



Smith + Andersen

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PROJECT NAME: 78 Clifton Road (Our Lady of Perpetual Help) Church Alterations

ATTENTION: Mr. John Kapov, Bogdan Newman Caranci Inc.

PROJECT NO.: 14214.002.M.001

DATE: 2016-07-21

POST ADDENDUM NO.: M-01

ISSUED BY: Cameron Leitch

1. **REFERENCE:**

1.1. **Drawings/Specs/Schedules**

- 1.1.1. A comprehensive package of all mechanical drawings, specifications, and schedules related to the scope of work is included in the post tender addendum.

1.2. **General**

- 1.2.1. Changes from the previously issued for tender specifications and schedules have been identified with yellow highlighting and strikethrough font. Changes on drawings have been identified with revision clouds.

2. **SPECIFICATIONS:**

2.1 **Section 15062 – Commissioning**

- 2.1.1. Revise item 1.1.7 to read as follows: “Conform to Section **15910 – STANDALONE CONTROLS.**”

2.2 **Section 15141 – Centrifugal Pumps**

- 2.2.1. Delete entire section.

2.3 **Section 15179 – Pipe System Filters**

- 2.3.1. Delete item 2.1.2 and replace with “NOT USED”.
2.3.2. Revise item 2.1.6.1 to read as follows: “Glycol heating system”.

2.4 **Section 15200 – Vibration and Noise Control**

- 2.4.1. Delete item 1.2.2 and replace with “NOT USED”.
2.4.2. Delete item 1.3.2 and replace with “NOT USED”.

This amendment is hereby made as part of the Contract Documents. The following revisions and/or additions shall be made to contract documents and the cost shall be included in the revised Tender Price.

Vancouver Kelowna Victoria Calgary Edmonton Winnipeg London **Toronto** Ottawa

- 2.4.3. Delete item 2.2.6 and all sub-items and replace with "NOT USED".
- 2.4.4. Delete items 2.2.9 through 2.2.13 and all sub-items and replace with "NOT USED".
- 2.4.5. Delete item 2.3 and all sub-items and replace with "NOT USED".
- 2.4.6. Delete items 3.2.1 through 3.2.12 and all sub-items and replace with "NOT USED".
- 2.4.7. Add item 3.2.13.1 as follows: "Fan coil units floor mounted shall be supported on concrete housekeeping pads (minimum 100 mm / 4" high) with type MEP isolation."
- 2.4.8. Delete item 3.2.14 and replace with "NOT USED".
- 2.4.9. Delete items 3.2.25 through 3.2.28 and all sub-items and replace with "NOT USED".
- 2.4.10. Delete item 3.2.30 and replace with "NOT USED".
- 2.4.11. Delete items 3.3, 3.4, and 3.6 and all sub-items and replace with "NOT USED".

2.5 Section 15350 – Natural Gas Piping Systems

- 2.5.1. Add sentence to end of item 3.1.6.1 as follows: "Mushroom operator shall be installed with tamper-proof enclosure to avoid unintended depression of operator and subsequent termination of gas supply."

2.6 Section 15410 – Pipes, Valves, and Fittings (Plumbing System)

- 2.6.1. Add item 2.1.20 as follows: "Backwater valves shall be "normally open" design by Mainline, J.R. Smith, Zurn, Mifab, or Watts."
- 2.6.2. Add item 2.1.20.1 as follows: "Unit up to 300 mm (12 in.) below grade, shall be complete with access cover at grade and extension sleeve between cover and valve casing."
- 2.6.3. Add item 2.1.20.2 as follows: "Unit more than 300 mm (12 in.) below grade, shall be complete with minimum 600 mm (24 in.) dia. galvanized steel, concrete or vitrified clay tile access pit with 600 mm (12 in.) dia. heavy duty scoriated manhole cover and frame."
- 2.6.4. Add item 3.1.20 as follows: "Provide a backwater valve on every fixture drain or common branch from fixture drains where the fixtures are located below the level of the adjoining street as required by the Ontario Building Code."

2.7 Section 15421 – Floor Drains

- 2.7.1. Add sentence to end of item 2.4.1 as follows: "Traps connected to Vestibule air plenums shall be connected to an electronic automatic trap seal primer system."

2.8 Section 15451 – Fixture Carriers

- 2.8.1. Revise item 2.2.1 to read as follows: "Carriers for water closets shown as **WC-6** shall be as described herein. Refer to Drawings for installation arrangement."
- 2.8.2. Delete item 2.3.1 and replace with "NOT USED."
- 2.8.3. Revise item 2.3.2 to read as follows: "Carriers for wall-hung lavatories shall be all coated with rectangular steel uprights, welded block base feet support and concealed

arms with locking device and levelling screws. J.R. Smith 700-M31, Zurn Z-1231, Mifab MC-41, Watts CA-411.”

- 2.8.4. Revise item 2.3.3 to read as follows: “Carriers for barrier free wall-hung lavatories shown as **L-6** shall be all coated with rectangular steel uprights, welded block base feet support and extended concealed arms with locking device and levelling screws. J.R. Smith 700-27-M31, Zurn Z-1231-79, Mifab MC-42, Watts CA-411-WC.”

2.9 Section 15618 – Condensing Boilers

- 2.9.1. Delete item 1.2.1 and replace with “NOT USED”.
- 2.9.2. Delete item 1.2.3 and replace with “NOT USED”.
- 2.9.3. Revise first sentence of item 2.1.1 to read as follows: “Boilers shall be wall-mounted Lochinvar KNIGHT as has been delivered to site.”
- 2.9.4. Revise item 2.1.2 to read as follows: “Boilers shall be A.S.M.E. rated, suitable for a maximum **80** psi (**550** kPa) working pressure at 82 deg. C. (180 deg. F.) and complete with the following:”
- 2.9.5. Revise item 2.1.2.1 to read as follows: “Heat exchanger shall be **439** Stainless Steel”
- 2.9.6. Delete item 2.1.2.4 and replace with “NOT USED”.
- 2.9.7. Delete items 2.1.8 and 2.1.9 and all sub-items and replace with “NOT USED”.
- 2.9.8. Add item 2.1.11 as follows: “The boiler shall be complete with standalone controls with an electronic display for boiler set-up, boiler status, and boiler diagnostics.”
- 2.9.9. Add item 2.1.12 as follows: “The boiler shall be equipped with two terminal strips for electrical connection.”
- 2.9.10. Add item 2.1.12.1 as follows: “A low voltage connection board for safety and operating controls, (e.g., Auxiliary Relay, Auxiliary Proving Switch, Alarm Contacts, Runtime Contacts, Manual Reset Low Water Cutoff, Flow Switch, High and Low Gas Pressure Switches, Tank Thermostat, Three Wall Thermostat/Zone Controls, System Supply Sensor, Outdoor Sensor, Building Management System Signal, Modbus, Control Contacts and Cascade Control Circuit.)”
- 2.9.11. Add item 2.1.12.2 as follows: “A high voltage terminal strip shall be provided for supply voltage. The high voltage terminal strip plus integral relays are provided for independent pump control of the System pump and the Boiler pump.”
- 2.9.12. Add item 2.1.13 as follows: “The boiler shall be installed and vented with a Direct Vent Sidewall system with a horizontal sidewall termination of both the vent and combustion air. The flue shall be PVC, CPVC or Stainless Steel sealed vent material terminating at the sidewall with the manufacturer’s specified vent termination. A separate pipe shall supply combustion air directly to the boiler from the outside. The air inlet pipe may be PVC, CPVC, ABS, Galvanized, Dryer Vent, or Stainless Steel sealed pipe. The air inlet must terminate on the same sidewall with the manufacturer’s specified air inlet cap. The boiler’s total combined air intake length shall not exceed 100 equivalent feet. The boiler’s total combined exhaust venting length shall not exceed 100 equivalent feet. Foam Core pipe is not an approved material for exhaust piping.”

2.10 Section 15641 – Steam and Heating Water Treatment

- 2.10.1. Delete item 1.5.2 and replace with “NOT USED”.

2.11 Section 15705 – Piping, Valves & Fittings (Except Plumbing)

- 2.11.1. Delete item 2.2 and all sub-items and replace with “NOT USED”.

- 2.11.2. Revise item 2.5.8 to read as follows:

2.5.8. Provide micro-bubble air and dirt separators where shown on the schematic piping diagrams and as necessary to remove free oxygen and dirt in the water and glycol systems. Air separators shall equal to “Spirotherm” model “VDR” for pipes sizes up to 2”Ø and model “VDT” for pipes sizes larger than 2”Ø (Ontor Ltd., 416-781-5286). The air separator is to be equipped with an automatic air vent to release all air from the system.

- .1 Unit shall include elements filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100% free air, 100% entrained air, and 99.6% dissolved air at the installed location.
- .2 Dirt separation efficiency shall be a minimum of 80% of all particles 30 micron and larger within 100 passes.
- .3 The elements must consist of a copper core tube with continuous wound copper wire medium permanently attached and followed by a separate continuous wound copper wire permanently affixed.
- .4 Each unit shall have a separate venting chamber to prevent system contaminants from harming the float and venting valve operation.
- .5 At the top of the venting chamber shall be an integral full port float actuated brass venting mechanism. Units shall include a valved side tap to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill.

2.12 Section 15708 – Expansion Tanks

- 2.12.1. Delete item 2.1.1 and all sub-items and replace with “NOT USED”.

- 2.12.2. Delete item 2.1.2.6 and replace with “NOT USED”.

2.13 Section 15752 – Wall Fin Convectors

- 2.13.1. Add section to specifications.

2.14 Section 15761 – Fan Coil Units

- 2.14.1. Revise item 2.2.4 and add sub-items to read as follows:

2.2.4. Fans shall be forward curved centrifugal direct driven type.

- .1 Direct drive fan (FCU-02) motors shall be permanent split capacitor suitable for multi-speed control from manual selector.
- .2 Belt drive fan (FCU-01) motors shall be single-phase, open drip proof, resilient mounted, NEMA frame motors.
 - .1 Motors shall be single speed, UL recognized or equivalent, Class B, continuous duty rated.
 - .2 Factory wired to unit junction or control box.
 - .3 Motor protected with internal thermal overload.
 - .4 Motor bearings shall be provided pre-greased (permanently lubricated).

- .5 Motor mounted on adjustable base for belt tensioning and alignment.
- .6 Motor and drive installed on same end as coil connections for ease of service.

2.14.2. Revise item 2.2.8 to read as follows: “Temperature controls specified under Section **15910 – STANDALONE CONTROLS.**”

2.14.3. Revise item 2.2.9 to read as follows: “Units shall be of the type and of capacity as shown in the **Fan Coil Unit Schedule.**”

2.14.4. Delete item 2.3 and all sub-items and replace with “NOT USED”.

2.15 Section 15791 – Cleaning and Filling

2.15.1. Delete items 2.1.4 through 2.1.6 and replace with “NOT USED”.

2.15.2. Add item 2.1.7 and sub-items as follows:

2.1.7. The glycol make-up package for the glycol system shall be an Axiom Industries Ltd. Model MF200. Packages by Ashland Drew, Expanflex, GE W&P Technologies, and Armstrong where they meet the specification shall also be accepted.

- .1 System shall include:
 - .1 25 litre (6.6 U.S. gallon) storage/mixing tank with molded-in level gauge, 125 mm (5”) fill/access opening and cover;
 - .2 Pump suction hose with inlet strainer and check valve; pressure pump with fuse protection; low fluid level pump cut-out float switch; manual diverter valve for purging air and agitating contents of storage tank; pressure switch with snubber, and two sets of SPST dry contacts, each individually adjustable from 70 kPa (10 psig) to 170 kPa (25 psig) cut-out pressure; factory cut-out pressure set to 115 kPa (17psig); and liquid filled pressure gauge.
- .2 Unit to be c/w UL listed and fused power supply adapter with LED power indicator light, 115/60/1 to 24 VDC 50 watts AC, supplied loose for field installation.
- .3 Feeder shall be compatible with glycol solutions of up to 50% concentration. Pump shall be capable of running dry without damage. Unit shall be completely assembled.

2.16 Section 15840 – Ductwork and Specialties

2.16.1. Add section to specifications.

2.17 Section 15842 – Casings and Plenums

2.17.1. Delete entire section.

2.18 Section 15870 – Diffusers, Grilles, and Registers

2.18.1. Revise item 2.3.1 to read as follows: “Floor grilles shown as type “G” shall be heavy duty linear floor grille type with 3 mm x 19 mm (1/8 in. x 3/4 in.) extruded heavy duty aluminum bars on 6 mm (1/4 in.) centers for zero deflection. Diffusers shall be in floor frame. **Blades shall run parallel to the long dimension of the grille. The grille border shall be heavy duty extruded aluminum construction with precise factory**

mitered corners and reinforcing support bars for extra support for the Mandrel tubes. The support bars and Mandrel tubes shall not exceed 12 in. on center. The core shall be held into the border with removable core clips allowing the removal of the core without special tools. Core shall be removable to allow servicing. Set frame high enough to suit architectural floor covering. E.H. Price LBMH-15A. Krueger 1850 Series, Carnes CTLB.”

- 2.18.2. Add item 2.3.2 as follows: “Wall grilles shown as type “H” shall be linear bar grilles with 3 mm (1/8 in.) fixed 15 degree blades, spaced 6 mm (1/4 in.) on center. The outlet shall have extruded aluminum blades mechanically locked into a heavy extruded aluminum receiving bar. Blades shall run parallel to the long dimension of the grille. The 500 (13 mm, 1/2 in.) grille border shall be extruded aluminum construction with precise factory mitered corners. The core shall be held into the border with Type D spring clips. The grille shall be complete with finish specified by the Architect and directional vanes mounted behind the core to provide directional air pattern. The core shall be oriented to direct air upwards as per the plans. E.H. Price LBPH-16A. Krueger 1600, Carnes CTP.”

- 2.18.3. Replace item 2.5.1 as follows: “All return grilles shown as type “E” shall be steel single deflection type of the sizes indicated on the plans. Grilles shall be 45 degree deflection fixed louver type with blades spaced 19 mm (3/4 in.) on center. The blades shall run parallel to the horizontal dimension of the grille. The grille shall be complete with finish specified by the Architect. E.H. Price 530. Krueger AFCS80, Carnes RSAB.”

2.19 Section 15905 – Building Automation System (BAS) Small Projects

- 2.19.1. Delete entire section and replace with 15910 – Standalone Controls

2.20 Section 15910 – Standalone Controls

- 2.20.1. Add section to specifications.

2.21 Section 15951 – Sequence of Operations

- 2.21.1. Replace entire section with that attached.

3. SCHEDULES:

- 3.1.1. Replace boiler, exhaust fan, expansion tank, fan coil, and pump schedules with those attached. Performance data changed as highlighted.

4. DRAWINGS:

- 4.1.1. Replace entire drawing package with that attached. Changes identified with revision clouds.

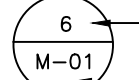
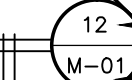
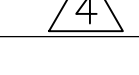
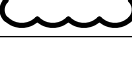
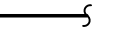
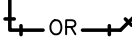
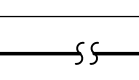
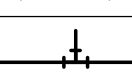
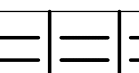
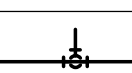
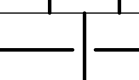
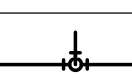
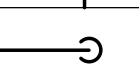
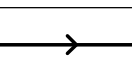
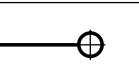
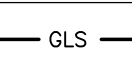
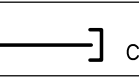
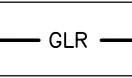
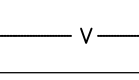
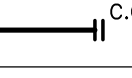
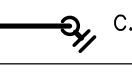
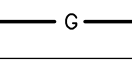
5. CLARIFICATION

- 5.1.1. This post tender addendum has been issued to reflect significant Architectural changes in the design of the “glass box”.

END OF MECHANICAL POST TENDER ADDENDUM NO. M-01

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	SUPPLY DUCT UP OR FROM ABOVE		ACOUSTICALLY LINED TRANSFER AIR DUCT
	SUPPLY DUCT DOWN OR FROM BELOW		SILENCER
	RETURN OR EXHAUST DUCT UP OR FROM ABOVE		CROSSTALK SILENCER
	RETURN OR EXHAUST DUCT DOWN OR FROM BELOW		DUCT WITH MINIMUM CLEARANCE FIRE RATED ENCLOSURE
	ROUND DUCT UP OR FROM ABOVE		DUCT WITH SLEEVE, INSULATION AND DAMPER
	ROUND DUCT DOWN OR FROM BELOW		CAPPED CONNECTION
	ACOUSTIC LINED DUCT		MOTOR OPERATED DAMPER
	FLEXIBLE CONNECTION		BALANCING DAMPER
	SQUARE ELBOW DUCT WITH TURNING VANE		SOUND BAFFLE
	RADIUS ELBOW WITH TURNING VANES		SPEED SWITCH
	AXIAL FAN/INLINE FAN		ELECTRIC THERMOSTAT/SENSOR
	CENTRIFUGAL FAN		PNEUMATIC THERMOSTAT
DIFFUSER GRILLE OR REGISTER TYPE NECK OR FACE SIZE (MM) AIR FLOW (L/s)			
	ROUND SUPPLY DIFFUSER		SUPPLY AIR BOOT DIFFUSER C/W FLEXIBLE DUCT
	DUCTED RETURN OR EXHAUST REGISTER OR GRILLE		LIGHT TROFFER DIFFUSER TOP INLET C/W FLEXIBLE DUCT
	SQUARE OR RECTANGULAR DIFFUSER		LIGHT TROFFER DIFFUSER SIDE INLET C/W FLEXIBLE DUCT
	NON DUCTED RETURN OR EXHAUST GRILLE		DUCT MOUNTED SUPPLY OR RETURN GRILLE
	NON DUCTED ROUND RETURN OR EXHAUST GRILLE		LINEAR SUPPLY OR RETURN GRILLE
	SQUARE PLAQUE DIFFUSER		SPIN-IN CONNECTION C/W BALANCING DAMPER AND FLEX DUCT
	DIFFUSERS WITH BLANK-OFF PORTION (QTY SHOWN)		SPIN-IN CONNECTION C/W BALANCING DAMPER AND RIGID DUCT
NOTE: NOT ALL SYMBOLS APPLY, REFER TO FLOOR PLANS AND DRAWINGS			

5 AIR HANDLING SYMBOLS AND ABBREVIATIONS
(MSD-0115)

3 AIR HANDLING SYMBOLS AND ABBREVIATIONS (MSD-0114)			
SYMBOL		SYMBOL	
	DETAIL NUMBER		SECTION NUMBER
	DRAWING NUMBER		DRAWING NUMBER
	REVISION NUMBER		REVISION BUBBLE
R.I.O.	ROUGH IN ONLY	N.O.	NORMALLY OPEN
R.I.C.	ROUGH IN AND CONNECT	N.C.	NORMALLY CLOSED
A.D.	ACCESS DOOR	S.S.	STAINLESS STEEL
	PIPING SERVICE CONTINUES		ELBOWS
	REFER TO STANDARD DETAIL DRAWINGS FOR ADDITIONAL REQUIREMENTS OF EQUIPMENT NOTED		TEE
	EQUIPMENT/PIPING/DUCTWORK SHOWN DASHED BELOW		BRANCH OFF BOTTOM OF MAIN
	PIPING INTERSECTS PIPING BELOW		BRANCH OFF TOP OF MAIN
	PIPE DROP OR FROM BELOW		DIRECTION OF FLOW
	PIPE UP OR FROM ABOVE		GLYCOL SUPPLY
	CAP CONNECTION		GLYCOL RETURN
	VENT		
	FLOOR DRAIN SIZE AS NOTED REFER TO SPECIFICATION FOR TYPES		FLOOR DRAIN FROM ABOVE WITH TRAP
	SANITARY ABOVE GRADE OR FLOOR		HORIZONTAL CLEANOUT
	SANITARY BELOW GRADE OR FLOOR		CLEANOUT IN RISER
	DOMESTIC COLD WATER (DCW)		NATURAL GAS
	DOMESTIC HOT WATER (DHW)		
NOTE: NOT ALL SYMBOLS APPLY, REFER TO FLOOR PLANS AND DRAWINGS			

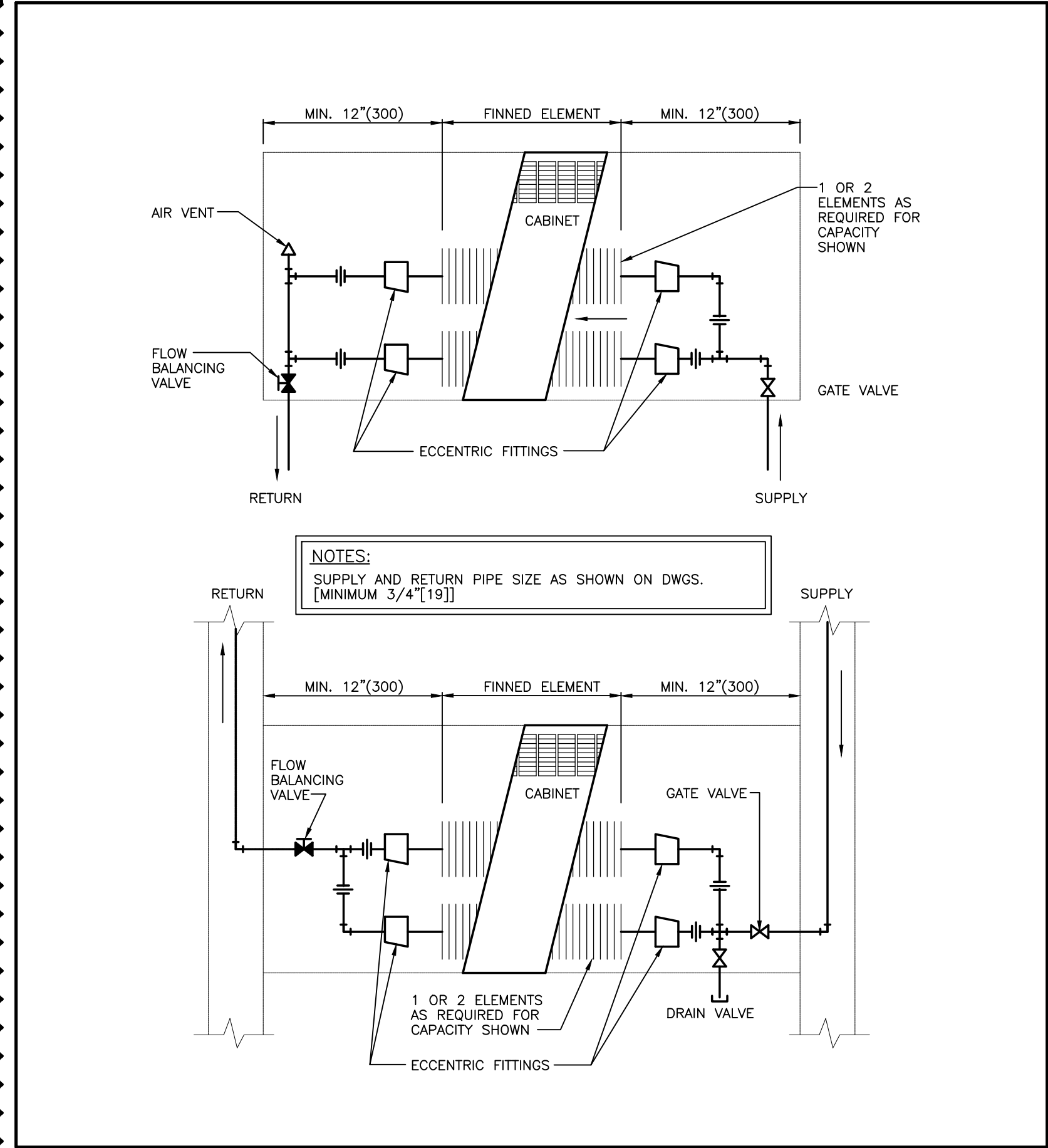
4 GENERAL AND SITE PLAN SYMBOLS AND ABBREVIATIONS
M-001 N.T.S.

MECHANICAL DRAWING LIST			
SYMBOL		DESCRIPTION	
	GATE VALVE		PIPE GUIDE
	GLOBE VALVE		PIPE SLEEVE
	BALL VALVE		ANCHOR
	LOCKSHIELD VALVE		STRAINER
	FLOW BALANCING VALVE		UNION
	PRESSURE INDEPENDENT FLOW BALANCING VALVE		FLANGE FITTING
	PLUG VALVE		ECCENTRIC FITTING
	PRESSURE REDUCING VALVE		CONCENTRIC FITTING
	CHECK VALVE		PRESSURE GAUGE
	SOLENOID VALVE		THERMOMETER
	SAFETY RELIEF VALVE		PRESSURE GAUGE COCK ASSEMBLY
	FLOW METERING STATION		THERMOMETER WELL
	BACKFLOW PREVENTOR		EXPANSION JOINT
	ANGLE VALVE		MANUAL AIR VENT
	ANCHOR		AUTOMATIC AIR VENT
	BUTTERFLY VALVE		AIR SEPARATOR
	2-WAY BUTTERFLY VALVE		SIGHT GLASS
	3 WAY CONTROL VALVE		PUMP
			P.R.V. C/W SHUT-OFF VALVE
VB	VACUUM BREAKER		P.R.V. STATION
B.W.V.	BACK WATER VALVE		FLOW SWITCH

