.
J. ESCUTCHEONS
1. INSTALL ONE-PIECE (TWO PIECE FOR EXISTING PIPING) POLISHED CHROME PLATED STEEL ESCUTCHEONS AT PENETRATIONS EXPOSED IN FINISHED ROOMS (ROOMS WHICH DON'T HAVE UNFINISHED CONCRETE FLOORS).
2. ESCUTCHEONS NOT REQUIRED WHERE INSULATION BUTTED TO WALL/CEILING FULLY COVERS THE SLEEVE/WALL OPENING AND INSULATION IS CAULKED AT WALL/CEILING.
3. ESCUTCHEONS WITH SPRINGS FOR WALL AND CEILING LOCATIONS.
4. ID TO CLOSELY FIT AROUND PIPE/INSULATION, OD THAT COMPLETELY COVERS THE OPENING.
K. PROJECT COMPLETION
1. INSTALL CLEAN SET OF FILTERS IN ALL UNITS AT TIME OF TESTING AND BALANCING.
2. CLEAN GRILLES AND EQUIPMENT AND LEAVE IN PROPER WORKING CONDITION AT THE TIME OF FINAL CLEAN-UP.
L. GAS SERVICE
1. COORDINATE INSTALLATION OF GAS SERVICE WITH GAS UTILITY. CONTACT GAS UTILITY TO ARRANGE SERVICE AND ASSIST OWNER IN APPLYING FOR NEW SERVICE.
2. GAS SERVICE COST BY OWNER.
3. GAS COMPANY
a. WE ENERGIES
b. CONTACT: LISA SMITH
1). (262) 968-5710
2). LISA.SMITH1@WE-ENERGIES.COM

23 05 13 MOTORS AND ELECTRICAL WORK

A. MOTORS
1. MANUFACTURERS: GENERAL ELECTRIC, LOUIS ALLIS, MARATHON, AND BALDOR.
2. MOTORS LESS THAN 250 WATTS: EQUIPMENT MANUFACTURER'S STANDARD AND NEED NOT CONFORM TO THESE SPECIFICATIONS.
3. OPEN DRIP-PROOF TYPE EXCEPT TOTALLY ENCLOSED FAN COOLED FOR THE FOLLOWING MOTORS:
a. EXTERIOR LOCATIONS
b. DRAW THRU AIR HANDLING UNITS
c. WHERE NOTED ON EQUIPMENT SCHEDULES
4. DESIGN FOR CONTINUOUS OPERATION IN 40 DEGREES C ENVIRONMENT AND FOR TEMPERATURE RISE IN ACCORDANCE WITH NEMA MG 1 LIMITS.
5. SINGLE PHASE POWER (PERMANENT-SPLIT CAPACITOR MOTORS) WITH STARTING TORQUE EXCEEDING ONE FOURTH OF FULL LOAD TORQUE AND STARTING CURRENT UP TO SIX TIMES FULL LOAD CURRENT. CLASS A (50 DEGREES C TEMPERATURE RISE) INSULATION, MINIMUM 1.0 SERVICE FACTOR, PRELUBRICATED SLEEVE OR BALL BEARINGS, AUTOMATIC RESET OVERLOAD PROTECTOR.
6. THREE PHASE POWER (SQUIRREL CAGE MOTORS) WITH STARTING TORQUE BETWEEN 1 AND 1-1/2 TIMES FULL LOAD TORQUE AND STARTING CURRENT SIX TIMES FULL LOAD CURRENT. NEMA DESIGN B MOTOR AND INSULATION SYSTEM. MINIMUM 1.15 SERVICE FACTOR FOR OPEN DRIP-PROOF MOTORS, 1.0 (MINIMUM) FOR OTHER TYPES. MINIMUM 85% NOMINAL POWER FACTOR UNDER RATED LOAD CONDITIONS. GREASE LUBRICATED ANTI-FRICTION BALL BEARINGS, RATED FOR MINIMUM AFBMA 9, L-10 LIFE OF 200,000 HOURS.
B. STARTERS
1. SEE ELECTRICAL STARTER DISCONNECT SCHEDULE ON PLANS.

23 05 29 PIPE AND EQUIPMENT HANGERS AND SUPPORTS

A. MANUFACTURERS: B-LINE, EMPIRE INDUSTRIES, GLOBAL PIPE HANGER PRODUCTS, GRINNELL, NATIONAL PIPE HANGER, UNI STRUT.
B. HOT DIP GALVANIZED HANGERS, RODS, AND ACCESSORIES AFTER FABRICATION WHICH ARE EXPOSED TO WEATHER.
C. ANGLES, CHANNELS, AND BEAMS: ASTM A36 AND A572 AS REQUIRED.
D. HANGERS SHALL NOT BE ATTACHED TO JOIST BRIDGING.
E. ATTACHMENT TO METAL DECK: HANGERS MAY BE ANCHORED TO METAL FLOOR/ROOF DECK IF ALL THE FOLLOWING CONDITIONS ARE MET:
a. MAXIMUM HANGER LOAD OF 50 LBS.
b. ANCHORED TO BOTTOM OF DECK FLUTES, NOT UPPER FLUTE.
c. ANCHOR LENGTH SHALL NOT EXCEED DECK DEPTH.
F. FASTENER SYSTEM
1. PULL-OUT TENSION AND SHEAR CAPACITIES APPROPRIATE FOR SUPPORTED LOADS AND BUILDING MATERIALS.
2. POWDER-ACTUATED FASTENERS: THREADED-STEEL STUD, FOR USE IN CONCRETE.
3. MECHANICAL-EXPANSION ANCHORS: INSERT-WEDGE TYPE, ZINC-COATED STEEL (STAINLESS IN PROCESS ROOMS), FOR USE IN CONCRETE. MINIMUM 1 1/2" EMBEDMENT.
G. PIPE HANGERS AND SUPPORTS
1. SEE DETAILS ON PLANS FOR ADDITIONAL PIPE HANGER SPECIFICATIONS.
2. SEE SCHEDULE ON PLANS FOR HANGER SPACING.
3. CONFORM TO ASME B31.9 AND MANUFACTURER'S STANDARDIZATION SOCIETY (MSS) SP-58-2009.
4. MATERIALS
5. INSTALL HANGERS AND SUPPORTS SO PIPING LIVE AND DEAD LOADS AND STRESSES FROM MOVEMENT WILL NOT BE TRANSMITTED TO CONNECTED EQUIPMENT. ADJUST HANGERS TO DISTRIBUTE LOADS EQUALLY ON ATTACHMENTS AND TO PROVIDE INDICATED PIPE SLOPES.
H. ROOF EQUIPMENT SUPPORT RAILS
1. MANUFACTURERS: CUSTOM CURB, PATE, ROOF PRODUCTS AND SYSTEMS, THYCURB, AND VENT PRODUCTS.
2. PIPE SUPPORT RAIL: GALVANIZED STEEL CHANNEL TRACK ATTACHED TO 16" HIGH EQUIPMENT RAIL, VERTICAL AND HORIZONTAL SUPPORT AND ADJUSTMENT. PAINTED STEEL ROLLER.

23 07 00 INSULATION

A. GENERAL
1. SEE INSULATION SCHEDULES ON PLANS FOR ADDITIONAL INFORMATION.
2. INSULATION, INSULATION SYSTEM AND JACKETS SHALL MEET UL-723/ASTM E84 REQUIREMENTS OF MAX. FIRE HAZARD CLASSIFICATIONS OF 25, AND MAX. FLAME SPREAD, FUEL CONTRIBUTED, AND SMOKE DEVELOPED OF 50 WHEN INSTALLED IN A RETURN AIR PLENUM.
3. INSTALL MATERIALS IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS AND MICA PUBLICATION "NATIONAL COMMERCIAL AND INDUSTRIAL STANDARDS", LATEST EDITION.
4. CONTINUE INSULATION WITHOUT INTERRUPTIONS THROUGH WALLS AND FLOOR PENETRATIONS AND HANGERS.
5. FLEX. F.G.:
a. O.C. SOFTR DUCT WRAP, KNAUF FRIENDLY FEEL DUCT WRAP, CERTAINTEED SOFTTOUCH, JOHNS MANVILLE MICROLITE EQ FSK DUCT WRAP.
b. GLASS FIBER INSULATION FACTORY LAMINATED TO FRK/FSK VAPOR RETARDER. LISTED THICKNESS IS NOMINAL.
c. 0.75 LB/CU. FT., R=3.3 / NOMINAL INCH AT 75 DEG F.
d. MAX 250 DEG F, JACKET MAX 150 DEG F, 0.02 PERM.
6. ACOUSTICAL DUCT LINING
a. O.C. QUIETR ROTARY DUCT LINER, KNAUF EQUIPMENT LINER M, CERTAINTEED TOUGHGARD 2, JOHNS MANVILLE LINATEX.
b. DUCT LINER COMPLYING WITH ASTM C1071, NFPA 90A AND 90B.
c. LININGS MUST MEET ASTM C1338, ASTM G21 FUNGI TEST AND ASTM G22 BACTERIA TEST.
d. AIR STREAM SURFACES SHALL BE EVALUATED IN ACCORDANCE WITH THE "EROSION TEST" IN UL 181 AND SHALL NOT BREAK AWAY, CRACK, PEEL, FLAKE OFF, OR SHOW EVIDENCE OF DELAMINATION OR CONTINUED EROSION UNDER TEST CONDITIONS.
e. EDGE COAT ALL TRANSVERSE JOINTS AND EXPOSED EDGES.
f. R= 4.2 /INCH AT 75 DEG F.
g. MAX 250 DEG F
B. ELASTOMERIC FOAM INSULATION
1. SEAL BUTT JOINTS WITH ADHESIVE. INSTALL PER MANUFACTURER INSTRUCTIONS.
2. PIPE
a. MANUFACTURERS: AEROFLEX AEROCEL SSPT, K-FLEX INSUL-LOCK DS, ARMACELL AP/ARMAFLEX BLACK LAPSEAL.
b. EPDM/PVC BASE ELASTOMERIC FOAM MATERIAL
c. DUAL TAPE CLOSURE
d. MAX. 'K' VALUE 0.245 AT 75 DEG F
e. MAX. CONTINUOUS TEMPERATURE 220 DEG F
f. MAX. 0.05 PERM PER ASTM E96
g. MAX. FIRE/SMOKE DEVELOPED OF 25/50 PER ASTM E84 FOR UP TO 2" THICK.
h. PROVIDE MANUFACTURER PREFORMED INSULATION OVER VALVES AND FITTINGS
C. JACKETS
1. PVC:
a. ZESTON, CEELCO, PROTO LOSMOKE PVC JACKET
b. 30 MIL WHITE PVC. MAX TEMP 150 DEG F.
c. FULLY ADHERE JOINT WITH SOLVENT WELDED ADHESIVE. CIRCUMFERENTIAL SEAMS MINIMUM 1" OVERLAP, LONGITUDINAL SEAMS MINIMUM 1.5" OVERLAP. LOCATE JOINT AT LEAST VISIBLE SIDE OF PIPE.
d. PROVIDE SLIP JOINTS PERIODICALLY ON LONG RUNS OF STRAIGHT PIPE BY INCREASING CIRCUMFERENTIAL OVERLAP TO MINIMUM 8" AND APPLYING A FLEXIBLE WHITE SEALANT IN THE OVERLAP AREA.
D. DUCT INSULATION REQUIREMENTS
1. INSULATE FITTINGS, JOINTS, FLANGES, FLEXIBLE CONNECTIONS, DAMPERS, AND IN-LINE ACCESSORIES WITHOUT INTERNAL LINING/INSULATION WITH SAME MATERIAL AND THICKNESS AS SPECIFIED FOR THE DUCT SYSTEM. STOP AND POINT INSULATION AROUND ACCESS DOORS AND DAMPER OPERATORS TO ALLOW OPERATION WITHOUT DISTURBING WRAPPING.
E. PIPE INSULATION REQUIREMENTS
1. INSULATE ENTIRE PIPING SYSTEM INCLUDING VALVES AND FITTINGS PER LATEST EDITION MICA INSULATION STANDARDS PLATES.
2. SEAL ALL INSULATION ENDS.

23 11 23 NATURAL GAS PIPING AND ACCESSORIES

A. PIPING
1. INSTALL, INSPECT, TEST, AND PURGE GAS PIPING IN CONFORMANCE WITH NFPA 54, UTILITY COMPANY AND ALL OTHER GOVERNING CODES.
2. MAKE BRANCH CONNECTIONS TO THE MAIN FROM THE TOP OR SIDE.
B. GAS VALVES
1. UL LISTED FOR USE AS NATURAL GAS SHUTOFF.
2. BALL VALVES (MANUFACTURERS: NIBCO 585/580-70UL, WATTS B6000UL): BRONZE BODY, THREADED ENDS, CHROME PLATED BRONZE BALL, FULL/CONVENTIONAL PORT, TEFLON SEAT, BLOWOUT-PROOF STEM, TWO-PIECE CONSTRUCTION, 150 PSIG WORKING PRESSURE.
3. PLUG VALVES (MANUFACTURERS: DEZURIK PEC, HOMESTEAD SERIES 612): CAST IRON BODY, FLANGED ENDS, BRONZE BEARINGS, ELECTROLESS NICKEL PLATED CAST IRON PLUG WITH HYCAR RESILIENT PLUG SEAL, BUNA-N STEM SEAL PACKING, LEVER ACTUATOR, 175 PSIG WOG.
4. PROVIDE A MAIN GAS LINE SHUTOFF VALVE IMMEDIATELY AFTER THE METER CONNECTION.
C. GAS PRESSURE REGULATORS
1. CAST IRON BODY, ALUMINUM SPRING CASE, ALUMINUM ORIFICE, BUNA-N DIAPHRAGM, INTERNAL RELIEF VALVE SET TO RELIEVE AT 7-10" W.C. ABOVE NORMAL OUTLET PRESSURE SETTING OF 7" W.C., TOPCOAT ENAMEL.
2. FOR REGULATORS INSTALLED INDOORS, PIPE THE RELIEF VALVE VENT FULL SIZE TO THE OUTSIDE OF THE BUILDING AT A NON-HAZARDOUS LOCATION. INCREASE VENT SIZE ONE PIPE SIZE IF VENT LENGTH EXCEEDS 10 FEET. TERMINATE WITH AN ELBOW DOWN WITH A SCREEN OVER THE OPENING. DO NOT COMBINE VENTS.
3. MAXITROL 325 SERIES WITH VENT LIMITER ARE PERMITTED FOR INDOOR APPLICATIONS WHERE SUPPLYING LESS THAN 300,000 BTUH.
4. FOR REGULATORS INSTALLED OUTDOORS, POSITION THE REGULATOR SO THE RELIEF VALVE VENT IS FACING DOWN OR INSTALL ELBOW FACING DOWN A MINIMUM 10 FEET FROM AN OUTSIDE AIR INTAKE AND 5 FEET FROM A GAS FLUE DISCHARGE.