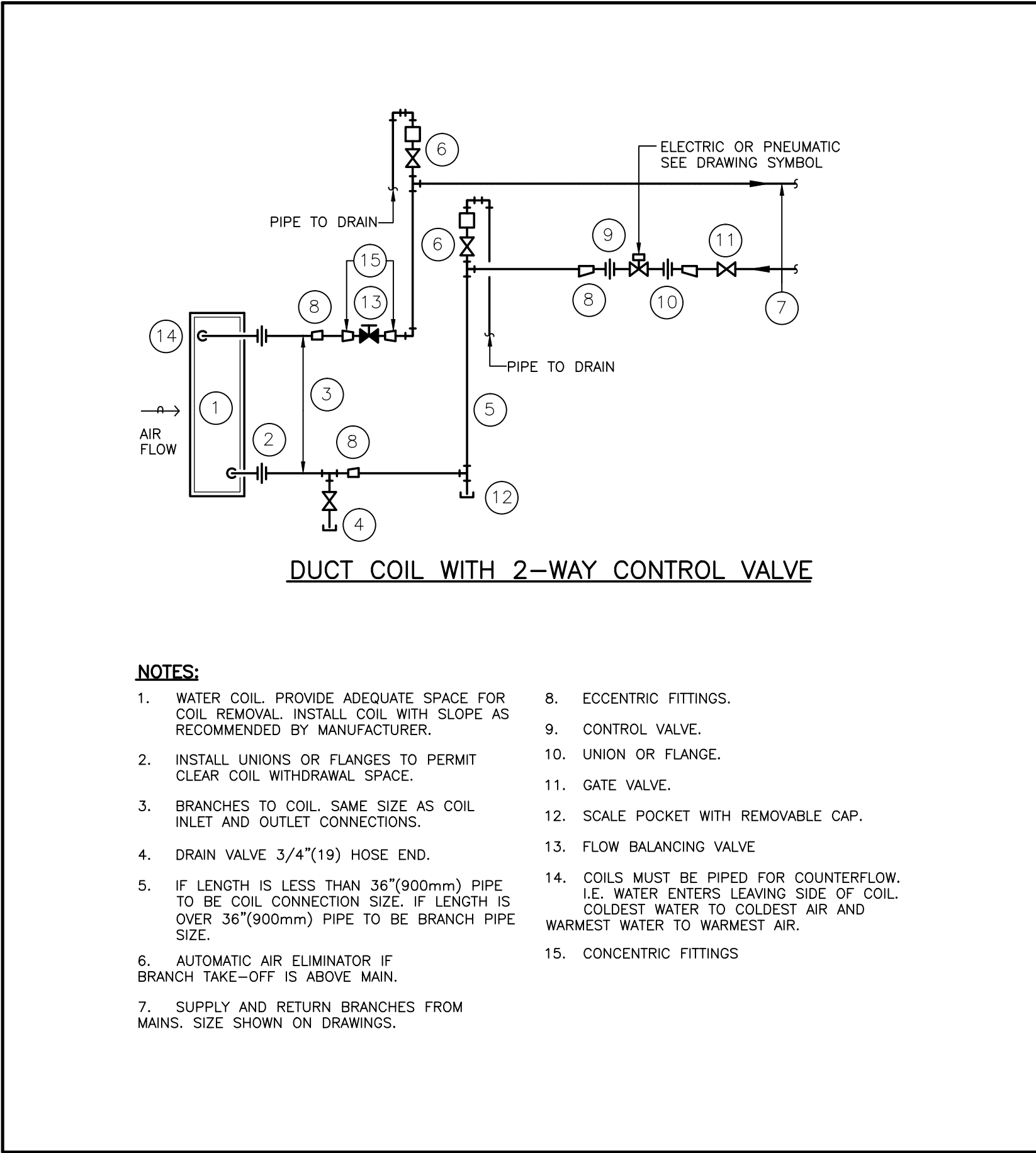
NOTE: NOT ALL SYMBOLS APPLY, REFER TO FLOOR PLANS AND DRAWINGS

2 VALVES AND APPURTENANCES
M-001 (MSD-0105)

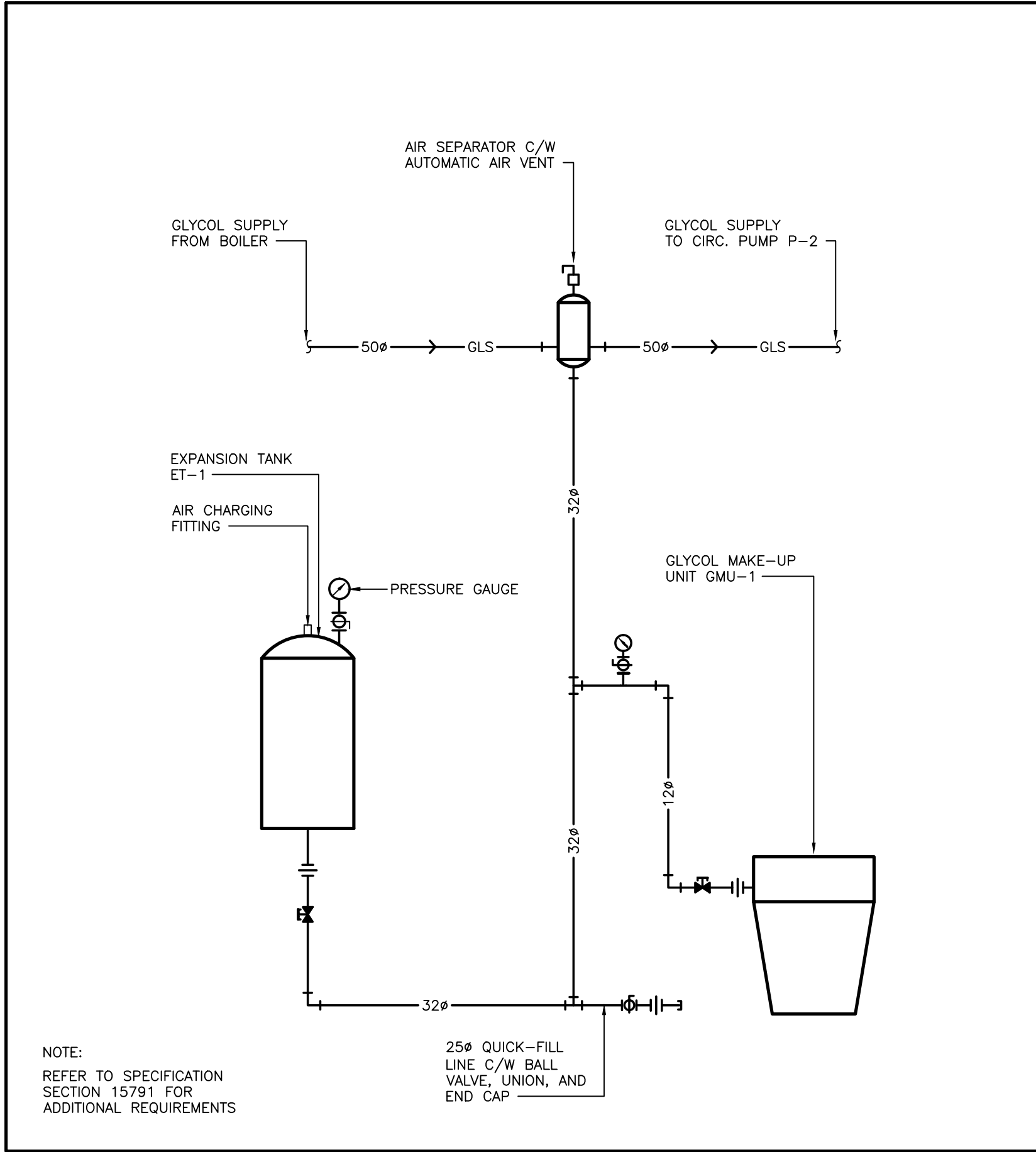
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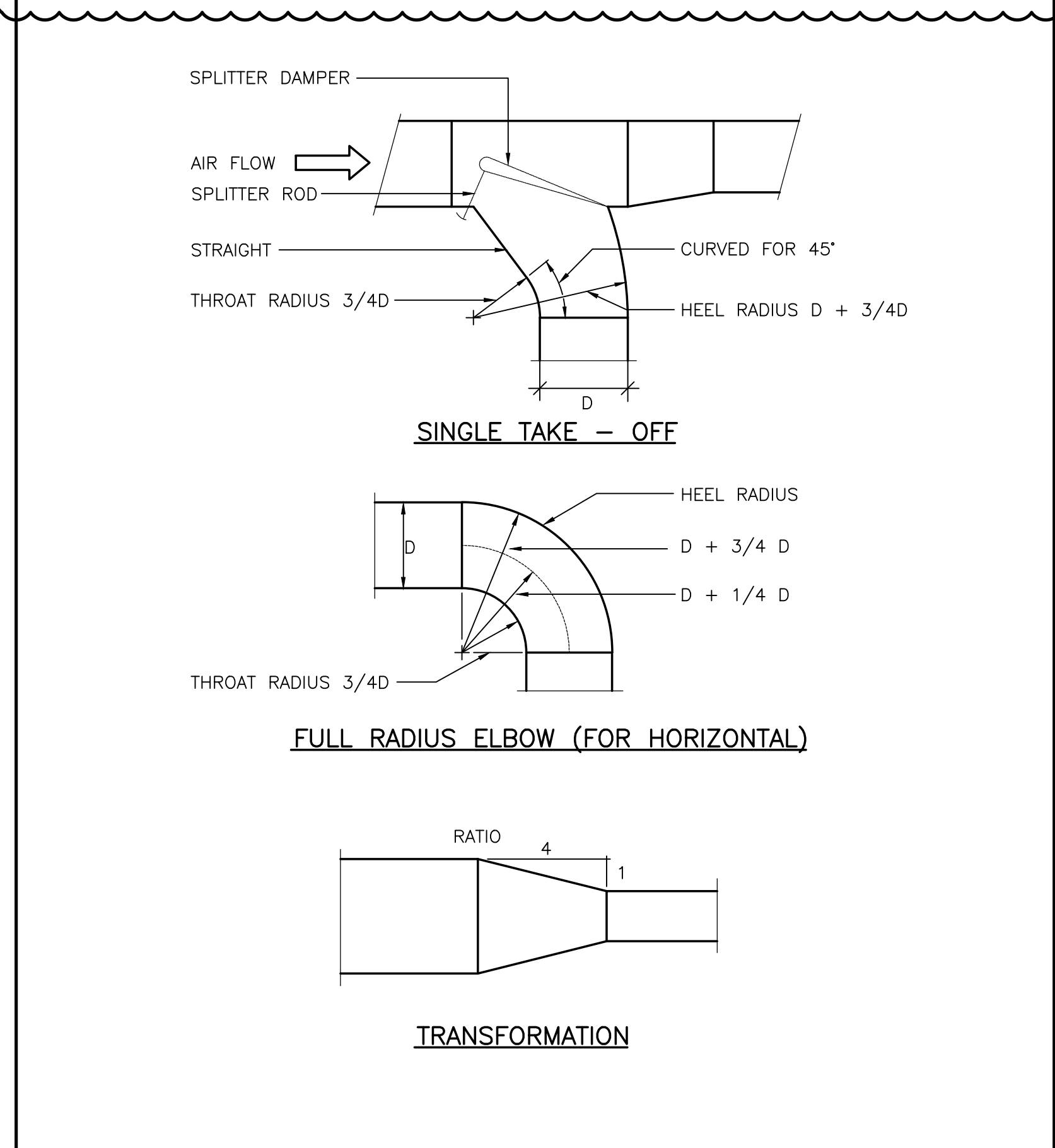
5 CONVECTORS (MSD-7531)



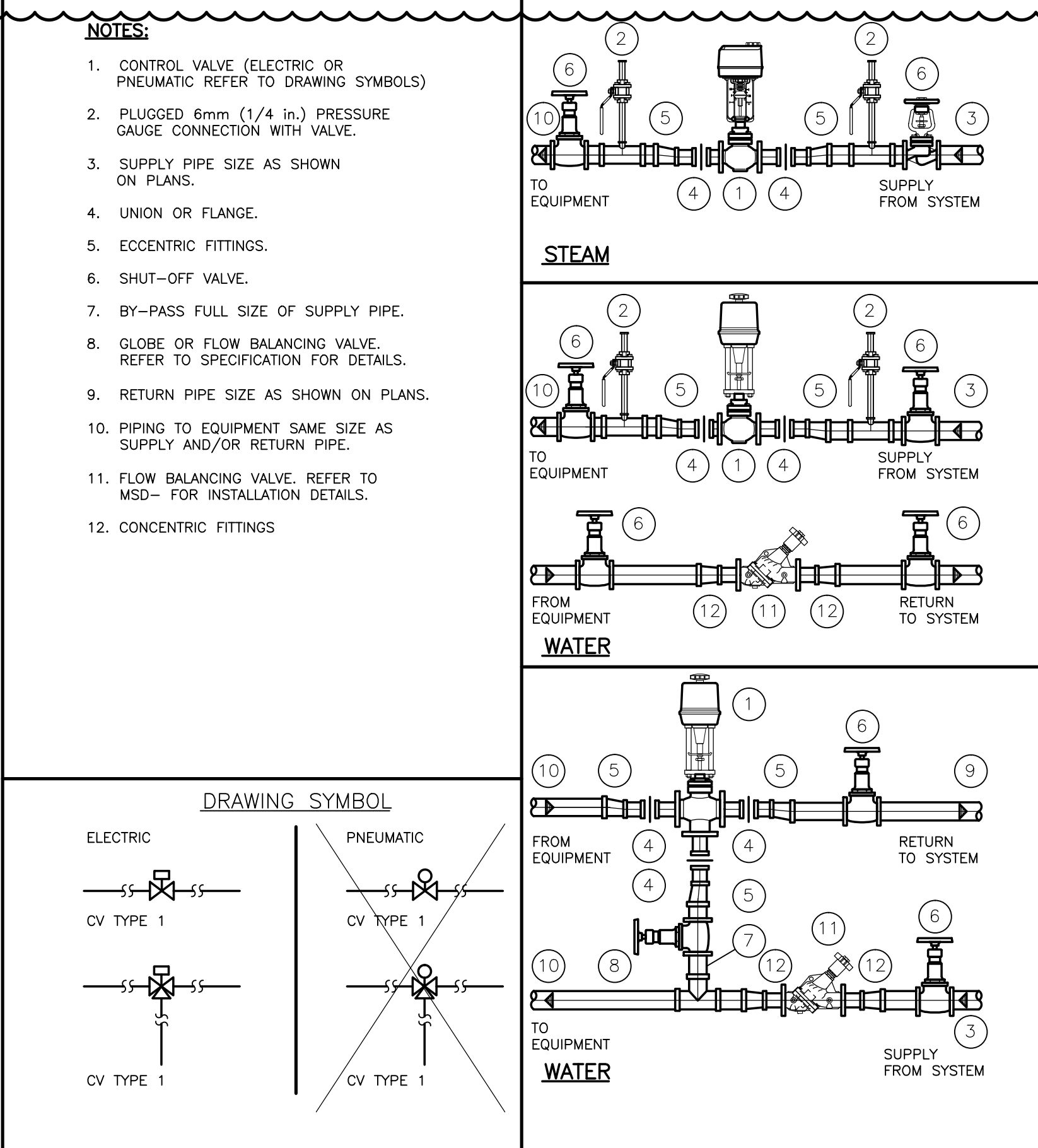
3 PIPING FOR FAN COIL UNIT INSTALLATION (TWO-WAY CONTROL VALVE) (MSD-7655)



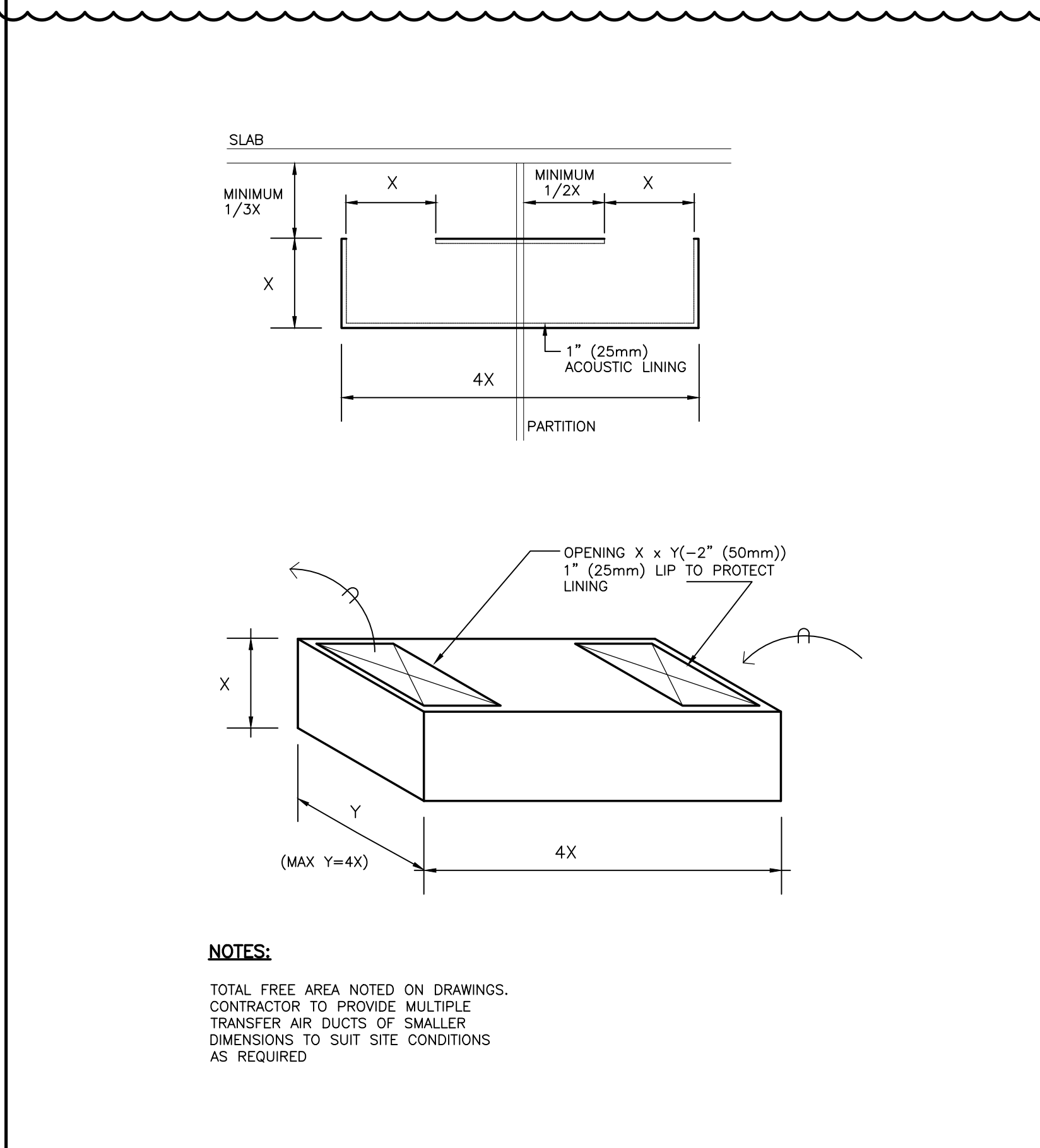
1 EXPANSION TANK, AIR SEPARATOR, GLYCOL FILL INSTALLATION N.T.S.



6 DUCT DETAILS (MSD-8405)



4 CONTROL VALVES (REVISED) (MSD-7051)



2 ACOUSTICALLY LINED TRANSFER DUCT (MSD-8415)

06	2016/07/21	ISSUED FOR PTA M-01
05	2016/07/15	ISSUED FOR REVIEW
04	2015/12/04	ISSUED FOR TENDER
03	2015/10/28	ISSUED FOR PERMIT
02	2015/10/08	ISSUED FOR REVIEW
01	2015/09/02	ISSUED FOR REVIEW
REV.	DATE	ISSUED

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TORONTO, ONTARIO

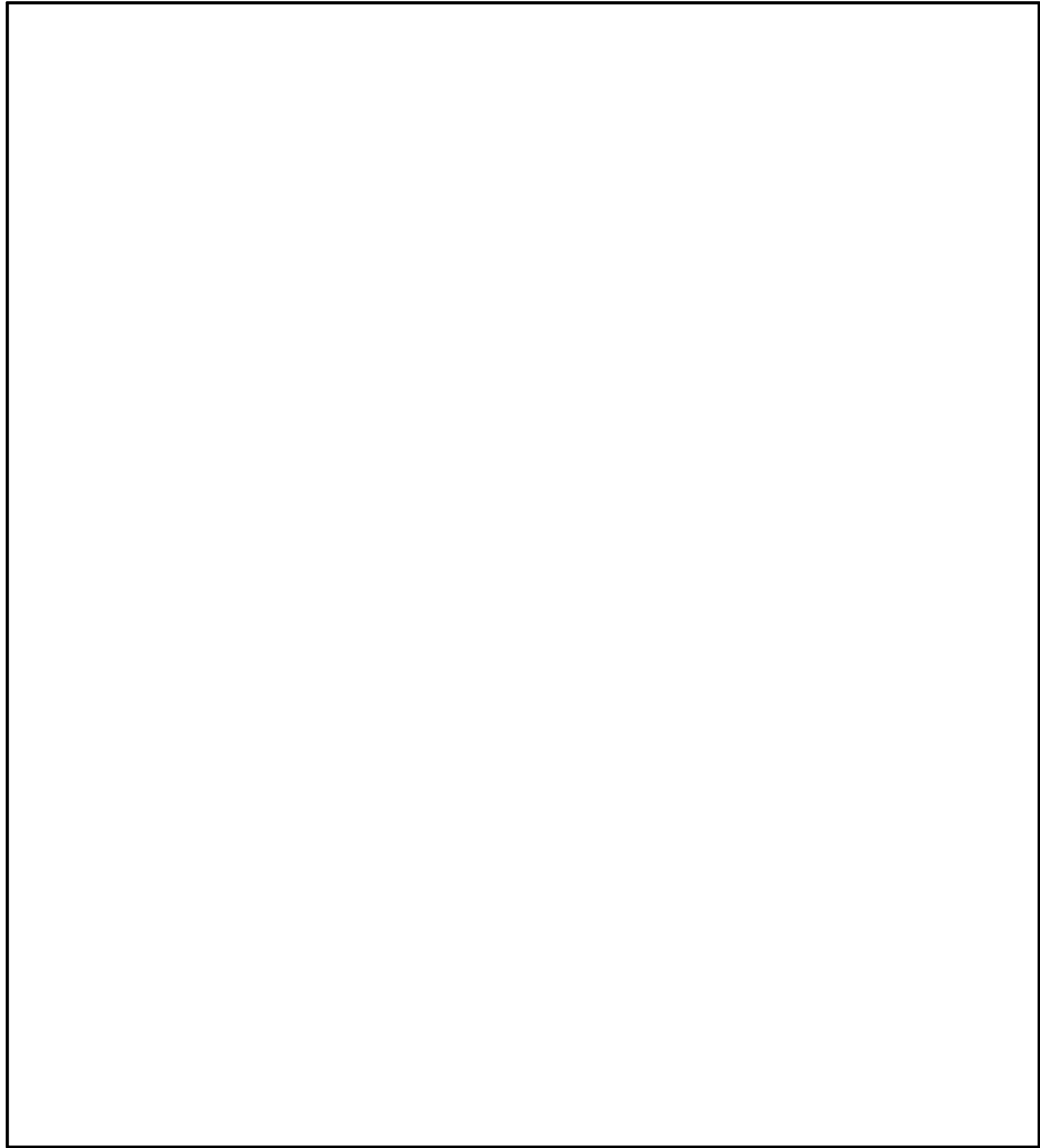
Our Lady of Perpetual Help Parish
78 Clifton Road
Toronto, ON M4T 2G2



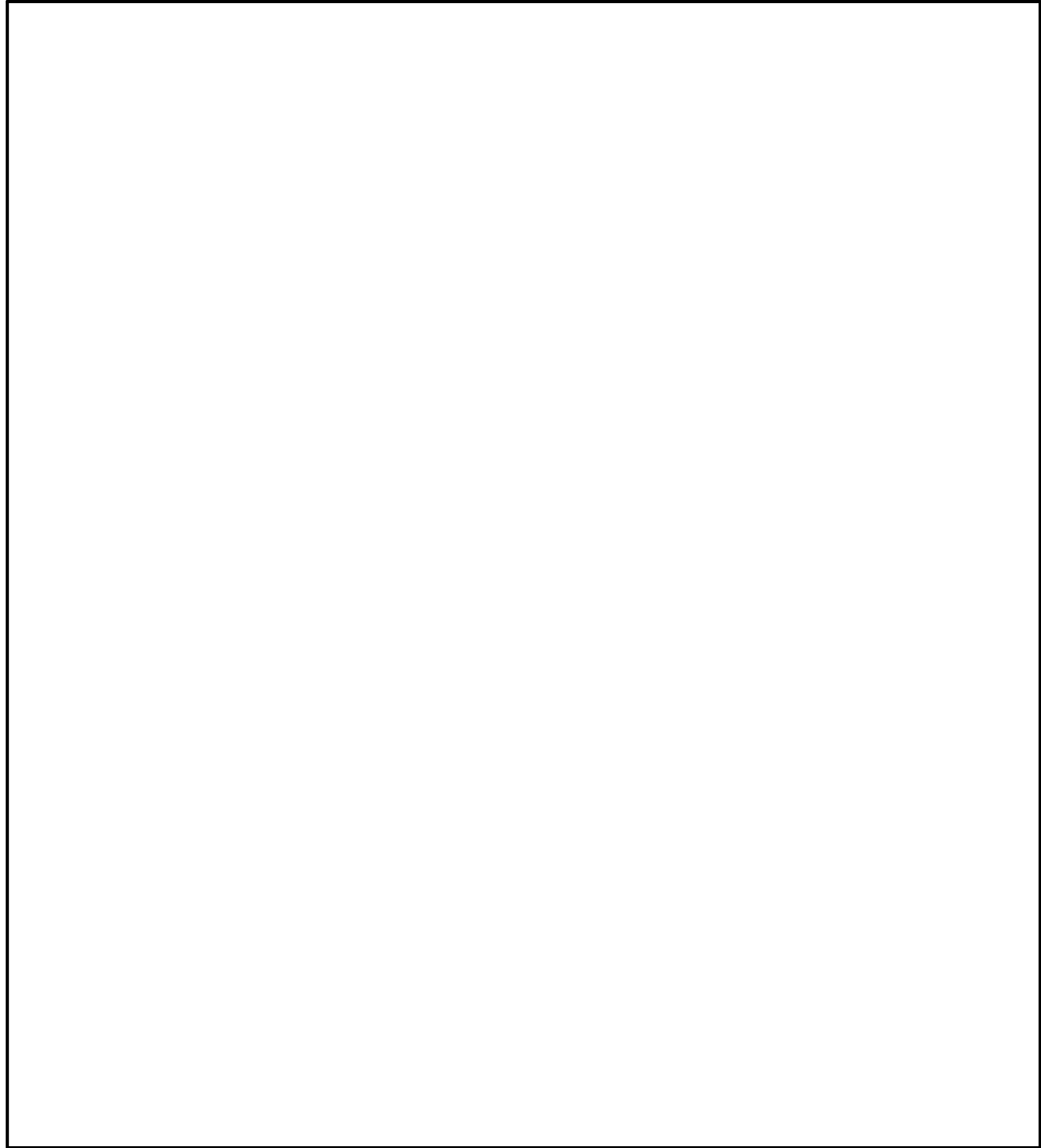
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416 487 8151 F 416 487 9104 smithandandersen.com
S+A PROJECT NUMBER: 14214.002.M.001

MECHANICAL STANDARD DETAILS

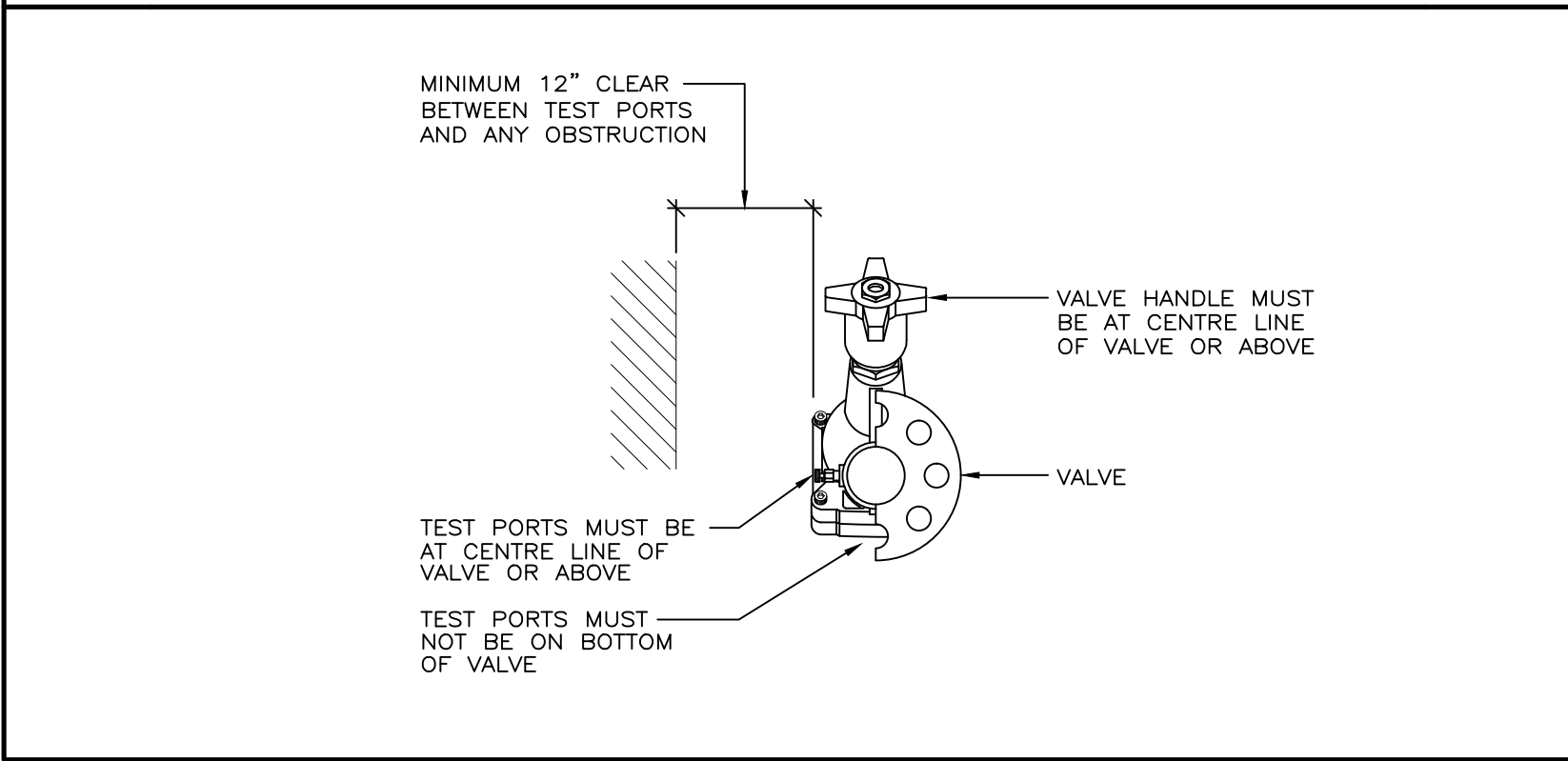
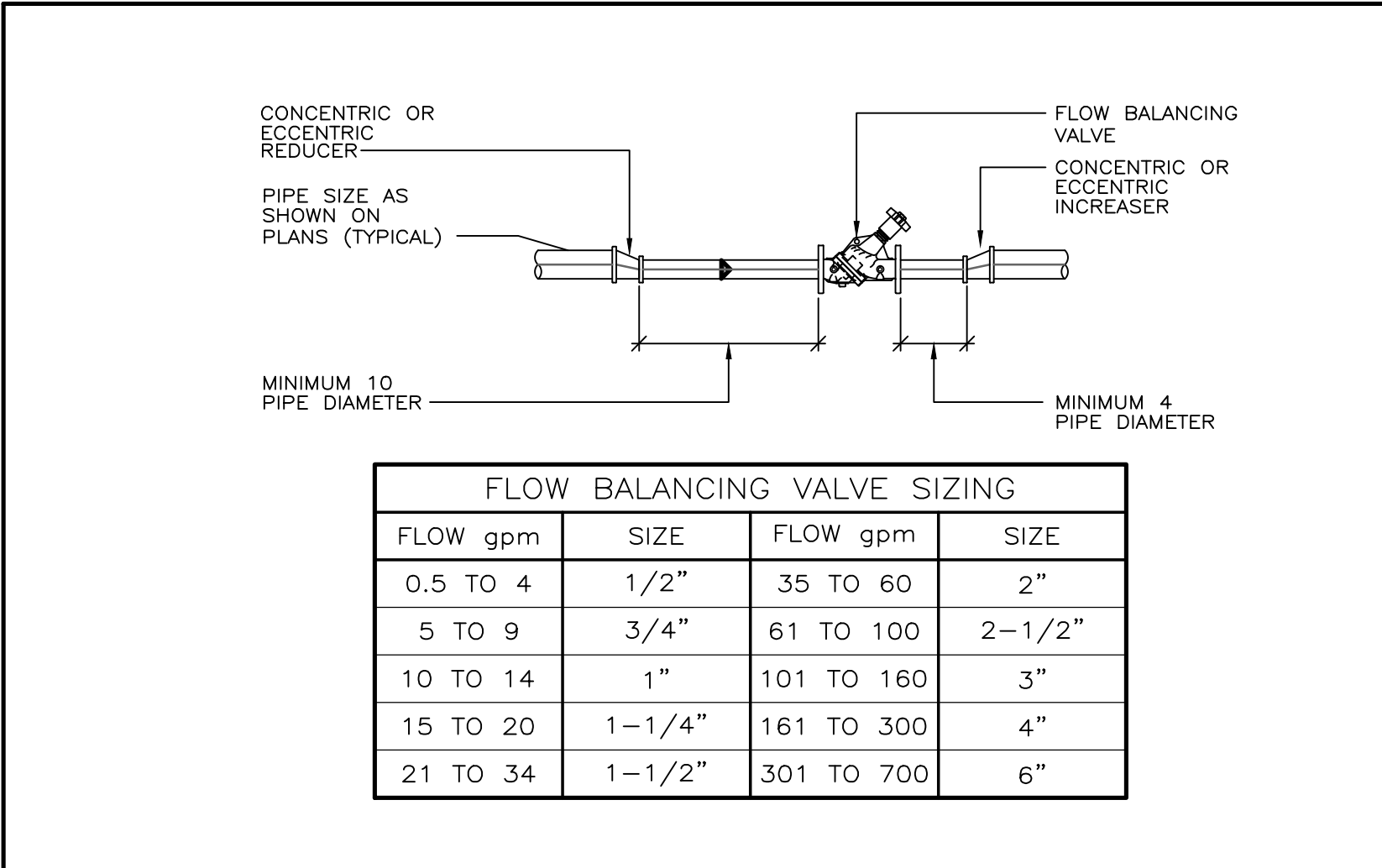
Drawn : VG	Scale : N.T.S.	Date : 04/22/2015
Project Number : 12062	Drawing Number :	M002
Drawing Stage : CD		



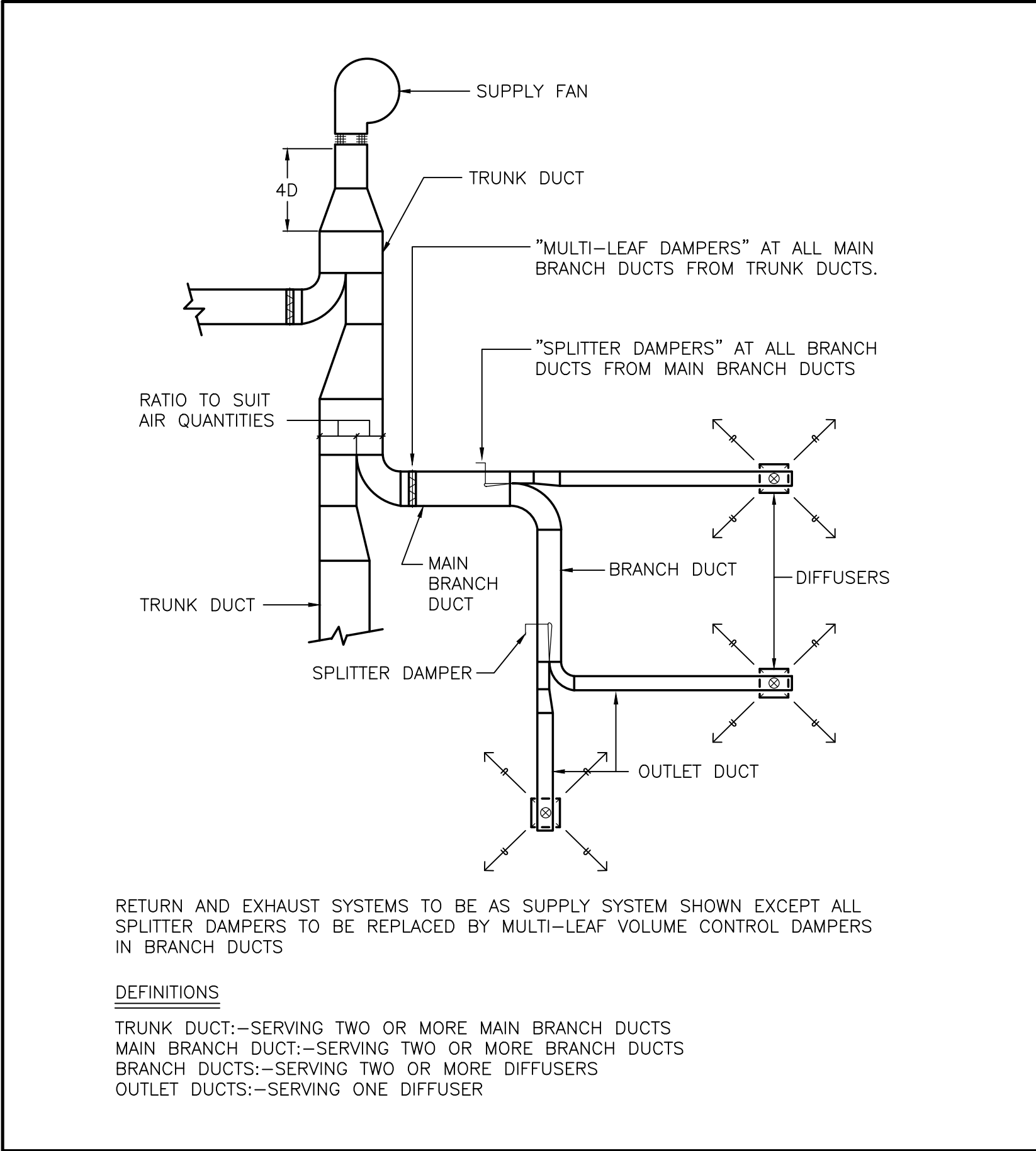
5 NOT USED
M-003



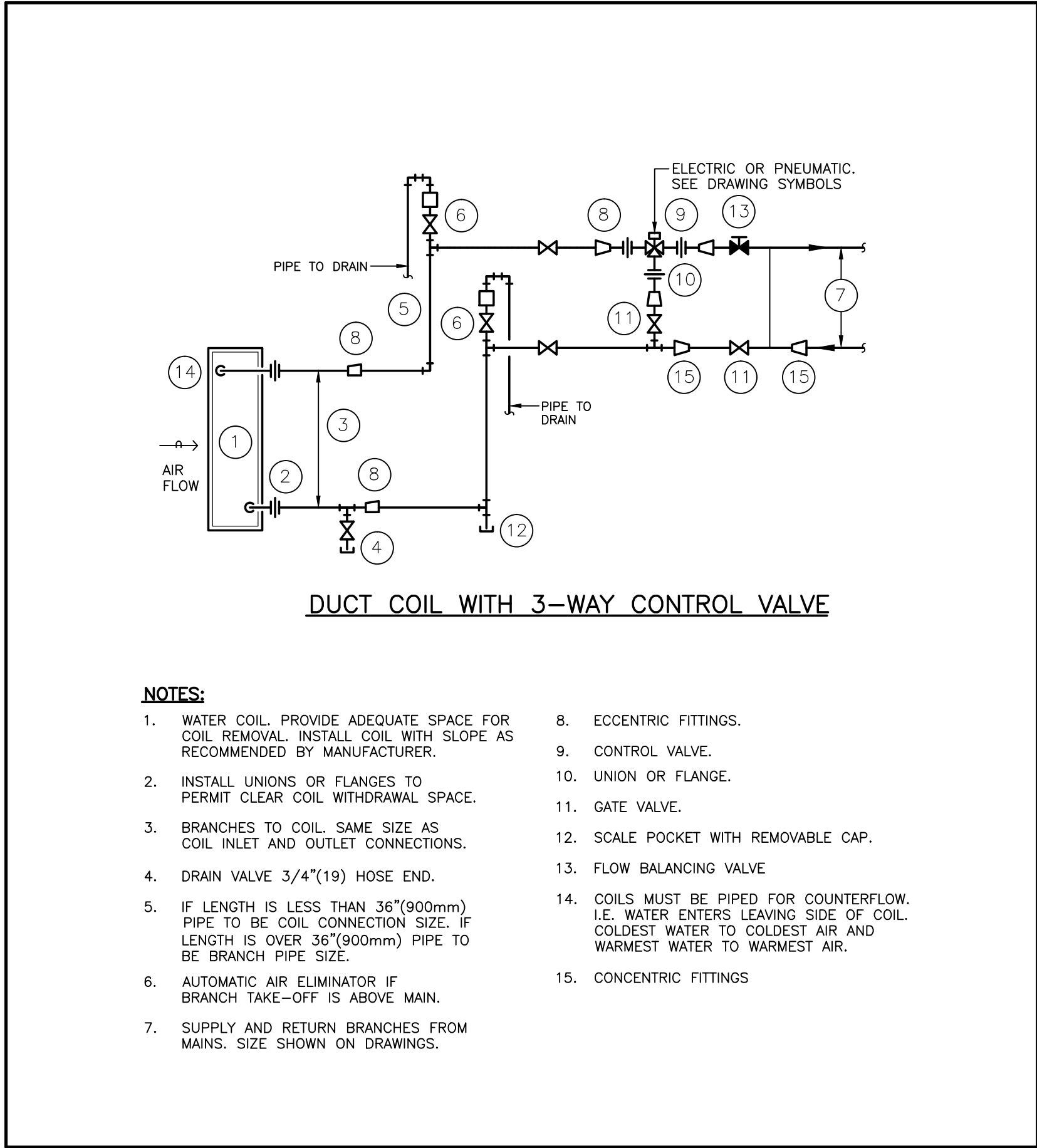
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M-003



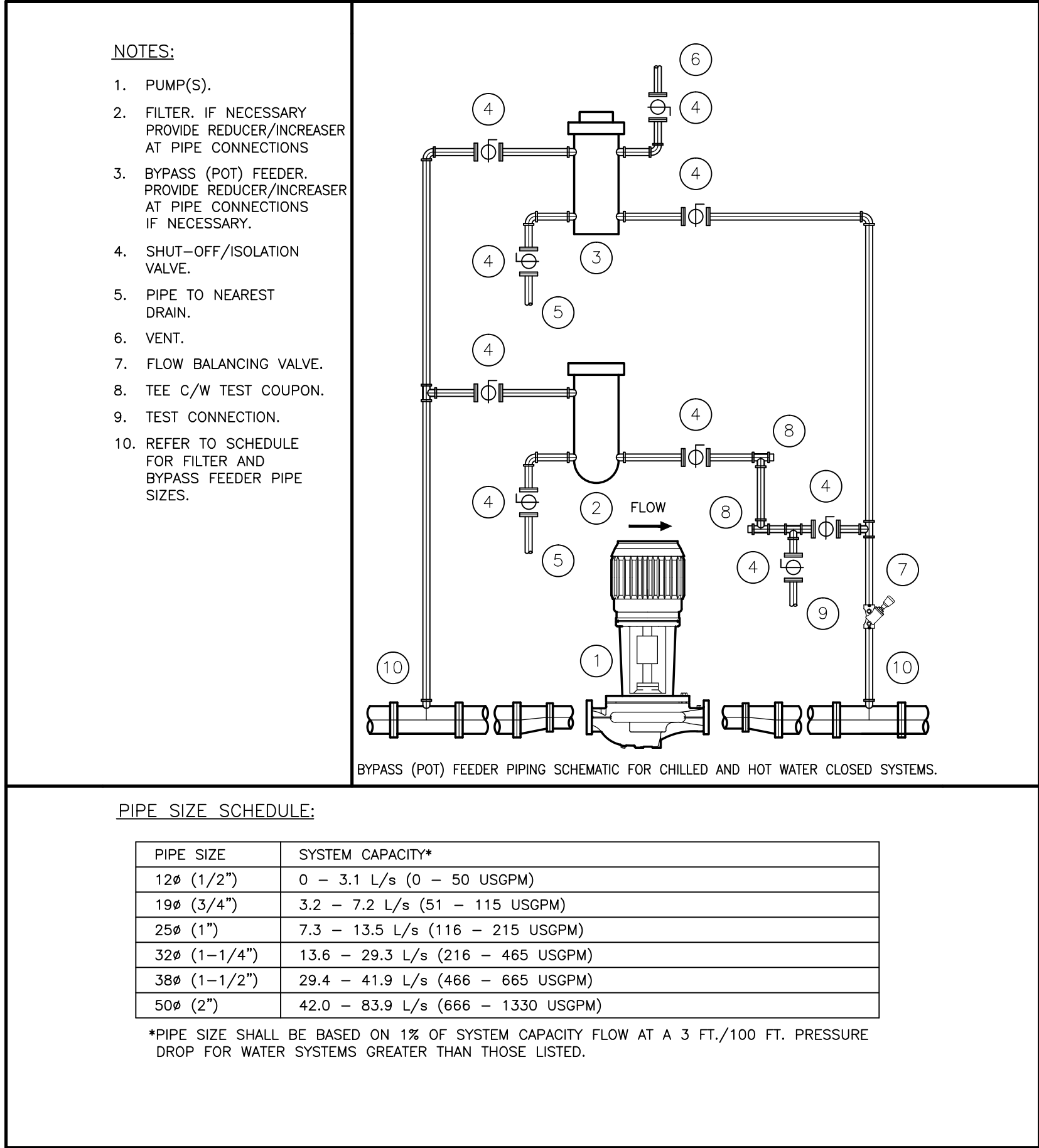
3 TYPICAL FLOW BALANCING VALVE INSTALLATION
MSD-7058



4 BALANCING DAMPERS
MSD-8403



1 PIPING FOR DUCT COIL INSTALLATION (3 WAY CONTROL VALVE)
MSD-7654



2 BYPASS (POT) FEEDER AND FILTER PIPING
MSD-7055

06	2016/07/21	ISSUED FOR PTA M-01
05	2016/07/15	ISSUED FOR REVIEW
04	2015/12/04	ISSUED FOR TENDER
03	2015/10/28	ISSUED FOR PERMIT
02	2015/10/08	ISSUED FOR REVIEW
01	2015/09/02	ISSUED FOR REVIEW
REV.	DATE	ISSUED

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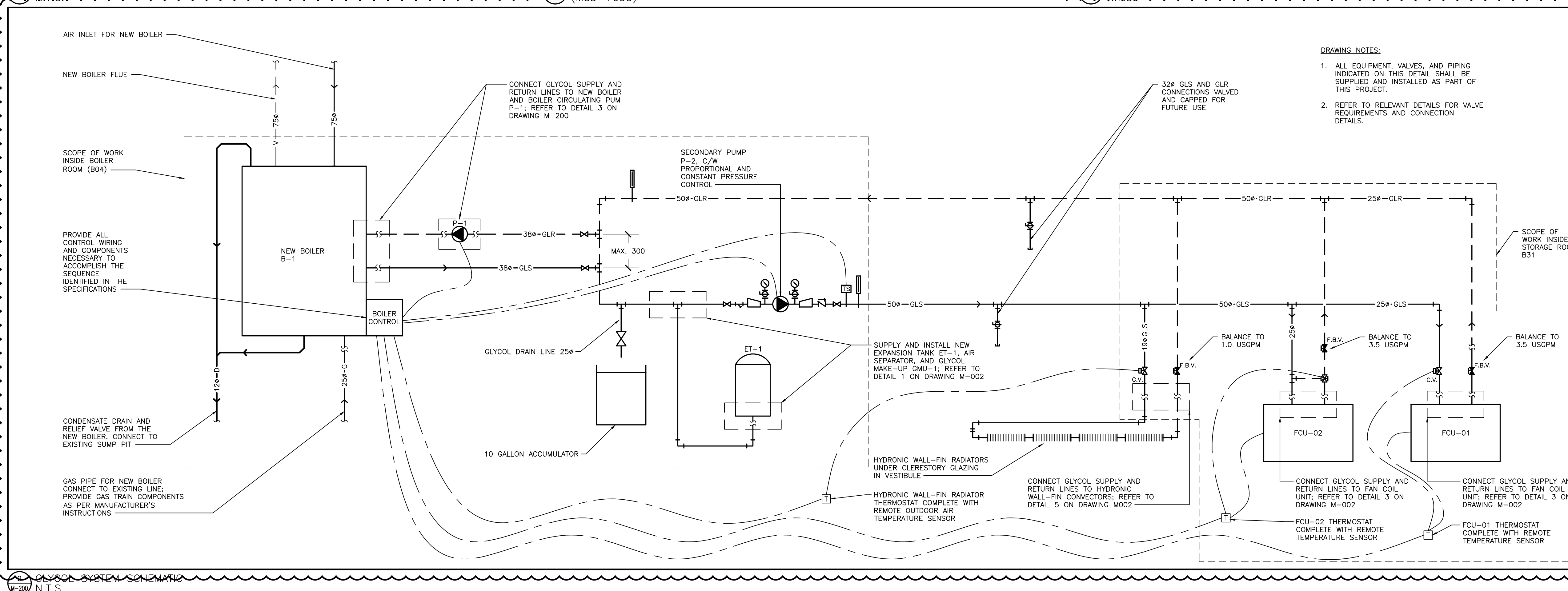
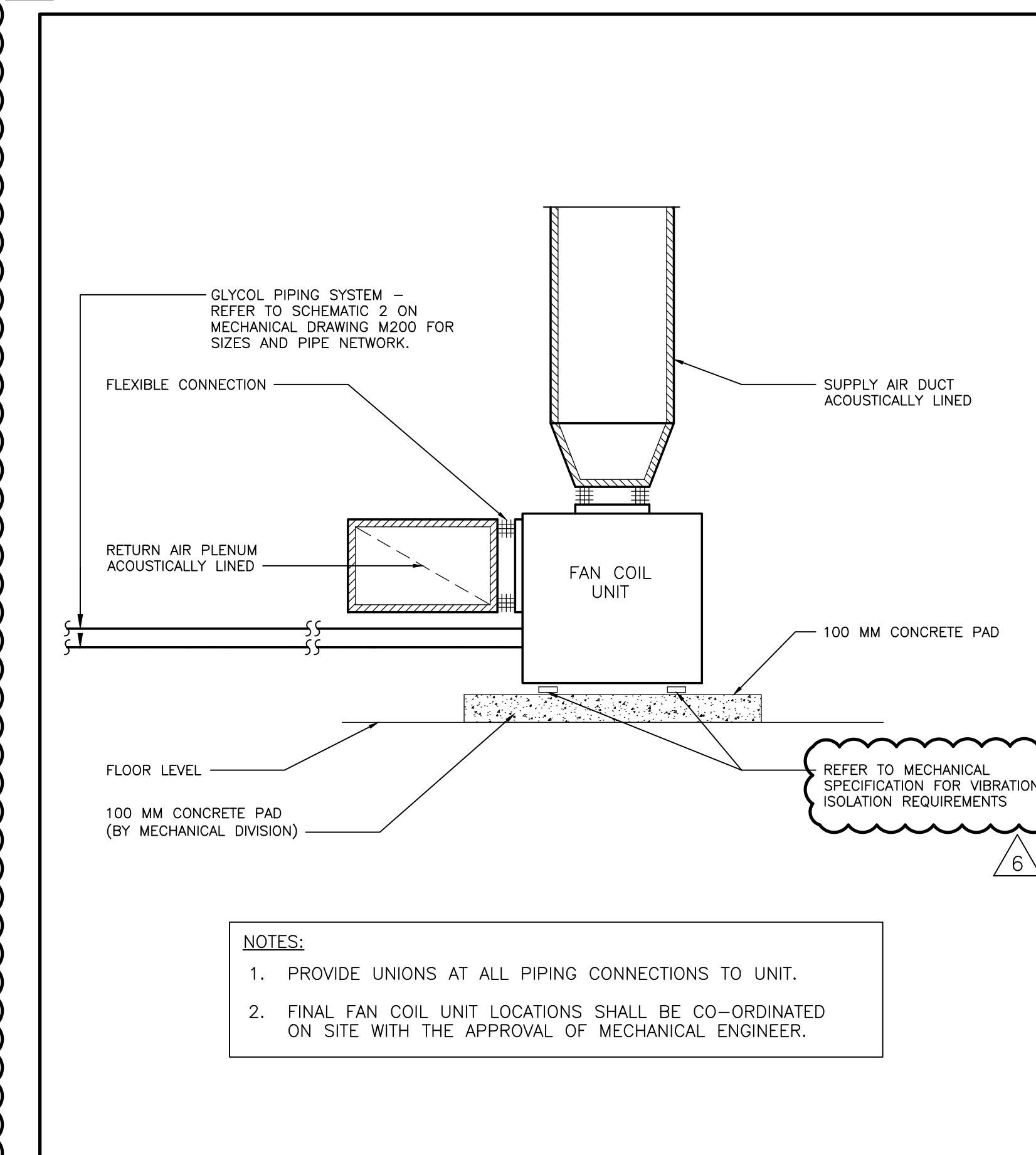
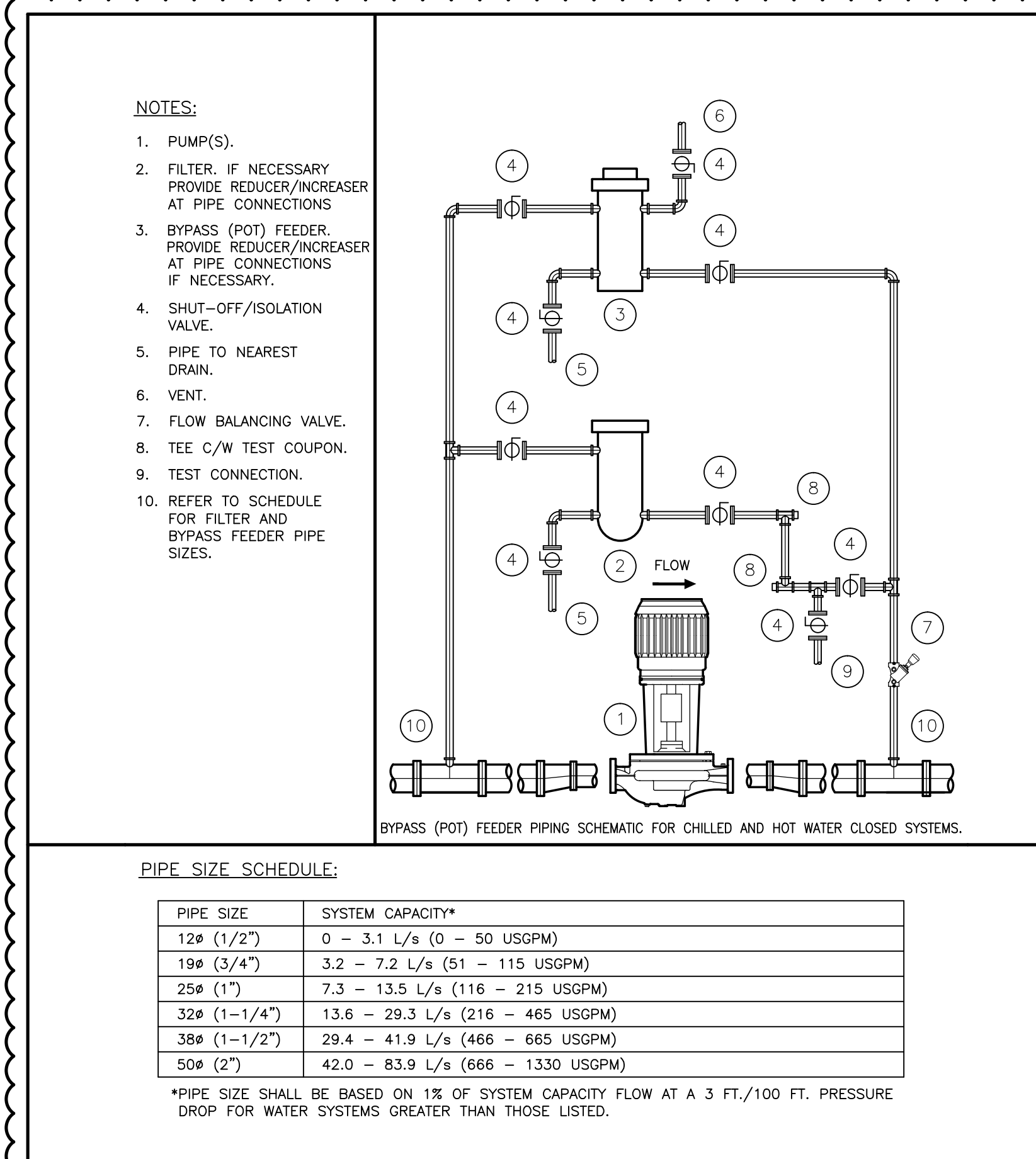
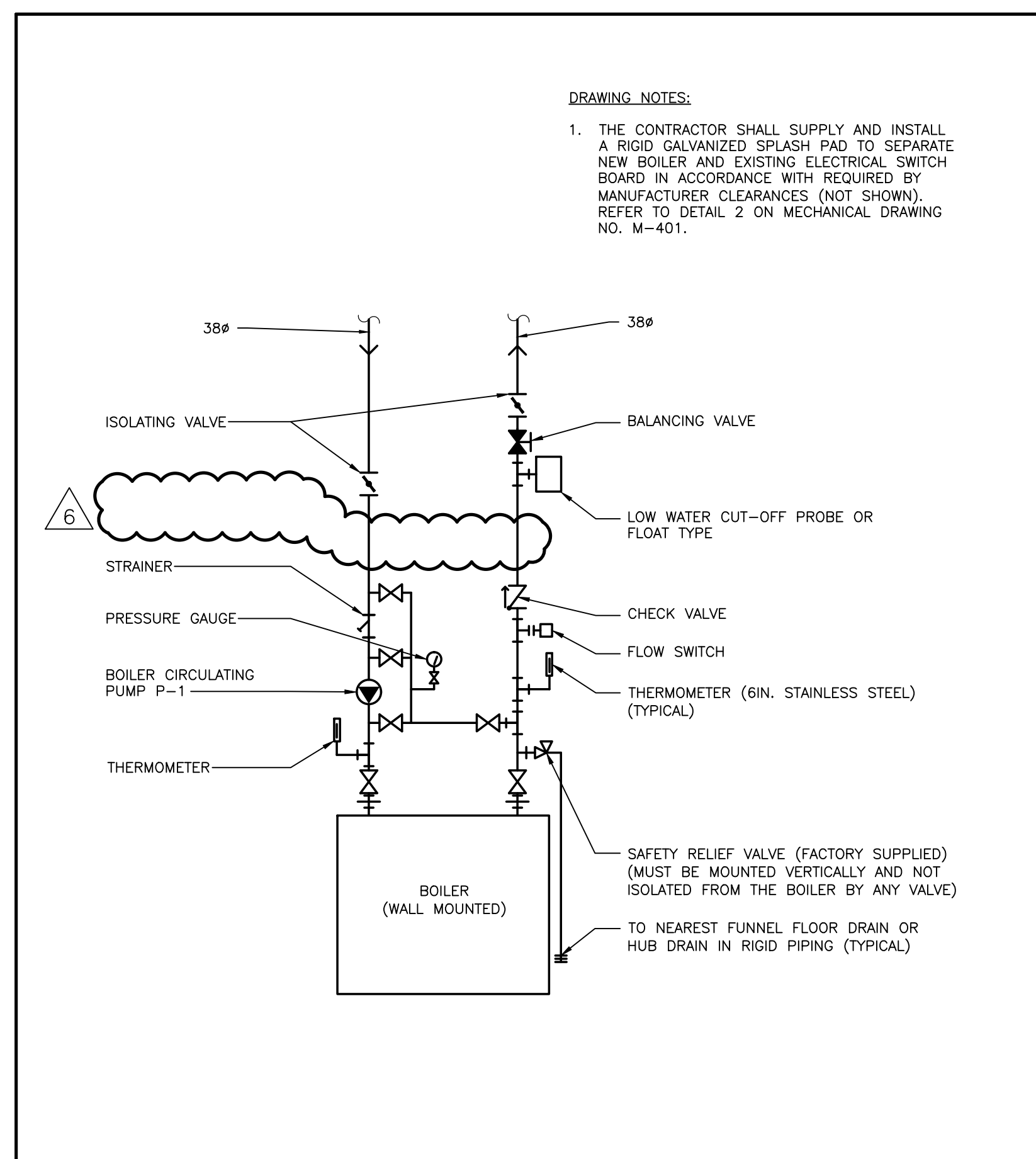
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MECHANICAL STANDARD DETAILS CONTINUED

Drawn :	VG	Scale :	N.T.S.	Date :	04/22/2015
Project Number :	12062	Drawing Number :			
Drawing Stage :	CD				



06	2016/07/21	ISSUED FOR PTA M-01
05	2016/07/15	ISSUED FOR REVIEW
04	2015/12/04	ISSUED FOR TENDER
03	2015/10/28	ISSUED FOR PERMIT
02	2015/10/08	ISSUED FOR REVIEW
01	2015/09/02	ISSUED FOR REVIEW
REV.	DATE	ISSUED

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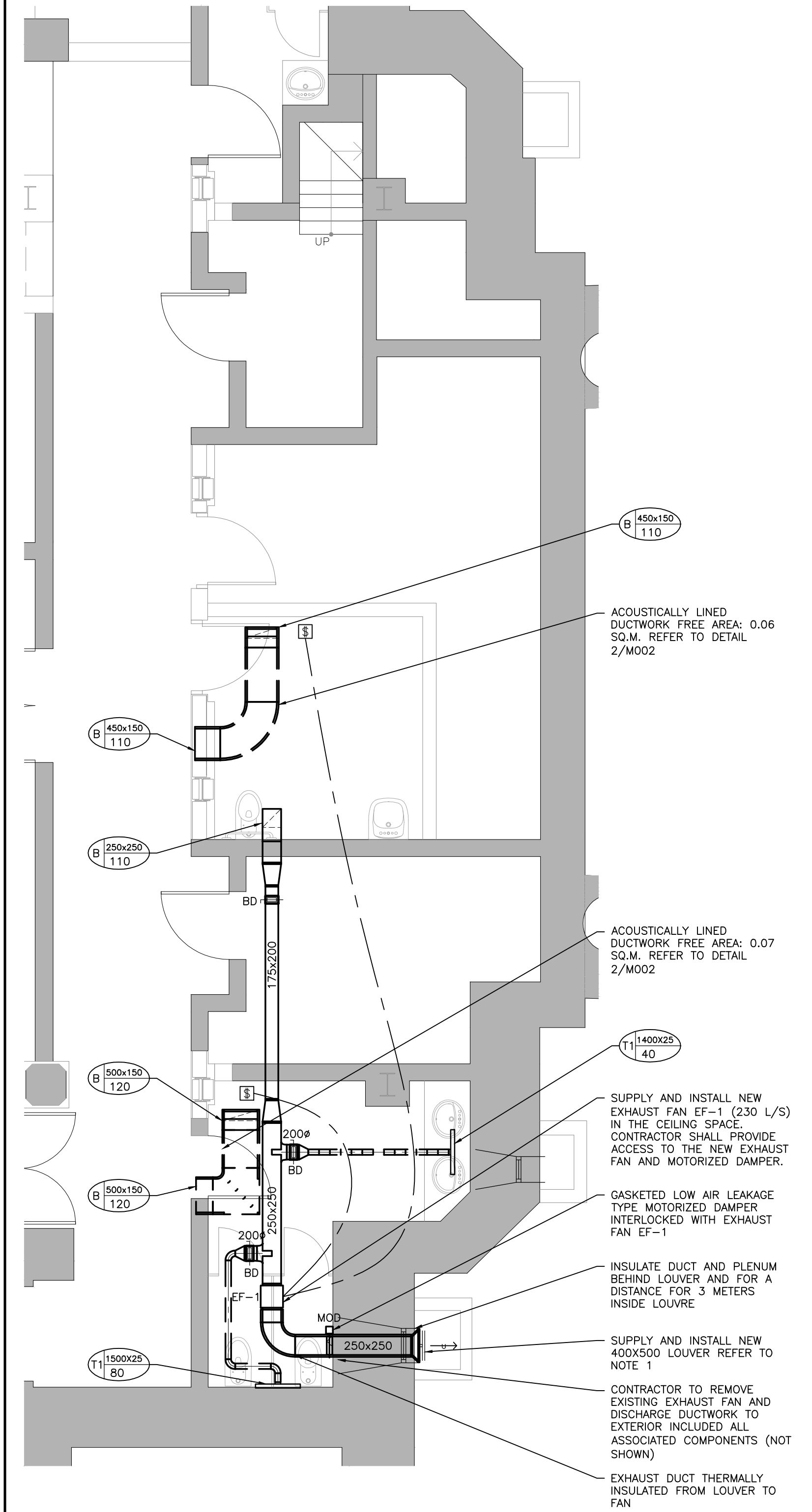
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S+A PROJECT NUMBER: 14214.002.M.001

MECHANICAL
SCHEMATICS AND
STANDARD DETAILS
CONTINUED

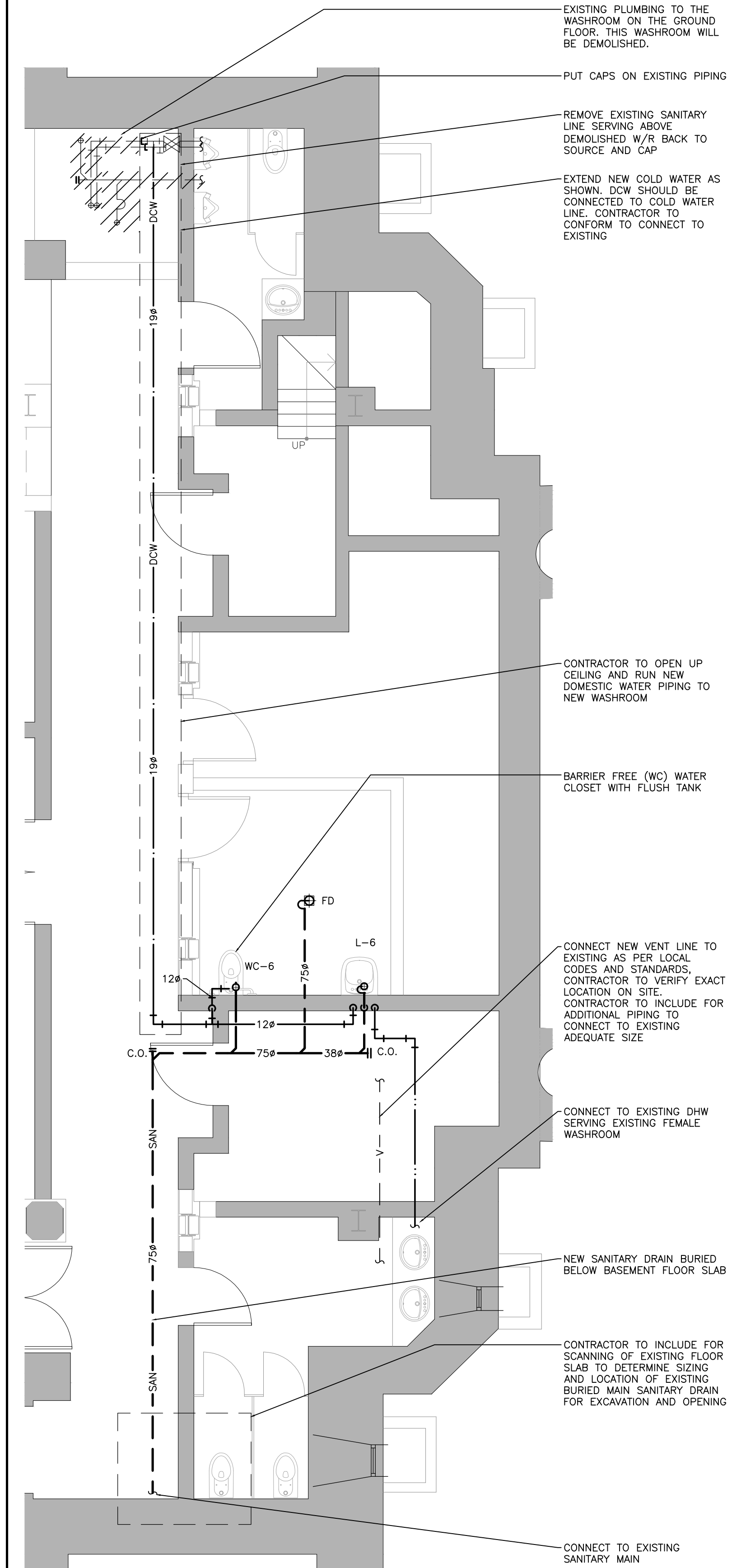
Drawn : VG	Scale : N.T.S.	Date : 04/22/2015
Project Number : 12062	Drawing Number :	M200
Drawing Stage: CD		

DRAWING NOTES:

1. SUPPLY AND INSTALL STATIONARY LOUVER MODELS 2420/2425 AS MANUFACTURED BY VENTEX INC. OR EQUAL. LOUVERS MUST BE LICENSED TO BEAR IN THE AMCA SEAL. LOUVERS SHALL BE 4" (102 MM) DEEP. BLADES SHALL BE EXTRUDED ALUMINUM ALLOY AND FRAME SHALL BE EXTRUDED ALUMINUM ALLOY. LOUVERS SHALL BE 19 GAUGE GALVANIZED 1/2 "X1/2 " BIRDSCREEN. ALL MATERIALS SHALL BE FACTORY FINISHED AFTER ASSEMBLY WITH POLYESTER POWER COAT IN A COLOR SELECTED BY THE BUILDING OWNER. CONTRACTOR SHALL PROVIDE COLOR CHIP TO ARCHITECT IN PRIOR TO ORDERING. CONTRACTOR SHALL SUBMIT SHOP DRAWING FOR THE LOUVER.