23 31 13 DUCTWORK

A. PERFORM WORK IN ACCORDANCE WITH THE LATEST EDITIONS OF SMACNA - HVAC DUCT CONSTRUCTION STANDARDS, NFPA 90A.
B. GENERAL
1. SEAL ALL OUTSIDE AIR DUCT JOINTS WATERTIGHT WITH SILICONE SEALANT.
2. PAINT THE INSIDE OF ALL DUCTS VISIBLE THROUGH GRILLES IN ROOMS WITH CEILINGS WITH DULL BLACK PAINT.
3. CERTAIN VERTICAL AND HORIZONTAL OFFSETS ARE INDICATED IN DUCTS TO INDICATE THE GENERAL POSITION RELATIONSHIP OF THE DUCTWORK SYSTEMS; PROVIDE ADDITIONAL OFFSETS AS REQUIRED TO COORDINATE WITH THE INSTALLATION OF OTHER SYSTEMS, CEILINGS AND STRUCTURE. THE DRAWINGS SHALL NOT BE SCALED TO DETERMINE EXACT LOCATION OF DUCTWORK.
4. PROVIDE TEMPORARY CLOSURES OF METAL OR TAPED POLYETHYLENE ON OPEN DUCTWORK TO PREVENT CONSTRUCTION DUST FROM ENTERING DUCTWORK SYSTEM.
5. LOCATE DUCTS WITH SUFFICIENT SPACE AROUND EQUIPMENT TO ALLOW NORMAL OPERATING AND MAINTENANCE ACTIVITIES.
6. INCREASE DUCT SIZES GRADUALLY, NOT EXCEEDING 15 DEGREES WHENEVER POSSIBLE. 30 DEGREE MAXIMUM.
7. ROUND DUCTS MAY BE SUBSTITUTED FOR RECTANGULAR IF SIZED IN ACCORDANCE WITH ASHRAE TABLES OF EQUIVALENT RECTANGULAR AND ROUND DUCTS.
C. ROUND DUCTWORK
1. CONCEALED BRANCH DUCTWORK TO GRILLES AND DIFFUSERS MAY BE LONGITUDINAL LOCKSEAM. ALL OTHER ROUND DUCTWORK SHALL BE SPIRAL LOCKSEAM WITH FITTINGS AND COUPLINGS MINIMUM 2 GAUGES HEAVIER THAN DUCT.
D. FLEXIBLE DUCTWORK
1. MANUFACTURERS: THERMAFLEX, FLEXMASTER, CLEVAFLEX.
2. U.L. 181 LISTED CLASS 1 FACTORY FABRICATED FLEXIBLE AIR DUCT, COMPLY WITH NFPA 90A, FLAME SPREAD OF 25 OR LESS, SMOKE DEVELOPED RATING OF 50 OR LESS.
3. MINIMUM PRESSURE RANGE -1/2" TO 4" W.C., TEMPERATURE RANGE 0-200 DEG F.
4. ACOUSTIC: THERMAFLEX M-KE OR G-KM, FLEXMASTER TYPE 1 OR 6
a. POLYETHYLENE, SPUNBOUND NYLON OR CHLORINATED POLYETHYLENE LINER.
b. DUCTWORK TO HAVE TESTED ACOUSTICAL PERFORMANCE NOT LESS THAN 2 DB LESS THAN THE TYPES SPECIFIED.
5. SEMI-RIGID FLEXIBLE ALUMINUM DUCTWORK NOT PERMITTED.
6. SUPPLY DUCTWORK SHALL BE INSULATED WITH FIBERGLASS INSULATION, MINIMUM R VALUE 4, WITH VAPOR BARRIER JACKET WITH MAXIMUM 0.10 PERM RATING
7. CONNECT TO SUPPLY DUCTWORK BY SLIDING CORE OVER COLLAR, TAPE JOINT WITH MINIMUM 3 WRAPS OF TAPE, AND APPLY METAL BAND CLAMP OR PANDUIT. FOR INSULATED DUCTWORK, PULL INSULATION AND OUTER JACKET BACK INTO POSITION, AND TAPE WITH MINIMUM 3 WRAPS OF TAPE BETWEEN FLEX DUCT AND DUCT INSULATION.
8. CONNECT TO GRILLES AND RETURN AND TRANSFER DUCTWORK WITH METAL BAND CLAMP OR PANDUIT.
9. MAXIMUM LENGTH FROM DUCTWORK TO GRILLES OR SLOTS 8'-0" WITH ONE 90 DEG ELBOW.
10. DO NOT RUN THROUGH WALLS OR PARTITIONS.
E. DUCTWORK SEALANTS
1. MANUFACTURERS: HARDCAST SURE-GRIP 404 SOLVENT BASED DUCT SEALANT OR EQUIVALENT.
a. SYNTHETIC RUBBER RESIN BASE.
b. -20 TO 200 DEG F.
c. PRESSURE CLASSES UP TO 10" W.C., MEETING SEAL CLASS A.
d. MAXIMUM FLAME SPREAD OF 25, SMOKE DEVELOPED OF 50.
e. APPLY MINIMUM 20-MIL THICK WET FILM AT TEMPERATURES BETWEEN 35-100 DEG F.
2. HARDCAST ALUMA-GRIP 701 OR EQUIVALENT PRESSURE SENSITIVE DUCT JOINT ROLLED SEALANT MAY BE USED IN PLACE OF MASTIC. SEALANT SHALL COMPLY WITH THE FOLLOWING:
a. MILL FINISH ALUMINUM SUSTRATE WITH GRAY ADHESIVE.
b. MINIMUM 30 MIL THICK
c. MIN. 17 LB PER LINEAR INCH PEEL STRENGTH
d. MAX FLAME SPREAD OF 25, MAX SMOKE DEVELOPED OF 50 WHEN TESTED IN ACCORDANCE WITH ASTM G-53.
e. VOC: 0 G/L, COMPLIANT WITH LEED SCAQMD RULE 1168.
f. PRESSURE CLASSES UP TO 10" W.C.
F. DUCT CLEANING
1. PROTECT DUCTWORK AGAINST ENTRY OF FOREIGN MATTER DURING CONSTRUCTION. PROVIDE TEMPORARY END CAPS AND SEALS. PROVIDE TEMPORARY FILTERS OVER RETURN OR EXHAUST AIR INLETS IF DUCTWORK IS USED DURING CONSTRUCTION.
2. REMOVE ALL DIRT AND FOREIGN MATTER AND CLEAN DIFFUSERS, REGISTERS, AND GRILLES BEFORE OPERATING FANS.
G. SEALING DUCT PENETRATIONS
1. THRU NON-RATED WALLS WHERE DRYWALL, CONCRETE, OR MASONRY EXTENDS TO STRUCTURE, FILL VOID BETWEEN DUCT AND WALL WITH MINERAL WOOL. CAULK BOTH SIDES WITH NON-HARDENING CAULK IF VOID NOT ABOVE CEILING.
2. PROTECT PENETRATIONS THRU FIRE-RATED WALLS WITHOUT FIRE DAMPERS WITH A UL APPROVED FIRE-STOP SYSTEM HAVING AN F-RATING NOT LESS THAN THE HOURLY RATING OF THE ASSEMBLY BEING PENETRATED, OR GROUT, CONCRETE, OR MORTAR THE FULL DEPTH OF THE PENETRATED ASSEMBLY WHEN THE ASSEMBLY IS CONSTRUCTED OF CONCRETE OR MASONRY.
3. PENETRATIONS THRU WALLS WITH FIRE DAMPERS INSTALL PER FIRE DAMPER INSTALLATION REQUIREMENTS.

23 33 00 DUCTWORK ACCESSORIES

A. GENERAL - ALL DUCT ACCESSORIES SHALL BE CONSTRUCTED OF SAME MATERIAL AS DUCTWORK BEING INSTALLED IN.

PROJECT DESIGN CRITERIA

MECHANICAL CODE **WISCONSIN**
ENERGY CODE **IECC 2015**
SEISMIC DESIGN CATEGORY **A**
NEAREST ASHRAE CITY **BURLINGTON**
ELEVATION **779**

	OUTSIDE	
	DB	WB
WINTER:	-10	N/A
SUMMER:	89	77

SHEET INDEX

SHEETS BELOW INTENDED TO BE PRINTED IN: COLOR. REFER TO DIGITAL FORMAT DRAWINGS IF PRINTED GRAYSCALE TO ENSURE SCOPE CLARITY.

LEGEND

NOTE: ALL SYMBOLS SHOWN MAY NOT APPEAR ON DRAWINGS.

SYM.	ABBR.	IDENTIFICATION	SYM.	ABBR.	IDENTIFICATION
DUCTWORK					
		DUCT (R)ISE/(D)ROP			SA DUCT DOWN OR AWAY
		RADIUS ELBOW			OA DUCT DOWN OR AWAY
		SQUARE ELBOW WITH TURNING VANES			EA DUCT DOWN OR AWAY
		SQUARE ELBOW WITHOUT TURNING VANES			RA DUCT DOWN OR AWAY
		SQUARE OR RECTANGULAR BRANCH TAKEOFF		VD	VOLUME DAMPER
		RECTANGULAR TO ROUND TAKEOFF		BDD	BACKDRAFT DAMPER
		TEE WITH TURNING VANES		MOD	MOTOR OPERATED DAMPER
		ROUND TO ROUND CONICAL TAKEOFF		DSD	DUCT SMOKE DETECTOR
		ECCENTRIC TRANSITION		FD	FIRE DAMPER
		CONCENTRIC TRANSITION		SD	SMOKE DAMPER
		SQUARE TO ROUND TRANS.		FSD	FIRE/SMOKE DAMPER
		DUCT CAP		SG	SUPPLY GRILLE
	ALD	ACOUSTICALLY LINED DUCT		EG,RG, TG	(E)XHAUST / (R)ETURN / (T)RANSFER GRILLE
	SA	SUPPLY AIR DUCT UP	DTG (0 SF)	DTG	DOOR TRANSFER GRILLE
	OA	OUTSIDE AIR DUCT UP	UCD	UCD	UNDERCUT DOOR (BY GC)
	RA	RETURN AIR DUCT UP		FC	FLEXIBLE CONNECTION
	EA	EXHAUST AIR DUCT UP		AD	ACCESS DOOR
MISCELLANEOUS AND CONTROLS					
		DETAIL OR SECTION NUMBER SHEET NUMBER			STATIC PRESS. SENSOR
		HUMIDISTAT / HUMID. SENSOR			SLAB TEMPERATURE SENSOR
		THERMOSTAT / TEMP. SENSOR			COMBINATION STARTER
VFD	VFD	VARIABLE FREQUENCY DRIVE	MS		MANUAL STARTER
	AFF	ABOVE FINISHED FLOOR		OC	ON CENTER
	AFG	ABOVE FINISHED GRADE		PC	PLUMBING CONTRACTOR
	AP	ACCESS PANEL		RAO	RETURN AIR OPENING
	BJ	BETWEEN JOISTS		TAO	TRANSFER AIR OPENING
	BOD	BOTTOM OF DUCT		EAO	EXHAUST AIR OPENING
	BOG	BOTTOM OF GRILLE		TCC	TEMPERATURE CONTROL CONTRACTOR
	EC	ELECTRICAL CONTRACTOR		TCP	TEMPERATURE CONTROL PANEL
	GC	GENERAL CONTRACTOR / CONSTRUCTION MANAGER		TJ	THRU JOISTS
	HC	HVAC CONTRACTOR		TYP.	TYPICAL
	IMP	INSULATED METAL PANEL		TTS	TIGHT TO STRUCTURE
	NIC	NOT IN CONTRACT		TV	TURNING VANES
	NTS	NOT TO SCALE		WWM	WELDED WIRE MESH
PIPING					
		SHUTOFF VALVE		PRV	PRESS. REDUCING VALVE
		BALANCE VALVE		SRV	SAFETY RELIEF VALVE
		CHECK VALVE			STEAM TRAP
		COMBINATION VALVE			ANCHOR
		STRAINER			GUIDE
		DRAIN VALVE			PIPING BOTTOM TAKE-OFF
		GLOBE VALVE			PIPING TOP TAKE-OFF
		THERMOMETER			PIPE DOWN OR AWAY
	PG	PRESSURE GAUGE			PIPE UP
		GAUGE COCK			PIPING CAP
	TCV	TEMP. CONTROL VALVE			UNION/FLANGE
		TEST CONNECTION			PIPE PITCH DOWN
	MAV	MANUAL AIR VENT			CONCENTRIC REDUCER
	FM	FLOW METER			ECCENTRIC REDUCER
		FLOW CONTROL / SHUTOFF VALVE		FC	FLEXIBLE CONNECTION
		FLOW CONTROL VALVE		BF	BLIND FLANGE
	GEO-S	GEOTHERMAL SUPPLY		HWS	HOT WATER SUPPLY
	GEO-R	GEOTHERMAL RETURN		HWR	HOT WATER RETURN
	CTS	COOLING TOWER WATER SUPPLY		GS	GLYCOL SUPPLY
	CTR	COOLING TOWER WATER RETURN		GR	GLYCOL RETURN
	MU	MAKEUP WATER		RWS	RADIANT WATER SUPPLY
	LPS	LOW PRESSURE STEAM		RWR	RADIANT WATER RETURN
	LPC	LOW PRESSURE CONDENSATE		SMS	SNOW MELT SUPPLY
	HPS	HIGH PRESSURE STEAM		SMR	SNOW MELT RETURN
	HPC	HIGH PRESSURE CONDENSATE		FOS	FUEL OIL SUPPLY
	PC	PUMPED CONDENSATE		FOR	FUEL OIL RETURN
	G/LP	NATURAL GAS/LP GAS		BF	BOILER FEED
	D	DRAIN		CF	CHEMICAL FEED
	CHWS	CHILLED WATER SUPPLY		A	COMPRESSED AIR
	CHWR	CHILLED WATER RETURN		V	VENT
		REFRIGERANT			
FIRE RATED WALLS					
		FIRE - 1 HOUR			FIRE - 3 HOUR
		FIRE - 2 HOUR			FIRE - 4 HOUR

EXCEL
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PROJECT INFORMATION

NEW CAR WASH FACILITY:
TSUNAMI EXPRESS CAR WASH
115 E WOLF RUN • MUKWONAGO, WI 53149

PROFESSIONAL SEAL

SHEET DATES
SHEET ISSUE SEP. 5, 2025
REVISIONS

JOB NUMBER
240303900

SHEET NUMBER
H0.1

HVAC LEGEND AND SPECIFICATIONS

HVAC SPECIFICATIONS (CONT.)

B. TURNING VANES
1. MANUFACTURERS: AERO/DYNE CO. H.E.P., HART & COOLEY, UNITED MCGILL, SEMCO.
2. RECTANGULAR DUCTWORK: TURNING VANES IN ACCORDANCE WITH SMACNA FIG. 2-3 AND 2-4. VANE RADIUS 4 INCHES WITH A 3-1/4 INCH SPACING.
3. ROUND DUCTWORK: TWO-PIECE MITERED, MINIMUM 20 GAUGE.

C. CONTROL DAMPER INSTALLATION
1. DAMPER SECTIONS AND MULTIPLE SECTION ASSEMBLIES MUST BE COMPLETELY SQUARE AND FREE FROM RACKING, TWISTING, OR BENDING.
2. FOLLOW MANUFACTURER'S INSTRUCTIONS FOR INSTALLATION OF CONTROL DAMPERS.
3. INSTALL EXTENDED SHAFT OR JACKSHAFT PER MANUFACTURER'S INSTRUCTIONS.
4. PROVIDE A VISIBLE INDICATION OF DAMPER POSITION ON THE DRIVE SHAFT END.
5. AFTER INSTALLATION OF LOW-LEAKAGE DAMPERS WITH SEALS, CAULK BETWEEN FRAME AND DUCT OR OPENING TO PREVENT LEAKAGE AROUND PERIMETER OF DAMPER.

D. MANUAL VOLUME DAMPERS
1. MANUFACTURERS: RUSKIN, VENT PRODUCTS, UNITED MCGILL.
2. DAMPERS WITH EXTENDED SHAFTS AND QUADRANTS, OPERATOR WITH LOCKING DEVICE, POSITION INDICATOR, AND ELEVATED PLATFORM FOR EXTERNALLY INSULATED DUCTWORK.
3. EVERY SUPPLY, RETURN AND EXHAUST GRILLE SHALL HAVE EITHER A VOLUME DAMPER IN THE BRANCH DUCT OR AT THE GRILLE WHERE SHOWN. IF ONE IS NOT SHOWN, CONTRACTOR SHALL PROVIDE VOLUME DAMPER IN DUCT IF DUCT IS ACCESSIBLE, OTHERWISE AT THE GRILLE.
4. RECTANGULAR DAMPERS WHICH DO NOT EXCEED 12" HIGH OR 36" WIDE: BUTTERFLY DAMPER, MINIMUM 22 GAUGE. SHAFT ALONG ENTIRE LENGTH OF DAMPER FOR DAMPERS EXCEEDING 18" IN WIDTH.
5. RECTANGULAR DAMPERS GREATER THAN 12" HIGH OR 36" WIDE: MULTI-BLADE DAMPER WITH CONNECTING LINKAGE TO CONTROL FROM A SINGLE POINT. BLADES MINIMUM 16 GAUGE WITH OPPOSED BLADE ACTION.
6. ROUND DAMPERS: MINIMUM 20 GAUGE BUTTERFLY DAMPER.

E. TAKE-OFF FITTINGS
1. MANUFACTURERS: FLEXMASTER, UNITED MCGILL.
2. ROUND BRANCH TAKE-OFFS TO MULTIPLE GRILLES SHALL BE CONICAL.
3. RECTANGULAR BRANCH TAKE-OFFS TO MULTIPLE GRILLES SHALL BE PER DUCT FITTING DETAIL ON PLANS.
4. ROUND TAKE-OFFS TO INDIVIDUAL GRILLES AND SLOT DIFFUSERS: ONE PIECE SPIN-IN WITH INTEGRAL FACTORY INSTALLED LOCKING TYPE BALANCING DAMPERS.

F. DUCT ACCESS DOORS
1. MANUFACTURERS: CESCO, FLEXMASTER, VENT PRODUCTS, KEES, UNITED MCGILL, SEMCO, DUCTMATE.
2. HINGE, LATCHES, HANDLES, AND RUBBER GASKET IN FRAME. 1" INSULATED DOUBLE WALL CONSTRUCTION FOR DOORS IN LINED OR EXTERNALLY INSULATED DUCTWORK. ATTACHMENT CABLES FOR SPIN-IN UNITS. DOOR SUITABLE FOR DUCT STATIC PRESSURE CLASS.
3. DOOR SIZE 2" LESS THAN THE WIDTH OF THE DUCT (MAX. DOOR SIZE 24"X 24" (24" DIA.).
4. ROUND DUCTWORK: 16 GAUGE ROLLED SHEET METAL HINGED ACCESS DOOR WITH BUCKLE LOCKS.
5. PROVIDE AT:
   a. MOTOR OPERATED AND BACKDRAFT DAMPERS
   b. UPSTREAM SIDE OF TURNING VANES IN RETURN AND EXHAUST DUCTWORK
   c. DRAIN PANS
   d. AT ANY DEVICE IN THE DUCT WHICH REQUIRES MAINTENANCE, SERVICE OR CLEANING.
6. USE HINGED ACCESS DOORS WHERE POSSIBLE. USE CAM OPERATED REMOVABLE DOORS WHERE SPACE PREVENTS THE OPENING OF A HINGED MODEL.

G. FLEXIBLE CONNECTIONS
1. MANUFACTURERS: VENTFABRICS, DURO-DYNE.
2. MATERIAL BOLTED SECURELY TO THE EQUIPMENT AND CONNECTING DUCTWORK WITH #16 GAUGE GALVANIZED IRON BAND (LOOP) CLAMPS BOLTED TIGHT TO MAKE AN AIRTIGHT CONNECTION, MINIMUM 6" WIDE.
3. PROVIDE AT INLET AND OUTLET OF ALL AIR HANDLING UNITS AND FANS IN ACCORDANCE WITH SMACNA FIGURE 2-17.
4. CONVENTIONAL INTERIOR: VENTGLAS, -20 TO 200 DEG F., 30 OZ. PER SQUARE YARD GLASS FABRIC DOUBLE COATED WITH NEOPRENE, UL 214 APPROVED.

23 90 00 TEMPERATURE CONTROLS

A. MANUFACTURERS: ALERTON, AMERICAN AUTO-MATRIX, DELTA CONTROLS INC., HONEYWELL INTERNATIONAL INC., KMC, RELIABLE, SIEMENS BUILDING TECHNOLOGIES, TREND.

B. INSTALLER QUALIFICATIONS: AUTOMATIC CONTROL SYSTEM MANUFACTURER'S AUTHORIZED REPRESENTATIVE WHO IS TRAINED AND APPROVED FOR INSTALLATION OF SYSTEM COMPONENTS REQUIRED FOR THIS PROJECT.

C. ALL PRODUCTS USED IN THIS INSTALLATION SHALL BE NEW, CURRENTLY UNDER MANUFACTURE, AND SHALL BE APPLIED IN STANDARD OFF THE SHELF PRODUCTS. THIS INSTALLATION SHALL NOT BE USED AS A TEST SITE FOR ANY NEW PRODUCTS UNLESS EXPLICITLY APPROVED BY THE ENGINEER IN WRITING. SPARE PARTS SHALL BE AVAILABLE FOR AT LEAST 5 YEARS AFTER COMPLETION OF THIS CONTRACT.

D. ELECTRICAL COMPONENTS, DEVICES, AND ACCESSORIES: LISTED AND LABELED AS DEFINED IN NFPA 70, ARTICLE 100, BY A TESTING AGENCY ACCEPTABLE TO AUTHORITIES HAVING JURISDICTION, AND MARKED FOR INTENDED USE.

E. LABOR AND MATERIALS FOR THE CONTROL SYSTEM SPECIFIED SHALL BE WARRANTED FREE FROM DEFECTS FOR A PERIOD OF 12 MONTHS AFTER FINAL COMPLETION AND ACCEPTANCE. CONTROL SYSTEM FAILURES DURING THE WARRANTY PERIOD SHALL BE ADJUSTED, REPAIRED, OR REPLACED AT NO ADDITIONAL COST OR REDUCTION IN SERVICE TO THE OWNER.