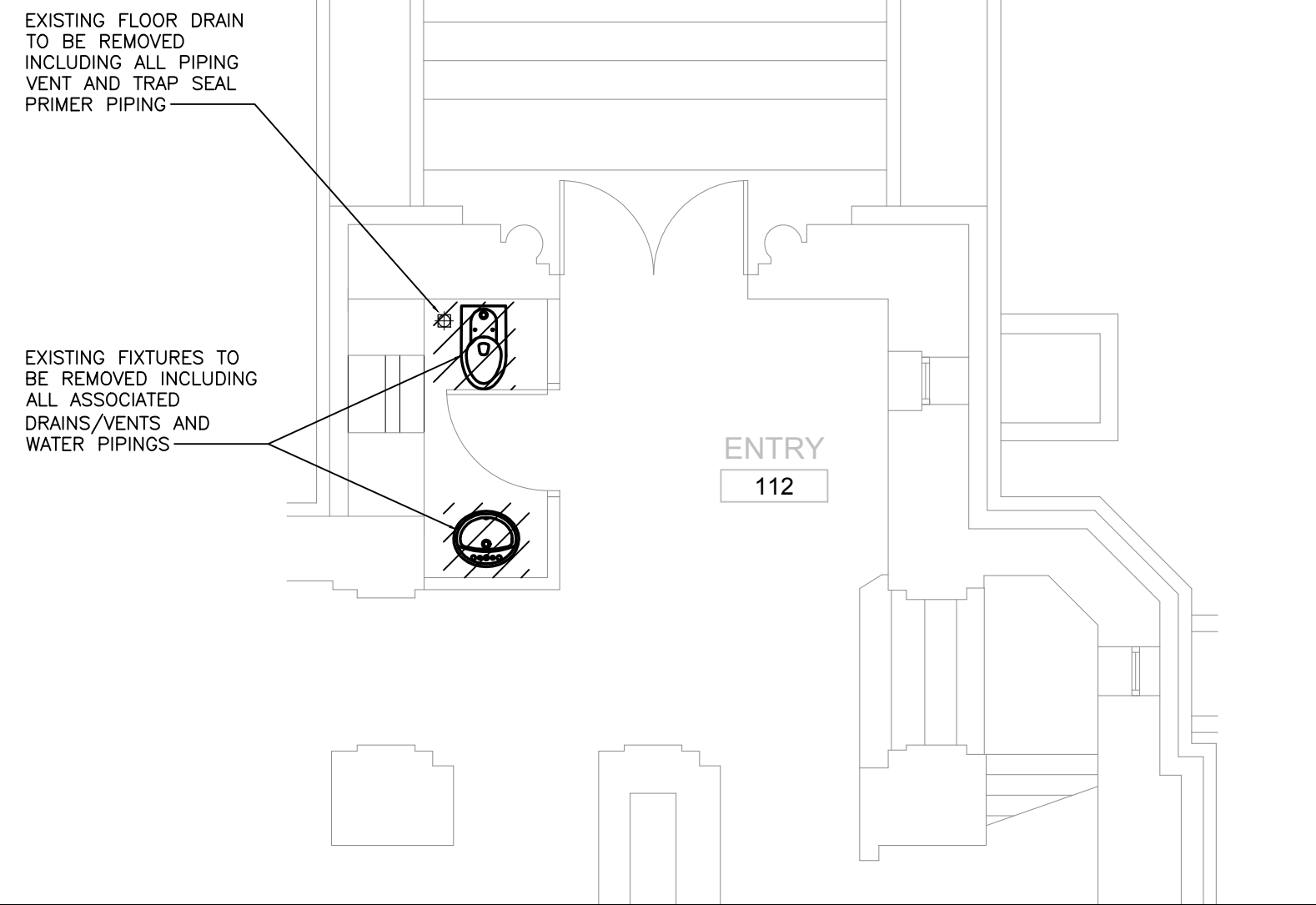
4 EXHAUST FAN LAYOUT
SCALE: 1:50



3 DRAINAGE AND PLUMBING LAYOUT
SCALE: 1:50

DRAWING NOTES:

1. REMOVE EXISTING VENT PIPING FROM THE DEMOLISHED WASHROOM BACK TO SOURCE AND CAP (NOT SHOWN).
2. REMOVE EXISTING EXHAUST FAN WITH RELATED DUCTWORK (NOT SHOWN). DISCONNECT EXHAUST FAN SWITCH BY DIV. 16.



1 GROUND FLOOR - WASHROOM DEMOLITION PLAN
SCALE: 1:50

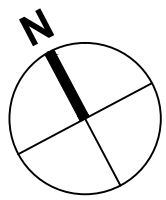
GENERAL NOTES:

- DO NOT SCALE DRAWINGS. THE LOCATIONS OF ALL ITEMS SHOWN ON THE DRAWINGS OR SPECIFIED THAT ARE NOT DEFINITELY FIXED BY DIMENSIONS ARE APPROXIMATE ONLY. THE EXACT LOCATIONS NECESSARY TO SECURE THE BEST CONDITIONS AND RESULTS MUST BE DETERMINED BY THE SITE CONDITIONS. REVIEW ALL REVISIONS WITH THE CONSULTANT.
- FLOOR PLANS SHALL BE READ IN CONJUNCTION WITH SCHEMATICS. INFORMATION SHOWN ON FLOOR PLANS SHALL BE ASSUMED TO BE APPLICABLE TO THE RELATED SYSTEM SCHEMATIC AND VICE-VERSA TO PROVIDE A COMPLETE AND OPERATIONAL SYSTEM.

2 NOTES
SCALE: 1:50

06	2016/07/21	ISSUED FOR PTA M-01
05	2016/07/15	ISSUED FOR REVIEW
04	2015/12/04	ISSUED FOR TENDER
03	2015/10/28	ISSUED FOR PERMIT
02	2015/10/08	ISSUED FOR REVIEW
01	2015/09/02	ISSUED FOR REVIEW
REV.	DATE	ISSUED

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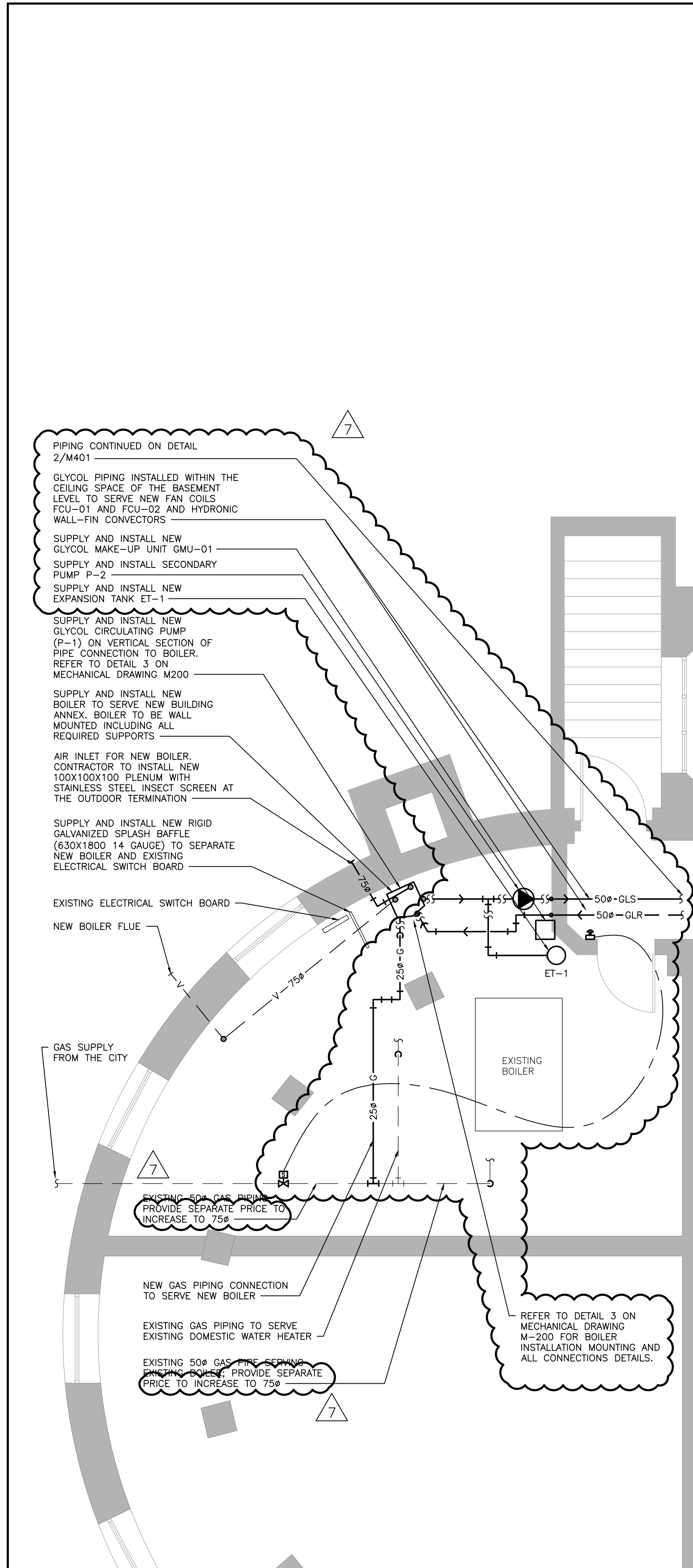
S+A PROJECT NUMBER: 14214.002.M.001

Title:

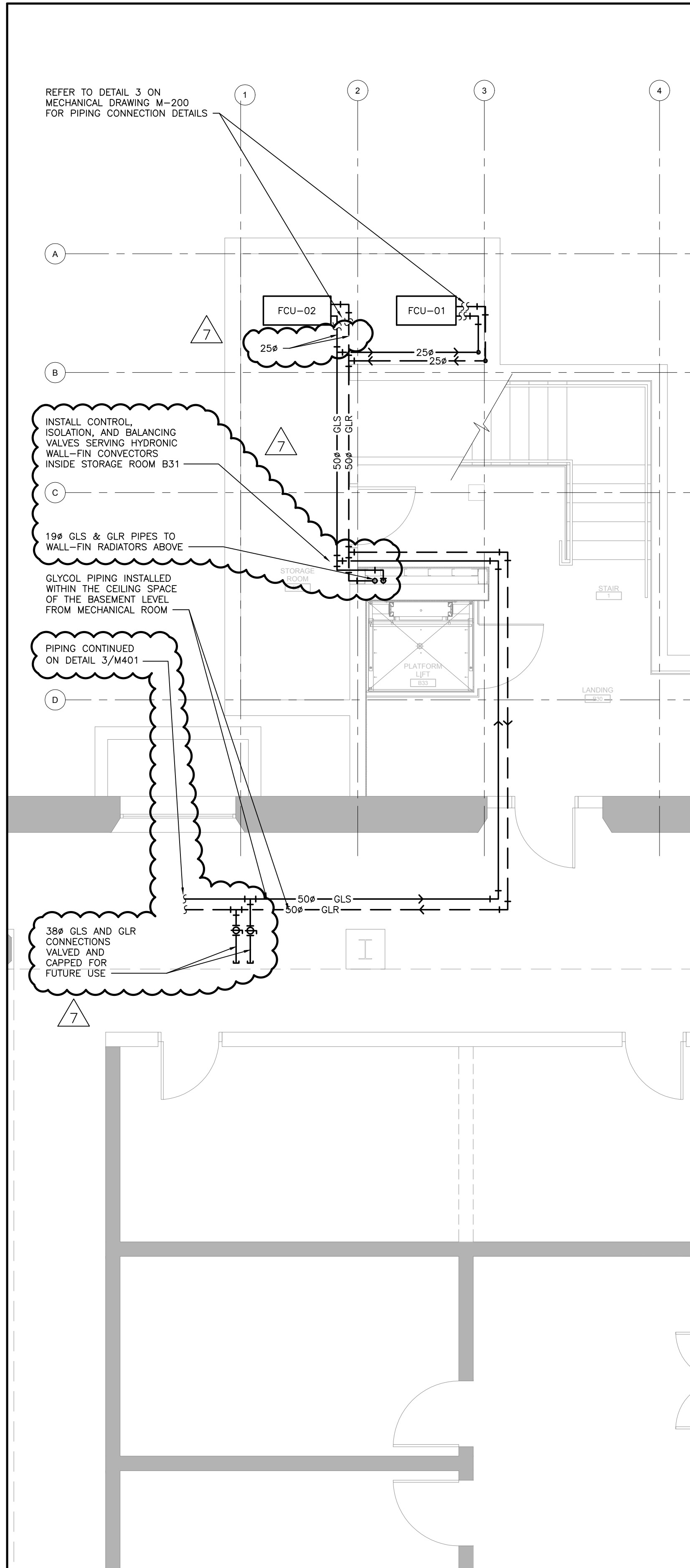
BASEMENT
WASHROOM
MECHANICAL PLANS

Drawn :	VG	Scale :	1:50	Date :	04/22/2015
Project Number :	12062	Drawing Number :			
Drawing Stage :	CD				

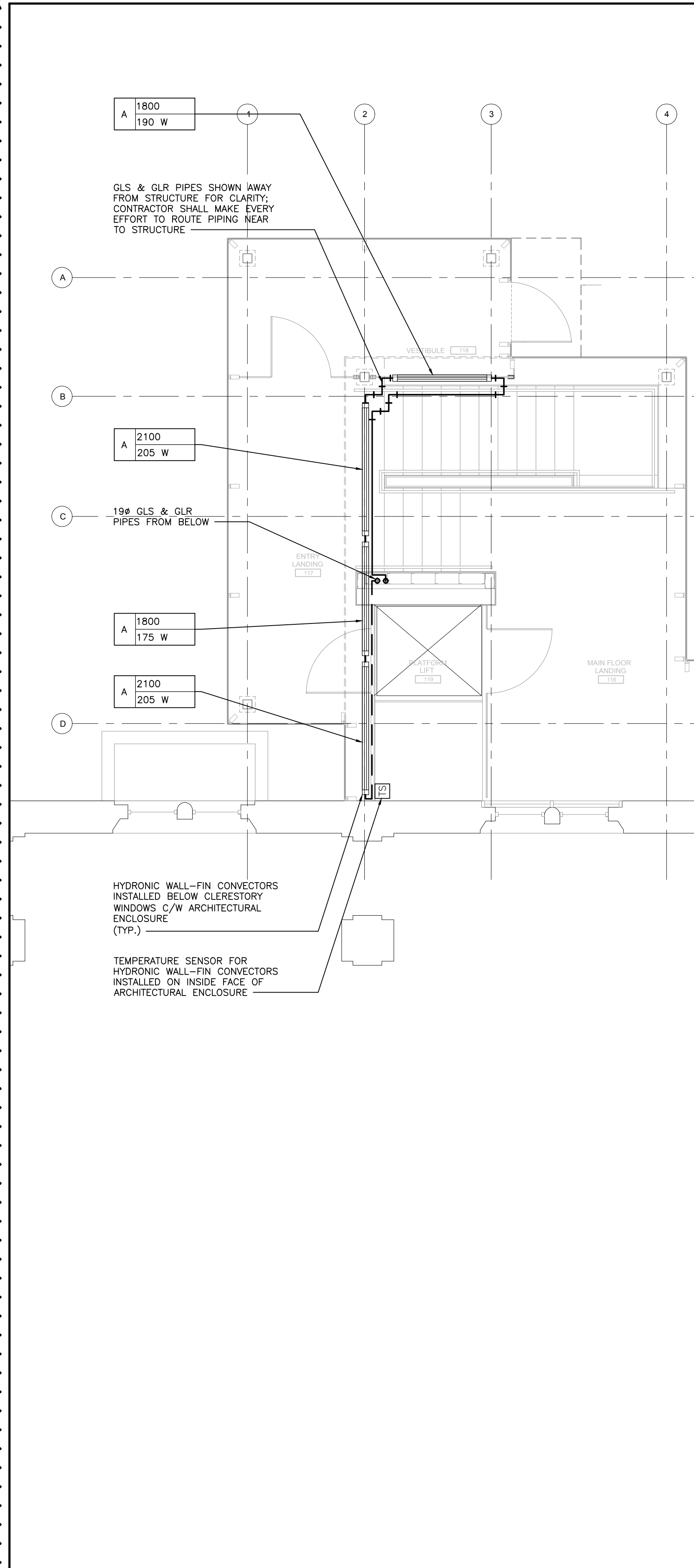
DRAWING_LOCATION



3 BASEMENT PLAN - WEST SIDE
SCALE: 1:50



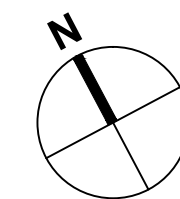
2 BASEMENT PLAN - EAST SIDE
SCALE: 1:50



1 GROUND FLOOR PLAN - EAST SIDE
SCALE: 1:50

07	2016/07/21	ISSUED FOR PTA M-01
06	2016/07/15	ISSUED FOR REVIEW
05	2016/07/12	ISSUED FOR ARCH. REVIEW
04	2015/12/04	ISSUED FOR TENDER
03	2015/10/28	ISSUED FOR PERMIT
02	2015/10/08	ISSUED FOR REVIEW
01	2015/09/02	ISSUED FOR REVIEW
REV.	DATE	ISSUED

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S+A PROJECT NUMBER: 14214.002.M.001

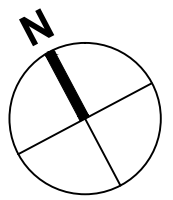
Title:
HEATING
WATER/GLYCOL
MECHANICAL PLANS

Drawn:	VG	Scale:	1:50	Date:	04/22/2015
Project Number:	12062	Drawing Number:			
Drawing Stage:	CD				M401

DRAWING_LOCATION

06	2016/07/21	ISSUED FOR PTA M-01
05	2016/07/15	ISSUED FOR REVIEW
04	2015/12/04	ISSUED FOR TENDER
03	2015/10/28	ISSUED FOR PERMIT
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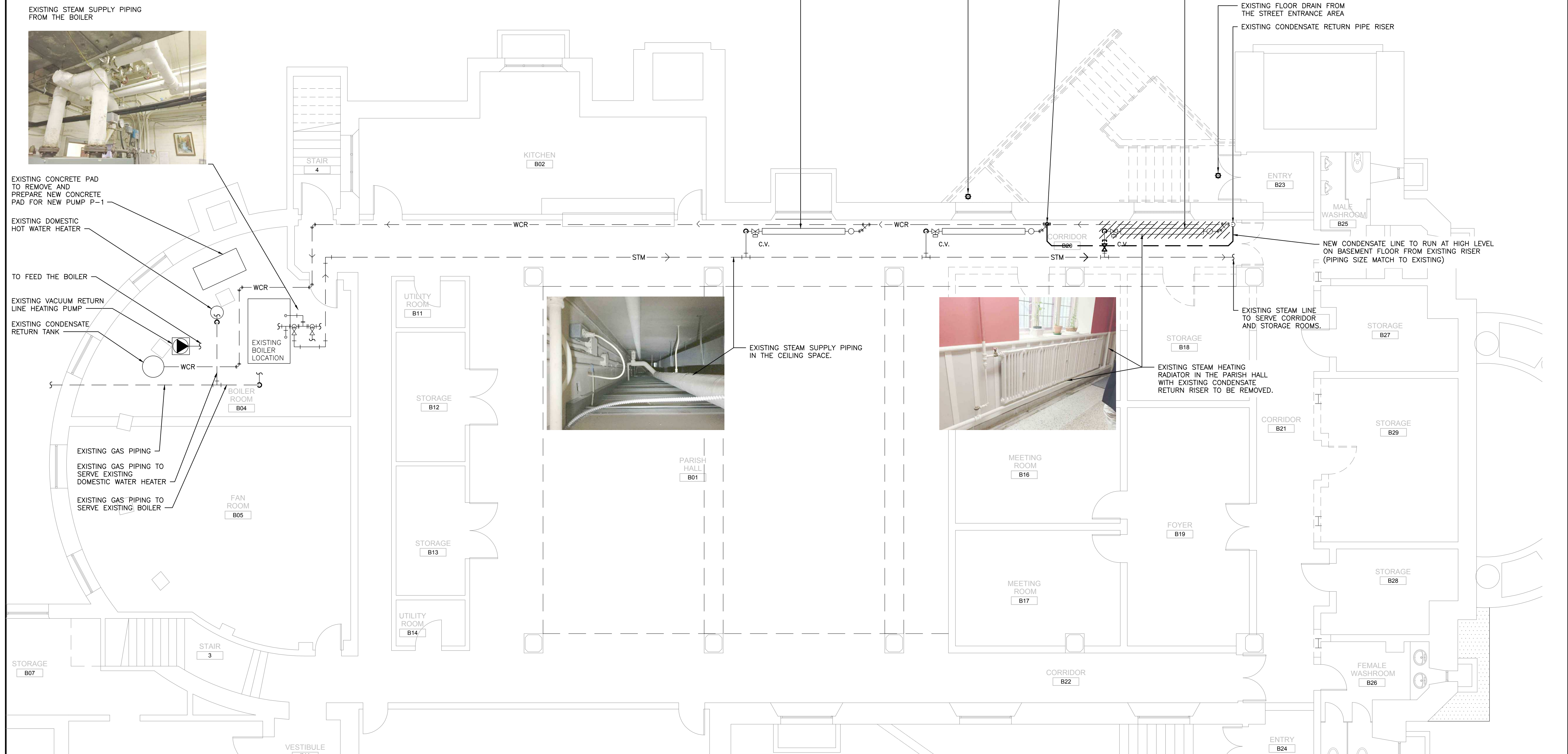


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416 487 8151 F 416 487 9104 smithandandersen.com
S+A PROJECT NUMBER: 14214.002.M.001

Title:
MECHANICAL
BASEMENT
DEMOLITION PLAN

Drawn : VG	Scale : 1:75	Date : 04/22/2015
Project Number : 12062	Drawing Number : M402	
Drawing Stage : CD		

DRAWING_LOCATION



1
M402 DEMOLITION -- BASEMENT PLAN
SCALE: 1:75

22' x 34'



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MECHANICAL SPECIFICATION

PROJECT NAME:

OUR LADY OF PERPETUAL HELP
PARISH CHURCH ALTERATIONS
78 CLIFTON RD., TORONTO, ON
M4T 2G2

OUR PROJECT NUMBER:

14214.002.M.003

DATE:

JULY 21, 2016

ISSUED / REVISION:

FOR POST TENDER ADDENDUM M-01

1. General

1.1. DEFINITIONS

- 1.1.1. The expression The Contract Documents shall mean and be construed as a reference to the Purchase Order and other documents listed on the Purchase Order including all modifications thereof incorporated in any of the documents before their execution.
- 1.1.2. The Owner means the "Our Lady of Perpetual Help Parish Church".
Owner's Agent means the "BNC Architect", or such person as he shall appoint from time to time.
- 1.1.3. The Contractor and Engineer's Representative(s) are those named as such in the Contract Documents.
- 1.1.4. The term work includes all labour, materials and services required, as shown or described in the Contract Documents.
- 1.1.5. The term Subcontractor includes only a person, firm or corporation having a contract for execution of part(s) of the work included in the contract, and involving on-site labour.
- 1.1.6. The term Other Contractor means any person or firm or corporation employed by or having a contract directly or indirectly with the Owner otherwise than through the Contractor.

1.2. DOCUMENTS

- 1.2.1. The Contract Documents are complimentary, and what is called for by any one shall be as binding as if called for by all. The intention of the documents is to include all labour and materials reasonably necessary for the proper execution of the work.
- 1.2.2. Should the Specifications conflict with the Drawings, the Specification shall govern. In the case of discrepancies between Drawings, those of larger scale, or if the scales are the same, those of later date shall govern.
- 1.2.3. All Drawings and Specification shall be interpreted in conformity with Purchase Order and General Requirements which shall govern.
- 1.2.4. The Contractor will not take advantage of manifest errors in the plans or Specifications.
- 1.2.5. The Contractor shall before proceeding with the work carefully examine and verify the Drawings, Specifications and Amendments (Addenda) thereto and shall immediately report to the Owner's Agent any errors, deviations, inconsistencies and/or omissions which may be disclosed by such examination and under no circumstances shall the Contractor proceed with any work while uncertain as to any feature of or interpretation to be placed upon the Drawings or Specifications.

1.3. DRAWINGS, SPECIFICATIONS

- 1.3.1. The Owner shall furnish to the Contractor without charge as many copies of the Drawings and Specifications as are reasonably necessary for the proper execution of the work.
- 1.3.2. The Contractor will maintain one up-to-date set of approved shop drawings, contract drawings and specifications at the site for his use and the Owner's use during the duration of the Contract.
- 1.3.3. On completion of the contract, the Contractor shall bring up-to-date one complete set of reproducible mylar plans with as-built information and hand same to the Owner's Agent. The as-built drawings shall include all work of all trades.

1.4. CONDUCT OF THE WORK

- 1.4.1. The entire project shall be carried out with maximum speed, consistent with good workmanship. The Contractor shall start work when notified and complete the entire project by the specified date. If requested by the Owner, the Contractor shall submit to the Owner a schedule of work broken down by trade before the commencement of any work at the site.
- 1.4.2. The entire work shall be carried out under the general direction of and to the entire satisfaction of the Owner's Agent.
- 1.4.3. Where work is being performed on premises being occupied by the Owner, the Contractor shall perform work in a manner which will provide a minimum of disruption to the Owner.

1.5. FOREMAN AND SUPERVISION

- 1.5.1. The Contractor shall keep on the work during its progress a competent foreman or superintendent and any necessary assistants, all satisfactory to the Owner.
- 1.5.2. The superintendent, or senior foreman, shall represent the Contractor in his absence and directions on matters given to him shall held to have been given to the Contractor.
- 1.5.3. The Contractor shall give efficient supervision to the work, using his best skill and attention at all times.

1.6. LABOUR, MATERIALS AND EQUIPMENT

- 1.6.1. Unless otherwise stipulated, the Contractor shall provide and pay for all labour, materials, tools and equipment necessary for the effective execution and completion of the work, including the placing in operation of all or part of the work where applicable.
- 1.6.2. Canadian labour and materials shall be used wherever possible and practicable throughout the work.
- 1.6.3. The Contractor shall employ only competent workmen for any part of the work. Any workman who is considered by the Owner's Agent to be incompetent or otherwise undesirable shall, upon his request, be withdrawn from the work and replaced by another acceptable workman.
- 1.6.4. All materials will be the best of their kind, new and all work carried out in accordance with the best standard practices. Standards or grades lower than the minimum CSA standard are not allowed.
- 1.6.5. If any materials and products are specified by name of manufacturer, brand, trade name or catalogue reference, the Contractor shall comply with such specification. Should the Contractor wish to use any materials or product not named in the Specification, the Contractor must secure the prior written approval of the Owner for their use and submit alternate prices indicating the differences in prices, if any, between the alternate materials and specified materials.

1.7. PERMITS, LICENSES, NOTICES, ETC.

- 1.7.1. The Contractor shall obtain and pay for all permits, fees, licenses and temporary encroachments and shall give all notices, and comply with all laws, ordinances, rules and regulations bearing on this work.

1.8. FEDERAL AND PROVINCIAL TAX

- 1.8.1. Tenders shall be submitted with Federal Sales Tax and Ontario Retail Sales Tax included unless otherwise stipulated on the Purchase Order.

1.9. INSURANCE

- 1.9.1. Fire and extended coverage perils insurance protection shall be provided and paid for by the Owner. The Contractor shall have the right to examine the Owner's policy and to obtain such additional insurance at his own expense as it may deem advisable. In the event of there occurring any damage or destruction covered by any policy of insurance maintained by the Owner, the liability (if any) of the Owner to the Contractor shall be limited to such amount (if any) as may be recovered by the Owner from the Insurer.
- The Contractor shall be responsible for the preparation and submission of all claims and supporting material for and on behalf of the Owner and will before submitting any claim provide the Owner with a copy thereof for his approval.
- 1.9.2. The Contractor shall maintain such insurance and pay such assessment as will protect him and the Owner from all claims under the Worker's Compensation Acts and from any other claims for damages or bodily injury, including death, and from claims for property damage which may arise from operations under this contract, specifically:
- .1 Comprehensive public liability and property damage insurance providing coverage against liability for bodily injury or death on an occurrence basis and/or damage to property.
 - .2 Automobile insurance for public liability and property damage providing coverage for each accident, on owned, non-owned, or hired vehicles.
 - .3 Completed operations coverage against liability for bodily injury, death and/or damage to property of others arising out of the existence of any condition in the completed work or any installation or repair operations during the period of one year next ensuing after acceptance of the completed work by the Owner.
- 1.10. WAGES
- 1.10.1. The Contractor shall pay the rate of wages prevailing in the district, to all workmen employed by him on any part of the work of this Contractor.
- 1.11. REVIEW OF WORK
- 1.11.1. The Owner and his representatives shall at all times have access to the work wherever it is in progress and the Contractor shall provide proper facilities for such access and for review. If any such work should be covered up without approval or consent of the Owner, it must, if required by the Owner, be uncovered for examination and made good at the Contractor's expense. If the Specifications, applicable laws, or the ordinances of any public authority require any work to be specifically tested or approved, the Contractor will make the necessary arrangements and bear any applicable expenses. Copies of such review certificates will be given to the Owner's Agent at the time of final review.
- 1.11.2. The final review shall be made by the Owner's Agent or his representative(s).
- 1.12. DEDUCTIONS FOR UNCORRECTED WORK
- 1.12.1. If work is not done in accordance with the Contract Documents, the Owner may deduct and withhold from the contract price the difference in value between the work as done and that called for by the contract.
- 1.13. WARRANTY
- 1.13.1. Should any material or workmanship supplied under this contract prove defective within a period of one year from the date of the Owner's acceptance, the Contractor shall immediately repair, replace the material or work at no cost or disruption to the Owner and shall be liable for and compensate the Owner for any damages to the Owner's property resulting from such defected or repairs.

1.14. PROTECTION OF PERSONS, WORK AND PROPERTY

- 1.14.1. The Contractor shall be responsible for the safety of the workmen and all other authorized personnel of the site, and for the strict enforcement of all safety regulations. The Contractor shall continually maintain adequate protection of all his works, the Owner's property, and adjacent property as provided by law, and conform to all local bylaws and ordinances.
- 1.14.2. The Contractor shall be fully responsible for continuously protecting all work from the elements, damage, fire and theft and shall take all reasonable precautions to protect the Owner's property from all injury arising in connection with the execution of the work.
- 1.14.3. The Contractor shall not, however, be responsible for damage or injury to the property of the Owner which may be directly due to errors in the Contract Documents or caused by the Owner, his Agents, or employees, provided that the Contractor has taken reasonable protective precautions.
- 1.14.4. Any loss or damage caused by this Contractor or any of his Subcontractors to the Owner shall be replaced or corrected under this contract at no cost to the Owner and to the Owner's satisfaction.

1.15. POWER, LIGHT AND WATER

- 1.15.1. The Owner shall allow the Contractor free use of existing facilities for the provision of power, light and water. Any extensions or changes in existing facilities required by the Contractor shall be at the Contractor's expense. Upon completion of the work the Contractor shall return the facility to its original condition unless otherwise specifically permitted by the Owner in writing.

1.16. CUTTING, FITTING, PATCHING AND DIGGING

- 1.16.1. The Contractor shall do all cutting, fitting or patching of the work that may be required to make its several parts come together properly and fit it to receive or be received by work of other Contractors shown upon, or reasonably implied by, the Contract Documents.
- 1.16.2. Any cost caused by ill-timed work shall be paid for by the party responsible therefore.
- 1.16.3. The Contractor shall not endanger any existing work by cutting, digging or otherwise. The Contractor shall not cut or alter the work of any other Contractor or except with the consent of the Owner's Agent.

1.17. CORRECTION AFTER COMPLETION

- 1.17.1. The expression accepted work in reference to acceptance of the work, where used in this Article, shall mean and refer to the work, or any part or parts thereof, which has or have been accepted by the Owner in writing as having been completed in accordance with the Contract Documents. Although work may be accepted by the Owner as aforesaid in whole or in part, the Owner shall not be obliged to accept part only of the work, notwithstanding that such part has been completed in accordance with the Contract Documents.
- 1.17.2. Subject to any express provisions in the Contract Documents the Contractor shall, at the Contractor's expense, remedy any defects (hereafter call guarantee defects) in accepted work or any part or parts thereof due to faulty materials workmanship appearing within a period of one year from the date of acceptance of such work and shall be liable for and shall compensate the Owner for any damage to other work resulting therefore which appears within such period and neither the written acceptance nor any payment made shall operate to relieve the Contractor from any obligation imposed by this Article.
- 1.17.3. This Article shall not be deemed to limit or reduce in any way a liability of the Contractor arising out of the Operation of any law in force in the Province of Ontario.

- 1.17.4. Any guarantee defects of which the Owner becomes aware shall be promptly reported by the Owner to the Contractor and the Contractor shall carry out the necessary remedial work and corrections as expeditiously as possible, without disrupting the functional operations of the Owner and at no additional cost to it.
- 1.17.5. The foregoing undertaking by the Contractor to remedy guarantee defects is additional to and in no way is substitution for any warranties or guarantees extending over a period of more than one year which the Owner is entitled to receive in respect of any part or parts of the work pursuant to the terms of the Contract Documents.
- 1.18. SURPLUS DEMOLITION MATERIAL
- 1.18.1. All material resulting from the demolition of existing installations specified for replacement or removal, shall become the property of the Contractor with the exception of items as noted which shall be delivered to a site designated by the Owner's Agent.
- All surplus materials not approved for re-use, shall be promptly removed from the Owner's premises.
- 1.19. CHANGES IN THE WORK
- 1.19.1. The Owner's Agent without altering the Contract may make changes by altering, adding to, or deducting from the work, the Contract Sum being adjusted accordingly. All such work shall be executed under the terms and conditions of the Contract except that any claim for extension or reduction of time caused thereby shall be adjusted at the time of ordering such change.
- No change shall be made unless in pursuance of a written order from the Owner's Agent and no claim for an addition to or deduction from the contract sum shall be valid unless so ordered and at the same time valued or agreed to be valued as provided.
- 1.20. VALUATION OF CHANGES
- 1.20.1. The value of any change shall be determined in one or more of the following ways agreed upon prior to the approval of such changes:
- .1 By estimate and acceptance in a lump sum
 - .2 By unit prices agreed upon
 - .3 By cost and percentage or by cost and a fixed fee
- 1.20.2. In cases of additional work to be paid for under method 1.20.1.3, the Contractor shall keep and present a correct account of the net cost of labour and materials, together with vouchers which will accompany monthly billing. Time and material sheets are to be submitted to the Owner's Agent weekly not later than the Monday following.
- 1.21. USE OF PREMISES
- 1.21.1. The Contractor shall confine his apparatus, the storage of materials and the operations of his workmen to limits dictated by governing laws, ordinances, permits or as directed by the Owner's Agent and shall not unreasonably encumber the site with his materials. The Contractor shall not load or permit to be loaded any part of the work, the site, or the cooling plant servicing the premises immediately adjacent thereto with a weight that will endanger the safety thereof. The Contractor shall enforce the Owner's instructions regarding signs, advertisements, fires, smoking and sanitation arrangements.
- 1.21.2. The Owner shall have the right to enter and occupy the building in whole or in part for the purpose of placing fitments and equipment, or for other use before completion of the work if, in

the opinion of the Owner's Agent such entry and occupation does not prevent the completion of the work by the Contractor or his responsibility to complete the work.

1.22. CLEAN UP

- 1.22.1. The Contractor shall at all times keep the site free from accumulations of waste materials or rubbish caused by this Subcontractors, employees or other persons engaged in carrying out the work, and at the completion of the work the Contractor shall remove or cause to be removed all rubbish, tools, equipment and surplus materials from and about the work and shall leave the work "broom clean" or its equivalent, unless otherwise specified.
- 1.22.2. In all areas, except mechanical rooms, all waste material or rubbish shall be removed immediately upon completion or daily if the work extends for more than one day. Failure to comply will result in the Owner removing the waste material and rubbish and charge the cost of removal to the Contractor.
- 1.22.3. In mechanical rooms, waste material or rubbish shall be removed weekly. In the event of any dispute, or if any order shall be made by any governmental authority having jurisdiction over the site, the Owner may, after giving 48-hour notice to the Contractor, remove the rubbish and charge the cost of removal to the Contractor.
- 1.22.4. At completion, the Contractor shall remove all storage sheds, offices, hoardings, fences, temporary protection, signs and surplus materials.
- 1.22.5. Where work is being performed, the Contractor shall prevent the spread of dust or debris outside the immediate work area.

1.23. DAMAGES AND MUTUAL RESPONSIBILITY

- 1.23.1. If either party to this Contract should suffer damage in any manner because of any wrongful act or neglect of the other party or of anyone employed by the other party, the party shall be reimbursed by the other party for such damage. Claims under this Article shall be made in writing to the party liable within a reasonable time after the first observance of such damage and not later than the date of the final acceptance, except as expressly stipulated otherwise in the case of faulty work or materials, and may be adjusted by agreement, and the party reimbursing the other party as aforesaid shall thereupon be subjugated to the rights of the other party in respect of such wrongful act or neglect if it be that of a third party. If the Contractor or any Subcontractor shall by any act or omission cause damage to or adversely affect the work of any other Contractor or the progress thereof, the Contractor shall compensate such other Contractor for such damage and expense as shall be suffered and incurred by it as a result of such act or omission. The value and amount of such damage and expense as shall be suffered and incurred by it as a result of such act or omission. The value and amount of such damage and expense shall be as certified in writing by the Owner's Agent. If such other Contractor shall sue the Owner on account of any damage alleged to have been so sustained, the Owner shall notify the Contractor who shall defend such proceedings at the Owner's expenses and if any final order or judgement against the Owner arises therefrom, the Contractor shall satisfy such judgement and pay all costs incurred by the by the Owner. Provided that if the Contractor shall become liable to pay or satisfy any final order or judgement against the Owner, then the Contractor shall have the right, upon undertaking to idemnify the Owner against any and all liability for costs, to appeal in the name of the Owner such final order or judgement to any and all courts of competent jurisdiction.

1.24. WORK STOPPAGE

- 1.24.1. Contractor or Owner will not be held responsible by the other party for damages resulting from strikes or legal lockouts. Contractor will be responsible for security and protection of the work during such stoppages.

1.25. SEPARATE CONTRACTS WITH OTHER CONTRACTORS

- 1.25.1. The Owner reserves the right to let separate contracts in connection with the work and the Contractor shall connect properly and coordinate its work with that of other Contractors. If any part of the Contractor's work depends for its proper execution or result upon the work of any other Contractor, the Contractor shall in writing report promptly to the Owner's Agent any defects in the work of such other Contractor's work. Should the Contractor fail so to inspect and report it shall have no claim against the Owner by reason of the defective or unfinished work of any other Contractor except as to latent defects not reasonably noticeable at the time of the commencement of the Contractor's work. In letting separate contracts the Owner shall be responsible for the coordination of fire precautions to avoid possible occurrence of a labour dispute or disputes on the work.

1.26. RELATIONSHIPS OF CONTRACTOR AND SUBCONTRACTOR

- 1.26.1. The Contractor agrees to bind every Subcontractor by the terms of the Contract Documents, to such extent as they shall be applicable to the work undertaken by the Subcontractor.

1.27. HOLDBACK

- 1.27.1. All Contracts and Purchase Orders are subject to holdback according to the provisions of the Construction Lien Act.

1.28. CONDITION OF THE SITE AND PREMISES

- 1.28.1. The Contractor shall be deemed conclusively to have inspected the site and prior to the execution hereof to have acquainted himself with and to have taken into account all existing conditions. No claims for extra payment for difficulties encountered due to site conditions will be allowed except where subsurface conditions at the site differ materially from those indicated in the Contract Documents, in which case the Contractor shall notify the Owner's Agent promptly in such conditions and if he finds that they differ materially from those indicated in the Contract Documents if will result in an increase or decrease in the cost or time required for performance of this Contract, and equitable adjustment shall be made between the parties and the Contract modified in writing accordingly.

END OF SECTION

SECTION	NUMBER	NAME	PAGES
	01000	General Requirements	7
	15000	Index	2
	15010	General Instructions for Mechanical Sections	7
	15012	Abbreviations	4
	15030	Record Drawings	2
	15031	Shop Drawings	2
	15052	Sleeves and Escutcheons	3
	15053	Wiring and Starters	3
	15054	Electric Motors	3
	15056	Nameplates	1
	15057	Valve Tags and Charts	2
	15058	Pipe and Ductwork Identification	2
	15059	Cleaning and Protection	1
	15060	Access Doors and Accessibility	2
	15061	Operating and Maintenance Instructions	3
	15062	Commissioning	3
	15080	Cutting and Patching	2
	15094	Hangers and Supports	5
	15148	Circulators	2
	15169	Indicating Instruments	4
	15179	Pipe System Filters	1
	15190	Testing and Balancing Piping Systems	2
	15192	Testing and Balancing Air Systems	2
	15200	Vibration and Noise Control	14
	15250	Mechanical Insulation	7
	15350	Natural Gas Piping Systems	1
	15410	Pipes, Valves and Fittings (Plumbing System)	5
	15421	Floor Drains	3
	15423	Cleanouts	1
	15450	Fixtures and Trim	3
	15451	Fixture Carriers	2
	15618	Condensing Boilers	3
	15641	Steam and Heating Water Treatment	2
	15705	Piping, Valves & Fittings (Except Plumbing)	9
	15706	Pipe Expansion, Joints, Guides and Anchors	2
	15707	Flexible Pipe Connectors	1
	15708	Expansion Tanks	2
	15752	Wall Fin Convectors	1
	15761	Fan Coil Units	2
	15791	Cleaning and Filling	3
	15820	Centrifugal Inline Fans	2
	15840	Ductwork and Specialties	7
	15870	Diffusers, Grilles and Registers	3
	15910	Standalone Controls	20
	15951	Sequence of Operation	3
		SCHEDULES	PAGES
		Boiler Schedule	1
		Cabinet Heater, Fan Coil, Unit Heater Schedule	1
		Expansion Tank Schedule	1
		Fan Schedule	1

Pump Schedule

1

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to the requirements of Division 1, which applies to and forms part of all sections of the work.
 - 1.1.2. The Specification is divided into Sections which are not intended to identify contractual limits between Subcontractors nor between the Contractor and his Subcontractors. The requirements of any one Section apply to all Sections. Refer to other Divisions and Sections to ensure a complete and operational system.
 - 1.1.3. Provide mechanical components and accessories which may not be specifically shown on the Drawings or stipulated in the Specifications, but are required to ensure complete and operational systems.
 - 1.2. INTENT
 - 1.2.1. Mention in the Specifications or indication on the Drawings of equipment, materials, operation and methods, requires provision of the quality noted, the quantity required, and the systems complete in every respect.
 - 1.2.2. The Specifications are an integral part of the accompanying Drawings. Any item or subject omitted from one or the other, but which is either mentioned or reasonably implied, shall be considered as properly and sufficiently specified.
 - 1.2.3. Be completely responsible for the acceptable condition and operation of all systems, equipment and components forming part of the installation or directly associated with it. Promptly replace defective material, equipment and part of equipment and repair related damages.
 - 1.3. SECTIONS AFFECTED
 - 1.3.1. These instructions apply to and form a part of all Mechanical Sections.
 - 1.4. REGULATIONS
 - 1.4.1. Work shall be performed in accordance with codes, rules, regulations, by-laws and requirements of the authorities having jurisdiction.
 - 1.4.2. The plumbing and drainage systems shall comply with regulations respecting plumbing made under the Ontario Water Resources Act except as modified by rules, regulations and by-laws of authorities having jurisdiction.
 - 1.4.3. Natural gas systems shall be in accordance with the Gas Protection Act and Installation Code of Natural Gas Burning Appliances and Equipment Code CAN-CSA-B149.
 - 1.4.4. These specifications are supplementary to the requirements above.
 - 1.4.5. Drawings and specifications should not conflict with the above regulations but where there are apparent discrepancies the Contractor shall notify the Engineer's Representative.
 - 1.5. PERMITS, FEES INSPECTION
 - 1.5.1. Obtain all permits, make submissions, pay all fees and arrange for all inspections required for the work of this Division.

1.6. EXAMINATION OF SITE

- 1.6.1. Before submitting Bids, each trade shall examine the site to determine the conditions which may affect the proposed work. No claims for extra payment will be considered because of failure to fulfil this condition.

1.7. DRAWINGS, CHANGES AND INSTALLATION

- 1.7.1. The Drawings shall be considered to show the general character and scope of the work and not the exact details of the installation. The installation shall be complete with all accessories required for a complete and operational installation.
- 1.7.2. The location, arrangement and connection of equipment and material as shown on the Drawings represents a close approximation to the intent and requirements of the work. The right is reserved by the Engineer's Representative to make reasonable changes required to accommodate conditions arising during the progress of the work, at no extra cost to the Owner.
- 1.7.3. In order to show more clearly the arrangement of the work, plans and sections do not show every valve, thermometer, pressure gauge or other system accessory. Refer to the Mechanical Standard Details and to the Specifications to determine the requirements.
- 1.7.4. Certain Details indicated on the Drawings are general in nature and specific labelled detail references to each and every occurrence of use are not indicated, however, such details shall be applicable to every occurrence.
- 1.7.5. All piping and ductwork in finished areas shall be concealed in ceiling spaces and shafts or chased into walls. No exposed piping or ductwork shall be installed in such areas unless specifically reviewed and accepted by the Engineer's Representative. No piping shall be concealed in outside walls.
- 1.7.6. Vent pipes, exhaust hoods or other mechanical equipment mounted on the roof, or housing for such equipment shall not be closer to the edge of the roof than a distance equal to the height of the pipe, hood or equipment, unless specifically reviewed and accepted by the Engineer's Representative.
- 1.7.7. The location and size of existing services shown on the Drawings are based on the best available information. The actual location of existing services shall be verified in the field before work is commenced. Particular attention shall be paid to buried services.
- 1.7.8. Changes and modifications necessary to ensure co-ordination and to avoid interference and conflicts with other Trades, or to accommodate existing conditions, shall be made at no extra cost to the Owner.
- 1.7.9. Leave areas clear of piping and ducts where space is indicated as reserved for future equipment and equipment for other Trades.
- 1.7.10. Adequate space and provisions shall be left for removal of coils and servicing of equipment, with minimum inconvenience to the operation of systems.
- 1.7.11. Where equipment is shown to be 'roughed-in only' obtain accurate information from the Engineer's Representative before proceeding with the work.
- 1.7.12. Before fabricating ductwork or piping for installation, make certain that such items can be installed as shown on the Drawings without interfering with the structure or the work of other Trades. Any problems that cannot be solved in agreement with the other Trades affected, shall be submitted for decision. If ductwork or piping is prefabricated prior to the investigation and reaching of a solution to possible interference problems, necessary changes in such prefabricated items shall be made at no extra cost to the Owner.
- 1.7.13. Location of diffusers, grilles registers, thermostats, sprinklers and all other equipment shown on plans is diagrammatic. Layout of each device in finished areas is critical in terms of symmetry and location. Refer to Architectural Drawings and to site instructions in all regards.

Any work not installed in the correct location (at the sole discretion of the Engineer's Representative) shall be remedied by this Contractor at his expense. This Contractor is responsible for mark-out of his work, fully co-ordinated with all other trades, in sufficient time for review by Engineer's Representative prior to rough-in. All mechanical and sprinkler services shall be located precisely.

- 1.7.14. Prepare dimensioned layouts of each room prior to rough-in for review by Architectural Consultant. Do not proceed with any work until the Engineer's Representative has reviewed the layout.

1.8. INSTALLATION, INTERFERENCE AND SETTING DRAWINGS

- 1.8.1. Installation, interference and setting Drawings dimensioned and to scale, shall be submitted for review by the Engineer's Representative, as may be required or requested by the Engineer's Representative to make clear the work intended or to show its relation to adjacent work or to the work of other trades. When an alternative piece of equipment is to be substituted for equipment shown, Drawings of the area involved shall be prepared by this Division. Three copies of such Drawings shall be submitted for review, of which one will be retained by the Engineer's Representative.
- 1.8.2. Installation working Drawings to 1:50 scale (1/4 in. equal to 1 ft.) for mechanical rooms showing plan and sections of the plant, services, bases, curbs, drains, motor terminals, shall be prepared by this Division.
- 1.8.3. Interference Drawings are required for shafts, ceiling spaces, typical floors and wherever there is possible conflict with the positioning of mechanical equipment, piping or ductwork and architectural or structural features or the work of other trades.
- 1.8.4. The design of the structural framing of the mechanical rooms and pipe spaces and major pipe run supports has been based on assumed loadings supplied during the design phase. Well ahead of the construction of the affected areas, prepare and submit Drawings for review by the Engineer's Representative showing the layout and weights of all finally selected mechanical equipment including details of concrete pads, concentrated pipe loads and point reactions of the equipment onto the structure.
- 1.8.5. This Division shall prepare sleeving Drawings indicating the size and locations of openings required in concrete floor slabs, roof slabs/decks and walls for piping, ductwork and equipment. In case of failure to provide information in time (i.e. before the concrete is poured) any extras incurred shall be at the expense of this Division.
- 1.8.6. Work shall not proceed in areas involved until after final review of such Drawings has been obtained.
- 1.9. MATERIALS
- 1.9.1. Make and quality of materials used in the construction of this work shall be subject to the approval of the Engineer's Representative.
- 1.9.2. Materials and equipment supplied by this Division shall be new and free from defects and shall be as specified by the manufacturer's name and catalogue reference.
- 1.9.3. Where a certain manufacturer's equipment has been specified by name or model number, the Contractor shall be responsible for ensuring that the performance and quality of any proposed alternative meets the specified equipment and that the same access or maintenance space is available for the alternative manufacturer's equipment and that piping, duct and electrical connections can be made at no extra cost to the Contract.

1.10. CO-OPERATION WITH CONSULTANTS

1.10.1. To assist in the successful execution of the project, the Contractor shall receive a job report that summarizes the expectations of the Consultant and the Contractor. This document covers topics such as progress billings breakdowns, shop drawing requirements, change order pricing breakdowns, the commissioning process, installation drawings, the specifications, as-builts and O+M manuals, along with a number of other items. This job report is intended to reiterate and elaborate on key items of the Contract Documents and is not intended to impose new requirements.

1.10.2. At the appropriate time during construction the Contractor shall submit the applicable documentation listed in the Mechanical/Electrical Unfinished Building Occupancy Checklist. The list shall be issued by the Consultant during the course of the project; however, a sample checklist can be provided at any time upon request. The checklist shall be completed by the Contractor when the information required for occupancy is submitted. The Consultant shall review the information and checklist and shall identify when the information is complete. The Consultant's general review letter (required for building occupancy) shall only be issued when all the information requested in the checklist is submitted by the Contractor and deemed to be complete by the Consultant.

1.11. CO-OPERATION WITH OTHER DIVISIONS

1.11.1. Particular attention must be paid to the proximity of electrical conduit and cable to mechanical piping and equipment.

1.11.2. Pipes transporting hot fluids shall be installed at least 150 mm (6 in.) away from pipes carrying cold fluids, unless approval from the Engineer's Representative is obtained to install services closer than 150 mm (6 in.).

1.11.3. Electrical conduits shall not touch or be supported from piping or ductwork.

1.11.4. Each Section shall confine itself to installing all materials in the spaces shown without encroaching upon space for materials installed under other Sections or Divisions. Where the space allocated to another Section or Division is encroached upon, the materials shall be relocated to their proper space allocation in such a manner to complete the work using space allocated to the various Sections and Divisions. Relocation of materials and work involved shall be paid for by the Section responsible for the encroachment at no extra cost to the Owner.

1.11.5. Supply all items to be built in ample time for rapid progress of the work. Schedule and proceed with work as required to satisfy the construction schedule.

1.11.6. The Contractor shall confirm the available voltage for all single phase and three phase motors or other similar electrically driven equipment with the Electrical Division prior to ordering the equipment. Any discrepancy between the requirements identified within the Contract Documents and those of the Electrical Division shall be reported to the Engineer's Representative and the equipment shall be adjusted to suit the appropriate power requirements. Failure to perform this coordination prior to ordering of the motors or equipment shall result in correction at no additional cost to the Owner.

1.12. TEMPORARY USE OF EQUIPMENT

1.12.1. Where the mechanical systems are operated during construction, the Mechanical Contractor shall maintain the system and equipment in proper operating condition.

1.12.2. Prior to application for substantial performance of the work as certified by the Engineer's Representative, the systems and equipment shall be returned to the initial new condition by replacing used air filters with new air filters, cleaning the air side of all coils in the air handling systems, replacing used belts in belt drives with new belts, lubricating all bearings according

to manufacturer's factory standards and adjusting the thermostatic control system according to specifications and/or to suit the Owner.

1.13. EXISTING SERVICES AND EQUIPMENT

- 1.13.1. All changes and connections to existing services shall be made only in a manner and at a time approved by the Engineer's Representative so as to avoid any interruption of such services during normal working hours. If necessary, changes and connections to existing services shall be made outside of normal working hours, at no extra cost to the Contract.
- 1.13.2. Whenever existing services or equipment are to be removed, all piping and ductwork for such services or equipment shall be removed back to the main, nearest pipe or duct and any open ends securely capped or plugged in an approved manner unless otherwise shown. If necessary to facilitate installation of new work, any existing services and equipment shall be removed and then replaced by this Division.
- 1.13.3. Whenever it becomes necessary to relocate existing piping, ductwork or equipment to make possible installation of the work under this Contract, such relocation shall be done by this Division without additional cost to the Contract.
- 1.13.4. Where connections are made to existing services, existing insulation shall be made good under this Division.

1.14. PROVISION FOR FUTURE EXPANSION

- 1.14.1. Where piping, ductwork and equipment is indicated for use in future expansion of the building, the Contractor shall leave sufficient clear space and shall install the piping, ductwork and equipment in such manner that connections to the future building expansion can be made without dismantling existing piping, ductwork and equipment and without removing existing floors, walls and ceilings.

1.15. INTERRUPTION OF SERVICES

- 1.15.1. Any interruption of the mechanical services to any part of the building shall come at a time agreeable to the Engineer's Representative. Make all necessary arrangements with those concerned and include for any overtime required to ensure that the interruption is held to a minimum.
- 1.15.2. Testing and operation of major equipment shall be approved by the Engineer's Representative to avoid excessive utility charges. Such testing to be generally carried out after normal working hours or on weekends.
- 1.15.3. All such overtime work shall be carried out without additional cost to the Contract.

1.16. STATEMENT OF PRICES

- 1.16.1. For the purpose of progress applications the Contractor shall submit a statement of his estimated prices for the various portions of the work, including labour, materials and equipment shown separately. The total price of all portions of the work shall equal the total price of the work covered under the Mechanical Division.
- 1.16.2. The Contractor shall submit the breakdown of work for this Contract to the Engineer's Representative for review and approval. The breakdown shall be in sufficient detail to enable the Engineer's Representative to evaluate the progress of work and shall identify all major equipment, components and sub trades.

1.17. METRIC CONVERSIONS

- 1.17.1. Particular care shall be taken with imperial versus S.I. metric conversions. This applies to all services including, but not limited to, equipment, pipes, ductwork and site services in both new and existing installations.
- 1.17.2. Conform to the Canadian Metric Practice Guide CSA-CAN3-2234-1-89.

1.18. DEMOLITION

- 1.18.1. The Demolition Drawings show the general scope of the demolition and not exact details or total extent. For exact details and total extent each service must be carefully checked on site. Before removing services follow the service through to ensure other areas of the building are not affected. Open shafts, walls and ceilings as required to examine the services.
- 1.18.2. If there are no isolating valves readily available to isolate sections of pipe that requires removal, add valves as required. The cost of these valves will be paid for from the Cash Allowance Section. Co-ordinate with the Engineer's Representative to shut-down the system. Install caps on all services. Add cap to all valves at the termination point of existing services.
- 1.18.3. Where valves are removed, remove valve tags, revise existing charts and hand tags over to Owner.

1.19. SCHEDULE, ACCESS, PROTECTION AND CLEAN-UP

- 1.19.1. The construction schedule places restrictions on the duration of construction within areas and the duration of shut-down of equipment. Refer to the General Conditions for all requirements.
- 1.19.2. Access to the site is limited to location and time of day. Access to areas of the building is limited to location and time of day. Refer to the General Conditions and conform to all requirements.
- 1.19.3. Refer to the security and protection requirements in the General Conditions and conform to all requirements. In particular no open flames shall be used without prior written approval of the Owner. There shall be no smoking, and the site shall be kept clean at all times.

1.20. HOUSEKEEPING PADS, CURBS AND SUPPORT PIERS

- 1.20.1. Provide concrete housekeeping pads, curbs and support piers under all floor mounted mechanical equipment and around all floor penetrations for pipes and ducts. Housekeeping pads and curbs shall be minimum 100 mm (4 in.) high unless detailed otherwise. Refer to the Drawings and Details for additional information.
- 1.20.2. Housekeeping pads, curbs and support piers under all floor mounted mechanical equipment and around all floor penetrations for pipes and ducts shall be provided by Division 3. This Division shall coordinate all sizes and locations for housekeeping pads and curbs. Provide dimensioned drawings for review by the Engineer's Representative. All housekeeping pads shall be minimum 100 mm (4 in.) high unless detailed otherwise. Refer to the Drawings and Details for additional information.

1.21. ASHRAE 90.1

- 1.21.1. All mechanical equipment shall comply with the minimum efficiency standards set out in ASHRAE 90.1 and the Model National Energy Code of Canada for Buildings. Submit all necessary information to substantiate conformance.

1.22. HOISTING FACILITIES

- 1.22.1. This Division shall provide its own hoisting facilities.

- 1.22.2. Hoisting facilities provided by General Contractor will be available for Subcontractors use at no cost. If hoist facilities are inadequate then Sub-Contractors must provide his own. Sub-Contractors must inform General Contractors of requirements before tender closing date.