F. CONNECT AND CONFIGURE EQUIPMENT AND SOFTWARE TO ACHIEVE SEQUENCE OF OPERATION SPECIFIED.

G. CONTROLLER HARDWARE USED OUTDOORS AND/OR IN WET AMBIENT CONDITIONS SHALL BE MOUNTED WITHIN NEMA 3R ENCLOSURES, AND RATED FOR OPERATION AT -40 DEG F TO 150 DEG F AND 10 TO 90% RH. HARDWARE USED IN CONDITIONED SPACE SHALL BE MOUNTED IN AN ENCLOSURE AND BE RATED FOR OPERATION AT 32 DEG F TO 120 DEG F.

H. POWER SUPPLIES: UL LISTED TRANSFORMERS WITH CLASS 2 CURRENT-LIMITING TYPE OR OVERCURRENT PROTECTION; LIMIT CONNECTED LOADS TO 80 PERCENT OF RATED CAPACITY. DC POWER SUPPLY SHALL MATCH OUTPUT CURRENT AND VOLTAGE REQUIREMENTS AND BE FULL-WAVE RECTIFIER TYPE.

I. POWER LINE FILTERING: INTERNAL OR EXTERNAL TRANSIENT VOLTAGE AND SURGE SUPPRESSION.

J. TIME CLOCKS: SOLID-STATE, PROGRAMMABLE TIME CONTROL WITH 8 SEPARATE PROGRAMS EACH WITH UP TO 100 ON-OFF OPERATIONS; SUPER CAPACITOR OR BATTERY BACKUP; KEYBOARD INTERFACE AND MANUAL OVERRIDE; INDIVIDUAL ON-OFF-AUTO SWITCHES FOR EACH PROGRAM; 365-DAY CALENDAR WITH 20 PROGRAMMABLE HOLIDAYS; CHOICE OF FAIL-SAFE OPERATION FOR EACH PROGRAM; SYSTEM FAULT ALARM.

K. ELECTRONIC SENSORS/TRANSMITTERS
1. INSTALLATION
   a. INSTALL ALL SENSORS IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.
   b. ROOM TEMPERATURE SENSORS SHALL BE INSTALLED ON CONCEALED JUNCTION BOXES PROPERLY SUPPORTED BY THE WALL FRAMING WITH CONDUIT STUB TO ABOVE THE CEILING.
   c. INSTALL DEVICES WHICH HAVE ADJUSTMENT 48 INCHES ABOVE THE FLOOR OR COMPLY WITH CURRENT ADA REQUIREMENTS. INSTALL NON-ADJUSTABLE CONTROL SENSORS AT 60 INCHES ABOVE THE FLOOR.
   d. COORDINATE LOCATION OF THERMOSTATS AND OTHER EXPOSED CONTROL SENSORS WITH PLANS AND ROOM DETAILS BEFORE INSTALLATION.
   e. ALL WIRES ATTACHED TO SENSORS SHALL BE AIR SEALED IN THEIR RACEWAYS OR IN THE WALL TO STOP AIR TRANSMITTED FROM OTHER AREAS AFFECTING SENSOR READINGS.

L. THERMOSTATS
1. ELECTRIC, SOLID-STATE, MICROCOMPUTER-BASED ROOM THERMOSTAT WITH REMOTE SENSOR (7 DAY PROGRAMMABLE): HONEYWELL VISIONPRO 8000. THERMOSTAT SHALL HAVE THE CAPABILITY TO SET BACK OR TEMPORARILY OPERATE THE SYSTEM TO MAINTAIN ZONE TEMPERATURES DOWN TO 55 DEG. F AND SHALL HAVE OPTIMAL START CAPABILITY.
   a. SEE "SEQUENCE OF OPERATION" FOR ADDITIONAL INFORMATION.
2. LINE-VOLTAGE, ON-OFF THERMOSTATS: BIMETAL-ACTUATED, OPEN CONTACT OR BELLOWS-ACTUATED, ENCLOSED, SNAP-SWITCH OR EQUIVALENT SOLID-STATE TYPE, WITH HEAT ANTICIPATOR; LISTED FOR ELECTRICAL RATING; WITH CONCEALED SET-POINT ADJUSTMENT, 55 TO 85 DEG F SET-POINT RANGE, AND 2 DEG F MAXIMUM DIFFERENTIAL.
   a. ELECTRIC HEATING THERMOSTATS: EQUIP WITH OFF POSITION ON DIAL WIRED TO BREAK UNGROUNDED CONDUCTORS.
   b. SELECTOR SWITCH: INTEGRAL, MANUAL ON-OFF-AUTO.
3. ELECTRIC, LOW- AND HIGH-LIMIT DUCT THERMOSTATS: SNAP-ACTING, SINGLE-POLE, SINGLE-THROW, MANUAL RESET SWITCH THAT TRIPS IF TEMPERATURE SENSED ACROSS ANY 12 INCHES OF BULB LENGTH IS BELOW OR ABOVE RESPECTIVE SET POINT. HARDWIRE TO OUTSIDE AIR DAMPER, HOT WATER VALVE, AND FAN STARTER.
   a. BULB LENGTH: MINIMUM 20 FEET.
   b. QUANTITY: ONE THERMOSTAT FOR EVERY 20 SQ. FT. OF COIL SURFACE.

M. AUXILIARY CONTROL DEVICES
1. RELAYS: SEE ELECTRICAL STARTER DISCONNECT SCHEDULE.
2. CURRENT TRANSFORMERS SPLIT-CORE TYPE. UL/CSA RECOGNIZED AND COMPLETELY ENCASED (EXCEPT FOR TERMINALS) IN APPROVED PLASTIC MATERIAL. AVAILABLE IN VARIOUS CURRENT RATIOS AND SHALL BE SELECTED FOR PLUS OR MINUS 1% ACCURACY AT 5 A FULL SCALE OUTPUT.
3. VOLTAGE TRANSFORMERS: UL/CSA RECOGNIZED, 600 VAC RATED, COMPLETE WITH BUILT-IN FUSE PROTECTION. SUITABLE FOR AMBIENT TEMPERATURES OF 40 TO 130 DEG F. PROVIDE PLUS OR MINUS 0.5% ACCURACY AT 24 VAC AND A 5 VA LOAD. WINDINGS COMPLETELY ENCLOSED WITH METAL OR PLASTIC MATERIAL.

N. ACTUATORS:
1. MANUFACTURERS: BELIMO AIRCONTROLS (USA), INC., HONEYWELL.
2. ELECTRONIC ACTUATORS: DIRECT-COUPLED TYPE DESIGNED FOR MINIMUM 50,000 FULL-STROKE CYCLES AT RATED TORQUE.
3. LISTED TO ISO 9001, CULUS, CE OR CSA.
4. DAMPERS
   a. SIZE FOR TORQUE REQUIRED FOR DAMPER SEAL AT LOAD CONDITION.
   b. DAMPER COUPLING: V-BOLT DUAL NUT CLAMP AND V-SHAPED, TOOTHED CRADLE.
   c. INSTALL DAMPER ACTUATORS ON OUTSIDE OF DUCT. MOUNT ACTUATORS ON SIDE OR TOP OF DUCT.
5. MOUNT AND LINK CONTROL ACTUATORS PER MANUFACTURER'S INSTRUCTIONS.
6. MINIMUM NEMA TYPE 2 HOUSING.
7. OVERLOAD PROTECTION: ELECTRONIC OVERLOAD OR DIGITAL ROTATION-SENSING CIRCUITRY WITHOUT THE USE OF END SWITCHES.
8. POWER REQUIREMENTS: 24, 120 OR 230 VAC. MAXIMUM 10 VA AT 24 VAC.
9. PROPORTIONAL SIGNAL: 2- TO 10-V DC OR 4 TO 20 MA
10. POSITION INDICATOR: VISUAL SCALE INDICATING PERCENT OF TRAVEL.
11. TRI-STATE, 3-POINT, FLOATING POINT ACTUATORS ARE NOT PERMITTED.
12. TEMPERATURE RATING AS REQUIRED FOR APPLICATION.
13. PROVIDE SPRING RETURN ACTUATORS FOR OUTSIDE AIR DAMPERS.
14. CHECK OPERATION OF DAMPER/ACTUATOR COMBINATION TO CONFIRM THAT ACTUATOR MODULATES DAMPER SMOOTHLY THROUGHOUT STROKE TO BOTH OPEN AND CLOSED POSITIONS.
15. WARRANT ALL COMPONENTS FOR 2 YEARS.

O. MOTOR OPERATED DAMPERS
1. TWO-POSITION SHUTOFF DAMPERS MAY BE PARALLEL OR OPPOSED BLADE TYPE.
2. MODULATING DAMPERS SHALL BE OPPOSED BLADE TYPE.
3. PROVIDE LOW LEAKAGE DAMPERS IN OUTSIDE AIR OR EXHAUST AIR DUCTWORK.
4. PROVIDE NON-LOW LEAKAGE OR LOW LEAKAGE DAMPERS IN RETURN OR TRANSFER DUCTWORK
5. ALL DAMPERS SHALL BE AMCA 500 RATED.
6. RECTANGULAR- VELOCITY BELOW 1,500 FPM.
   a. MAXIMUM 2" DIFFERENTIAL PRESSURE.
   b. MAXIMUM VELOCITY 1,500 FPM.
   c. MAX PRESSURE DROP OF 24"X24" DAMPER 0.1" W.C. AT 1,500 FPM PER AMCA STD 500 FIG. 5.3.
   d. MIN. 16 GA. BLADES, MAXIMUM 6 INCHES WIDE AND 48 INCHES LONG, WITH THREE LONGITUDINAL GROOVES.
   e. 16 GAUGE HAT CHANNEL FRAME WITH REINFORCED CORNERS AND HOLES FOR DUCT MOUNTING
   f. LOW LEAKAGE
      1). CLASS 1A LEAKAGE RATED. MAXIMUM LEAKAGE RATE OF 4 CFM PER SQ. FT. AT 1" W.C. DIFFERENTIAL PRESSURE.
      2). GALVANIZED
         a). GREENHECK VCD-23, RUSKIN CD36, ARROW SERIES 395
         b). GALVANIZED-STEEL FRAME, DAMPER BLADES, FLEXIBLE METAL COMPRESSION JAMB SEALS. VINYL, PVC COATED OR TPE BLADE SEALS.
         c). 1/2 INCH ROUND OR HEX PLATED STEEL AXLES WITH SYNTHETIC OR BRONZE BEARINGS.
7. ROUND
   a. PROVIDE ACTUATOR MOUNTING BRACKET.
   b. MAXIMUM 2,500 FPM,
   c. MIN. 20 GAUGE FRAME
   d. LOW LEAKAGE
      1). MAX LEAKAGE OF 3 CFM PER INCH OF CIRCUMFERENCE AT 1" W.C. DIFFERENTIAL PRESSURE, MAX 180 DEG F. MAX. 4" W.G. SYSTEM PRESSURE.
      2). GALVANIZED
         a). GREENHECK VCDR-53, RUSKIN CDRS25, ARROW 70
         b). GALV STEEL FRAME, DOUBLE SKINNED OR REINFORCED GALV STEEL DAMPER BLADE, 1/2" PLATED STEEL AXLE, SS OR BRONZE BEARINGS, EPDM OR NEOPRENE BLADE SEAL.

P. ELECTRICAL WIRING AND CONNECTION INSTALLATION
1. PROVIDE 120 VAC POWER TO ANY CONTROL PANELS RELATED TO THIS SECTION NOT SHOWN ON THE DRAWINGS.
2. ALL CONTROL AND INTERLOCK WIRING SHALL COMPLY WITH NATIONAL AND LOCAL ELECTRICAL CODES AND ELECTRICAL SPECIFICATION. WHERE THE REQUIREMENTS OF THIS SECTION DIFFER WITH THOSE IN THE ELECTRICAL SPECIFICATIONS, THE MORE STRINGENT REQUIREMENTS SHALL TAKE PRECEDENCE.
3. ALL NEC CLASS 1 (LINE VOLTAGE) WIRING SHALL BE UL LISTED IN APPROVED RACEWAY PER NEC AND ELECTRICAL SPECIFICATIONS.
4. SEE ELECTRICAL SPECIFICATIONS FOR CONDUIT REQUIREMENTS.
5. ALL LOW-VOLTAGE WIRING SHALL MEET NEC CLASS 2 REQUIREMENTS. (LOW-VOLTAGE POWER CIRCUITS SHALL BE SUB-FUSED WHEN REQUIRED TO MEET CLASS 2 CURRENT-LIMIT).
6. ALL WIRING IN MECHANICAL, ELECTRICAL, OR SERVICE ROOMS AND WHERE SUBJECT TO DAMAGE SHALL BE INSTALLED IN RACEWAY.
7. WHERE NEC CLASS 2 (CURRENT-LIMITED) WIRES ARE IN CONCEALED AND ACCESSIBLE LOCATIONS, APPROVED CABLES NOT IN RACEWAY MAY BE USED PROVIDED THAT CABLES ARE UL LISTED FOR THE INTENDED APPLICATION.
8. DO NOT INSTALL CLASS 2 WIRING IN RACEWAY, BOXES AND PANELS CONTAINING CLASS 1 WIRING.
9. SUPPORT CABLES AND RACEWAYS FROM STRUCTURAL MEMBERS. CABLES AND RACEWAYS SHALL NOT BE SUPPORTED BY DUCTWORK, ELECTRICAL RACEWAYS, PIPING, OR CEILING SUSPENSION SYSTEMS. SECURE AND SUPPORT CABLE AT INTERVALS NOT EXCEEDING 30 INCHES AND NOT MORE THAN 6 INCHES FROM CABINETS, BOXES, FITTINGS, OUTLETS, RACKS, FRAMES, AND TERMINALS.
10. INSTALL WIRING IN SLEEVES WHERE IT PASSES THROUGH WALLS AND FLOORS. MAINTAIN FIRE RATING AT ALL PENETRATIONS.
11. SIZE OF WIRE AND RACEWAY SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR, AND BE PER THE MANUFACTURER'S RECOMMENDATION AND NEC REQUIREMENTS.
12. INCLUDE ONE PULL STRING IN EACH RACEWAY 1" OR LARGER.
13. LOCATE CONTROL AND STATUS RELAYS IN DESIGNATED ENCLOSURES ONLY.
14. FLEXIBLE METAL RACEWAYS ARE NOT PERMITTED OVER 6 FEET.
15. MAINTAIN UPDATED (AS-BUILT) WIRING DIAGRAMS WITH TERMINATIONS IDENTIFIED AT THE JOB SITE.
16. IDENTIFICATION OF HARDWARE AND WIRING
   a. LABEL ALL WIRING AND CABLING, INCLUDING THAT WITHIN FACTORY-FABRICATED PANELS, AT EACH END WITHIN 2" OF TERMINATION WITH THE DDC ADDRESS OR TERMINATION NUMBER.
   b. PERMANENTLY LABEL OR CODE EACH POINT/OBJECT OF FIELD TERMINAL STRIPS TO SHOW THE INSTRUMENT OR ITEM SERVED.

Q. INSTALLATION
1. INSTALL EQUIPMENT, PIPING, AND WIRING/RACEWAY PARALLEL TO BUILDING LINES (I.E., HORIZONTAL, VERTICAL, AND PARALLEL TO WALLS) WHEREVER POSSIBLE.
2. INSTALL ALL EQUIPMENT IN READILY ACCESSIBLE LOCATIONS AS DEFINED BY CHAPTER 1, ARTICLE 100, PART A OF THE NATIONAL ELECTRICAL CODE (NEC).
3. THE CONTRACTOR SHALL PROTECT ALL WORK AND MATERIAL FROM DAMAGE BY HIS WORK OR EMPLOYEES, AND SHALL BE LIABLE FOR ALL DAMAGE THUS CAUSED.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR HIS WORK AND EQUIPMENT UNTIL FINALLY INSPECTED, TESTED, AND ACCEPTED. THE CONTRACTOR SHALL PROTECT ANY MATERIAL THAT IS NOT IMMEDIATELY INSTALLED.
5. TEST AND BALANCE: FURNISH ALL TOOLS NECESSARY TO INTERFACE TO THE CONTROL SYSTEM FOR TEST AND BALANCE PURPOSES. PROVIDE A QUALIFIED TECHNICIAN TO ASSIST IN THE TEST AND BALANCE PROCESS.

R. FIELD QUALITY CONTROL
1. INSPECT, TEST, AND ADJUST FIELD-ASSEMBLED COMPONENTS AND EQUIPMENT INSTALLATION, AND TO ASSIST IN FIELD TESTING.
2. PERFORM THE FOLLOWING FIELD TESTS AND INSPECTIONS AND PREPARE TEST REPORTS:
   a. OPERATIONAL TEST: AFTER ELECTRICAL CIRCUITRY HAS BEEN ENERGIZED, START UNITS TO CONFIRM PROPER UNIT OPERATION. REMOVE AND REPLACE MALFUNCTIONING UNITS AND RETEST.
   b. TEST AND ADJUST CONTROLS AND SAFETIES.
   c. TEST CALIBRATION OF ELECTRONIC CONTROLLERS BY DISCONNECTING INPUT SENSORS AND SIMULATING OPERATION WITH COMPATIBLE SIGNAL GENERATOR.
   d. TEST EACH POINT THROUGH ITS FULL OPERATING RANGE TO VERIFY THAT SAFETY AND OPERATING CONTROL SET POINTS ARE AS REQUIRED.
   e. TEST EACH CONTROL LOOP TO VERIFY STABLE MODE OF OPERATION AND COMPLIANCE WITH SEQUENCE OF OPERATION. ADJUST PID ACTIONS.
   f. TEST EACH SYSTEM FOR COMPLIANCE WITH SEQUENCE OF OPERATION.
   g. TEST SOFTWARE AND HARDWARE INTERLOCKS.

S. CALIBRATING AND ADJUSTING:
1. CALIBRATE INSTRUMENTS.
2. MAKE THREE-POINT CALIBRATION TEST FOR BOTH LINEARITY AND ACCURACY FOR EACH ANALOG INSTRUMENT.
3. CALIBRATE EQUIPMENT AND PROCEDURES USING MANUFACTURER'S WRITTEN RECOMMENDATIONS AND INSTRUCTION MANUALS. USE TEST EQUIPMENT WITH ACCURACY AT LEAST DOUBLE THAT OF INSTRUMENT BEING CALIBRATED.
4. CONTROL SYSTEM INPUTS AND OUTPUTS:
   a. CHECK ANALOG INPUTS AT 0, 50, AND 100 PERCENT OF SPAN.
   b. CHECK ANALOG OUTPUTS USING MILLIAMPERE METER AT 0, 50, AND 100 PERCENT OUTPUT.
   c. CHECK DIGITAL INPUTS USING JUMPER WIRE.
   d. CHECK DIGITAL OUTPUTS USING OHMMETER TO TEST FOR CONTACT MAKING OR BREAKING.
   e. CHECK RESISTANCE TEMPERATURE INPUTS AT 0, 50, AND 100 PERCENT OF SPAN USING A PRECISION-RESISTANT SOURCE.
5. TEMPERATURE:
   a. CALIBRATE RESISTANCE TEMPERATURE TRANSMITTERS AT 0, 50, AND 100 PERCENT OF SPAN USING A PRECISION-RESISTANCE SOURCE.
   b. CALIBRATE TEMPERATURE SWITCHES TO MAKE OR BREAK CONTACTS.

T. TRAINING
1. PROVIDE A MINIMUM OF ONE ONSITE TRAINING CLASS, 4 HOURS, AT THE COMPLETION OF CALIBRATING AND ADJUSTING FOR PERSONNEL DESIGNATED BY THE OWNER.
2. RECORD ALL OPERATING INSTRUCTIONS TO A DIGITAL FILE FORMAT (MP4 OR MPEG) AND PROVIDE A COPY TO OWNER ON A LABELED USB FLASH DRIVE. INCLUDE THE INSTALLATION FILE FOR A COMPATIBLE VIDEO PLAYER ON THE DRIVE.
3. PROVIDE DOCUMENTATION OF ITEMS COVERED IN TRAINING EITHER IN HARD COPY OR ELECTRONIC FORMAT.
4. TRAIN THE OWNER DESIGNATED DAY-TO-DAY OPERATORS TO ENABLE THEM TO:
   a. PROFICIENTLY OPERATE THE SYSTEM
   b. ADJUST AND CHANGE SYSTEM SETPOINTS, TIME SCHEDULES, AND HOLIDAY SCHEDULES
   c. UNDERSTAND SYSTEM DRAWINGS, AND OPERATION AND MAINTENANCE MANUAL
   d. UNDERSTAND THE JOB LAYOUT AND LOCATION OF CONTROL COMPONENTS
5. OCCUPANCY ADJUSTMENTS: WHEN REQUESTED WITHIN 12 MONTHS OF DATE OF SUBSTANTIAL COMPLETION, PROVIDE ON-SITE ASSISTANCE IN ADJUSTING SYSTEM TO SUIT ACTUAL OCCUPIED CONDITIONS. PROVIDE UP TO TWO VISITS TO PROJECT DURING OTHER THAN NORMAL OCCUPANCY HOURS FOR THIS PURPOSE.

23 90 10 SEQUENCE OF OPERATION

A. ROOM AIR CONDITIONING UNIT — RACU-1:
1. MOUNT AND WIRE THERMOSTAT AND ALL CONTROL WIRING ASSOCIATED WITH THE ROOM AIR CONDITIONING AND CONDENSING UNIT.
2. MINIMUM OUTSIDE AIR:
   a. PROVIDE MOTOR OPERATED DAMPER AND TWO-POSITION ACTUATOR.
   b. RACU THERMOSTAT CONTROLLER SHALL OPEN THE DAMPER DURING OCCUPIED SCHEDULE.
3. PROVIDE ANY ADDITIONAL DEVICES NECESSARY FOR A COMPLETE OPERATIONAL SYSTEM.

B. PACKAGED TERMINAL AIR CONDITIONING UNIT — PTAC-1:
1. MOUNT AND WIRE THERMOSTAT AND ALL CONTROL WIRING ASSOCIATED WITH THE PACKAGED TERMINAL AIR CONDITIONING UNIT.
2. PROVIDE ANY ADDITIONAL DEVICES NECESSARY FOR A COMPLETE OPERATIONAL SYSTEM.

C. ROOF EXHAUSTER AND INLINE FAN - RE-1 / IF-1:
1. PROVIDE A REVERSE ACTING THERMOSTAT.
2. PROVIDE MOTOR OPERATED DAMPER AND TWO-POSITION ACTUATOR FOR ROOF HOOD/INLINE FAN.
3. TURN ON ROOF EXHAUSTER WITH A RISE IN SPACE TEMPERATURE ABOVE SETPOINT.
4. INTERLOCK INLINE FAN TO RUN WHEN ROOF EXHAUSTER IS ON.
5. OPEN OUTSIDE AIR DAMPER WHEN INLINE FAN IS ON .

D. GAS UNIT HEATER — GUH-1:
1. PROVIDE 7-DAY PROGRAMMABLE THERMOSTAT.
2. PROVIDE ANY ADDITIONAL DEVICES NECESSARY FOR A COMPLETE OPERATIONAL SYSTEM.

E. RADIANT GAS UNIT HEATERS — RGUH-1 & 2:
1. MOUNT AND WIRE THERMOSTAT AND ALL CONTROL WIRING ASSOCIATED WITH THE UNIT.
2. PROVIDE NEMA 4X ENCLOSURE FOR THERMOSTAT AND MOUNT REMOTE SENSOR TO THE UNDERSIDE OF THE ENCLOSURE.
3. PROVIDE ANY ADDITIONAL DEVICES NECESSARY FOR A COMPLETE OPERATIONAL SYSTEM.

F. CEF-1
1. FAN IS INTERLOCKED TO RUN WHEN LIGHTING IS ON.
2. PROVIDE ANY ADDITIONAL DEVICES NECESSARY FOR A COMPLETE OPERATIONAL SYSTEM.

G. CEF-2
1. FAN IS INTERLOCKED TO RUN WHEN LIGHTING IS ON.
2. PROVIDE ANY ADDITIONAL DEVICES NECESSARY FOR A COMPLETE OPERATIONAL SYSTEM.

H. JET HEATER — GUH-2:
1. INTERLOCK WITH CARWASH CONTROLS.
2. MOUNT AND WIRE ASSOCIATED DOOR INTERLOCK SWITCH AND ANY OTHER ASSOCIATED SENSORS. PROVIDE ANY ADDITIONAL DEVICES NECESSARY FOR A COMPLETE AND OPERATIONAL SYSTEM.

23 95 00 TESTING, ADJUSTING AND BALANCING

A. QUALITY ASSURANCE
1. PERFORM TOTAL SYSTEM BALANCE IN ACCORDANCE WITH AABC NATIONAL STANDARDS FOR FIELD MEASUREMENT AND INSTRUMENTATION, TOTAL SYSTEM BALANCE OR NEBB PROCEDURAL STANDARDS FOR TESTING, BALANCING AND ADJUSTING OF ENVIRONMENTAL SYSTEMS, AND ASHRAE STANDARD 111.
2. THE TESTING, ADJUSTING AND BALANCING (TAB) CONTRACTOR SHALL BE AN INDEPENDENT COMPANY SPECIALIZING IN THE TESTING, ADJUSTING, AND BALANCING OF SYSTEMS WITH MINIMUM THREE YEARS EXPERIENCE AND NOT ASSOCIATED WITH THE SUPPLIERS OF EQUIPMENT OR THE INSTALLING CONTRACTOR.
3. PERFORM WORK UNDER SUPERVISION OF AABC CERTIFIED TEST AND BALANCE ENGINEER OR NEBB CERTIFIED TESTING, BALANCING AND ADJUSTING SUPERVISOR.

B. SUBMITTALS
1. CONTRACTOR SHALL SUBMIT THE FINAL TESTING AND BALANCING REPORT PRIOR TO PROJECT COMPLETION AND IN ADVANCE OF DATE OF OCCUPANCY. THE FINAL TESTING AND BALANCING REPORT SHALL COMPLY WITH SPS 364.0313. SUBMIT REPORTS ON AABC NATIONAL STANDARDS FOR TOTAL SYSTEM BALANCE OR NEBB FORMS.
2. SUBMIT THE DESIGN AND ACTUAL DATA FOR EACH SCHEDULED PIECE OF EQUIPMENT: MODEL; SUPPLY, RETURN, AND OUTSIDE AIR FLOWS; STATIC PRESSURE PROFILES OF AIR HANDLING UNIT COMPONENTS AND ALL FANS; FAN RPM, BHP, AMPERAGE; FAN AND MOTOR SHEAVE, DIAMETER, BORE AND MAKE; ROOM AIR FLOW; EQUIPMENT FLOW RATES AND PRESSURE DROPS.

C. INSTALLATION TOLERANCES
1. AIR HANDLING SYSTEMS: ADJUST SUPPLY SYSTEMS TO WITHIN PLUS OR MINUS 5 PERCENT OF DESIGN AND RETURN AND EXHAUST SYSTEMS TO PLUS OR MINUS 10 PERCENT OF DESIGN.
2. AIR OUTLETS AND INLETS: ADJUST TOTAL AIR FLOW TO SPACE TO WITHIN PLUS 10 PERCENT AND MINUS 5 PERCENT OF DESIGN.
3. ADJUST OUTLETS AND INLETS IN SPACE TO WITHIN PLUS OR MINUS 10 PERCENT OF DESIGN.
4. HYDRONIC SYSTEMS: ADJUST TO WITHIN PLUS OR MINUS 10 PERCENT OF DESIGN FOR HEATING SYSTEMS.

D. AIR SYSTEM BALANCE
1. VARY TOTAL SYSTEM AIR QUANTITIES BY ADJUSTING FAN SPEEDS. VARY BRANCH AIR QUANTITIES BY DAMPER REGULATION.
2. ADJUST SETTINGS ON DIRECT DRIVE FANS WITH ECM MOTORS AS REQUIRED TO ACHIEVE DESIGN AIRFLOW.
3. ADJUST OUTSIDE AIR, RETURN AIR, AND EXHAUST AIR AUTOMATIC DAMPERS FOR DESIGN CONDITIONS.
4. TEST AIR HANDLING UNITS AT MINIMUM AND 100% OUTSIDE AIR.

E. FANS WITH FIXED MOTOR SHEAVES - TEST THE FAN EQUIPMENT. IF THE DESIGN CONDITIONS ARE NOT OBTAINED, CALCULATE THE FINAL FIXED MOTOR SHEAVE AND/OR BELTS REQUIRED TO OBTAIN DESIGN CONDITIONS. HEATING CONTRACTOR SHALL OBTAIN THE FINAL FIXED MOTOR SHEAVE AND BELT(S) FROM THE FAN MANUFACTURER AND TURN THEM OVER TO THE TAB CONTRACTOR FOR INSTALLATION.

F. WISCONSIN SPS 364.0313 REQUIREMENTS
1. DOCUMENT THE AMOUNT OF OUTDOOR AIR BEING PROVIDED AND TURN THIS DOCUMENT OVER TO THE OWNER.
2. AIR SYSTEM BALANCING SHALL BE ACCOMPLISHED PER PARAGRAPH 364.0313(1)(A) GUIDELINES.

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PROJECT INFORMATION
NEW CAR WASH FACILITY:
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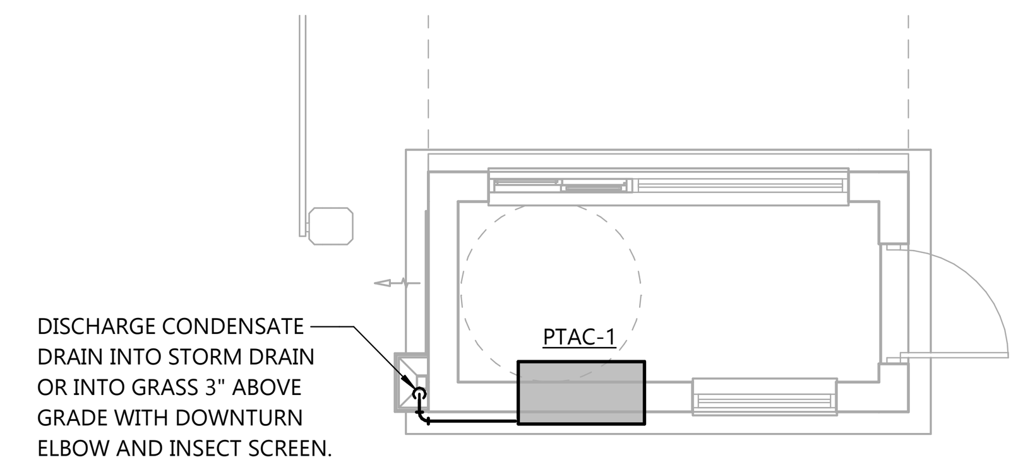
115 E WOLF RUN • MUKWONAGO, WI 53149

PROFESSIONAL SEAL

SHEET DATES
SHEET ISSUE SEP. 5, 2025
REVISIONS

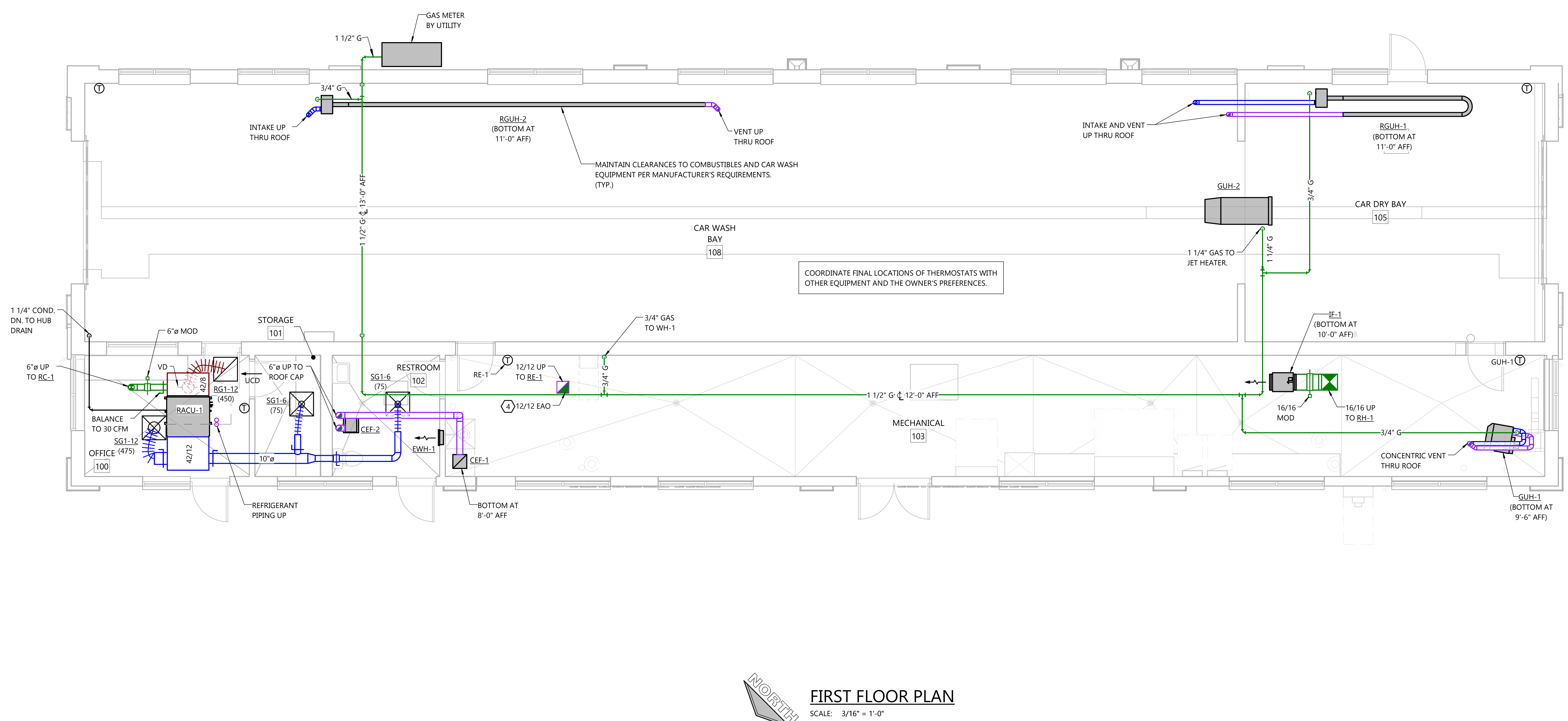
JOB NUMBER
240303900

SHEET NUMBER
H0.2



SALES BOOTH

SCALE: 3/16" = 1'-0"



FIRST FLOOR PLAN

SCALE: 3/16" = 1'-0"

0' 4' 8'

GENERAL NOTES

- DUCT FITTINGS SHALL BE TYPE SHOWN ON PLAN OR CALLED OUT BY KEYNOTE. SEE DETAIL 1/H3.0 FOR ADDITIONAL FITTING DETAIL.
- VERIFY BUILDING OPENING AND CURB SIZES LISTED ON PLANS WITH ACTUAL EQUIPMENT SCHEDULED AND SUPPLIED. COORDINATE REQUIRED OPENING SIZES AND LOCATIONS WITH CONTRACTORS PROVIDING OPENING. SCHEDULES AND ACTUAL EQUIPMENT SIZES SHALL TAKE PRECEDENCE OVER SIZES SHOWN ON PLANS.
- PENETRATE MASONRY WALLS PER STRUCTURAL DRAWINGS. PENETRATIONS NOT PERMITTED THROUGH MARKED GROUTED/REINFORCED MASONRY, AND SHALL NOT BE MODIFIED WITHOUT WRITTEN APPROVAL FROM STRUCTURAL ENGINEER.
- DETAIL REFERENCES ON PLANS ARE TO AID THE CONTRACTOR IN IDENTIFYING THE APPLICABLE DETAIL. NOT ALL DETAILS, OR INSTANCES OF DETAILS, ARE REFERENCED ON PLANS. CONTRACTOR IS RESPONSIBLE TO REVIEW AND COMPLY WITH ALL APPLICABLE DETAILS WHETHER OR NOT REFERENCED ON PLANS.
- COORDINATE LOCATION OF ALL EXPOSED PIPING AND DUCTWORK WITH OWNER PRIOR TO INSTALLATION.
- IF DUCT SYSTEMS ARE USED FOR TEMPORARY HEAT, PROVIDE TEMPORARY FILTERS AT RETURN AIR OPENINGS AND INSTALL FILTERS IN THE UNITS EQUIVALENT TO THE EFFICIENCY OF THE SPECIFIED FILTERS FOR THE UNIT. IF PROPER EFFICIENCY FILTERS ARE NOT INSTALLED IN UNIT, UNIT AND ALL DUCTWORK DOWNSTREAM OF UNIT SHALL BE CLEANED BEFORE TEST AND BALANCE.