- 2. Products

- 2.1. NOT USED

- 3. Execution

- 3.1. NOT USED

END OF SECTION

1. General

1.1. ABBREVIATIONS

1.1.1. Generally, the following abbreviations are used in this Division:

A.A.B.C.	-	Associated Air Balance Council
AAP	-	Alarm Annunciator Panel
A.B.M.A.	-	American Boiler Manufacturers Association
ACO	-	Acid Resistant Cleanout
AD	-	Acid Resistant Drawings
AFD	-	Acid Resistant Floor Drain
AFF	-	Above Finished Floor
A.G.A.	-	American Gas Association
A.M.C.A.	-	Air Moving and Conditioning Association
A.N.S.I.	-	American National Standards Institute
A.R.I.	-	Air-Conditioning and Refrigeration Institute
A.S.H.R.A.E.	-	American Society of Heating, Refrigerating and Air Conditioning Engineers
A.S.M.E.	-	American Society of Mechanical Engineers
A.S.T.M.	-	American Society for Testing and Materials
AV	-	Acid Resistant Vent
A.W.G.	-	American Wire Gauge
AWS	-	American Welding Society
A.W.W.A.	-	American Water Works Association
B.H.P.	-	Boiler Horsepower or Brake Horsepower
Btu/hr	-	British Thermal Units per Hour
B.W.G.	-	British Wire Gauge
CAD	-	Computer Aided Drafting
CAFV	-	Controllable Air Flow Venturis
CAP	-	College of American Pathologists
CCA	-	Chromated Copper Arsenate
C.E.M.A.	-	Canadian Electrical Manufacturer's Association
CEMS	-	Central Energy Management System
CCF	-	Central Computer Facility
cfm	-	Cubic Feet per Minute
C.G.A.	-	Canadian Gas Association
C.G.S.B.	-	Canadian General Standards Board
C.I.	-	Cast Iron
CPU	-	Central Processing Unit
C.R.N.	-	Canadian Registration Number
CSA	-	Canadian Standards Association
cu.m.	-	Cubic Feet
cu.m.	-	Cubic Meter
db	-	Dry Bulb
dB	-	Decibel
dBA	-	A-weighted Decibel
DDC	-	Direct Digital Control
deg. C	-	Degrees Celsius
deg. F.	-	Degree Fahrenheit
dia.	-	Diameter
DPDT	-	Double Pull Double Throw
DPTX	-	Differential Pressure Transmitters
EAP	-	Excess Exhaust Alarm Panel

E.D.R.	-	Equivalent Direct Radiation
EF	-	Exhaust Fan
E.E.M.A.C.	-	Electrical and Electronic Manufacturers Association of Canada
EEPROM	-	Electrically Erasable Programmable Read-Only Memory
EMT	-	Electrical Metallic Tubing
EP	-	Electric Pneumatic
EPDM	-	Ethylene Propylene Diene-Rubber
EPROM	-	Electrically Programmable Read Only Memory
ERW	-	Electric Resistance Welded
FACP	-	Fire Alarm Control Panel
FDA	-	Food and Drug Administration
F.E.	-	Flexible Elastomeric
FHC	-	Fume Hood Controller or Firehose Cabinet
F.L.A.	-	Full Load Amps
fpm	-	Feet per Minute
fps	-	Feet per Second
F.M.	-	Factory Mutual
ft.	-	Foot or Feet
ga	-	Gauge
gal	-	Gallons
GFD	-	Gallons per Square Feet per Day
G.P.D	-	Gallons per Day
G.P.H.	-	Gallons per Hour
GSS	-	Galvanized Sheet Steel
h-cu.ft.	-	Hour-cubic foot
HCFC	-	HydroChloroFlouorocarbons
HEPA	-	High Efficiency Particulate Air
H.O.A.	-	Hand/Off/Auto
HOT	-	Hand Held Operator Terminal
H.S.S.	-	Hollow Steel Sections
HTK	-	Hood Termination Kit
hp	-	High Pressure or Motor Horsepower
hz	-	Hertz
I.A.O.	-	Insurance Advisory Organization of Canada
I.C.U.	-	Intensive Care Unit
(I.)G.P.H.	-	(Imperial) Gallons per Hour
(I.)G.P.M.	-	(Imperial) Gallons per Minute
in.	-	Inch or Inches
kg	-	Kilogram
kg/cu.m.	-	Kilogram per cubic meter
kPa	-	Kilopascals
KVA	-	Kilovolt-amps
kW	-	Kilowatts
lbs/cu.ft.	-	Pounds per cubic foot
lbs/hr.	-	Pounds per Hour
L	-	Litre
L/s	-	Litres per Second
LFC	-	Laminar Flow Cabinets
LEDS	-	Light Emitting Diode
LCP	-	Laboratory Control Panel
lin.ft.	-	Linear foot
lin.m.	-	Linear meter
ma	-	Milliamps
MAC	-	Make-up Air Controller
mADC	-	Milliamps Direct Circuit

M.B.H.	-	1000 British Thermal Units per Hour
M.C.C.	-	Motor Control Centre
mm	-	Millimetre
m	-	Metre
m/s	-	Metres per Second
mL	-	Millilitre
MCP	-	Motor Control Panel
M.O.V.	-	Motor Over Voltage
mPa	-	Millipascals
MSC	-	Master Summing Controller
MSG	-	Manufacturers' Standard Gauge
N.B.S.	-	National Bureau of Standards
N.C.	-	Noise Criterion as Defined by Graph in A.S.H.R.A.E.
NCCLS	-	National Committee for Clinical Laboratory Standard
N.E.M.A.	-	National Electrical Manufacturer's Association
N.F.P.A.	-	National Fire Protection Association
NIM	-	Network Interface Module
NIST	-	National Institute of Standards and Technology
NIOSH	-	National Institute of Occupancy Safety and Health
NPS	-	American National Standard Straight Pipe Thread
N.P.S.H.	-	Net Positive Suction Head
NPT	-	American National Standard Taper Pipe Thread
No.	-	Number
OAT	-	Outside Air Temperature
O.B.C.	-	Ontario Building Code
OC	-	On Centre
OCP	-	Operator Control Panel
OPSS	-	Ontario Provincial Standard Specification
O.S. & Y.	-	Outside Screw and Yoke
O.W.R.A.	-	Ontario Water Resources Act
oz.	-	Ounce or Ounces
PCU	-	Personal Computer Unit
PE	-	Pneumatic Electric
PIT	-	Portable Interface Terminal
ph	-	Hydrogen Ion Concentration
ppm	-	Part per Million
psf	-	Pounds per Square Foot
psi	-	Pounds per Square Inch
psia	-	Pounds per Square Inch Absolute
psig	-	Pounds per Square Inch Gauge
PWM	-	Pulse Width Modulation
PVC	-	Polyvinyl Chloride
qt.	-	Quart
RAH	-	Return Air Humidity
Rh	-	Relative Humidity
rpm	-	Revolutions per Minute
RPU	-	Remote Processing Unit
RPU-TU	-	Remote Processing Unit for Terminal Units
SCR	-	Silicone Controlled Rectifier
SMACNA	-	Sheet Metal and Air Conditioning Contractors National Association
sp. in. wg.	-	Static Pressure, Inches Water Gauge
S.P.D.T.	-	Single Pull Double Throw
SPS	-	Sash Position Sensor
s.s	-	Stainless Steel
SF	-	Supply Fan

SPS	-	Sash Position Sensor
SPWM	-	Sine-Coded Pulse Width Modulated
S.S.P.C.	-	Steel Structures Painting Council (The Society of Protective Coatings)
sq.m.	-	Square Meter
STC	-	Supply/Exhaust Tracking Controller
SWS	-	Sidewall Velocity Sensors
T.D.S.	-	Totally Dissolved Solids
TEFC	-	Totally Enclosed Fan Cooled
TIG	-	Tungsten Inert Gas
TKV-TWA	-	Threshold Limit Value – Time Weighted Average
UACU	-	Unitary Air Conditioning Units
U.L.	-	Underwriter's Laboratories
U.L.C.	-	Underwriter's Laboratories of Canada
um	-	Ohm
USP	-	United States Pharmacopoeial
U.S. gal.	-	United States Gallons
USGPH	-	United States Gallons per Hour
USGPM	-	United States Gallons per Minute
VAC	-	Volts Alternating Current
VACFH	-	Closed Loop Variable Frequency Drive
VDC	-	Volts Direct Current
VFD	-	Variable Frequency Drive
VSC	-	Variable Speed Controllers
VSD	-	Variable Speed Drives
W	-	Watt
W/cu.m.	-	Watts per Cubic Meter
W/ft.	-	Watts per Foot
W/m	-	Watts per Meter
W/sq.in.	-	Watts per Square Inch
W/sq.m.	-	Watts per Square Meter
WC	-	Water Closet
wb	-	Wet Bulb
wg	-	Water Gauge
WHMIS	-	Workplace Hazardous Material Information System
WSP	-	Working Steam Pressure
WOG	-	Water, Oil, Gas

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.2. RELATED WORK SPECIFIED ELSEWHERE
 - 1.2.1. Refer to Record Drawings in Section 01700 (01780) – CLOSEOUT SUBMITTALS.
 - 1.3. PRINTS
 - 1.3.1. The Owner will provide the Mechanical Contractor with two sets of white prints to mark the project progress, changes and deviations.
2. Products
 - 2.1. NOT USED
3. Execution
 - 3.1. DOCUMENTATION REQUIREMENTS
 - 3.1.1. As the project progresses mark all changes and deviations from that shown on the drawings to the white prints.
 - 3.1.2. After review and approval of service lines in trenches, take as-built measurements, including all depths, prior to commencement of backfilling operations. It will not be sufficient to check off line locations. Take and record definitive measurements for each service line. Show locations and inverts of buried piping on the drawings and dimensioned from grid co-ordinates.
 - 3.1.3. Keep drawings up-to-date during construction and in addition to field measurements include change orders, site instructions and all other changes. Drawings shall be available for review at all times.
 - 3.1.4. On completion of the work, forward to the Engineer's Representative the two sets of drawings indicating all such changes and deviations for review by the Engineer's Representative.
 - 3.1.5. After the drawings have been reviewed, transfer all as-built mark-ups from prints to a DVD or USB Storage Device using a version of AutoCAD software up to the latest published version. The Contractor shall request the acceptable version(s) of AutoCAD that may be used. Submit prints/plots of drawings with the submission of the USB Storage Device or DVD for review by the Engineer's Representative.
 - 3.1.6. Final as-built prints/plots shall not contain markings or corrections by hand (i.e. marker, pen, pencil, etc.). Drawings containing mark-ups shall be revised on computer and printed/plotted.
 - 3.1.7. The project will remain incomplete and a holdback will be retained until satisfactory as-built drawings and disks are provided.
 - 3.1.8. The Mechanical Contractor may request from the Engineer's Representative the most current mechanical drawings on AutoCAD, IBM PC DVD format (at a nominal charge of \$500.00).
 - 3.1.9. The AutoCAD documents shall meet all the Owner's and Engineer's Representative's requirements.

3.2. CADD REQUIREMENTS

- 3.2.1. A complete list of layer names and brief description of each layer's use shall accompany all files.
- 3.2.2. Fonts for text shall be AutoCAD standard. Custom fonts, shape files, etc., are not to be used.
- 3.2.3. Final as-built drawings shall be returned on a DVD.
- 3.2.4. Each DVD shall be clearly labelled with Engineer's Representative and Owner, Contract number, file names and Drawing number. If a complete listing exceeds the label size provide a "readme.txt" file in ASCII format with each DVD. A printed copy of the readme file shall accompany each DVD.
- 3.2.5. All drawings shall be in the same units as issued on Bid Documents.
- 3.2.6. Provide a complete list of symbol (block) names with a description of each symbol.
- 3.2.7. Special effort shall be made to ensure that drafting is accurate: i.e. appropriate lines are indeed horizontal and vertical; lines that should intersect do but not over-intersect and ensure that entities are placed on correct layers.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.2. RELATED WORK SPECIFIED ELSEWHERE
 - 1.2.1. Comply with Section 01300 for Submittals except as amended below.
2. Products
 - 2.1. SHOP DRAWINGS
 - 2.1.1. Shop Drawings shall be organized by Specification Section. Do not combine more than one section into one submission. Incorrect submissions will be returned without review.
 - 2.1.2. Shop drawings shall be submitted electronically in PDF format. Any drawings not submitted electronically without prior approval from the consultant shall be returned not reviewed.
 - 2.1.3. Shop Drawings shall indicate clearly the materials and/or equipment actually being supplied, all details of construction, accurate dimensions, capacity, operating characteristics and performance. Each Shop Drawings shall give the identifying number as noted in the documents of the specific pump, fan, etc. for which it was prepared.
 - 2.1.4. Each Shop Drawing for non-catalogue items shall be prepared specifically for this project. Shop Drawings and brochures for catalogue items shall be marked clearly to show the items being supplied.
 - 2.1.5. When requested, Shop Drawings shall be supplemented by data explaining the theory of operation – for example: a variable speed motor control – the Engineer's Representative may also request that this information be added to the maintenance and operating manual.
 - 2.1.6. Provide a cover sheet with the project name, issue date, issue number, Specification section number, title of section and with space for Shop Drawing review stamps for the Contractor and Engineer's Representative.
3. Execution
 - 3.1. SUBMISSIONS
 - 3.1.1. Each Shop Drawing or catalogue sheet shall be stamped and signed by the Contractor to indicate that he has checked the drawing for conformance with all requirements of the Drawings and Specifications, that he has co-ordinated this equipment with other equipment to which it is attached and/or connected and that he has verified all dimensions to ensure the proper installation of equipment within the available space and without interference with the work of other trades. Ensure that electrical co-ordination is complete before submitting drawings for review.
 - 3.1.2. Installation of any equipment shall not start until after final review of Shop Drawings by the Engineer's Representative has been obtained.
 - 3.1.3. Provide all necessary copies required for the trades, suppliers or other Consultants.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.2. RELATED WORK SPECIFIED ELSEWHERE
 - 1.2.1. Firestopping and smoke seals within mechanical assemblies (i.e. inside ducts, dampers, etc.) with the exception of sleeves shown for future use installed in fire or smoke rated partitions shall be the responsibility of Division 15. All other firestopping and smoke seals of mechanical services are specified under [07860 – FIRESTOPPING AND SMOKE SEALS]
2. Products
 - 2.1. MATERIALS
 - 2.1.1. Sleeves passing through stud partitions shall be 0.75 mm (0.0299 in. - 22 G.S.G.) steel.
 - 2.1.2. Sleeves passing through concrete or masonry partitions shall be Schedule 40 steel pipe.
 - 2.1.3. Sleeves passing through floors in finished areas and concealed spaces may be sheet metal or factory fabricated reusable type.
 - 2.1.4. Sleeves passing through floors in kitchens, laundries, mechanical rooms, garages, pipe spaces or other similar areas except slab on grade, shall extend 50 mm (2 in.) above the surrounding housekeeping pad or floor and shall be Schedule 40 steel pipe.
 - 2.1.5. Sleeves passing through floors with a waterproof membrane and not located within a housekeeping pad shall have a flashing collar, 50 mm (2 in.) wide at the membrane level. Flashing collar shall be continuously welded to sleeve. Sleeves shall extend 50 mm (2 in.) above the finished floor and shall be Schedule 40 steel pipe.
 - 2.1.6. Sleeves for pipes passing through exterior foundation walls shall be pre-manufactured molded non-metallic HDPE equal to PSI-Thunderline Model CS Century-Line. Each sleeve assembly shall have end caps manufactured of the same material as the sleeve and installed at each end to prevent deformation during the concrete pour.
 - .1 The annular space between the service pipe and the sleeve shall be a modular EPDM seal element, reinforced nylon polymer pressure plates, joined with ASTM B633 carbon steel bolts with zinc dichromate and corrosion inhibiting coating equal to PSI-Thunderline Link-Seal Model C wall seal.
 - .2 A reinforced concrete bridge shall be installed between the wall and the adjacent undisturbed soil.
 - 2.1.7. Firestopping and smoke seal systems shall be in accordance with CAN4-S115 – Standard Method of Fire Tests for Firestop Systems, CAN/ULC-S101 – Standard Methods for Fire Endurance Tests of Building Construction and Materials, ASTM E119 – Standard Test Methods for Fire Tests of Building and Construction Materials, and ASTM E814 – Standard Test for Fire Tests of Through-Penetration Firestop Stops.
 - .1 Unless noted otherwise “F” and “T” ratings are shown on the drawings.
 - .2 Systems shall be asbestos free and maintain an effective barrier against flame, smoke, and gases in accordance with CAN4-S115 and shall not exceed opening sizes for which they are intended.

- .3 Firestopping and smoke seals at openings around mechanical services shall be an elastomeric seal for sound and vibration control.
 - .4 Fire resistance rating of firestopping assembly shall not be less than the fire resistance rating of surrounding floor or wall assembly.
 - .5 Service penetration assemblies shall be ULC certified in accordance with CAN4-S115 and listed in ULC Guide No. 40 U19.
 - .6 Service penetration firestop components shall be ULC certified in accordance with CAN4-S115 and listed in ULC Guide No. 40 U19.13 and ULC Guide No. 40 U19.15.
- 2.1.8. Firestopping and smoke seals shall be by Hilti, Tremco/Royal Quickstop, or 3M.
- 2.1.9. Escutcheons shall be satin finish stainless steel or satin finish chrome or nickel plated brass, with non-ferrous set screws. Do not use stamped steel split plates. Split cast plates with screw locks may be used. For escutcheons for plumbing fixtures refer to Section 15450 - FIXTURES AND TRIM.
- 2.1.10. Provide adequate bracing for support of sleeves during concrete and masonry work. For floors and walls with a fire resistance rating, build fire damper assemblies into structure to attain fire rated construction, in a manner acceptable to the governing authorities.
- 2.1.11. Cover exposed duct sleeves in finished areas with 1.42 mm (0.0561 in. - 18 G.S.G.) galvanized sheet steel in the form of duct collars. Fix in position with non-ferrous metal screws.
- 2.1.12. Counter flashing for roof penetrations shall be commercial quality galvanized sheet steel to ASTM A653/A653M-02, 0.70 mm (0.0276 in. - 24 G.S.G.) minimum thickness, Z275 275 zinc coated by hot dip process.
3. Execution
- 3.1. INSTALLATION
- 3.1.1. Arrange for all chases and formed openings in walls and floors as required by the Mechanical Division for the mechanical services. These chases and openings shall not be larger than necessary to accommodate the equipment and services. Advise on these requirements well in advance, before the concrete is poured and the walls are built. All necessary sleeves and inserts shall be supplied by this Division.
- 3.1.2. Chases and openings not located in accordance with the above provisions shall be made at the expense of this Division. Cutting of structural members shall not be permitted without specified written acceptance of the Engineer's Representative.
- 3.1.3. Provide sleeves for all service penetrations through walls, partitions, floor slabs, plenums and similar barriers.
- 3.1.4. Sleeves shall be sized to maintain insulation and vapour barrier around all pipes and ducts for all service penetrations. Coordinate thickness requirements with Section 15250 – MECHANICAL INSULATION.
- 3.1.5. For sleeves through barriers without a fire resistance rating, for non-insulated pipe, fill the annular space between the service and the sleeve with fire rated insulation as specified in Section 15250 – MECHANICAL INSULATION and caulk around the edges with smoke and acoustic sealant.
- 3.1.6. Firestopping and smoke seal material and components shall be installed in accordance with the ULC certification and Manufacturer's instructions. Examine the sizes and conditions of the cavities to be filled to determine the correct thicknesses and installation of materials. All substrates and surfaces in contact with firestopping materials shall be dry and prepared in accordance with the Manufacturer's instructions at appropriate ambient conditions.

- 3.1.7. Where holes are core drilled in existing structures, sleeves shall be provided as specified complete with a combination puddle/anchor flange bolted to the floor. Seal watertight between the flange and the floor.
- 3.1.8. Provide escutcheons at all penetrations of piping into finished areas, and at insulated pipes, make the escutcheons large enough to fit around the insulation.
- 3.1.9. Counter flash vertical duct penetrations through roof at intersection of roof curb and duct.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.1.2. All power and control wiring from starters, fused and non-fused switches, whether mounted in M.C.C.'s or individually, to all mechanical devices and equipment shall be provided by this Division except where shown and specified under the Electrical Division.
 - 1.1.3. All starters for devices supplied by this Division shall be provided by this Division except where shown and specified under the Electrical Division.
 - 1.2. RELATED WORK SPECIFIED ELSEWHERE
 - 1.2.1. All power wiring and starters for devices supplied by this Division shall be provided by the Electrical Division except where shown and specified under this Division. All control wiring shall be provided by this Division.
 - 1.2.2. SUBMITTALS
 - 1.2.3. Further to requirements of Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS, submit Shop Drawings of following:
 - .1 Submit an overload thermal element list with all supporting data for review prior to installation of the elements.
 - .2 Submit samples of nameplates for review before manufacturing.
2. Products
 - 2.1. DISCONNECT SWITCHES
 - 2.1.1. Disconnect safety switches shall either be fusible or non-fusible safety switches and shall be heavy duty type A with quick-make, quick-break contacts, and shall be horsepower rated to match motor protected. Manufacturer shall be Canadian Westinghouse, Schneider, Klockner Moeller, Cutler Hammer or Siemens. Provide hole for padlock in off position.
 - 2.1.2. Fuse clips shall be supplied with non-renewable type fuses suitably rated to motor nameplate current for proper short circuit protection. All fuse holders shall be suitable for HRC Class J time delay fuses. Supply three (3) additional sets of spare fuses for each size of fuse used.
 - 2.1.3. Utilize switches of one manufacturer throughout the building.
 - 2.2. MOTOR CONTROL CENTRES
 - 2.2.1. All motor control centres shall be free standing E.E.,M.A.C.1 Class II, Type B construction in all areas without sprinklers and shall be E.E.M.A.C.-2 drip-proof in all areas with sprinklers as manufactured by Allen Bradley, Siemens, Klockner Moeller, Schneider, Cutler Hammer.
 - 2.2.2. All buswork shall be fully insulated and shall be copper, braced to withstand 40,000 AMP short circuit symmetrical.
 - 2.2.3. No more than 7 NEMA size 1 or smaller combination of standard starters shall be installed in one section. Leave space for a fire alarm shutdown relay compartment as required.
 - 2.2.4. All starters shall be complete with control transformer, pilot lights, and two normally open, normally closed auxiliary contacts. Separate pilot lights shall be used to indicate ON, OFF, LOW SPEED, and/or HIGH SPEED. Selector switches and pilot lights shall be heavy duty

type. Provide high/low speed test positions in the hand mode for multi-speed motors. Starters smaller than size 1 shall not be used.

- 2.2.5. Provide elementary wiring diagrams to Class 2B standards to indicate the control scheme. A separate elementary wiring diagram shall be provided for each fan or pump and the following shall be indicated in each wiring diagram:

Breaker size
Motor hp
Motor F.L.A.
Control transformer KVA
Overload size
Interlock scheme
Remote connection, etc.
Thermistors

- 2.2.6. In each starter identify each wire and terminal with permanent number markings identical to the wiring diagrams.
- 2.2.7. The latching relay, pilot light and the alarm contact shall be housed as part of the starter in the motor control starter.
- 2.2.8. Size the overload thermal elements to the motor nameplate data and to the test curves (time/current/torque).
- 2.2.9. Overload relays, thermistor relays, heater elements and other devices shall be sized to fully protect the motor for all starting and locked rotor conditions with the overloads remaining active in the circuit at all times.
- 2.2.10. All three phase starters shall have 3 phase overload relays.
- 2.2.11. All starters shall operate with 120 V control circuits. The control circuit fuse shall be on the secondary side of the control transformer.
- 2.2.12. Provide an engraved lamaroid nameplate for the motor control centre and each individual starter within the motor control centre. M.C.C. identification shall be 50 mm (2 in.) high letters. All other identified shall be 6 mm (1/4 in.) high letters.

Typical Identification Plate for Motor Control Centre

First Line	- M.C.C. #1
Second Line	- Voltage/Phase/# of Wires
Third Line	- Fed from main secondary switchboard
Fourth Line	- In main electrical room

Typical Identification Plate for Individual Starters

First Line	- Supply Fan SF-1
Second Line	- Voltage/Phase/# of Wires

All nameplates shall be fastened with self-tapping screws.

2.3. INDIVIDUAL STARTERS

- 2.3.1. Individual starters shall meet all requirements specified for M.C.C.'s except as noted below.
- 2.3.2. Individually mounted manual starters shall generally be the toggle operated type with quick-make, quick-break mechanism, heavy duty sliding contacts in E.E.M.A.C. 1 general purpose enclosure in all areas without sprinklers and in E.E.M.A.C.-2 (drip proof) enclosure in all areas with sprinklers, pilot lights in cover and cover engraved with ON-TRIP-OFF positions.
- 2.3.3. Manual starters installed in finished areas shall be as above except suitable for flush mounting with stainless or bronze coverplates.

- 2.3.4. All magnetic starters individually mounted, standard or combination type, shall be for operation with a 120 V AC control transformer and coil, three phase overload protection, pilot lights, reset and pushbuttons or selector switches on the cover. All magnetic starters shall have auxiliary contacts.
- 2.3.5. All combination starters individually mounted shall be combination fusible type complete with pilot lights, on/off selector and reset button on cover. All combination starters shall have auxiliary contacts.
- 2.3.6. Provide an engraved lamacoid nameplate for each individual starter. Identification shall be 6 mm (1/4 in.) high letters.

Typical Identification Plate

First Line	- Exhaust Fan EF-1
Second Line	- 208 V/3 ph/3 W
Third Line	- Fed from splitter #1

3. Execution

3.1. INSTALLATION

- 3.1.1. All wiring and starters provided by this Division shall comply with the requirements of the Electrical Division of the Specifications.
- 3.1.2. Refer to Electrical Drawings and Specifications for work provided under that Division.
- 3.1.3. This Division shall review the shop Drawings for the motor starters submitted by the Electrical Division to ensure that all field connections are shown, the motor horsepower are correct and that the motor control schematics reflect all requirements.
- 3.1.4. Unless otherwise stated, this Section shall be responsible for the complete supply, installation and wiring of all starters, fused and non-fused switches and circuit breakers, auxiliary 120 V controls such as relays and pushbutton stations for the equipment supplied under other Sections of this Division.
- 3.1.5. Use non-fused disconnect switches for local equipment isolation only (e.g. fan motor downstream of fused starter in M.C.C.) all other disconnect shall be fused.
- 3.1.6. Where required provide a galvanized steel hood over switches, M.C.C.'s and individual starters. Hoods shall be suitably reinforced and securely supported from the structure.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.1.2. Electric motors for all driven equipment supplied by this Division shall be provided and installed by this Division.
 - 1.2. SUBMITTALS
 - 1.2.1. Shop Drawings for all electrical motors shall be in accordance with the Section 15031 – SHOP DRAWINGS and shall incorporate the following information.
 - .1 Horsepower
 - .2 Voltage
 - .3 Frequency
 - .4 Speed
 - .5 Starting current and torque characteristics
 - .6 Full load current
 - .7 Class of insulation
 - .8 Enclosure type
 - .9 Service factor
 - .10 Ambient temperature reference
 - .11 Type of bearings
 - .12 Locations of connection box
 - .13 Manufacturer
 - .14 Nominal full load motor Efficiency
2. Products
 - 2.1. MATERIALS
 - 2.1.1. Unless otherwise specified motors shall be squirrel cage induction type with standard drip proof enclosure.
 - 2.1.2. Motors unless otherwise specified shall meet all requirements of E.E.M.A.C. and CSA standards for electrical motors and where possible shall be of Canadian manufacturer.
 - 2.1.3. Generally, all motors shall have starting current-torque characteristics in accordance with E.E.M.A.C., Design B unless otherwise specified or unless load characteristics require a higher starting torque. Each motor shall have sufficient starting torque to start the driven equipment and to accelerate it to full speed within 10 seconds. Motor horsepower shown are minimums. Submit starting times for review.
 - 2.1.4. All motors shall be nominal 1750 rpm, unless otherwise specified.
 - 2.1.5. Unless noted otherwise, all motors shall have Class B insulation and shall be designed for continuous operation at 40 deg. C. (104 deg. F.) Motors controlled from variable speed drives shall have Class H windings and Class F insulation.

- 2.1.6. Motor connection boxes shall be located on side of motor most easily accessible for maintenance and remote from belts, gears or driven equipment. If boxes are factory installed on wrong side of motor they shall be relocated.
- 2.1.7. Each multi-speed motor and associated switching device shall be circuited such that the overload device in the starter protects the motor on each step of the multi-speed switch. As an alternative to this requirement, the motor may have integral overload protection. Multi-speed motors shall be single winding variable torque for 50% motor speed reduction and double winding, two speed for all other speed reductions.
- 2.1.8. Motors shall have the following electrical characteristics
 - .1 For 0.375 kW (1/2 hp) and larger xxx volt, 3 phase, 60 cycle
 - .2 For 0.25 kW (1/3 hp) and smaller 115 volt, 1 phase, 60 cycle
- 2.1.9. Single phase motors 0.25 kW (1/3 hp) and smaller shall be capacitor start.
- 2.1.10. All motors 22.4 kW (30 hp) and larger shall have heat detector protection embedded in the windings for connection into the motor control circuit. Protection shall be Siemens thermistor.
- 2.1.11. All motors 74.6 kW (100 hp) and larger shall be suitable for reduced voltage starting, delta-wye.
- 2.1.12. Motor enclosures shall be as follows:
 - .1 If protected from the weather and entraining moisture, use open drip-proof, service factor 1.15.
 - .2 Motors located in air streams shall be selected to operate satisfactorily at maximum temperature and moisture levels of surrounding air.
 - .3 For all other locations, use totally-enclosed fan-cooled, service factor 1.0.
 - .4 Use explosion proof motors where scheduled.
- 2.1.13. High efficiency motors shall be T frame, A.C., three phase, meet or exceed the CSA-390M-2010 Table 3 Premium Efficiency Levels and be approved under the Canadian Electrical Safety Code:
 - .1 High efficiency motors shall be used on all fans and pumps having motors 0.75 kW (1 hp) or larger.
- 2.1.14. Each electric motor shall be complete with a lamacoid nameplate securely fastened in a conspicuous place on the motor. The nameplate shall be a minimum of 2 mm (3/32 in.) thick laminated phenolic plastic 100 mm (4 in.) long x 50 mm (2 in.) wide with black face and white centre, 5 mm (7/32 in) high letters shall be engraved through to the white lamination with the following:
 - .1 Motor No.
 - .2 Mechanical Equipment Driven
 - .3 Circuit No.
 - .4 Panel No.
 - .5 Panel Location
- 2.1.15. Manufacturer nameplate shall include the nominal full load motor efficiency.
- 2.1.16. Electric motors shall be manufactured by Canadian General Electric, Westinghouse, Lincoln, U.S. Motors, Weg. or Baldor.

3. Execution

3.1. INSTALLATION

- 3.1.1. Drive between any motor and driven equipment shall be provided with a guard, except where casing acts as a guard. Guards for belt-driven equipment shall have a hole for tachometer reading on each shaft.

END OF SECTION

1. General

1.1. WORK INCLUDED

- 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.1.2. Nameplates for systems such as thermostatic controls, are covered in the Articles specifying the equipment.
 - 1.1.3. Every piece of equipment shall have a nameplate.
- 1.2. SUBMITTALS
- 1.2.1. Submit samples of nameplates before installation.

2. Products

2.1. MATERIALS

- 2.1.1. The nameplates shall be a minimum of 2 mm (3/32 in.) thick laminated phenolic plastic. Minimum size shall be 100 mm (4 in.) long x 50 mm (2 in.) wide with maximum size to suit nomenclature required. Nameplate shall be with black face and white centre and with 5 mm (7/32 in.) high lettering engraved through to the white lamination.
- 2.1.2. The nameplates shall have the equipment type and name as indicated in the Equipment Schedules.
- 2.1.3. The nameplates shall have the service and area of the building served (e.g. Chilled Water – South Zone).

3. Execution

3.1. INSTALLATION

- 3.1.1. Nameplates shall be securely fastened with screws or brass chains in a conspicuous place on the equipment.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.2. SUBMITTALS
 - 1.2.1. Submit samples of charts and numbering system before installation.
2. Products
 - 2.1. MATERIALS
 - 2.1.1. Tags shall be square colour coded phenolic with engraved numbers and/or letters as required. Tags shall be a minimum of 25 mm (1 in.) square and maximum to suit numbering system. Numbers shall be nominally 9 mm (3/8 in.) high. Letters shall be nominally 6 mm (1/4 in.) high.
 - 2.1.2. Number and nameplates for standpipe and sprinkler system supervisory and main operating valves shall be minimum 2 mm (3/32 in.) thick laminated phenolic plastic and a minimum 125 mm (5 in.) long x 100 mm (4 in.) wide with red face and white centre. Lettering shall be a minimum 9 mm (3/8 in.) high with maximum to suit local authorities and shall be engraved through to the white lamination. Each nameplate shall contain the system name, service and valve number.
 - 2.1.3. For all other valves on standpipe and sprinkler system not required to have laminated number and nameplates, provide plastic tags as specified above.
 - 2.1.4. Abbreviations and colour code shall be as shown on Standard Details.
3. Execution
 - 3.1. INSTALLATION
 - 3.1.1. Tags and nameplates shall be attached to the valve body or handle with brass hooks or chains.
 - 3.1.2. All valves shall be provided with tags, other than valves on convectors, induction units or other space heating, cooling units and valves on plumbing fixtures. Provide a chart or charts, indicating location, service and zone of each valve. This work shall be co-ordinated between the various Mechanical Sections to prevent overlapping of numbering systems.
 - 3.1.3. Provide separate charts for all fire system nameplates and tags.
 - 3.1.4. For extension and/or alterations to existing systems, provide new charts conforming in appearance to the existing charts.
 - 3.1.5. Co-ordinate valve identification with pipe and ductwork identification.
 - 3.1.6. Roof drains used for restricting or controlling the flow of water from the roof or acting as an overflow shall be affixed with an identification label "Control Flow Roof Drain – Do Not Remove Restriction Device".
 - 3.1.7. Charts shall be set in metal picture frames with a clear acrylic front and fastened securely where directed by Engineer's Representative or Owner.