KEYNOTES

(A) - (H) SEE DUCT FITTING DETAILS 1/H3.0

(1) NOT USED

(2) NOT USED

(3) NOT USED

(4) WWM OVER DUCT OPENING

GAS LOAD SUMMARY

ITEM	MBH INPUT	REQUIRED PRESSURE (1)
RGUH-1	75	6"-14" W.C.
RGUH-2	125	6"-14" W.C.
GWH-1	200	5"-14" W.C.
GUH-1	120	5" W.C.
GUH-2	950	6" W.C.
GRAND TOTAL	1,470	

- GAS PRESSURE AT METER = 2 PSIG
- PROVIDE GAS PRESSURE REGULATOR AT EACH PIECE OF EQUIPMENT LISTED ABOVE.
- CONNECT TO EACH PIECE OF EQUIPMENT LISTED ABOVE.

(1) VERIFY PRESSURE REQUIRED WITH ACTUAL EQUIPMENT INSTALLED ON PROJECT BEFORE SIZING REGULATOR.

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H1.1

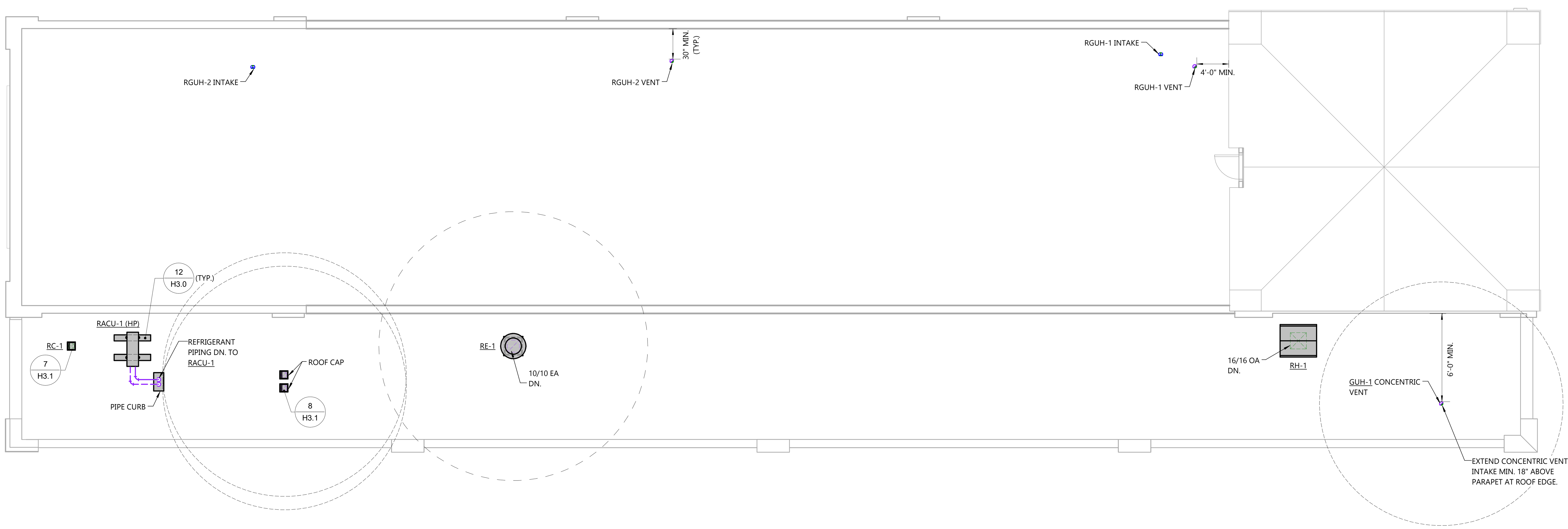
HVAC FIRST FLOOR PLAN

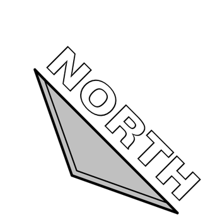
GENERAL NOTES

- VERIFY BUILDING OPENING AND CURB SIZES LISTED ON PLANS WITH ACTUAL EQUIPMENT SCHEDULED AND SUPPLIED. COORDINATE REQUIRED OPENING SIZES AND LOCATIONS WITH CONTRACTORS PROVIDING OPENING. SCHEDULES AND ACTUAL EQUIPMENT SIZES SHALL TAKE PRECEDENCE OVER SIZES SHOWN ON PLANS.
- DETAIL REFERENCES ON PLANS ARE TO AID THE CONTRACTOR IN IDENTIFYING THE APPLICABLE DETAIL. NOT ALL DETAILS, OR INSTANCES OF DETAILS, ARE REFERENCED ON PLANS. CONTRACTOR IS RESPONSIBLE TO REVIEW AND COMPLY WITH ALL APPLICABLE DETAILS WHETHER OR NOT REFERENCED ON PLANS.
- TERMINATE ALL UNIT HEATER INTAKES/FLUES MINIMUM 10'-0" FROM EDGE OF ROOF.
- TERMINATE ALL GAS REGULATOR VENTS MINIMUM 10'-0" FROM EDGE OF ROOF. VENTS SHALL NOT BE TERMINATED OUT EXTERIOR WALLS
- DASHED LINES AROUND EXHAUST TERMINATIONS INDICATE 10'-0" REQUIRED CLEARANCE TO OUTSIDE AIR INTAKES.

KEYNOTES

1. CONNECT TO EXISTING
2. NOT USED
3. VERIFY LOCATION WITH OWNER
4. WWM OVER DUCT OPENING





ROOF PLAN

SCALE: 3/16" = 1'-0"

0' 4' 8'

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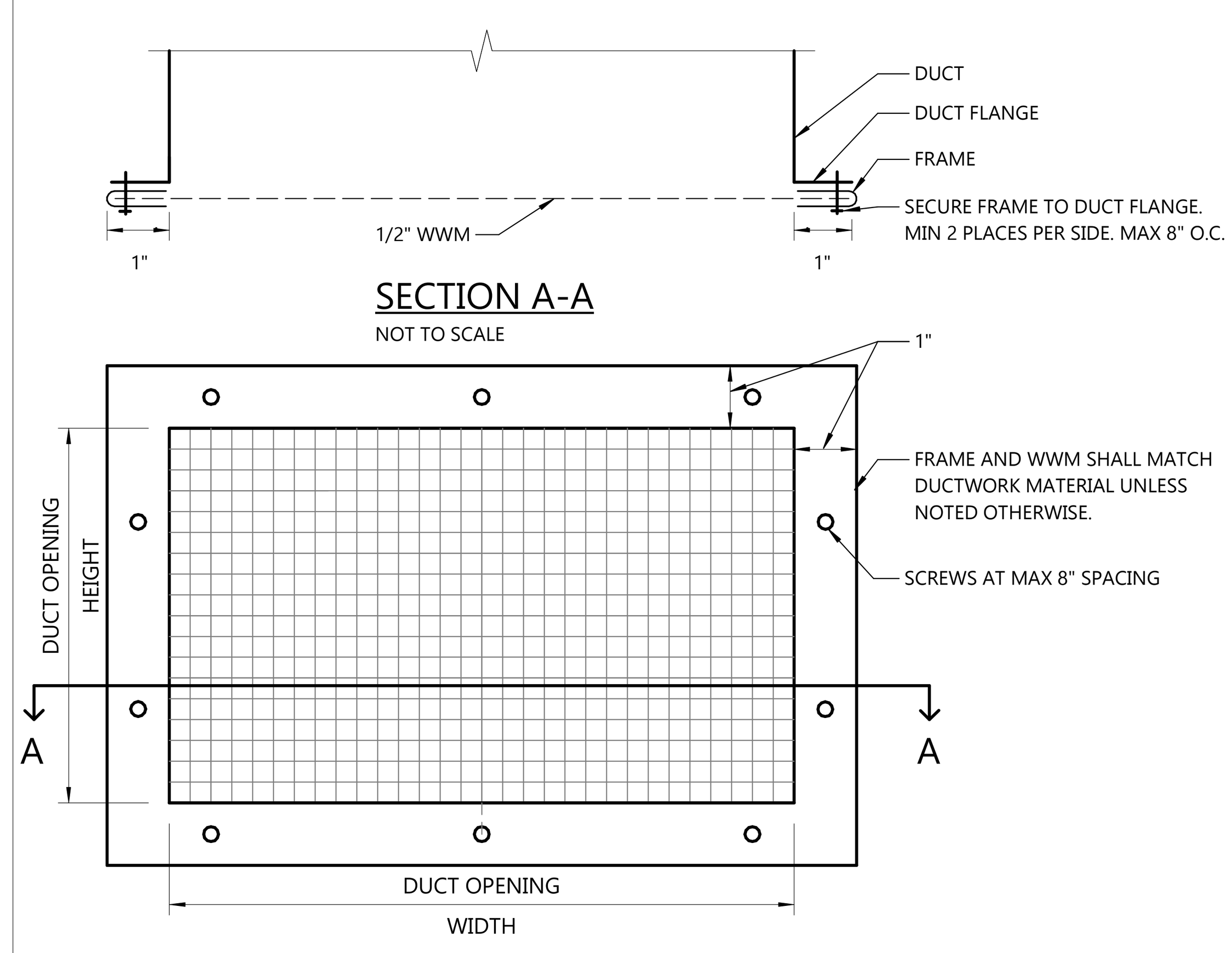
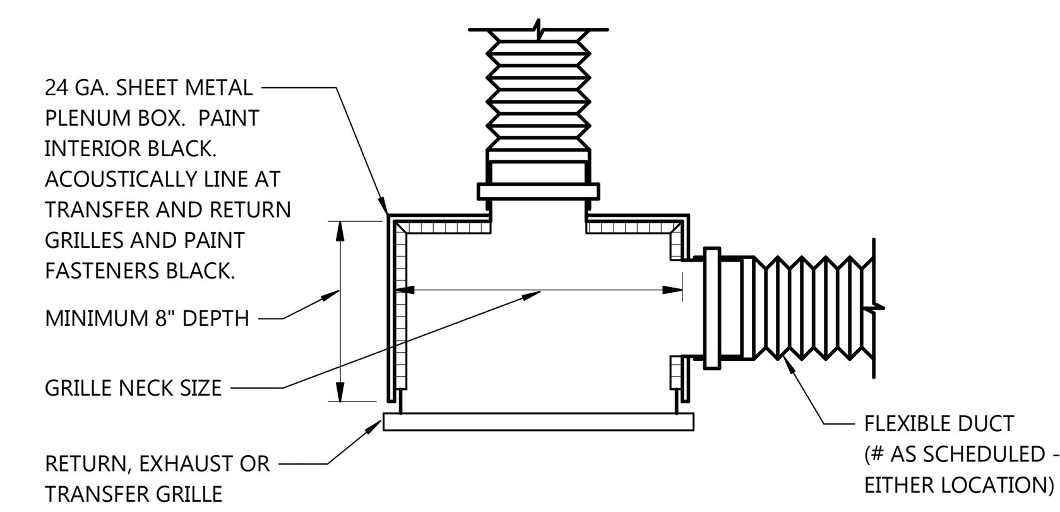
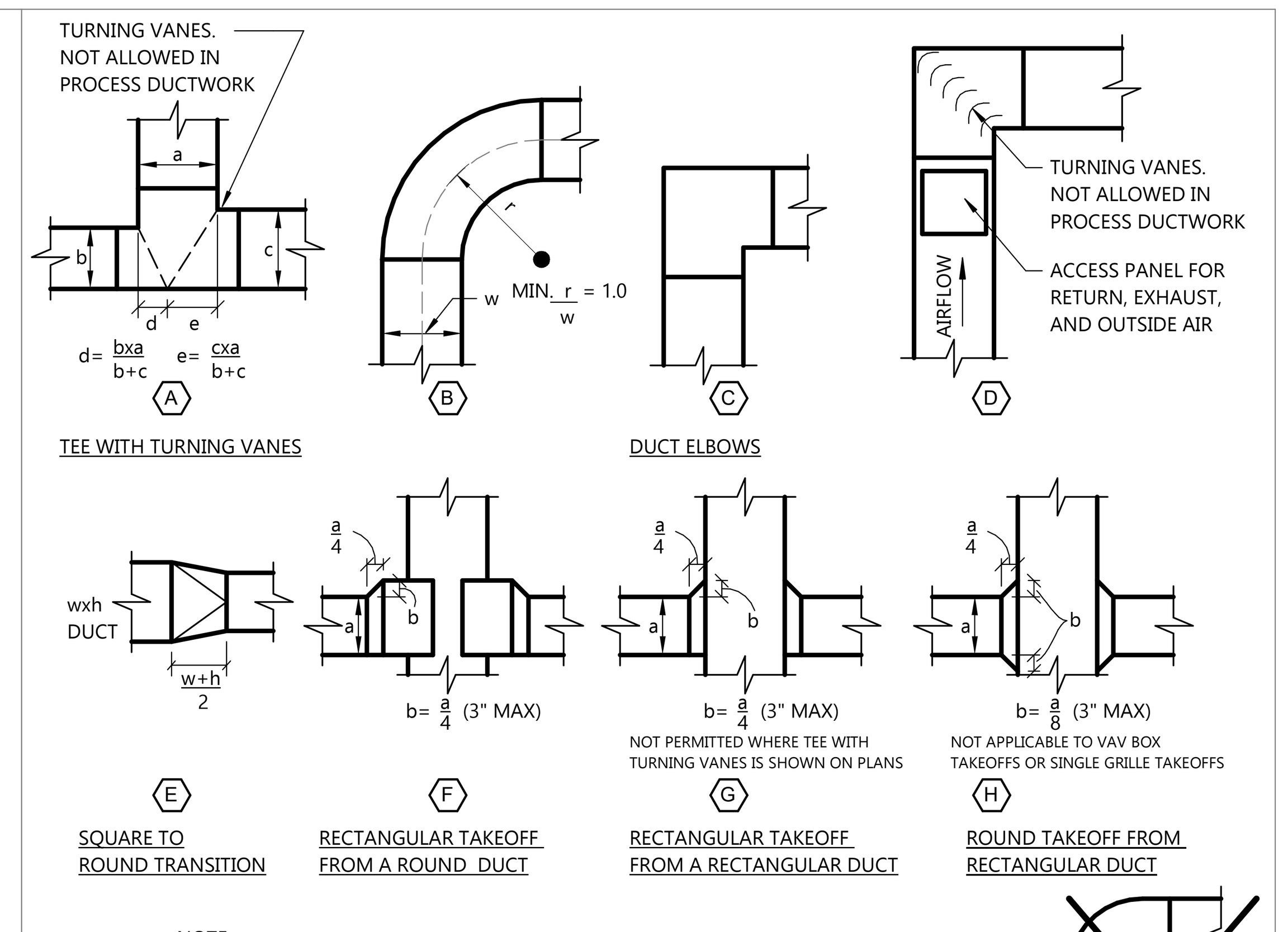
HVAC ROOF PLAN



3 / H3.0 **WWM SCREEN OVER OPENING DETAIL**
NOT TO SCALE

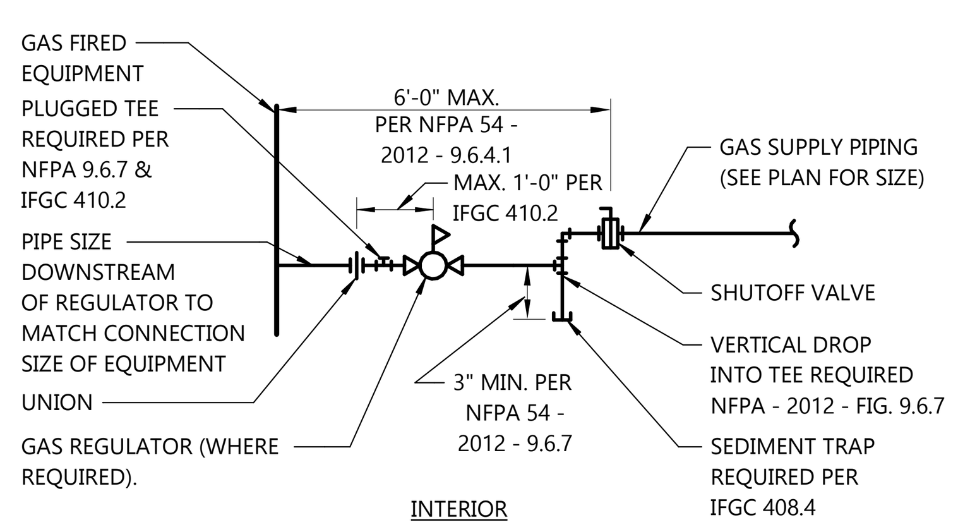


2 / H3.0 **GRILLE PLENUM BOX DETAIL**
NOT TO SCALE

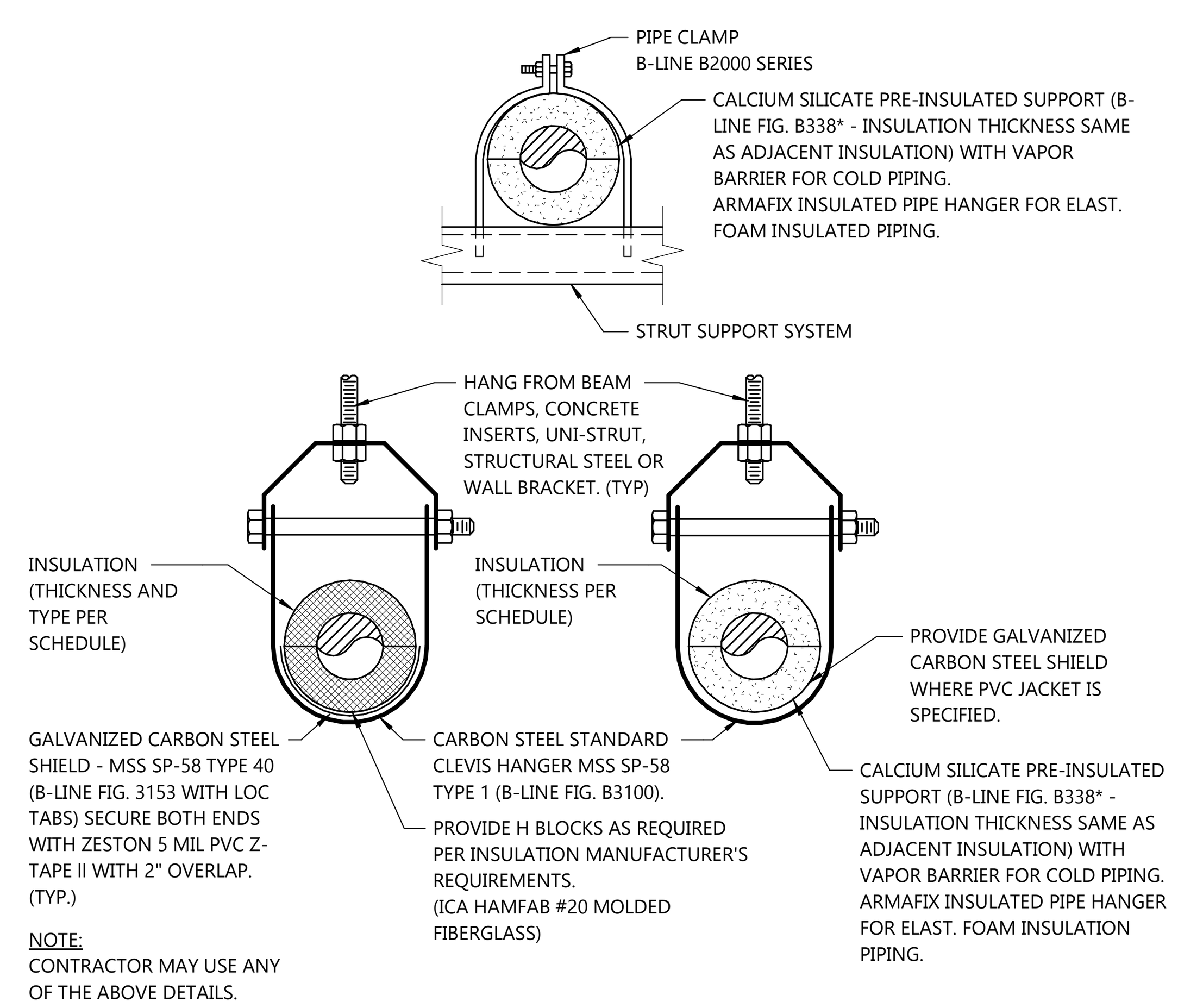


NOTE:
DETAILS ARE SHOWN TO PROVIDE INFORMATION ON FITTING CONSTRUCTION. THEY ARE NOT SHOWN TO DETAIL ACCEPTABLE ALTERNATIVES TO FITTINGS SHOWN.

1 / H3.0 **DUCT FITTING DETAILS**
NOT TO SCALE

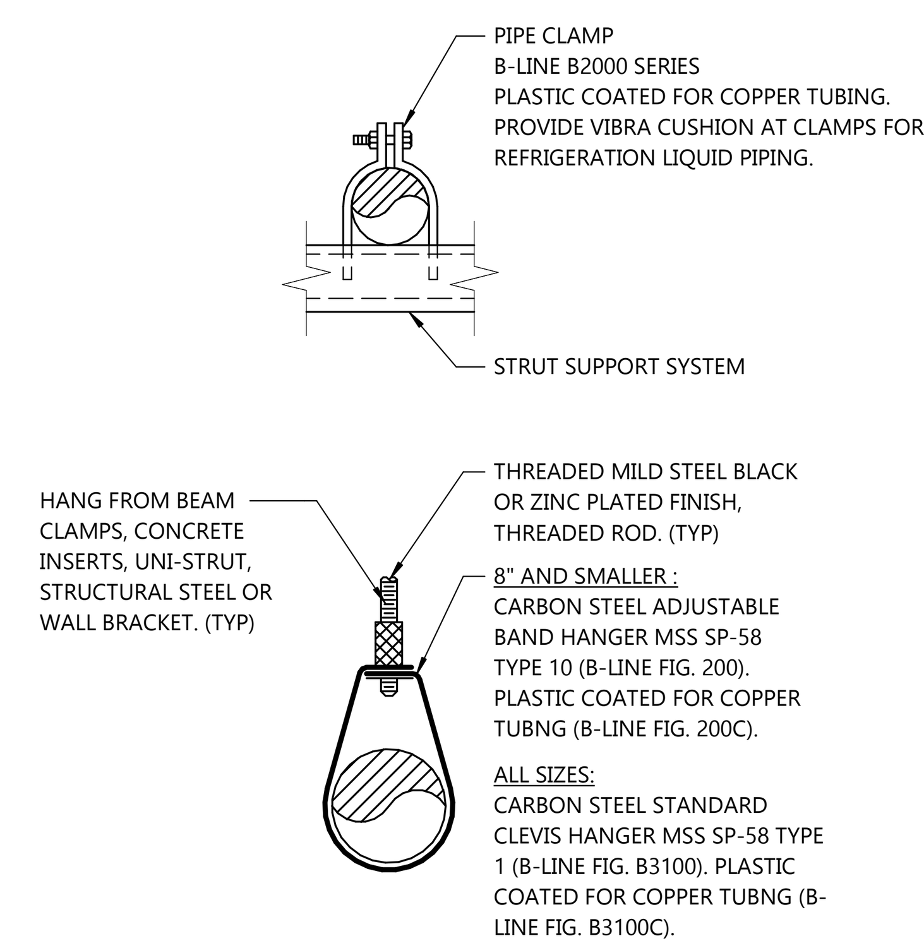


8 / H3.0 **GAS PIPE CONNECTION DETAIL**
NOT TO SCALE



NOTE:
CONTRACTOR MAY USE ANY OF THE ABOVE DETAILS.

7 / H3.0 **INSULATED PIPE HANGER DETAILS**
NOT TO SCALE



6 / H3.0 **UNINSULATED PIPE HANGER DETAIL**
NOT TO SCALE

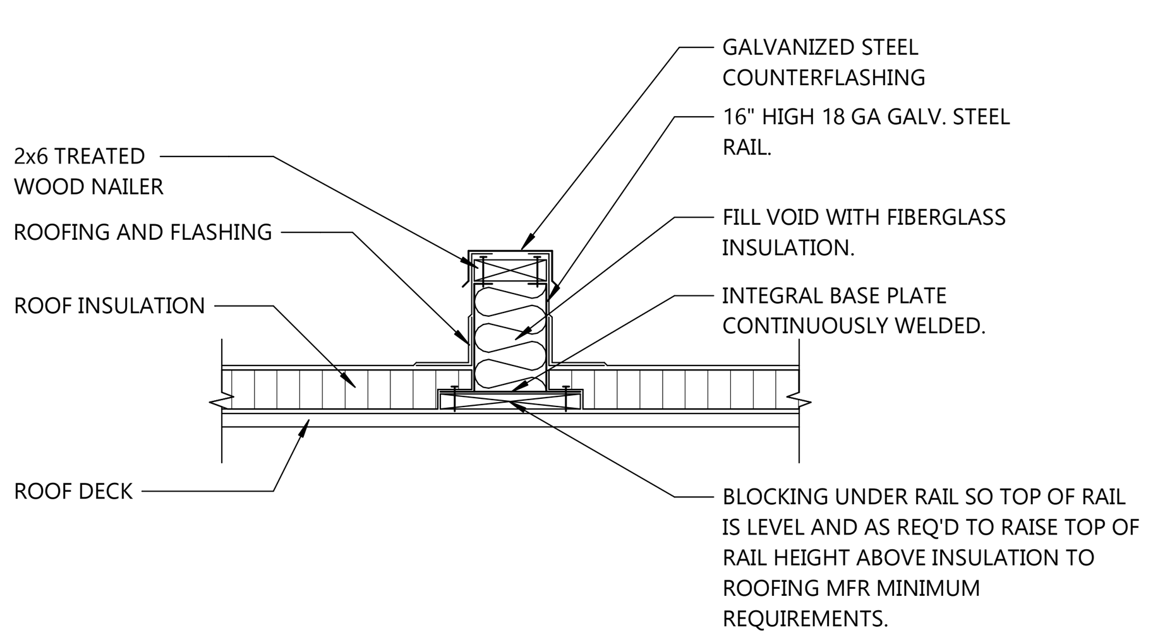
MAX. SPACING BETWEEN PIPE SUPPORTS AND MIN. HANGER ROD SIZES									
PIPE SIZE	STEEL			COPPER		PVC	PEX	MIN. ROD	
	WATER	VAPOR	NAT. GAS	WATER	VAPOR	CPVC		METAL PIPE	PLASTIC PIPE
1/4"-1/2"	7'	8'	6'	5'	6'	4'	32"	3/8"	3/8"
3/4"	7'	9'	8'	5'	7'	4'	32"	3/8"	3/8"
1"	7'	9'	8'	6'	8'	4'	32"	3/8"	3/8"
1 1/4"	7'	9'	10'	7'	9'	4'	32"	3/8"	3/8"
1 1/2"	9'	12'	10'	8'	10'	4'	32"	3/8"	3/8"
2"	10'	12'	10'	8'	11'	4'	-	3/8"	3/8"
2 1/2"	11'	12'	10'	9'	12'	4'	-	3/8"	3/8"
3"	12'	12'	10'	10'	12'	4'	-	3/8"	3/8"
4"	12'	12'	10'	12'	12'	4'	-	3/8"	3/8"
6"	12'	12'	10'	12'	12'	4'	-	3/8"	3/8"
8"	12'	12'	-	-	-	4'	-	1/2"	3/8"
10"	12'	12'	-	-	-	4'	-	1/2"	3/8"
12"	12'	12'	-	-	-	4'	-	5/8"	3/8"
14"	12'	12'	-	-	-	4'	-	5/8"	3/8"
16"	12'	12'	-	-	-	4'	-	3/4"	3/8"
MAX VERT. (1)	15'	15'	-	10'	10'	10'	10'	-	-

(1) SUPPORT AT MINIMUM EVERY FLOOR LEVEL OR SPACING LISTED.
MSS = MANUFACTURER'S STANDARDIZATION SOCIETY
- INSTALL ADDITIONAL HANGERS WITHIN 12" OF ELBOWS AND TEES AND AT CONCENTRATED LOADS, INCLUDING VALVES, FLANGES AND STRAINERS 2 1/2" AND LARGER.

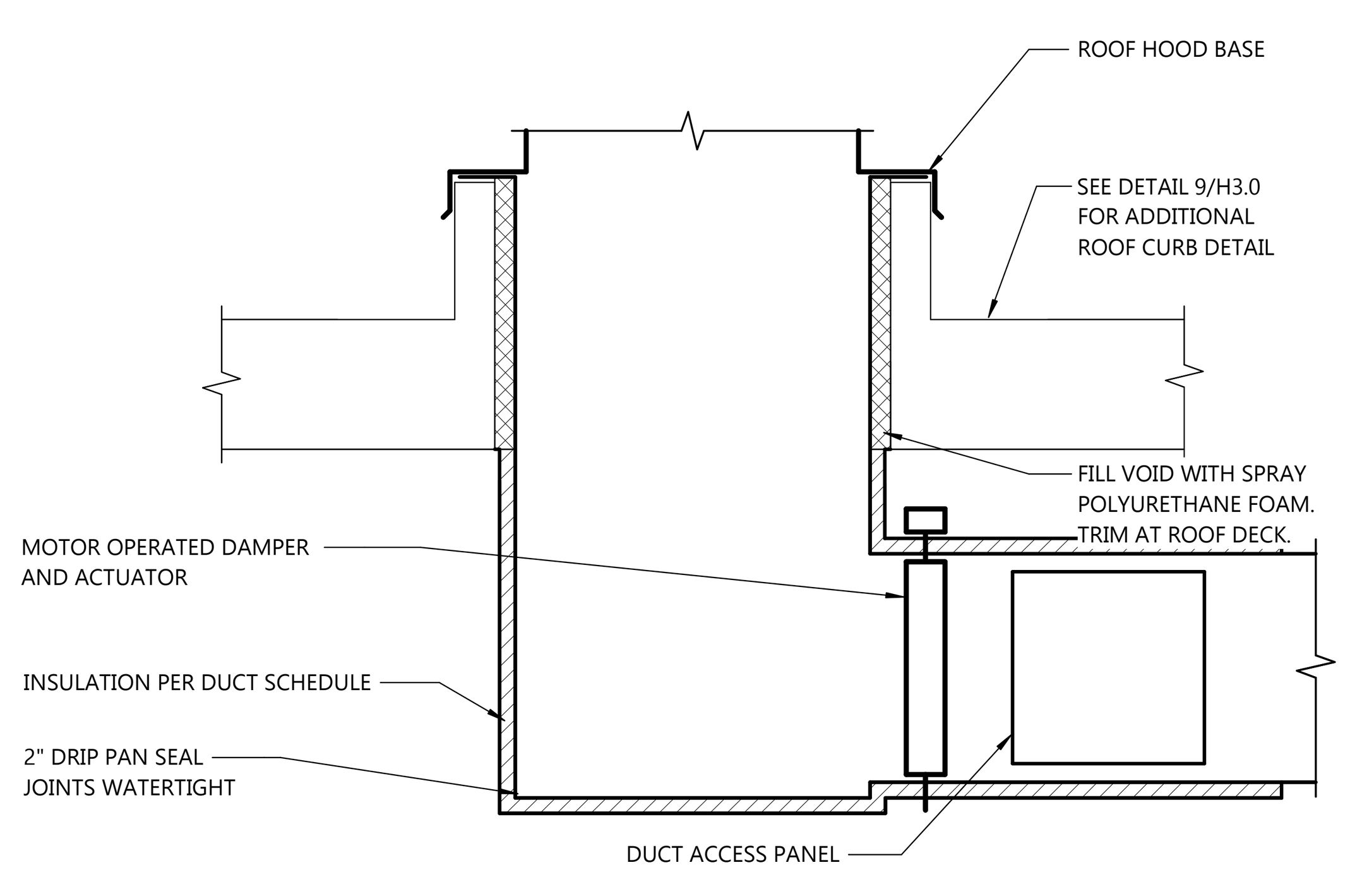
MAX. HANGER ROD CAPACITY	
ROD DIA.	MAX LOAD (1)
3/8"	600#
1/2"	1,100#
5/8"	1,800#
3/4"	2,700#

(1) MAX LOAD IS WEIGHT ALLOWED PER EACH ROD.