3.1.8. All valve tag numbers for all systems shall be shown on the As-Built Drawings.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.2. RELATED WORK SPECIFIED ELSEWHERE
 - 1.2.1. Field painting of non-colour coded piping and ductwork – under Division 9, Section 09900 – PAINTING AND COATING.
2. Products
 - 2.1. MATERIALS
 - 2.1.1. Paint shall be compatible with the surface material to be painted.
 - 2.1.2. Colour code shall conform to CAN/CGSB 24.3-92 and ANSI A131-1981.
 - 2.1.3. Pipe covering shall be SMS, Brady, and Seton equal to SMS Coil-Mark system pipe markers.
 - 2.1.4. All identification shall incorporate direction of flow arrows, and the specified system designations and abbreviations. Designations and abbreviations shall be submitted for review prior to installation.
3. Execution
 - 3.1. INSTALLATION
 - 3.1.1. After completion of insulation and/or painting, all piping and ductwork shall be marked to show the service and direction of flow.
 - 3.1.2. Marking shall be placed at each side of any wall, partition or floor, at 9.1 m (30 ft.) intervals (maximum) on all exposed piping and ductwork and at each access panel or door. Marking shall be located so as to be in full view and visible from the floor.
 - 3.1.3. All pipe identification shall be installed in accordance with the manufacturer's recommendations.
 - 3.1.4. Pipe identification markers for insulated or non-insulated pipe sizes less than 150 mm (6 in.) circumference shall be pre-coiled and shall cover the pipe in its entirety and be joined using adhesive along the longitudinal joint. In addition to the adhesive the marking system shall be banded with clear plastic tie-wraps on each end.
 - 3.1.5. Pipe identification markers for insulated or non-insulated pipe sizes equal to and greater than 150 mm (6 in.) circumference shall be strapped on with recommended tie-wraps.
 - 3.1.6. Adhesive labels are not acceptable.
 - 3.1.7. Gas piping shall be painted yellow for the entire length and identified with pipe identification markers. Banding shall not be accepted.
 - 3.1.8. All electric traced piping shall have additional identification to show it is traced.
 - 3.1.9. Identify ductwork with 50 mm (2 in.) stencils using black or white ink to contrast the surface being identified.

- 3.1.10. Identification location for ductwork shall conform to the guidelines for pipe and shall indicate flow medium, function, and direction.
- 3.1.11. Contractor shall ensure stenciling is performed in a neat, quality manner.

END OF SECTION

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. NOT USED

3. Execution

3.1. INSTALLATION

3.1.1. Clean thoroughly all fixtures and equipment from grease, dirt, plaster or any other foreign material. Chrome-plated fittings, piping and trim shall be polished upon completion.

3.1.2. Any dirt, rubbish, or grease on walls, floors or fixtures accumulated from the work of the Mechanical Division shall be removed promptly from the premises by this Division.

3.1.3. Fixtures and equipment shall be properly protected from damage during the construction period and shall be cleaned and polished in accordance with manufacturer's directions. Motors and equipment bearings shall be protected with plastic sheets, tied or taped in place. Aluminum fin heating or cooling elements shall be protected with cardboard covers.

3.1.4. Any unpainted steel surfaces, installed for longer than one year prior to the completion date, shall be prime coated under this Division.

3.1.5. During construction protect all services and equipment from dirt and debris, by using temporary caps over the open ends of pipes ductwork and equipment connections.

3.1.6. All equipment installed or stored on site shall be maintained in accordance with manufacturers recommended instructions (i.e. rotate shafts on fans, pumps, etc).

3.1.7. Refinish and restore to the original condition and appearance all mechanical equipment which has sustained damage to the manufacturer's prime and finish coats of enamel or paint. Materials and workmanship shall be equal to the manufacturers original.

3.1.8. All cleaning and protective measures shall be in accordance with the SMACNA – IAQ Guidelines for Occupied Buildings under Construction and the IAQ Management Plan developed by the general contractor to conform to LEED requirements.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.1.2. Submit Drawings showing size, type and location of all access doors, for review, before installation.
2. Products
 - 2.1. MATERIALS
 - 2.1.1. Access doors shall be Acudor, or Mifab Manufacturing Inc.
 - 2.1.2. Doors in solid walls shall be with a 14 U.S. gauge, prime painted steel door panel, rust resistant concealed hinges, flanged frame, and screwdriver operated lock. Acudor Model UF 5000 or Mifab Model UA.
 - 2.1.3. Doors in plaster partitions or ceilings shall be with a 16 US gauge, prime painted steel recessed door panel with metal lath for the acceptance of plaster finish, concealed hinges, metal lath frame, and screwdriver operated lock. Acudor model AP 5010 or Mifab Model CAD-PL.
 - 2.1.4. Doors in drywall partitions or ceilings shall be 16 US gauge, prime painted steel recessed door panel for the acceptance of a drywall insert, concealed hinges, drywall bead frame, and screwdriver operated lock. Acudor model DW 5015 or Mifab Model CAD-DW.
 - 2.1.5. Doors in drywall partitions or ceilings shall be 14 US gauge, prime painted steel flush door panel, concealed hinges, drywall bead frame, and screwdriver operated lock. Acudor model DW 5040 or Mifab Model MDW.
 - 2.1.6. Access doors in fire rated walls or ceilings shall be ULC labeled with insulated door panel, concealed hinge, self closing, self latching, flanged frame, and prime painted. Provide master key operated catch in areas accessible to the public. Acudor Model FW 5050 or Mifab MPFR.
 - 2.1.7. Doors in tiled walls or ceilings shall be 16 US gauge, stainless steel, type 304 with #4 satin finish, concealed hinges, wall frame and screw driver operated lock. Acudor Model UF 5000 or Mifab Model UA-SS.
 - 2.1.8. Doors for medium and high security applications in solid walls shall be 10 US gauge door with minimum 4 mm (3/16 in.) welded angle frame with heavy duty butt hinges welded to the door and frame with master keyed cylinder lock provided by the Owner. Acudor Model SD 6000 or Mifab Model MI-SADH.
 - 2.1.9. Minimum size of doors shall be 300 mm x 450 mm (12 in. x 18 in.). Wherever possible 600 mm x 600 mm (24 in. x 24 in.) doors shall be used.
3. Execution
 - 3.1. INSTALLATION
 - 3.1.1. All parts of the installation requiring periodic maintenance shall be accessible. Wherever valves, dampers and other appurtenances are concealed by building construction, access doors shall be furnished by this Section and installed under the respective Trade Sections (i.e.

- masonry, plaster, drywall, tile, etc.) This Section is responsible for the proper location of the access doors.
- 3.1.2. Wall mounted plumbing fixtures with back water connection shall have an adjacent access door.
 - 3.1.3. Wherever possible, items requiring access shall be located in easily accessible areas (i.e. exposed or T-bar ceilings).
 - 3.1.4. Group items in order to minimize the number of access doors required.
 - 3.1.5. Each access door shall be installed to provide complete access to equipment for maintenance and servicing.
 - 3.1.6. Make any changes to locations of access doors as directed by the Engineer's Representative.
 - 3.1.7. The final installed locations of all access doors shall be shown on the As-Built Record Drawings.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.1.2. Comply with all requirements of Section 15030 – RECORD DRAWINGS.
 - 1.1.3. Comply with all requirements of Section 15031 – SHOP DRAWINGS.
 - 1.1.4. Comply with all requirements of Section 15062 – COMMISSIONING.
 - 1.1.5. Comply with all requirements of Section 01780 – CLOSEOUT SUBMITTALS.
2. Products
 - 2.1. REQUIREMENTS FOR MANUALS
 - 2.1.1. Three copies of complete and approved operating and maintenance instructions for all mechanical equipment and systems shall be supplied before substantial completion. Manuals shall be also submitted in electronic format. Electronic manuals shall be prepared in Adobe PDF format with all sections bookmarked for quick reference and submitted on DVD.
 - 2.1.2. Binders shall be three-ring, hard-cover, loose-leaf type and identified on the binding edges as “Maintenance Instructions and Data Book”, for “(Project Name)”.
 - 2.1.3. Terminology used in all the Sections shall be consistent.
 - 2.1.4. Volume One shall contain the master index of all systems, the name of the Contractor, Mechanical Sub-Contractors and the date of substantial performance for the Contract.
 - 2.1.5. Volume One shall contain a section with all necessary warranty information.
 - 2.1.6. Each binder shall have a complete index for all volumes.
 - 2.1.7. Each binder shall be no more than half filled.
 - 2.1.8. There shall be a separate section for all materials used on the project which fall under the WHMIS legislation. There shall be a hazard data sheet for each of the materials.
 - 2.1.9. There shall be a separate section for all Insurance Certificates, Test Certificates, Verification Forms and Test Forms.
 - 2.1.10. All relevant information relating to a system or product shall be contained within one binder.
 - 2.1.11. The manual sections shall follow the specification sections.
 - 2.1.12. Any diagrams, installation drawings, flow charts, etc. shall be mechanically reduced while maintaining full legibility to standard page size. If this cannot be achieved they shall be carefully folded and contained within a clear plastic wallet within the manual.
 - 2.2. DATA FOR MANUALS
 - 2.2.1. Equipment data shall contain:
 - .1 Operating instructions
 - .2 Operating conditions such as temperature and pressure
 - .3 Location of equipment
 - .4 Maintenance instructions and schedules for one year routine
 - .5 Recommended list of spare parts

- .6 Lubrication schedule
- .7 A trouble shooting table showing where to look for problems under various conditions of malfunction
- .8 All wiring diagrams
- .9 Equipment operating curves
- .10 Equipment nameplate data and serial numbers
- 2.2.2. System data shall contain:
 - .1 A listing of all systems
 - .2 A valve schedule and locations
 - .3 Equipment name tags
 - .4 Filter schedule
 - .5 An electric pipe tracing schedule including location and electrical service location
 - .6 Cleaning, maintaining and preserving instructions for all material, products and surfaces. Include warnings of harmful cleaning, maintaining and preserving practices.
- 2.2.3. Sub-Contractor manuals are required for:
 - .1 BAS
 - .2 Water treatment
 - .3 Sprinkler system
 - .4 Water and air balancing
- 2.2.4. As-built documentation shall contain:
 - .1 Reviewed As-Built Shop Drawings
 - .2 As-Built Construction Drawings
 - .3 Originals of Test Forms
 - .4 Originals of Test Certificates
- 2.3. OPERATING INSTRUCTIONS
- 2.3.1. Instruct the Owner's representative in all aspects of the operation and maintenance of systems and equipment.
- 2.3.2. Comply with all requirements of Section 15062 – COMMISSIONING, for duration of tests.
- 2.3.3. Instruct the Owner for a minimum of five (5) working days.
- 2.3.4. Arrange for and pay for the services of engineers and other manufacturers' representatives required for instruction on the systems and the equipment as requested by the Engineer's Representative and/or the Owner.
- 2.3.5. At the time of final review, provide a sheet for each system and piece of equipment showing the date instructions were given. Each sheet shall show the duration of instruction, name of persons receiving instruction, other persons present (manufacturer's representative, Engineer's Representative, etc.), system or equipment involved and signature of the Owner's staff stating that they understood the system installation, operating and maintenance requirements. This information shall be inserted in the manuals after all instructions have been completed.
- 2.3.6. Review information with the Owner's representative to ensure that all information required has been provided.
- 2.3.7. Mechanical equipment and systems included in the instruction requirements are:

- .1 Heating water generators and associated equipment
- .2 Steam generators and associated equipment
- .3 Automatic controls and instrumentation
- .4 Water treatment and cleaning
- .5 Life safety and fire protection
- .6 Noise and vibration
- .7 Heating water distribution systems
- .8 Steam distribution systems and condensate
- .9 Air handling distribution and components
- .10 Miscellaneous ventilation systems
- .11 Storm, sanitary and domestic water pumping and distribution system

2.4. TRIAL USAGE

- 2.4.1. The Owner shall be permitted trial usage of systems or parts of systems for the purpose of testing and learning operational procedures. Trial usage shall not affect the warranties nor be construed as acceptance, and no claim for damage shall be made against the Owner for any injury or breakage to any part or parts due to the tests, where such injuries or breakage are caused by a weakness or inadequacy of parts, or by defective materials or workmanship of any kind.

3. Execution

3.1. NOT USED

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.1.2. Conform to Section 15030 – RECORD DRAWINGS.
 - 1.1.3. Conform to Section 15031 – SHOP DRAWINGS.
 - 1.1.4. Conform to Section 15061 – OPERATING AND MAINTENANCE INSTRUCTIONS.
 - 1.1.5. Conform to Section 15191 – TESTING AND BALANCING OF PIPING SYSTEMS.
 - 1.1.6. Conform to Section 15193 – TESTING AND BALANCING OF AIR SYSTEMS.
 - 1.1.7. Conform to Section 15910 – STANDALONE CONTROLS.
 - 1.1.8. The commissioning process for the Mechanical Systems shall include:
 - .1 Verification that the installation meets the requirements of the contract documents.
 - .2 Verification that the systems performance meets the design intent.
 - .3 Provision of building operator training.
 - .4 Provision of as-built documentation, operating and maintenance manuals, and systems operating manuals.
 - 1.1.9. The Contractor, Engineer's Representative shall provide the services to complete the process. The execution portion of this Section defines the areas of responsibility.
 - 1.1.10. Provide labour, equipment and material to conduct the Contractor commissioning process as outlined in this Section.
 - 1.1.11. An Independent Testing and Balancing Contractor will provide the services identified in the Sections for "Testing and Balancing of Water and Air Systems".
 2. Products
 - 2.1. MATERIALS
 - 2.1.1. The Contractor and manufacturers shall provide all instrumentation and equipment necessary to conduct the tests as specified in the Mechanical Sections. The Contractor shall advise the Engineer's Representatives of instrumentation to be used and the dates the instruments were calibrated.
 3. Execution
 - 3.1. INSTALLATION
 - 3.1.1. This Section describes the commissioning process to be performed by the Contractor. The process shall provide a high level of quality control during the construction.
 - 3.1.2. The commissioning process shall consist of:
 - .1 Shop Drawings/Record Drawings
 - .2 Installation review and equipment verification
 - .3 Plumbing and drainage system testing

- .4 Testing of piping systems
- .5 Independent Contractor balancing of water systems
- .6 Testing of air systems
- .7 Independent Contractor balancing of air systems
- .8 Testing of equipment and systems
- .9 Commissioning meetings
- .10 Operating and maintenance manuals
- .11 Training
- .12 Systems acceptance

3.2. INSTALLATION REVIEW AND EQUIPMENT VERIFICATION

- 3.2.1. The Contractor shall complete the equipment verification forms for each piece of equipment. The completed forms shall be forwarded to the Engineer's Representative for review and be included in the operating and maintenance manual.

3.3. TEST FORMS AND VERIFICATION FORMS

- 3.3.1. The Contractor shall prepare test forms for every test identified in this Specification. The Contractor shall complete each form as tests are completed and forward a copy to the Engineer's Representative for review on a monthly basis.
- 3.3.2. The forms shall be signed by either the authorities, the Engineer's Representative.
- 3.3.3. Test forms and verification forms have been included with this Section. Obtain approval from the Engineer's Representative if the Contractor wishes to use different forms.

3.4. PLUMBING AND DRAINAGE SYSTEM TESTING

- 3.4.1. The plumbing and drainage system shall be tested in accordance with Section 15191.
- 3.4.2. The Contractor shall notify the Building Inspector when systems are available for testing. The Contractor shall document all tests performed and shall arrange for the Building Inspector to sign the forms for tests completed.

3.5. TESTING OF PIPING SYSTEMS

- 3.5.1. Test all piping systems in accordance with Section 15191 - TESTING AND BALANCING PIPING SYSTEMS.
- 3.5.2. All tests for the systems shall be performed in the presence of the Engineer's Representative or the Commissioning Agent.

3.6. TESTING OF AIR SYSTEMS

- 3.6.1. Conform to Section 15193 – TESTING AND BALANCING AIR SYSTEMS.
- 3.6.2. All tests shall be performed in the presence of the Engineer's Representative or the Commissioning Agent.

3.7. TESTING OF EQUIPMENT AND SYSTEMS

- 3.7.1. Conform to Section 15061 – OPERATING AND MAINTENANCE INSTRUCTIONS
- 3.7.2. The Contractor shall hire the services of the manufacturers technicians to test the equipment and associated systems. The technician shall record the results of the tests on the testing

- forms. The tests shall be witnessed by the Engineer's Representative. When the tests have been completed satisfactorily the technician and witnessing authority shall sign the forms.
- 3.7.3. Should equipment or systems fail a test, the test shall be repeated after repairs or adjustments have been made. The additional tests shall be witnessed by the Engineer's Representative.
- 3.7.4. Tests which have not been witnessed shall not be accepted and shall be repeated.
- 3.8. OPERATING AND MAINTENANCE MANUALS
- 3.8.1. Conform to Section 15061 – OPERATING AND MAINTENANCE INSTRUCTIONS.
- 3.8.2. Submit Operating and Maintenance Manuals to Commissioning Agent for review.
- 3.9. OPERATOR TRAINING
- 3.9.1. Conform to Section 15061 – OPERATING AND MAINTENANCE INSTRUCTIONS.
- 3.9.2. Submit Operating and Maintenance manuals to Engineer for review.
- 3.9.3. The training shall be conducted at the equipment or system.
- 3.9.4. Training will begin when the operating and maintenance manuals have been delivered to the Owner and reviewed by the Engineer's Representative.
- 3.9.5. Submit a course outline to the Engineer's Representative before training commences. Provide course documentation for up to eight people.
- 3.9.6. Each training session will be structured to cover:
- .1 The operating and maintenance manual
 - .2 Operating procedures
 - .3 Maintenance procedures
 - .4 Trouble-shooting procedures
 - .5 Spare parts required
- 3.9.7. Training shall be provided for the following systems:
- | System | Minimum Training Times |
|-----------------------|------------------------|
| The mechanical system | 4 hours |
- 3.9.8. Refer to Section 15900 – BUILDING AUTOMATION SYSTEMS.
- 3.9.9. The training requirement for the mechanical system shall include a walk-through of the building by the Contractor. During the walk through the Contractor shall:
- .1 Identify equipment
 - .2 Identify starters associated with equipment
 - .3 Identify valves and balancing dampers
 - .4 Identify access doors
 - .5 Review general maintenance of equipment
 - .6 Review drain locations in pipework systems
 - .7 Identify maintenance items

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.1.2. Openings required for mechanical services for new construction shall be in accordance with Section 15052 – SLEEVES AND ESCUTCHEONS. This Section shall apply for openings required in existing construction or where sleeves for mechanical services have been omitted in new construction in error.
 - 1.1.3. Include for all cutting and patching for all mechanical services for holes and openings with dimensions up to 200 mm (8 in.) in size and related patching. Carry out cutting and patching work in accordance with requirements of Section 01600 – PROJECT FORMS.
 - 1.1.4. Cutting and Patching shall be in accordance with Section 01600 – PROJECT FORMS.
2. Products
 - 2.1. MATERIALS
 - 2.1.1. All services and materials used for the cutting and patching shall meet all requirements specified in Section 01600 – PROJECT FORMS, and shall be carried out by professional workers experienced in the cutting and patching work to be done.
3. Execution
 - 3.1. INSTALLATION
 - 3.1.1. Locate all openings in non-structural elements requiring cutting and patching in cooperation with Section 01600 – PROJECT FORMS in a timely manner to avoid unnecessary cutting. All openings shall be shown on Drawings and submitted to the Engineer's Representative for review. No holes through structure shall be permitted prior to review by the Structural Engineer's Representative.
 - 3.1.2. Core drilling for individual services shall be by this Division. Cut all openings no larger than is required for the services.
 - 3.1.3. Locate all openings in structure elements requiring cutting and patching and x-ray the structure to obtain Structural Engineer's Representative's approval prior to cutting or core drilling of existing structure. Make adjustments to location of openings as required to minimize cutting of rebar and completely avoid electrical conduit.
 - .1 Cut holes through slabs only.
 - .2 Do not cut holes through beams.
 - .3 Holes to be cut are 200 mm (8 in.) (diameter) or smaller only.
 - .4 Maintain at least 100 mm (4 in.) clear from all beam faces. Space at least 3 hole diameters on Centre.
 - .5 For holes that are required closer than 25% of slab span from the supporting beam face, use cover meter above the slab to clear slab top bars.
 - .6 For holes that are required within 50% of slab span, use cover meter underside of slab to clear slab bottom bars.

- .7 X-rays shall be performed by a qualified technician, in a safe manner and in accordance with all applicable regulations governing this activity.
- 3.1.4. Obtain written approval from the Structural Engineer's Representative before cutting or core drilling any openings or holes.
- 3.1.5. Patch all openings after services have been installed to match the surrounding finishes.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.1.2. Piping and equipment provided under the Mechanical Division shall be complete with all necessary supports and hangers required for a safe and workmanlike installation.
 - 1.1.3. Hangers, supports, anchors, guides, and restraints shall be selected to withstand all static and dynamic loading conditions which act upon the piping system and associated equipment. The Mechanical Division shall prepare detailed shop drawings showing all anchors and guides for all systems with the potential for thermal expansion/contraction and/or loads due to weight or thrust. The drawings shall bear the signed seal of a Professional Engineer licensed to practice in the appropriate discipline and place of work. The drawings shall include all details of construction, static and dynamic forces at points of attachment, etc. necessary for review and acceptance by the project Structural Engineer's Representative. Make adjustments as necessary to satisfy the requirements of the Structural Division. No anchor points shall be permitted without reviewed shop drawings and, where installed prior to review, shall be removed and replaced to the satisfaction of the Engineer's Representative.
2. Products
 - 2.1. MATERIALS
 - 2.1.1. Provide hangers and supports manufactured by Anvil International or E. Myatt & Co.
 - 2.1.2. All pipe hangers and supports shall be manufactured to the latest requirements of MSS-SP-58. Where applicable, design and manufacture of hangers and supports shall also conform to ANSI/ASME Code for Pressure Piping B31.1.
 - 2.1.3. Pipe rolls shall have cast iron rollers, shaped to accept the outside diameter of the insulated pipe. Roll shall either rotate on a steel shaft mounted on a cast iron stand or shall roll on a cast iron bed plate.
 - 2.1.4. Pipe slide assembly shall be manufactured to the latest requirements of MSS-SP-69. Assembly shall be complete with Carbon steel structural or fabricated tee, 100% virgin PTFE bonded slide plates and carbon steel base.
 - .1 For cold services such as domestic cold water, dual temperature, and chilled water to maintain the integrity of the insulation and vapour barrier and where slides can not be directly welded to the pipe provide a plain carbon steel pipe clamp to be welded to the tee support. Clamp shall be full length of tee support and shall be minimum 150mm (6 in.) or as recommended by manufacturer for the specific pipe size.
 - .2 For hot services such as steam, heating water, etc. where the piping is 50mm (2 in.) and larger, use a standard catalogue protection saddle tack welded to the pipe, which provides a space between the pipe and tee equal to the thickness of the insulation. Weld the tee to the protection saddle.
 - .3 For longitudinal movement only provide hold down lugs.
 - .4 For free movement in all directions width of slide plate base shall be sufficient for full travel.
 - .5 As an alternative to the above, for compact installations, tees may be welded to the pipe directly provided that the temperature is suitable, extended structural or fabricated tees are used, and the tee is vapour sealed at the insulation and completely insulated to

prevent condensation for cold services. Provide details and obtain approval from the Engineer's Representative prior to proceeding with this arrangement.

- 2.1.5. Roof supports for pipe or duct runs greater than 30 ft. shall be Thaler Roof Specialities.
- 2.1.6. Roof supports for pipe or duct runs less than 30 ft. shall be Thaler Roof Specialties, MIRO Industries (Unitrust), Advanced Support Products, Inc. or Portable Pipe Hangers Inc.
- 2.1.7. All hangers, supports, brackets and other devices installed exterior to the building shall be galvanized to prevent failure from environmental corrosion. If galvanized components cannot be used submit samples of proposed substitute for review prior to installation.
- 2.2. CONSTANT SUPPORT HANGERS
 - 2.2.1. For piping at hanger locations where the vertical movement of the piping is 12mm (1/2 in.) or more or where necessary to avoid the transfer of load to adjacent hangers or connected equipment, pipe hangers shall be constant support design.
 - 2.2.2. The total travel for constant support hangers shall be equal to travel plus 20%. In no case shall the difference between the actual and total travel be less than 25mm (1 in.) The constant support hanger shall have travel scales on both sides of the support frame for inspection purposes.
 - 2.2.3. Each constant support hanger shall be individually calibrated prior to shipment to support the exact loads specified.
 - 2.2.4. Alloy springs shall meet the requirements of ASTM A-125 and shall be shot peened and examined by magnetic particle. The spring rate tolerance shall be +/- 5%.
 - 2.2.5. Constant supports shall have a wide range of load adjustability. No less than 10% of this adjustability shall be provided either side of the calibrated load for plus or minus field adjustment. Load adjustment scale shall be provided to aid the field in accurate adjustment of loads and load adjustment shall be possible without the use of special tools and shall not impact the travel capabilities of the supports.
 - 2.2.6. Constant supports shall be furnished with travel stops to prevent upward and downward movement of the hanger. The travel stops shall be factory installed so that the hanger level is at the cold position. The travel stops shall be designed to permit future re-engagement.
- 3. Execution
 - 3.1. INSTALLATION
 - 3.1.1. Pipe hangers shall be capable of supporting the pipe in all conditions of operation. They shall allow free expansion and contraction of the piping, and prevent undue stress to building structural components.
 - 3.1.2. Piping shall be supported from walls, beams, columns, and slabs using approved structural attachments. In situations where approved attachments cannot be used, alternative attachments or substructure assemblies shall receive approval prior to installation. Prior approval shall be given for any cutting or drilling of building structural steel. Damage or modification to the structure through welding, cutting, or drilling shall not be permitted if it reduces the integrity of the building structure as deemed by the Structural Engineer's Representative. It shall be the responsibility of the Mechanical Division to supply anchor bolts and base diagrams for equipment and pipe supports showing exact location of attachments.
 - 3.1.3. All drilling for hangers, rod inserts and work of similar nature shall be done by this Division.
 - 3.1.4. Auxiliary structural members shall be provided under the Mechanical Section concerned where piping, ducts or equipment must be suspended between the joists or beams of the

structure, or where required to replace individual hanger to allow for installation on new services. Auxiliary structural members shall be the same material and finish as the primary structure (i.e. prime painted, galvanized, etc.). Submit details for review as requested.

- 3.1.5. Depending on the type of structure, hangers shall be either clamped to steel beams or joists, or attached to approve concrete inserts. Submit proposed hanger details for review and acceptance by the Structural Engineer's Representative. Make adjustments as necessary to satisfy the requirements of the Structural Division.
- 3.1.6. For precast concrete construction, hanger rods shall pass between slabs and be supported on the slab within the topping by a 100mm x 100mm x 3mm (4 in. x 4 in. x 1/8 in.) steel plate welded to the hanger rod. A lock nut threaded to the hanger rod together with a 50mm (2 in.) minimum dia. washer shall be applied tight against the under surface of the deck to prevent rising of the hanger.
- 3.1.7. Approved type expansion shields and bolts may be used for pipe up to 100mm (4 in.) diameter where the presetting of concrete inserts is not practical. Submit proposed hanger details for review and acceptance by the Structural Engineer's Representative. Make adjustments as necessary to satisfy the requirements of the Structural Division.
- 3.1.8. Suspension from metal deck shall not be allowed unless specifically accepted by the Engineer's Representative. Drawings of the proposed method of suspension must be submitted for review.
- 3.1.9. Hangers, hanger rods and inserts in all parking and ramp areas shall meet the requirements of CAN/CSA-S413-94 (R2005) and shall be of corrosion-resistant material or have an effective, durable corrosion resistant coating. Submit samples for approval.
- 3.1.10. Hanger rods shall be subject to tensile loading only. Suspended piping shall be supported by adjustable hanger rods sized as follows:

Pipe Size	Hanger Rod Diameter
50mm (2 in.) and under	9mm (3/8 in.)
65mm (2-1/2 in.) and 75mm (3 in.)	12mm (1/2 in.)
100mm (4 in.) and 125mm (5 in.)	16mm (5/8 in.)
150mm (6 in.)	19mm (3/4 in.)
200mm (8 in.) to 300mm (12 in.)	22mm (7/8 in.)

- 3.1.11. Unless otherwise specified or shown hanger spacing for all services shall be as follows:

Nominal Pipe Diameter	Maximum Span
Up to and including 25mm (1 in.)	2.1 m (7 ft.)
32mm (1-1/4 in.) to 125mm (5 in.)	3 m (10 ft.)
150mm (6 in.) and larger	4.6 m (15 ft.)

In addition, provide a hanger within 600mm (2 ft.) on each side of valves on pipes over 38mm (1½ in.) diameter, elbows or tees.

- 3.1.12. Hanger spacing for plumbing and drainage services shall be in accordance with the plumbing code.
- 3.1.13. Hanger spacing for fire protection services shall be in accordance with the N.F.P.A. codes.
- 3.1.14. All horizontal piping 50mm (2 in.) diameter and larger shall be supported by adjustable wrought iron clevis type hangers. Smaller piping shall be supported by adjustable split ring hangers or clevis type hangers.
- 3.1.15. Suspending one hanger from another shall not be permitted.

- 3.1.16. For hot water or steam piping 50mm (2 in.) and larger, use a standard catalogue protection saddle tack welded to the pipe, which provides a space between the pipe and hanger equal to the thickness of the insulation.
- 3.1.17. For hot water or steam piping 38mm (1-1/2 in.) and smaller, use line size hangers.
- 3.1.18. For cold water services such as domestic cold water, chilled water pipe on dual chilled and hot water pipe 25mm (1 in.) and smaller, install a section of high density insulation complete with continuous vapour barrier between the pipe and the hanger. Refer to Section 15250 – MECHANICAL INSULATION.
- 3.1.19. For cold water services such as domestic cold water, chilled water pipe or dual chilled and hot water pipe larger than 25mm (1 in.), use a galvanized steel shield between the insulation and the hanger. Between the shield and the pipe, install a section of high density insulation complete with continuous vapour barrier. Refer to Section 15250 – MECHANICAL INSULATION.
- The shield width shall be minimum 1/4 of the pipe circumference. The length and gauge shall be as follows:
- .1 150mm (6 in.) long and 14 US gauge for pipe larger than 25mm (1 in.) up to 50mm (2 in.) diameter
 - .2 250mm (10 in.) long and 12 US gauge for pipes 65mm (2-1/2 in.) to 300mm (12 in.) diameter
 - .3 300mm (12 in.) long and 10 US gauge for pipes 350mm (14 in.) to 400mm (16 in.) diameter
- 3.1.20. Hangers and riser clamps in contact with copper pipe shall be copper coated construction or plastic coated. Taped hangers and riser clamps shall not be accepted.
- 3.1.21. Unless otherwise specified or shown, all pipes supported from below shall be mounted on pipe rolls or pipe slides.
- 3.1.22. Provide constant support hangers where shown for horizontal or vertical pipes which require vertical movement for expansion. Vertical movement shown for these hangers shall be movement either up or down. Provide hangers to allow for movement in both directions.
- 3.1.23. Unless otherwise specified or shown, vertical pipes shall be supported at least every fourth floor or every 12 m (40 ft.) maximum.
- 3.1.24. Pipe slides shall be pre-engineered type. Structural or fabricated tees shall be welded to the pipe or to the protection saddle as shown.
- 3.1.25. Install resilient hangers in accordance with Section 15200 – VIBRATION AND NOISE CONTROL.
- 3.1.26. Install additional seismic supports in accordance with Section 15225 – SEISMIC RESTRAINT SYSTEMS.
- 3.1.27. Other means of support shall be as shown or as specified hereunder.
- 3.1.28. For special equipment supports refer to equipment sections. Where no support method is identified secure wall mounted equipment to metal framing or masonry, with steel toggle or expansion fasteners, machine screws or sheet metal screws as applicable. Plastic, fibre or soft metal inserts shall not be acceptable. Wall mounted equipment shall not exceed 45.5 Kg (100 lbs) in weight or 250mm (10") in depth unless reviewed or detailed by the Engineer's Representative. Where framing does not permit direct attachment, provide metal strut sub-framing or minimum 19mm (3/4 in.) fire retardant treated plywood backboards, unpainted, attached to the framing. Provide attachments for backboards at 600mm (24 in.) on centres with no less than 4 attachments.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
2. Products
 - 2.1. MATERIALS
 - 2.1.1. Circulators shall be Armstrong, Taco or ITT Industries wet rotor inline pumps, in cast iron or lead free bronze body construction specifically designed for quiet operation, with flanged inlet and outlet, mechanical seal and suitable for 125 psig working pressure and 230° F temperature.
 - 2.1.2. Flange dimensions shall be HVAC industry standard 2 or 4 bolts sizes.
 - 2.1.3. For domestic water systems pump shall be all bronze with brass impeller.
 - 2.1.4. For all systems except domestic water pump shall be cast iron, steel impeller and stainless steel shaft.
 - 2.1.5. Pump capacity shall be as shown in the Pump Schedule.
 - 2.1.6. Secondary (Load) System Circulator shall be Bell & Gossett ecocirc XL, Grundfos Magna3, or Taco 00e.
 - .1 Motor shall be a synchronous, permanent-magnet (PM) motor and tested with the pump as one unit. Conventional induction motors will not be acceptable.
 - .2 Each motor shall have an Integrated Variable Frequency Drive tested as one unit by the manufacturer.
 - .3 Integrated motor protection shall be verified by UL to protect the pump against over/under voltage, over temperature of motor and/or electronics, over current, locked rotor and dry run (no load condition).
 - .4 Pump shall have MODBUS or BACnet connections built into the VFD as standard options.
 - .5 Analog inputs, such as 0-10V and 4-20mA, are standard inputs built into the VFD.
 - .6 Pumps shall be UL 778 listed and bear the UL Listed Mark for USA and Canada with on-board thermal overload protection.
 - .7 Each pump shall be factory performance tested before shipment.
 - .8 The pump shall be complete with the following operating modes:
 - .1 Proportional Pressure – The differential pressure will continuously increase or decrease along a linear curve based on the flow demand.
 - .2 Constant Pressure – The pump maintains a constant differential pressure set by the user at any flow demand until the maximum speed is reached.
 - .3 Constant Speed – The pump maintains a constant speed at any flow rate
 - .4 Night Set Back – The pump will recognize a 10°C water temperature reduction and will switch to nighttime operation.
 - .5 T-Constant – This control will use a PI algorithm to vary the speed of the pump in order to maintain a constant temperature of the fluid media.