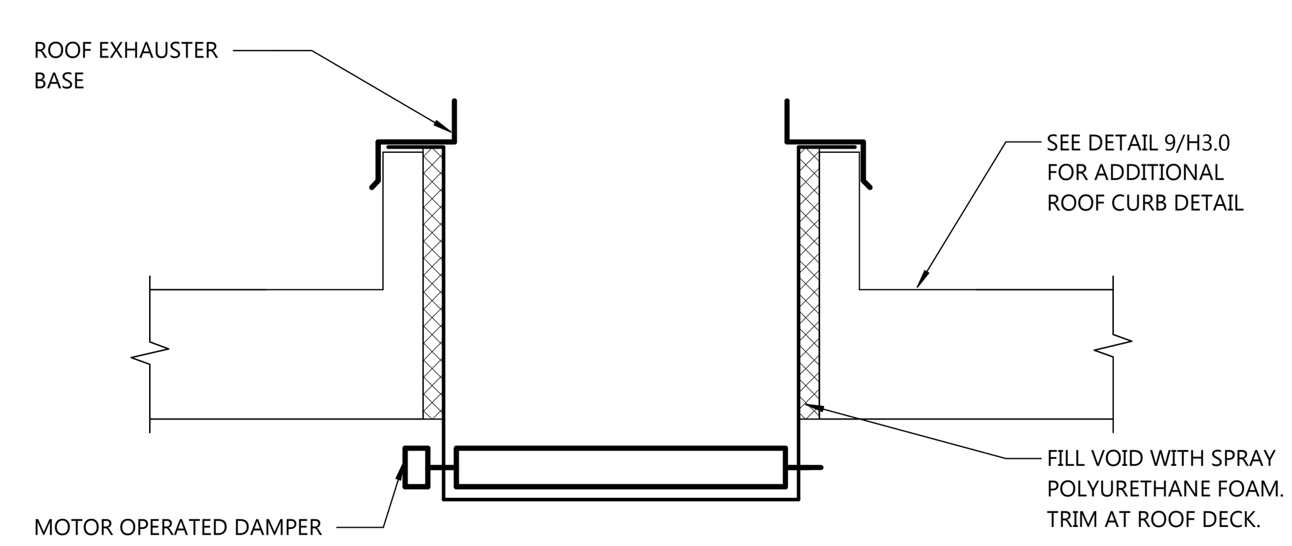
5 / H3.0 **PIPE SUPPORT AND HANGER ROD SCHEDULE**
NOT TO SCALE



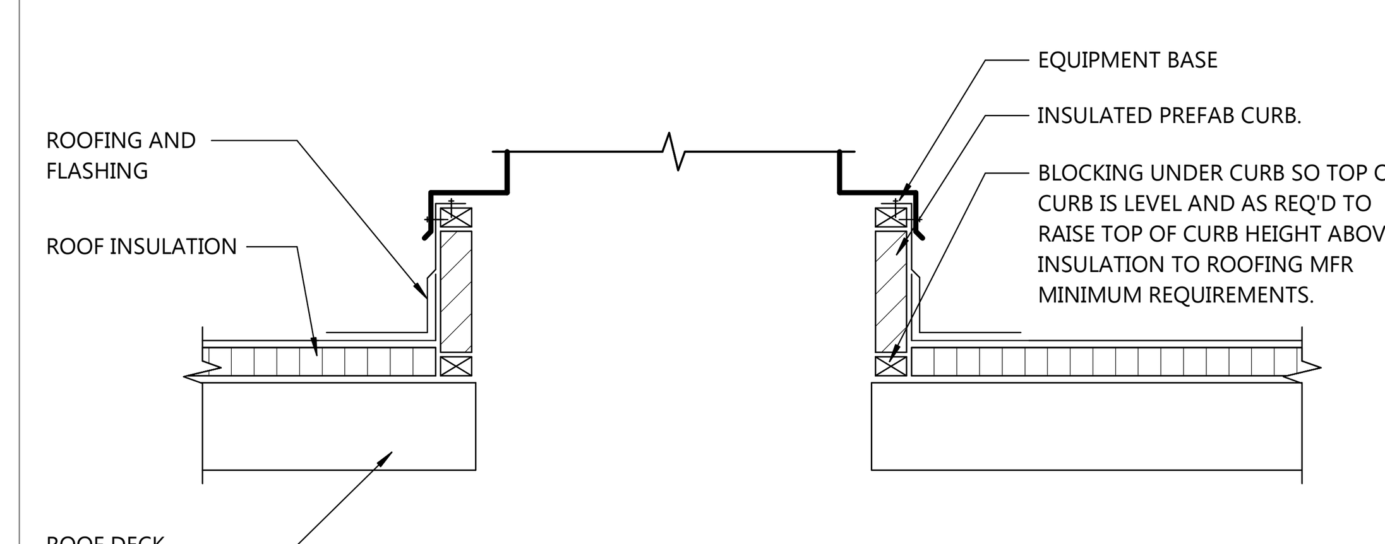
12 / H3.0 **EQUIPMENT SUPPORT RAIL DETAIL**
NOT TO SCALE



11 / H3.0 **ROOF HOOD DETAIL**
NOT TO SCALE



10 / H3.0 **ROOF EXHAUSTER DETAIL**
NOT TO SCALE



9 / H3.0 **TYPICAL ROOF CURB DETAIL**
NOT TO SCALE

HVAC DETAILS

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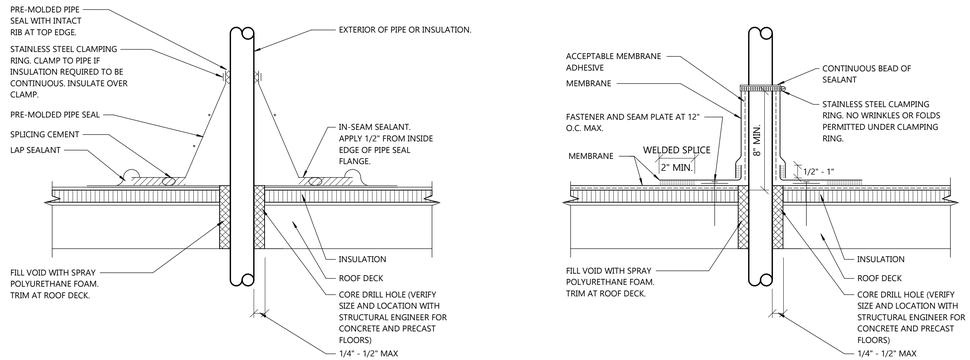
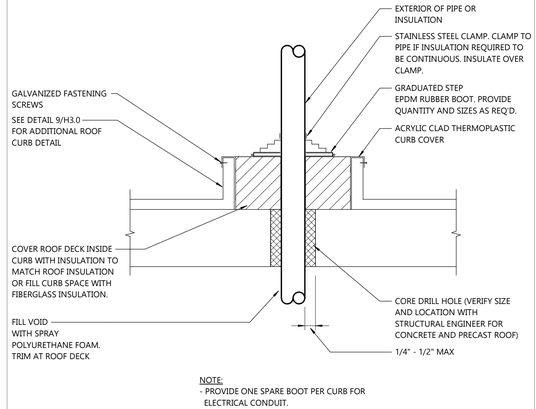
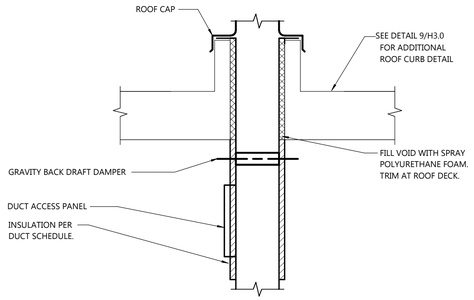


3/H3.1 ROOF PIPE PENETRATION DETAIL
NOT TO SCALE

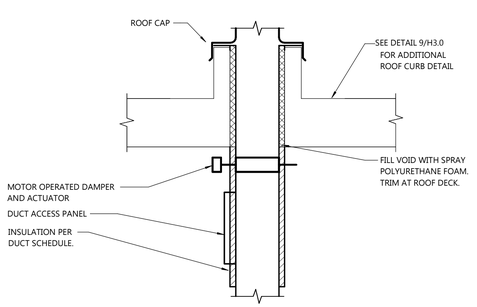


NOTE:
- PROVIDE ONE SPARE BOOT PER CURB FOR ELECTRICAL CONDUIT.

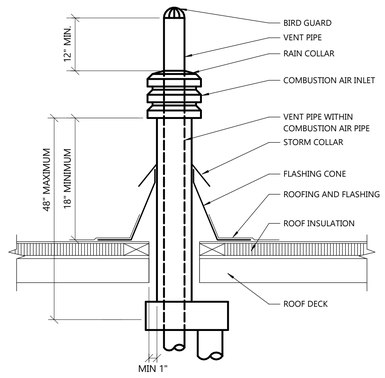
1/H3.1 ROOF PIPE CURB PENETRATION DETAIL
NOT TO SCALE



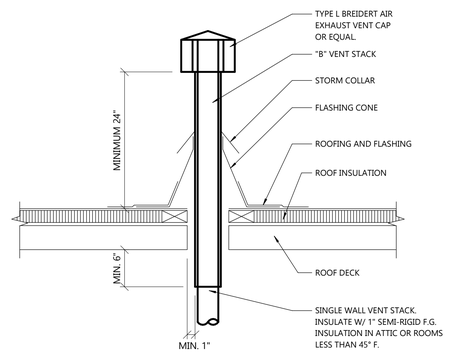
8/H3.1 ROOF CAP DETAIL
NOT TO SCALE



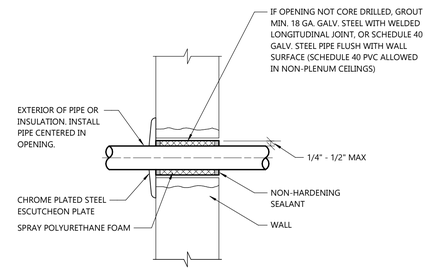
7/H3.1 ROOF CAP DETAIL
NOT TO SCALE



GAS UNIT HEATER
CONCENTRIC VENT THRU ROOF DETAIL
6/H3.1 NOT TO SCALE



5/H3.1 RADIANT GAS UNIT HEATER VENT THRU ROOF DETAIL
NOT TO SCALE



EXPOSED IN FINISHED ROOMS

CONCEALED SIDE OF WALL, EXPOSED IN MECH. EQUIP. ROOM, OR OUTDOORS

PIPE PENETRATION THRU
MASONRY OR CONCRETE WALL
9/H3.1 NOT TO SCALE

HVAC DETAILS

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ELECTRICAL/STARTER/DISCONNECT SCHEDULE

SYM.	ELECTRICAL DATA HP	KW	FLA	MCA	MOP	VOLT	PH.	STARTER TYPE	LOCATION	FURN. BY	AUX. CONTACT	ACCESS-ORIES	SMOKE DETECTOR	DISCONNECT DIS-CONNECT	FURN. BY	REMARKS
RACU-1	-	-	-	-	-	208	1	INTEG.	INTEGRAL	EM	-	-	-	R	EC	(5)
RACU-1 (HP)	-	-	-	29	48	208	1	INTEG.	INTEGRAL	EM	-	-	-	R	EC	-
IF-1	1/2	-	-	-	-	120	1	RELAY	(28)	HC	-	-	-	R	EM (2)	(20)
RE-1	1/4	-	-	-	-	120	1	RELAY	(28)	HC	-	-	-	R		(3)
CEF-1	-	0.10	-	-	-	120	1	(10)	(10)	EC	-	-	-	R	EM	-
CEF-2	-	0.13	-	-	-	120	1	(10)	(10)	EC	-	-	-	R	EM	-
GUH-1	(1)	-	-	-	-	120	1	INTEG.	INTEGRAL	EM	-	-	-	R	EC	-
GUH-2	(1)	-	-	-	-	460	3	INTEG.	INTEGRAL	EM	-	-	-	R	EC	-
RGUH-1	-	-	(1)	-	-	120	1	INTEG.	INTEGRAL	EM	-	-	-	NR	-	REC.
RGUH-2	-	-	(1)	-	-	120	1	INTEG.	INTEGRAL	EM	-	-	-	NR	-	REC.
EWH-1	-	2	-	-	-	208	1	INTEG.	INTEGRAL	EM	-	-	-	R	EM	-
PTAC-1	-	-	-	(1)	20	208	1	INTEG.	INTEGRAL	EM	-	-	-	R	EC	REC.

STARTER TYPE:
INTEG.= INTEGRAL: PROVIDED INTEGRAL WITH EQUIPMENT.
RELAY= UL LISTED MOTOR RATED RELAY WITH SEPARATE ENTRANCES FOR INPUT AND OUTPUT CONTACTS (RIBT SERIES), OVERRIDE SWITCH AND LED STATUS INDICATOR. CONTACT RATING, CONFIGURATION, AND COIL VOLTAGE SUITABLE FOR APPLICATION.
MAN= MANUAL: NEMA ICS 2, AC GENERAL PURPOSE CLASS A MANUALLY OPERATED, FULL-VOLTAGE CONTROLLER WITH QUICK MAKE AND BREAK TOGGLE ACTION AND DOUBLE BREAK SILVER ALLOY CONTACTS. BIMETALLIC OR MELTING ALLOY TYPE THERMAL OVERLOAD UNITS. NEMA ICS 6 GENERAL PURPOSE FLUSH MOUNTED ENCLOSURE WITH STAINLESS STEEL COVER PLATE IN FINISHED AREAS AND TYPE 1 SURFACE MOUNTED IN UNFINISHED AREAS.
MAG= MAGNETIC: NEMA ICS 2, AC GENERAL PURPOSE CLASS A MAGNETIC ACROSS-THE-LINE CONTROLLER. DOUBLE BREAK SILVER ALLOY CONTACTS. NEMA SOLID STATE OVERLOAD RELAY WITH USER SELECTABLE SETTINGS, CLASS 10, 20, AND 30; BUILT-IN MEMORY TO PREVENT HOT MOTOR RESTART. OPERATING TEMPERATURE: -20 DEGREE C TO +70 DEGREE C. PHASE CURRENT LOSS PROTECTION. PHASE CURRENT UNBALANCE PROTECTION (ADJUSTABLE 20-50%). PROVIDE NEMA ICS 6, TYPE 1 ENCLOSURE AUXILIARY CONTACT(S) AS REQUIRED FOR CONTROL. PROVIDE 120V, 60 HZ, SECONDARY, 100VA FUSED MINIMUM, TRANSFORMER IN EACH STARTER. FUSED PRIMARY AND SECONDARY, BOND UNFUSED LEG OF SECONDARY TO ENCLOSURE.
COMB= COMBINATION: COMBINE MAGNETIC STARTER AND NON-FUSED DISCONNECT SWITCH IN COMMON ENCLOSURE. LOCKABLE IN OPEN POSITION, MOLDED CAST TYPE MOTOR CIRCUIT PROTECTOR (MAGNETIC PROTECTION ONLY).
VFD= VARIABLE FREQUENCY DRIVE- SEE SPECS.

FURNISHED BY:	ACCESSORIES:	DISCONNECT:	REMARKS:
EM = EQUIPMENT MANUFACTURER	HOA = HAND-OFF-AUTO	NR= NOT REQUIRED	REC.=RECEPTACLE
HC = HEATING CONTRACTOR	PL =LED PILOT LIGHT	R = REQUIRED	
EC = ELECTRICAL CONTRACTOR	PB = PUSH BUTTON	F = FUSED	

- ACCEPTABLE MANUFACTURERS: ALLEN BRADLEY, CUTLER HAMMER, SQUARE D, GENERAL ELECTRIC.
- VERIFY VOLTAGE AND PHASE WITH ELECTRICAL CONTRACTOR BEFORE ORDERING EQUIPMENT.
- FURNISH MOTOR STARTERS TO E.C. FOR INSTALLATION AND WIRING WHEN THE STARTER SCHEDULE CALLS FOR H.C. TO FURNISH.
- NEMA RATINGS OF COMPONENTS SHALL BE SUITABLE FOR THE ENVIROMENT THEY ARE MOUNTED IN (NEMA 3R FOR OUTDOORS, NEMA 4X FOR WASHDOWN, ETC)

(1) SEE SCHEDULE.
(2) DISCONNECT FACTORY MOUNTED AND PREWIRED BY EQUIPMENT MANUFACTURER.
(3) EC SHALL WIRE TO 120 VOLT MOTOR OPERATED DAMPER ACTUATOR LOCATED INSIDE BUILDING BELOW ROOF EXHAUSTER FROM SAME FEED AS ROOF EXHAUSTER.
(5) EC SHALL PROVIDE POWER WIRING BETWEEN CU AND INDOOR UNIT.
(10) WALL OCCUPANCY SENSOR PROVIDED BY EC TO TURN ON ROOM LIGHTS AND FAN.
(20) EC SHALL MOUNT AND WIRE SPEED SWITCH FURNISHED BY EQUIPMENT MANUFACTURER.
(28) MOUNT RELAY ON WALL NEAR ELECTRICAL PANEL THAT SERVES FAN. COORDINATE LOCATION WITH ELECTRICAL CONTRACTOR.

PACKAGED TERMINAL AIR CONDITIONING UNIT (P.T.A.C.)

NO.	TOTAL CFM	O.A. CFM	COOLING AMB. TEMP	COOLING MBH	HTG KW	MCA	MOCP	VOLT.	CODE EER	ARI 310/380 EER	WALL SLEEVE DEPTH	OUTDOOR GRILLE	REFRIG.	MODEL	REMARKS
1	310	10	95	7.2	3.5	-	20	208/1	12.5	13.0	(2)	(3)	R32	PDH07K	FRIEDRICH (1)(4)

- ACCEPTABLE MANUFACTURERS: GE, FRIEDRICH, LG, AMANA, TRANE.
- PROVIDE WITH INTERNAL DRAIN KIT FOR PIPED RISERS.
- PROVIDE INSULATED SLEEVE.

(1) PROVIDE WITH SUB-BASE BASED FOR PERMANENT WIRING OF UNIT.
(2) CONTRACTOR TO COORDINATE SLEEVE DEPTH WITH WALL CONSTRUCTION AND WITH OWNER.
- SLEEVE TO PROJECT INTO ROOM 7" MINIMUM - 8" MAXIMUM.
(3) OUTDOOR GRILLE FURNISHED WITH PTAC UNIT.
- POLYCARBONATE GRILLE, COLOR SELECTED BY ARCHITECT / STAMPED ALUMINUM GRILLE / EXTRUDED ALUMINUM ARCHITECTURAL GRILLE.
(4) PROVIDE WITH LINE-CORD KIT, FOR PLUGGING UNIT INTO RECEPTACLE.

INLINE FAN SCHEDULE (IF)

NO.	AREA SERVED	CFM	SP " WC	MAX. BHP	MOTOR HP	FAN RPM	DRIVE	VFD	DISC.	MAX. SONES	FAN ORIENTATION	DISCH. CONFIG. (5)	INSUL. HOUSING	GUARD INLET	GUARD OUTLET	MODEL	REMARKS
1	MECHANICAL	1,200	0.50	0.22	1/2	1,382	DIRECT (1C)	NO	(3)	8.6	HORIZONTAL	IN-LINE	NO	NO	YES	SQ-120	GREENHECK

- ACCEPTABLE MANUFACTURERS: GREENHECK, COOK, TWIN CITY, FANTECH.
- PERMANENTLY LUBRICATED SEALED BALL BEARING MOTORS MOUNTED ON VIBRATION ISOLATORS OUT OF THE AIRSTREAM. SEE MOTOR SPEC FOR ADDITIONAL REQUIREMENTS.
- FAN SHALL BEAR THE AMCA CERTIFIED RATINGS SEAL FOR SOUND AND AIR PERFORMANCE.
- PROVIDE NEOPRENE ISOLATOR FOR FANS WITH MOTORS LESS THAN OR EQUAL TO 1/3 HP, SPRING ISOLATOR FOR FANS WITH MOTORS GREATER THAN 1/3 HP.

MOTOR
(1C) PROVIDE DIRECT DRIVE FANS WITH SPEED SWITCH.
DISCONNECT
(3) PROVIDE PRE-WIRED DISCONNECT SWITCH OR TWIST LOCK PLUG.
MISC
(5) IN DIRECTION OF AIRFLOW.

ROOF EXHAUSTER SCHEDULE (RE)

NO.	SERVICE	CFM	SP " WC	MAX. BHP	MOTOR HP	FAN RPM	MOTOR RPM	DRIVE	VFD	DISC.	DAMPER DAMPER	DAMPER LOC.	DAMPER ACTUATOR	MAX. SONES	CURB (16)	WEIGHT LBS.	MODEL	REMARKS
1	MECHANICAL	900	0.30	0.13	1/4	1,432	1,725	DIRECT (1C)	NO	(3)	M.O.D. (6)	(8)	(10)	10.1	18"	108	G-099-A	GREENHECK

- ACCEPTABLE MANUFACTURERS: GREENHECK, COOK, CARNES, PENN-BARRY, ACME, TWIN CITY.
- PERMANENTLY LUBRICATED SEALED BALL BEARING MOTORS MOUNTED ON VIBRATION ISOLATORS OUT OF THE AIRSTREAM. SEE MOTOR SPEC FOR ADDITIONAL REQUIREMENTS.
- PROVIDE GREASABLE BEARINGS WITH MINIMUM L10 LIFE IN EXCESS OF 100,000 HOURS (EQUIVALENT TO L50 AVERAGE LIFE OF 500,000 HOURS).
- PROVIDE WITH 1/2" MESH BIRD SCREEN AND CURB SEAL.
- PROVIDE WITH TOOL-LESS TOP CAP REMOVAL.
- BELT DRIVE FANS WITH AUTOMATIC BELT TENSIONERS.

MOTOR
(1C) PROVIDE DIRECT DRIVE FANS WITH PREWIRED SPEED SWITCH UNDER FAN HOUSING.
DISCONNECT
(3) PROVIDE PRE-WIRED NEMA 1 DISCONNECT SWITCH OR TWIST LOCK PLUG, NEMA 3R IF NOT PROECTED FROM THE WEATHER.
DAMPER
(6) PROVIDE WITH GREENHECK VCD-23 DAMPER. 16 GA. GALV. FRAME AND BLADES, TPE BLADE SEALS, SS COMPRESSION JAMB SEAL PLATED STEEL LINKAGE AND AXLES, SYNTHETIC BEARINGS. MAXIMUM 4 CFM PER SF LEAKAGE AT 1.0" W.G.
DAMPER LOCATION
(8) DAMPER MOUNTED IN DUCT DROP IN BUILDING, NOT IN CURB. EXTERNAL MOUNT ACTUATOR.
ACTUATOR
(10) 120 VOLT.

CABINET EXHAUST FAN SCHEDULE (C.E.F.)

NO.	AREA SERVED	TYPE	CFM	S.P. " W.C.	RPM	MOTOR WATTS	MAX. SONES	DUCT COLLAR SIZE (IN.)	MODEL	TERMINATION TYPE	THROAT (INCHES)	APD.	SCREEN	DAMPER	MODEL	REMARKS
1	MECHANICAL	CEILING	75	0.38	950	100	1	6	SP-B110 (3)	FLAT ROOF	7	0.01	BIRD	NO	RCC-7 (1)	"GREENHECK"
2	RESTROOM	CEILING	100	0.38	1,050	128	2.5	6	SP-B150 (3)	FLAT ROOF	7	0.01	BIRD	NO	RCC-7 (1)	"GREENHECK"

- ACCEPTABLE MANUFACTURERS: GREENHECK, COOK, PENN-BARRY, CARNES, TWIN CITY FAN.
- PROVIDE SPEED CONTROL MOUNTED ON FAN HOUSING. INTERNAL PLUG-IN DISCONNECT AND BACKDRAFT DAMPER.

(1) PROVIDE 18" HIGH ROOF CURB.
(3) PROVIDE WHITE ALUMINUM GRILLE.

ELECTRIC WALL HEATER SCHEDULE - (E.W.H.)

NO.	AREA SERVED	CFM	EAT F	LAT F	MBH	HTG KW	THERMOSTAT	CABINET RECESS DEPTH	CABINET HGT. AFF	MODEL	REMARKS
1	RESTROOM	100	60	122	6.8	2	INTEG., PREWIRED, TAMPER-RESISTANT	3-3/4"	12"	FRC-4020	"BERKO"

- ACCEPTABLE MANUFACTURERS: BERKO, RAYWALL, Q-MARK, MARKEL.
- PROVIDE ALL EWH'S WITH PREWIRED DISCONNECT SWITCH, PREWIRED MANUAL RESET THERMAL OVERLOAD PROTECTION, BUILT-IN FAN DELAY CONTROLS, 18 GAUGE FRONT BAR GRILLE.

DUCTWORK AND DUCTWORK INSULATION SCHEDULE

SERVICE	LOCATION	DUCT MAT'L	SMACNA PRESS. CLASS	INSULATION RECTANGULAR DUCT	INSULATION ROUND DUCT	INSUL. JACKET
SUPPLY RACU-1	CONCEALED	GALV. ST.	+1"	1" A.L.D. (1)	1.5" FLEX F.G.	N.R.
RETURN UPSTREAM OF RACU-1	CONCEALED	GALV. ST.	-1"	1" A.L.D. (1)	N.R.	N.R.
OUTSIDE AND MIXED AIR	CONCEALED	GALV. ST.	-1"	2" FLEX F.G. (11)	2" FLEX F.G. (11)	N.R.
EXHAUST UPSTREAM OF RE-1	CONCEALED	GALV. ST.	-1"	1.5" FLEX F.G. (2)	1.5" FLEX F.G. (2)	N.R.
EXHAUST DOWNSTREAM OF CEF-1 AND CEF-2	CONCEALED	GALV. ST.	+1"	1.5" FLEX F.G. (2)	1.5" FLEX F.G. (2)	N.R.
GAS UNIT HEATER INTAKES	ALL	SEE SCHEDULE	-	N.R.	N.R.	N.R.

N.R. = NOT REQUIRED
EXPOSED = VISIBLE FROM OCCUPIED SPACE, DOES NOT INCLUDE DUCTWORK ABOVE WALK-ON CEILINGS AND IN MECHANICAL ROOMS. DUCTWORK IN ROOMS WITH CLOUD CEILINGS ARE CLASSIFIED AS EXPOSED.
CONCEALED = HIDDEN FROM VIEW BY WALLS AND CEILINGS. INCLUDES DUCTWORK ABOVE WALK-ON CEILINGS AND IN MECHANICAL ROOMS.
MATERIALS:
GALV. STEEL: ASTM A653, LOCK FORMING QUALITY, 1.25 OUNCES/ S.F. ZINC COATING (G90 IN ACCORDANCE WITH ASTM A90 BOTH SIDES).
STAINLESS STEEL: ASTM A240/A240M, TYPE 304 OR 316.
- ALL JOINTS, LONGITUDINAL AND TRANSVERSE SEAMS AND CONNECTIONS IN DUCTWORK SHALL BE SEALED PER 2015 IECC 403.2.9. / 2018 IECC 403.11.1.
(1) DUCT DIMENSIONS ARE SHEET METAL DIMENSIONS AND INCLUDE LINING.
(2) INSULATE FROM 18" UPSTREAM OF THE BACKDRAFT OR MOTOR OPERATED DAMPER TO THE POINT WHERE THE DUCT EXITS THE BUILDING.
(11) PROVIDE RIGID OR SEMI-RIGID F.G. INSULATION AT DUCT PENETRATIONS THRU MASONRY OR PRECAST WALLS TO MINIMUM 6" BEYOND WALL FACE.

PIPE SCHEDULE

SERVICE	PIPE SIZE	STEEL PIPE BLACK STEEL	GALVANIZED	ASTM GR. B A53 F	A53 E	A106 S	SCHEDULE	STEEL FITTINGS CAST IRON THREADED ASTM A126/ANSI B16.4	MALLEABLE IRON THREADED ASME/ANSI B16.3	FORGED STEEL THREADED OR WELDED ASTM A105 GRADE II/ ANSI B16.11	SEAMLESS CARBON STEEL WELDED ASTM A234, GR. WPB/ ANSI 16.9	COLD PRESS MECHANICAL JOINT	COUPLING JOINT	CLASS	COPPER PIPE ASTM B280 TYPE ACR	ASTM B88 TYPE L HARD DRAWN	PRECHARGED LINE SET	COPPER FITTINGS ASME B16.22 WROUGHT COPPER	SOLDER / BRAZING	COLD PRESS MECHANICAL JOINT	COUPLING JOINT	PLASTIC PRESSURE RATED	NON-PRESSURE RATED	SCHEDULE	PLASTIC PIPE PVC ASTM D1784, D1785, D2672	CPVC ASTM D1784, F411	PLASTIC FITTINGS PVC ASTM D2464, D2467, D1784	CPVC ASTM F437, F439, D1784	STAINLESS STEEL PIPE ASTM A312 304	316	SCHEDULE	TUBE 16 GAUGE 304	FITTINGS ASTM A403, GR. WP304 BUTT WELDED	THREADED	COLD PRESS MECHANICAL JOINT	PEX	PE	MISC
GAS (≤ 5 PSIG)	1/2" - 2"	X		X	X	X	40	X	X	X	X			125/150																								
GAS REGULATOR VENTS	ALL SIZES	X		X	X	X	40	X	X	X	X			125/150																								
REFR. SUCTION AND LIQ. ≤ 5 TONS	ALL																X																					
COOLING COIL COND. DRAIN	ALL		X	X	X	X	40	X	X					125									X	40	X	X	(3)	(19)										

(3) ASTM F656 SOLVENT WELD WITH ASTM D2564 CLEAR SOLVENT CEMENT.
(19) ASTM F656 SOLVENT WELD WITH ASTM F493 CLEAR SOLVENT CEMENT.

PIPE INSULATION SCHEDULE

SERVICE	LOCATION	INSULATION NONE REQUIRED	RIGID F.G.	ELASTOMERIC FOAM	POLYISO	POLYISO-HT-450	CLOSED CELL GLASS	POLYSTYRENE	JACKET NONE REQUIRED	PVC	ALUMINUM	STAINLESS STEEL	PIPE SIZE < 1"	1" - 1.25"	1.5" - 3"	4" - 6"	> 6"
REFRIGERATION SUCTION	OUTDOORS			X						X			1/2"	1"	1"	1"	1"
REFRIGERATION SUCTION	INDOORS			X					X				1/2"	1"	1"	1"	1"
REFRIGERATION LIQUID	ALL	X							X				-	-	-	-	-
COOLING COIL COND. DRAIN	UNCOOLED ROOMS			X						X			1/2"	1/2"	1/2"	1/2"	1/2"

GAS APPLIANCE VENTING SCHEDULE

APPLIANCE	SERVICE	LISTING	CONTINUOUS FLUE TEMP RATING	VENT PRESSURE RATING	GAS APPL. CAT.	MATERIAL
DIRECT VENT SEALED	INTAKE	-	-	-	-	PVC: ASTM D1785 SCH 40 PIPE, ASTM D2466 SCH 40 FITTINGS, ASTM D2564 CEMENT
COMB. RADIANT HEATERS	VENT INSIDE	-	-	POSITIVE	III	ASTM A527 22 GA GALV. STEEL (1)
IN WASH BAY	VENT OUTSIDE	UL 441	400 DEG F	NEU., NEG.	II	B VENT (ALUM. INNER PIPE, AIR SPACE, GALV. STEEL OUTER PIPE) (2)
DIRECT VENT SEALED	INTAKE	-	-	-	-	24 GAUGE STAINLESS STEEL, -1" W.C.
COMB. UNIT HEATERS	VENT INSIDE	-	-	POSITIVE	III	ASTM A527 22 GA GALV. STEEL (1)
	VENT OUTSIDE	UL 441	400 DEG F	NEU., NEG.	II	B VENT (ALUM. INNER PIPE, AIR SPACE, GALV. STEEL OUTER PIPE) (2)

- MAINTAIN UL LISTED CLEARANCES TO COMBUSTIBLE MATERIALS.
- INSTALL IN ACCORDANCE WITH CHAPTER 5 OF THE 2012 IFGC.
- TERMINATE STACKS AT A MINIMUM 3' ABOVE ROOF AND 2' HIGHER THAN ANY RIDGE, PEAK OR PARAPET WITHIN 10'.

(1) SEAL JOINTS WITH TEMPERATURE RESISTANT SEALANT.
(2) PROVIDE UL LISTED STAINLESS STEEL SUPPORT ACCESSORIES. (CARBON STEEL ACCESSORIES ARE NOT PERMITTED)

ROOM AIR CONDITIONING AND HEAT PUMP SCHEDULE (R.A.C.U.) / (H.P.)

NO.	ROOM SERVED	COOLING MBH	HEATING MBH	INDOOR UNIT CFM	OA CFM	MCA	MOP	VOLT. / PH.	MTG	COND. PUMP	MODEL	HEAT PUMP AMB. DEG F	MCA	MOP	VOLT.	MODEL	EFFICIENCY MIN. CODE	UNIT RATING	TEST PROC.	REFRIG.	REMARKS
1	OFFICE	30.8	21.3 (6)	625	20	2.25	15	208/1	DUCTED	YES	PEAD-AA3ONL	95	29	48	208/1	PUZ-AK30NLHZ	13.0 SEER, 7.5 HSPF	18.5 SEER, 10.4 HSPF	ARI 210/240	R-454B	"MITSUBISHI" (1)(2)(3)(4)

- ACCEPTABLE MANUFACTURERS: MITSUBISHI, PANASONIC, CARRIER, SAMSUNG, LG.
- SCHEDULED MANUFACTURER BASED ON ANTICIPATED AVAILABILITY OF UNITS IN STOCK. USE OF MANUFACTURER, MODEL, OR REFRIGERANT OTHER THAN LISTED IN SCHEDULE ABOVE WILL BE CONSIDERED A SUBSTITUTION. CONTRACTOR RESPONSIBLE FOR ASHRAE VENTILATION COMPLIANCE FOR ALTERNATE REFRIGERANTS.
- PROVIDE WITH PRE-CHARGED LINE SET.
- PROVIDE WITH BUILT-IN BASE PAN HEATER.

(1) WIRING TO POWER INDOOR UNIT FROM HEAT PUMP PROVIDED BY EC.
(2) PROVIDE WITH FB SERIES FILTER BOX WITH MERV 8 FILTERS.
(3) PROVIDE WITH PAR-40MAAU THERMOSTAT CONTROLLER.
(4) PROVIDE FRONT WIND BAFFLE PLATE.
(6) HEATING CAPACITY AT -13 DEG-F.

GAS UNIT HEATER SCHEDULE (GUH)

NO.	CFM	ESP " W.C.	MBH IN	MBH OUT	MOTOR HP	VOLT. (7)	DRIVE	CONTROL	TYPE	VENT DIA.	COMB. INLET DIA.	WGHT	MODEL	REMARKS
1	1,540	-	120	100	1/20	120/1	DIRECT	(3)	SEP. COMB.	4"	4"	110	UDXC-125	"REZNOR" (5)
2	7,800	-	950	-	2	460/3	DIRECT	(3)(8)	DOORJET HEATER	-	-	300	DJTE-95-460	"SOLARONICS" (9)

- ACCEPTABLE MANUFACTURERS: REZNOR, MODINE, TRANE.
- PROVIDE WITH VERTICAL LOUVERS, 30 OR 60 DEG DOWNTURN NOZZLE, DUCT FLANGE.

(1) PROVIDE STAINLESS STEEL HEAT EXCHANGER AND BURNER.
(3) CONTROL BY TEMPERATURE CONTROL CONTRACTOR.
(5) PROVIDE STAINLESS STEEL HEAT EXCHANGER AND VERTICAL CONCENTRIC VENT KIT.
(7) PROVIDE STEPDOWN TRANSFORMER AS REQUIRED.
(8) PROVIDE NEMA 4X DOOR INTERLOCK SWITCH TO DISABLE HEATER WHEN DOOR IS CLOSED.
(9) PROVIDE HEATER WITH STAINLESS-STEEL UNIVERSAL HEATER MOUNTING KIT.

RADIANT GAS UNIT HEATER SCHEDULE (RGUH)

NO.	FIRING TYPE	MBH INPUT	STAGES	MTG. HT. (FT.)	MTG. ANGLE (DEG.)	TUBE LENGTH (FT.)	NO. OF SIDE SHIELDS	STARTING/ RUNNING AMPS	WEIGHT (LBS.)	MODEL	REMARKS
1	INDIRECT	75	2	11	45	20	1	4.8 / 1.1	120	HL3-20-75	"DETROIT RADIANT" (1)(3)
2	INDIRECT	125	2	11	45	30	1	4.8 / 1.1	160	HL3-30-125	"DETROIT RADIANT" (1)(3)

- ACCEPTABLE MANUFACTURERS: DETROIT RADIANT, REZNOR.
- PROVIDE WITH "U" AND "L" HEAT EXCHANGER TUBES PER PLAN, REFLECTOR CAP COVERS AND REMOTE MOUNTED THERMOSTAT WITH SHIELD.

(1) PROVIDE POLISHED ALUM. REFLECTOR, COATED ALUMINIZED STEEL COMB. CHAMBER AND TUBES, 0.95 EMISSIVITY BLACK COATING.
(2) PROVIDE TH-BR5Z PROGRAMMABLE TWO-STAGE THERMOSTAT WITH DRPCO-ODRS REMOTE SENSOR FOR WASHDOWN AREA

EXCEL
Always a Better Plan
100 Camelot Drive
Fond du Lac, WI 54935
920-926-9800
excelengineer.com

PROJECT INFORMATION

NEW CAR WASH FACILITY:
TSUNAMI EXPRESS CAR WASH
115 E WOLF RUN • MUKWONAGO, WI 53149

PROFESSIONAL SEAL

SHEET DATES
SHEET ISSUE SEP. 5, 2025
REVISIONS

JOB NUMBER
240303900

SHEET NUMBER
H4.0

HVAC SCHEDULES

ROOF HOOD SCHEDULE (RH)

NO.	SERVICE	CFM	THROAT SIZE		MAX. APD " WC	MAT'L	DAMPER	PAINTED FINISH	SCREEN	INSUL. CURB HEIGHT (4)	MODEL	REMARKS
			W	L								
1	O.A. INTAKE	1,200	16	16	0.06	ALUM.	(4)	-	INSECT	24	FGI	"GREENHECK"

- ACCEPTABLE MANUFACTURERS: GREENHECK, COOK, CARNES, ACME, TWIN CITY FAN.
- BIRD SCREEN: 1/2"x 1/2" 19 GAUGE GALVANIZED WIRE.
- INSECT SCREEN: 18x16 ALUMINUM MESH.
(4) DUCTWORK SHALL BE CONTINUOUS THRU CURB. IF NO DUCTWORK SHOWN, CURB SHALL HAVE INTERIOR LINER TO CONCEAL INSULATION

ROOF CAP SCHEDULE

NO.	SERVICE	TYPE	THROAT	CFM	APD.	SCREEN	DAMPER	MODEL	REMARKS
1	O.A. INTAKE	FLAT	7	20	0.00	BIRD	NO	RCC-7 (1)	"GREENHECK"

- ACCEPTABLE MANUFACTURERS: GREENHECK, CARNES, AMERICAN ALDES, DRYER JACK.
(1) PROVIDE 18" HIGH ROOF CURB.

SUPPLY GRILLE SCHEDULE (S.G.)

NO.	TYPE	CFM RANGE	NECK/ FACE SIZE	INLET DUCT DIA.	MAT'L	VOL. DMPR	FINISH	FRAME	THROW	MODEL	REMARKS
1-6	LOUVER	0-75	9 X 9	6"	STEEL	(1)	WHITE	LAY-IN	(3)	SMD	"PRICE"
1-12	LOUVER	375-550	15 X 15	12"	STEEL	(1)	WHITE	LAY-IN	(3)	SMD	"PRICE"

- ACCEPTABLE MANUFACTURERS: PRICE, TITUS, CARNES, METALAIRE, ANEMOSTAT, KRUEGER, NAILOR, GREENHECK.
(1) VOLUME DAMPER AT THE GRILLE INDICATED BY A "D" AFTER THE GRILLE DESIGNATION. EXAMPLE: SG1S-8D IS SG1S-8 WITH A DAMPER.
(3) NUMBER OF THROW DIRECTION INDICATED ON PLAN BY GRILLE SHADING. SHADED QUADRANT DOES NOT HAVE AIRFLOW.

RETURN GRILLE SCHEDULE (RG)

NO.	TYPE	MAX. CFM	NECK/ FACE SIZE	FLEX. DUCT. DIA.	MAT'L	VOL. DMPR	FINISH	FRAME	MODEL	REMARKS
1-12	LOUVERED	750	22 X 22	12"	STEEL	(1)	WHITE	LAY-IN (3)	530	"PRICE"

- ACCEPTABLE MANUFACTURERS: PRICE, TITUS, CARNES, METALAIRE, ANEMOSTAT, KRUEGER, NAILOR, GREENHECK.
(1) VOLUME DAMPER AT THE GRILLE INDICATED BY A "D" AFTER THE GRILLE DESIGNATION. EXAMPLE: RG1S-8D IS RG1S-8 WITH A DAMPER.
(3) SURFACE MOUNT BORDER WITH NO SCREW HOLES FOR LAY-IN APPLICATION.

HVAC SCHEDULES

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