- .6 Delta-T Constant – This control mode will use a PI algorithm to vary the speed of the pump in order to maintain a constant differential temperature between the built-in temperature sensor and external temperature sensor.
 - .7 Delta-P-T – This control mode is paired with proportional or constant pressure mode. The nominal differential pressure set point will vary according to the fluid temperature.
 - .8 Delta-P-Delta-T – This control mode is paired with proportional or constant pressure mode. The nominal differential pressure set point will vary according to the differential temperature between the built-in temperature sensor and external temperature sensor.
- 2.1.7. Primary (Boiler) Circulator shall be Grundfos UPS, Bell & Gossett NRF, or Taco 011 and shall be provided with the boiler.

3. Execution

3.1. INSTALLATION

- 3.1.1. Support pump as shown on Standard Details.

END OF SECTION

- 1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.2. SUBMITTALS
 - 1.2.1. Shop Drawings: Further to requirements of Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS, submit working ranges of thermometers and gauges with Shop Drawings.
- 2. Products
 - 2.1. MATERIALS
 - 2.1.1. Pipeline thermometers shall be complete with:
 - .1 Dust-tight stainless case and stem with 127 mm (5 in.) dial.
 - .2 Bi-metal type.
 - .3 White face with black lettering
 - .4 Range normally 0 to 115 deg. C. (32 to 240 deg. F.) for hot water and -17 to 49 deg. C. (0 to 120 deg. F.) for chilled water but range shall suit maximum and minimum temperatures of location and be shown on shop drawings.
 - .5 Temperature marking in 1 deg. C. (2 deg. F.) increments in both imperial and metric scales.
 - .6 Eternal recalibration adjustment.
 - .7 Separable socket with extension neck as required for insulated pipe.
 - .8 Universal adjustable hinge
 - .9 Wells shall be registered with the provincial Boiler and Pressure Vessel Safety Branch and have a C.R.N. registration number.
 - 2.1.2. For ducts up to 750 mm (30 in.) in the largest dimension thermometers shall be similar to pipeline thermometers but with an additional perforated bulb guard and shall be flanged for mounting on ducts.
 - 2.1.3. For ducts over 750 mm (30 in.) in largest dimension thermometer shall be complete with:
 - .1 115 mm (4½ in.) diameter, cast aluminum case construction
 - .2 Black pointer
 - .3 White face with black lettering
 - .4 Range normally 0 to 115 deg. C. (32 to 240 deg. F.) for heated supply air, 0 to 80 deg. C. (32 to 175 deg. F.) for cooled supply, mixed and return air and -40 to 90 deg. C. (-40 to 195 deg. F.) for outside air but range shall suit maximum and minimum temperature of location and shall be shown on Shop Drawings.
 - .5 Temperature marking in 1 deg. C. (2 deg. F.) increments in both imperial and metric scales.
 - .6 Vapour filled
 - .7 1500 mm (60 in.) minimum length copper averaging bulb with bronze braided armour.

- .8 Flanged for mounting on ducts.
- .9 For insulated ducts or plenums provide a bracket for mounting thermometer clear of insulation.
- 2.1.4. Thermometers for remote reading shall be similar to duct thermometers specified above but with armoured extension capillary and bulb with separable well for pipelines or flanged duct connection for averaging bulb, as required.
- 2.1.5. Pressure gauges shall be complete with:
 - .1 Dust-tight nominal 115 mm (4½ in.) dia. case, solid front complete with back blow-out to A.N.S.I. B40-1 Grade 2A Level Standards.
 - .2 Back-flanged where required.
 - .3 Black pointer
 - .4 White dial with black markings
 - .5 Dial range to cover twice the average working pressure of the equipment and shall be compound gauges on pump suction for all open systems.
 - .6 Clear lens
 - .7 Phosphor bronze bourdon tube, silver soldered.
 - .8 Brass or stainless steel movement, bronze or nylon brushed, scale and movement mounted independent of the case.
 - .9 Brass socket
 - .10 kPa and psi scales
 - .11 Provincial Boiler and Pressure Vessel Safety Branches registration number
- 2.1.6. Manometers shall be inclined tube, differential type complete with:
 - .1 Adjustable scale of anodized aluminum or polished and chrome plated with black figure and graduations
 - .2 Range 0 to 0.5 kPa (0 to 2 in.) with 0.005 kPa (0.02 in.) graduations in both metric and imperial scales.
 - .3 Built in level vial
 - .4 Adjustable flanged base for mounting on duct or plenum
 - .5 Two static pressure tips, flanged for mounting on duct
 - .6 Two 1500 mm (60 in.) lengths of tubing
 - .7 Bottle of red gauge oil
- 2.1.7. Manometers shall be Magnahelic gauge type in dust free case with black pointer. Gauge range shall be 2½ times the maximum filter resistance. Case shall be suitable for duct or plenum mounting. Provide bracket for mounting gauge on insulated ducts or plenums.
- 2.1.8. Thermometers shall be Trerice, Taylor, Weksler, Winters or Ashcroft.
- 2.1.9. Pressure gauges shall be Trerice, Ashcroft, Morrison, Winters or Weksler.
- 2.1.10. Manometers shall be Airflow Developments or Dwyer.
- 2.1.11. Gauge glasses shall be Pyrex Red Line 12 mm (1/2 in.) equipped with leakproof pet cocks and ball check valves.

3. Execution

3.1. INSTALLATION

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- 3.1.1. Locate all thermometers and pressure gauges so as to assure easy reading from the floor or platform.
 - 3.1.2. Where direct reading instruments cannot be satisfactorily located use a remote instrument.
 - 3.1.3. Locate remote instruments next to the point of the reading, on wall or structure.
 - 3.1.4. Each remote or panel mounted instrument shall have an engraved lamacoid nameplate identifying the system and service.
 - 3.1.5. Insert pipeline thermometer into tanks, equipment tappings or in pipeline using screwed tees or forged steel couplings, welded into the lines.
 - 3.1.6. Duct thermometers shall be attached to duct using sheet metal screws through thermometer flange.
 - 3.1.7. Insert pressure gauges into equipment tappings or in pipelines using screwed tees or forged steel couplings welded into the lines.
 - 3.1.8. Provide thermometers in the following locations in pipelines:
 - .1 In and out of each water coil or other coil, handling liquid, except individual reheat coils in ductwork.
 - .2 On each branch of 3 port control valves, excluding valves on fan coil, induction units, or individual reheat coils in ductwork.
 - .3 In and out of each heat exchanger, condenser, cooler or type of other heat exchanger.
 - .4 Each heating water return and each heating water supply for each main system
 - .5 Each hot or cold water storage tank
 - .6 And where specifically shown
 - 3.1.9. When a common supply header provides the same temperature water to many coils or to many zones, provide a thermometer on the common header only, rather than a thermometer on each branch.
 - 3.1.10. For control valves with by-pass located thermometer in common pipe to allow for manual temperature control.
 - 3.1.11. Provide thermometers in the following locations in ducts or plenums:
 - .1 Upstream and downstream from each coil, spray or humidifier, except individual reheat coils in ductwork.
 - .2 On each of 3 ducts or plenums at mixing dampers
 - .3 Return air from each zone
 - .4 Outside air entering air handling units
 - .5 And where specifically shown
 - 3.1.12. Where a common duct or plenum provides the same temperature air to many zones, provide a thermometer on the common duct only, rather than at each branch of a zone.
 - 3.1.13. Provide test wells for thermometers where shown. Test wells shall be compatible with the thermometers used. Wells shall be registered with the Provincial Boiler and Pressure Vessel Safety Branch and have a C.R.N. registration number.
 - 3.1.14. Provide a Watts B6000 ball valve on the inlet to each gauge. In addition, install a coil syphon on each steam gauge. Install a pressure snubber on any gauge installed near a pump or in any location where damping is required to prevent rapid oscillation of the pointer. When the equipment is subject to vibration, mount the gauge on adjacent wall or on a mounting plate, supported from the floor.
 - 3.1.15. Provide pressure gauges in the following areas:
 - .1 City water line where it enters the building
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- .2 In and out of each pump
 - .3 In and out of all pressure reducing valves
 - .4 On each steam, hot water supply and hot water return header
 - .5 Air cushion tank or expansion tank
 - .6 City water make-up line
 - .7 Each fire standpipe at highest fire hose cabinet
 - .8 In and out of each heat exchanger, condenser, cooler or type of other heat exchanger
 - .9 And where specifically shown
- 3.1.16. Valved connections for pressure gauges shall be installed on each side of coils.
- 3.1.17. Install manometer at each bank of filters to show the resistance to air flow through the filters. Where prefilters and final filters are mounted in a common frame it is only necessary to provide a single manometer to show the resistance across the total filter assembly. Where filters are separately mounted in individual frames provide a manometer for each set of filters.
- 3.1.18. Install gauge glasses on each fire water storage, expansion tank and where shown. Gauge glasses shall be full height of tank. Individual gauge glasses shall be a maximum of 450 mm (18 in.) high where more than one gauge glass is required to give full coverage on any tank, glasses shall overlap by a minimum of 150 mm (6 in.). Provide shut-off valves on all connections to gauge glasses.

END OF SECTION

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. MATERIALS

2.1.1. Provide pipe system filters equal to Ashland Drew Low Flow Micron Filters Series 9238-02-4 or Filterite LMO Series.

2.1.2. ~~Provide pipe system filters equal to Ashland Drew Micron Medium Flow Filters Series 9240/9241 or GE W&P Technologies 3CMC/6CMC. NOT USED.~~

2.1.3. Shell and heads shall be suitable for 1035 kPa (150 psi) working pressure and filter media shall be suitable for 149 deg. C. (300 deg. F.) service temperature.

2.1.4. Filter media shall be bleached cotton for selective removal of particles from 1 to 100 microns. Media shall be non-rupturing and mounted so that no by-pass of media shall occur. Filters shall be equal to Ashland Drew PN 9236 or Viper VPYC.

2.1.5. Filters shall be sized for 3% of total system flow and shall be within the mid-capacity of the filter operating flow rate.

2.1.6. Pipe system filters shall be installed in the following systems:

- .1 ~~Perimeter heating systems~~ Glycol heating system
- .2 Constant temperature heating system
- .3 Chilled water system

3. Execution

3.1. INSTALLATION

3.1.1. Install pipe system filters across the pumps with valved inlet and outlet. Outlet valve shall be a flow balancing valve. Refer to Section 15705 – PIPES, VALVES AND FITTINGS (EXCEPT PLUMBING). Provide flanges or unions for servicing. Provide valved drain on unit casing.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
2. Products
 - 2.1. NOT USED
3. Execution
 - 3.1. INSTALLATION
 - 3.1.1. Test all plumbing systems in accordance with all applicable plumbing codes.
 - 3.1.2. Test all fire protection systems in accordance with all applicable NFPA codes.
 - 3.1.3. Compressed air system shall be tested to a minimum of 125% and a maximum of 150% of pressure setting of relief valve, using nitrogen for 24 hours and pressure drop shall not exceed 10% of the minimum pressure.
 - 3.1.4. All other systems not covered by codes noted above shall be tested and proven tight over a period of 24 hours by a hydrostatic test. Remove vents and gauges and temporarily plug connections.
 - 3.1.5. Test pressure for steam and water systems shall be:
1-1/2 times the system working pressure but not less than 1035 kPa (150 psig)
OR
The maximum working pressure of expansion joints and vibration isolators
 - 3.1.6. Repair any leaks or defects and repeat the tests to the satisfaction of the Engineer's Representative.
 - 3.1.7. After completion of the testing, balance the water systems. Adjust the circuits by means of balancing valves.
 - 3.1.8. Where multiple branch hot or chilled recirculation lines are installed, the flow in these shall be balanced to ensure hot or chilled water, as applicable, at all fixtures or equipment.
 - 3.1.9. Balance on water lines shall be obtained by inserting thermometers between the pipe and insulation of the various return lines and adjusting flow until all thermometers read the same appropriate system temperature.
 - 3.1.10. Balance on water lines shall be obtained by inserting thermometers in thermometer wells provided for this purpose at each balancing valve and adjusting flow until all thermometers read the same appropriate system temperature.
 - 3.1.11. Adjust bleed-off from cooling tower, evaporative condensers, spray coils and similar equipment to prevent lime deposits. Record bleed-off rate.
 - 3.1.12. Submit report showing the balanced temperatures at all systems.
 - 3.1.13. The balancing of the water and air systems shall be performed by the same balancing company.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
2. Products
 - 2.1. NOT USED
3. Execution
 - 3.1. LEAKAGE TESTING
 - 3.1.1. Test for leakage in all medium and high velocity ductwork between air handling units and dual duct mixing boxes or other pressure reducing devices. Seal ducts at all equipment connections and pressurize with a small blower. Leakage shall not exceed 1 percent of total designed air volume for the total system at a pressure of 1.5 kPa (6 in. W.G.). In addition, seal any leaks causing noise. Test system as a whole or in parts provided all ductwork is accessible for at the time of test. Provide blower and all test equipment.
 - 3.2. SYSTEM BALANCING
 - 3.2.1. Balance the complete air system including air volumes and control settings under maximum system pressure drop conditions (filter at replacement condition). Test the entire system for noise, tightness of joints and proper functioning of the system. Make noise tests under minimum system pressure drop conditions (highest air velocities and clean filter conditions). Make necessary alterations and repeat the tests until satisfactory operation is achieved.
 - 3.2.2. Adjust minimum outside air controller and adjust return air and exhaust air damper linkages to ensure correct air quantities.
 - 3.2.3. Employ one of the qualified Independent Balancing Company to balance the air systems.
 - 3.2.4. The Independent Balancing Company measures and reports upon the air volume at each diffuser, register and grille. Report shall also show the air quantity handled by each fan, the static pressure upstream and downstream of the fan, the fan speed and the motor current. Also to be reported upon are the air flow at outdoor, return and exhaust air dampers under conditions of minimum outdoor air.
 - 3.2.5. Provide assistance to the air balancing company and shall provide control settings, new filters, and other incidentals and equipment required for the measurements.
 - 3.2.6. Air volumes measured by the balancing company shall be within plus or minus 5% of those shown on Drawings for diffusers, grilles and registers and within 10% for fans.
 - 3.2.7. In all cases where measurements by the balancing company show failure to comply with the Drawings and Specifications, engage the balancing company to rebalance the system at no increase to Contract price.
 - 3.2.8. The balancing of the air and water systems shall be performed by the same balancing company.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.2. RELATED WORK SPECIFIED ELSEWHERE
 - 1.2.1. Concrete work on grade or cast integrally with a floor is provided under Division 3.
 - 1.2.2. ~~Sound isolated concrete floors – under Section 13080 [Division 13]. NOT USED.~~
 - 1.3. SUBMITTALS
 - 1.3.1. Shop Drawings: Supply Shop Drawings of the vibration and noise control equipment being supplied. Provide Shop Drawings showing completely the various acoustic assemblies.
 - 1.3.2. ~~Report: Submit a report, complete with resultant sound curves to the Engineer's Representative substantiating that all equipment has been adequately isolated and that acceptable noise levels exist in the occupied zones. NOT USED.~~
 - 1.4. PERFORMANCE REQUIREMENTS
 - 1.4.1. Adequately isolate all equipment to maintain acceptable noise levels in the occupied area of the building as specified below. Take noise measurements over the complete audible frequency range in each of the occupied zones under, above and beside Mechanical Equipment Rooms, and where indicated. [by the Engineer's Representative] Noise levels due to mechanical equipment, ductwork, grilles, registers, terminal devices, diffusers, etc, shall not exceed sound pressure levels in all 8 octave bands corresponding to the NC levels per ASHRAE handbook as indicated.

AREAS	N.C. LEVELS
Residential Suites	30
General Offices	35
Meeting Rooms	35
Corridors and Lobbies	35
Storage Rooms	40
Entrance Halls	40
Amenity Space	35
Outdoors	45 dBA
2. Products
 - 2.1. MATERIALS
 - 2.1.1. All equipment provided for vibration isolation or noise control shall be new and manufactured specifically for the purpose intended.
 - 2.1.2. All vibration isolation devices shall be Vibro-Acoustics, Kinetics Noise Control or Mason Industries and shall be one manufacturer throughout the project.
 - 2.1.3. All factory built silencers and acoustic plenums shall be Vibro-Acoustics, Kinetics Noise Control/Vibron, or EH Price and shall be one manufacturer throughout the project.

- 2.1.4. Provide vibration isolation devices in accordance with the Vibration Isolation Schedule. Static deflection of isolators shall be as given in the Schedule and specified below. The Vibration Isolation Schedule shall take precedence.
- 2.1.5. Provide silencers in accordance with the Silencer Schedule.
- 2.1.6. Provide vibration isolation with integral seismic restraint for equipment intended to provide restraint from seismic and wind forces. Housings shall be capable of withstanding the applicable design forces for the specific installation. Installation shall be in accordance with Section 15225 – SEISMIC FORCE RESTRAINING SYSTEMS.
- 2.2. VIBRATION ISOLATION
 - 2.2.1. Type EP (Elastomeric Pad) – Vibro-Acoustics Model N, Kinetics Model NPD, or Mason Industries Model W or Super W.
 - .1 Type EP shall be 8mm thick ribbed or waffle neoprene pads. Isolator pads shall be selected for less than 80% maximum rated load.
 - .2 If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 602/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.
 - 2.2.2. Type MEP (Metal and Elastomeric Sandwich Pad) – Vibro-Acoustics Model NSN, Kinetics Model NGS or Mason Industries Model WSW.
 - .1 Type MEP shall consist of two 8mm thick ribbed or waffle neoprene pads bonded to each side of a 16-gauge stainless or galvanized steel shim plate. Isolator pads shall be selected for less than 80% maximum rated load.
 - .2 If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 602/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.
 - 2.2.3. Type DDNM (Double Deflection Neoprene Mounts) – Vibro-Acoustics Model RDM, Kinetics Model RD, or Mason Industries Model ND.
 - .1 Type DDNM shall be laterally stable, double deflecting, molded neoprene isolators. All metal surfaces shall be covered with neoprene. The top and bottom surfaces shall be ribbed and bolt holes shall be provided in the base. The mounts shall have leveling bolts rigidly secured to the equipment.
 - .2 DDNM mounts shall be selected for a static deflection of 9.5mm unless specified otherwise.
 - 2.2.4. Type DDNH (Double Deflection Neoprene Hangers) – Vibro-Acoustics Model RHD, Kinetics Model RH or Mason Industries Model HD.
 - .1 Type DDNH shall consist of a molded neoprene isolating element in a steel hanger box. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel. The diameter of the clear hole in the hanger box shall be at least 19mm larger than the diameter of the hanger rod and permit the hanger rod to swing through a 30 degree arc. When installed the hanger box shall be allowed to rotate through a full 360 degrees without encountering an obstructions.
 - .2 Unless otherwise specified the static deflection of DDNH hangers shall be 8mm.
 - 2.2.5. Type SPNM (Spring and Neoprene Mounts) – Vibro-Acoustics Model FS, Kinetics Model FDS or Mason Industries Model SLFSW
 - .1 Type SPNM shall have a free standing and laterally stable steel spring without any housing, and two type WP isolation pads sandwiching a 16 gauge stainless or galvanized steel separator plate shall be bonded to the isolator base plate. Springs

shall be designed so that the ratio of the horizontal to vertical spring constant is between one and two. The spring diameter shall not be less than 80% of the compressed height of the spring at rated load. Loaded springs shall have a minimum additional travel to solid equal to 50% of the specified static deflection.

- .2 Unless otherwise specified the minimum static deflection of SPNM isolators under actual load conditions for equipment mounted on grade slabs shall be 25 mm (1 in.), and 50 mm (2 in.) for equipment mounted above grade level.
- .3 Unless otherwise specified, isolators need not be bolted to the floor for indoor installations. If base plates are bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 602/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.

2.2.6. Type SPNMS (Spring and Neoprene Mounts – Seismic Restrained) – Vibro-Acoustics Model SFS, Kinetics Model FHS or Mason Industries Model SSLFH. NOT USED.

- .1 Type SPNMS shall be laterally stable restrained steel spring type. Springs shall be designed so that the ratio of the horizontal to vertical spring constant is between one and two. The spring diameter shall not be less than 80% of the compressed height of the spring at rated load. Loaded springs shall have a minimum additional travel to solid equal to 50% of the specified static deflection. NOT USED.**
- .2 Unless otherwise specified the minimum static deflection of SPNMS isolators under actual load conditions for equipment mounted on grade slabs shall be 25 mm (1 in.), and 50 mm (2 in.) for equipment mounted above grade level. NOT USED.**
- .3 Isolators shall be bolted to the floor and equipment. Provide a neoprene vibration isolation washer and sleeve (Uniroyal Type 602/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate. NOT USED.**

2.2.7. Type SPH (Spring Hangers) – Vibro-Acoustics Model SH, Kinetics Model SH, or Mason Industries Model 30

- .1 Type SPH shall consist of a steel spring and welded steel housing. Spring diameter and hanger box hole shall be large enough to permit the hanger rod to swing through a 30 degree arc. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 19 mm (3/4 in.) larger than the diameter of the hanger rod. When installed, the spring element shall not be cocked, and the hanger box shall be allowed to rotate through a full 360 degree arc without encountering any obstructions.
- .2 Unless otherwise specified, the static deflection of SPH hangers under actual load conditions shall be 50 mm (2 in.).

2.2.8. Type SPNH (Spring and Neoprene Hangers) – Vibro-Acoustics Model SHR, Kinetics Model SRH, or Mason Industries Model 30N

- .1 Type SPNH shall be as above with the addition of a neoprene element in series with the spring. The neoprene element shall have a deflection of not less than 9mm with a strain not exceeding 15%. Unless otherwise specified, the static deflection of SPNH hangers under actual load conditions shall be 50 mm (2 in.).

2.2.9. Type CSNM (Constrained Spring and Neoprene Mounts) – Vibro-Acoustics Model CSR, Kinetics Model FLS, or Mason Industries Model SLR NOT USED.

- .1 Type CSNM shall be a spring and neoprene mount that incorporates a housing which contains unrestrained stable springs with built-in leveling device and resilient vertical limit stops to prevent spring elongation when partial load is removed and limits the movement of equipment when it is subjected to wind loading. NOT USED.**

- .2 A minimum clearance of 25 mm (1 in.) shall be maintained around the restraining bolts and between the housing and the spring so as not to interfere with the spring operation. Limit stops shall provided minimum 6 mm (1/4 in.) clearance under normal operation, and a neoprene washer shall be installed beneath the bolt head/washer used to restrain the isolator. NOT USED.
 - .3 For Installations subject to wind load, provide tapped hole in top and bottom plates for bolting to equipment and the roof or supporting structure with a neoprene sleeve. NOT USED.
 - .4 Provide minimum 6mm thick neoprene acoustical base pad on the underside of the mount unless designated otherwise. NOT USED.
 - .5 Mount shall be capable of supporting equipment at a fixed elevation during equipment erection. Installed and operating heights shall be identical. NOT USED.
 - .6 Unless specified otherwise, the minimum static deflection for Type CSNM mounts under actual load conditions shall be 50 mm (2 in.). NOT USED.
- 2.2.10. Type SCSNM (Constrained Spring and Neoprene Mounts — Seismic Restrained) — Vibro-Acoustics Model SCSR, Kinetics Model FLSS, or Mason Industries Model SLRS. NOT USED.
- .1 Type SCSNM shall be a spring and neoprene mount that incorporates welded steel housings and heavy top plates containing laterally stable restrained springs with built-in leveling device and vertically restraining limit stops to prevent spring elongation when partial load is removed and limits the movement of equipment when it is subjected to wind or seismic loading. NOT USED.
 - .2 A maximum clearance of 6 mm (1/4 in.) shall be maintained around the restraining bolts and between the housing and the spring so as not to interfere with the spring operation. Top plate and restraining bolts shall be out of contact with the housing during normal operation. NOT USED.
 - .3 Provide tapped hole in top and bottom plates for bolting to equipment and the roof or supporting structure with a neoprene sleeve. NOT USED.
 - .4 Provide minimum 6mm thick neoprene acoustical base pad on the underside of the mount unless designated otherwise. NOT USED.
 - .5 Mount shall be capable of supporting equipment at a fixed elevation during equipment erection. Installed and operating heights shall be identical. NOT USED.
 - .6 Unless specified otherwise, the minimum static deflection for Type SCSNM mounts under actual load conditions shall be 50 mm (2 in.). NOT USED.
- 2.2.11. Type RTIC (Rooftop Isolation Curb) — Vibro-Acoustics Model RTR, Kinetics Model KSR or Mason Industries Model RSC. NOT USED.
- .1 Type RTIC shall be curb type rail with integral isolators which is designed to fit over the roof curb and under the isolated equipment. The top and bottom members shall contain weather resistant springs having a minimum 25 mm (1 in.) deflection with 50% additional travel to solid. Spring diameter shall not be less than 80% of the compressed height of the spring. NOT USED.
 - .2 Wind resistance shall be provided by means of resilient snubbers with a minimum clearance of 6 mm (1/4 in.) so as not to interfere with the spring action except in high winds. NOT USED.
 - .3 The weather seal shall consist of continuous closed cell sponge materials both above and below the base and a waterproof, flexible neoprene connection joining the outside perimeter of the upper and lower members. NOT USED.
 - .4 The curb shall be manufactured as a single assembly. NOT USED.
- 2.2.12. Type SB (Steel Base) — Vibro-Acoustics Model S, Kinetics Model SFB or Mason Industries Type MSLFSW. NOT USED.

- .1 Type SB inertia base which shall be a structural steel base frame with clearance holes located to correspond to the mounting bolt holes of the equipment mounted on the base. Fan bases shall have built-in motor slide rails, and shall be reinforced as necessary to withstand belt pull without drive misalignment or base distortion. NOT USED.
- .2 The bases shall be constructed with deep angle steel sections with a minimum vertical angle leg of 100 mm (4 in.) for motors of 7.5 hp or less, 125 mm (5 in.) for motors between 7.5 hp and 20 hp, and 150 mm (6 in.) for motors over 20 hp. NOT USED.
- .3 Structural steel base frames shall be prime-painted (galvanized). NOT USED.
- 2.2.13. Type CB (Concrete Base) – Vibro-Acoustics Model C, Kinetics Model CIB-L or Mason Industries Type KSLFSW NOT USED.
- .1 Type CB inertia base shall have an integral rectangular structural steel form to which concrete is poured. NOT USED.
- .2 Perimeter members shall be beams of depth equal to 10% of the longest span of the base, but not more than 300 mm (12 in.) or less than 150 mm (6 in.) deep. Forms shall include motor slide base and all reinforcing steel. Where anchor bolt locations fall in concrete, the reinforcing steel shall include drilled members with sleeves welded below the steel to accept the anchor bolts. Height saving steel brackets shall be used in all mounting locations. NOT USED.
- .3 When the concrete base is T-shaped, isolators shall be located under the projections as well as under the main body in order to prevent cantilever distortion. NOT USED.
- .4 Inertia bases for pumps shall be of sufficient size to accommodate supports for pipe elbows at pump suction and discharge connections. NOT USED.
- .5 Height saving brackets or welded steel pockets shall be incorporated to ensure a 50 mm (2 in.) minimum clearance under each inertia base. NOT USED.
- .6 The weight of each inertia base shall be sufficient to lower the centre of gravity to or below the isolator support plane. NOT USED.
- .7 The structural perimeter frame, mounting templates, height saving brackets, and spring system shall be provided as an assembly by the vibration control vendor. NOT USED.
- .8 Structural perimeter frames shall be prime-painted (galvanized). NOT USED.
- 2.2.14. All spring mounts shall be complete with levelling devices 6 mm (1/4 in.) thick ribbed neoprene sound pads and completely colour coded stable springs.
- 2.2.15. Where steel spring isolation systems are described in the specifications, the mounting assemblies shall utilize bare springs with the spring diameter not less than 80% of the loaded operating height of the spring. Each spring isolator shall be designed and installed so that the ends of the spring remain parallel during and after spring installation.
- 2.2.16. All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer, and must be linear over a deflection range of not less than 50% above the design deflection.
- 2.2.17. All vibration isolators shall have either known undeflected heights of calibration markings to that, after adjustment, verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being provided according to design.
- 2.2.18. All mounts installed outdoors or exposed to high humidity conditions shall have two coats of rust resisting paint and springs shall be cadmium plated and neoprene coated. Nuts and bolts shall be cadmium plated. All metal parts of mountings (except springs and hardware) shall be hot dip galvanized.
- 2.2.19. Neoprene mounting sleeves for hold down applications of equipment with vibration isolators shall be Uniroyal Type 620/660 or as approved.

- 2.2.20. Grout: Non-shrink, self-levelling grout having ability to withstand thermal, vibratory and impact stresses; "Embeco 636 Grout", "Imperial Grout", or "Sauereisen F-100".
- 2.2.21. Acoustic Sealant: Non-hardening, non-skinning permanently flexible, to CAN/CGSB-19.21-M87. Tremco, CGC Acoustic Sealant or approved equivalent.

2.3. SILENCERS NOT USED.

- 2.3.1. Factory Built Silencers shall be completely pre-fabricated of incombustible materials and shall have a minimum insertion loss and a maximum air pressure drop as shown in Silencer Schedule. Submitted silencer performance shall be according to ASTM E477-06a "Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers" NOT USED.
- 2.3.2. Media filled silencers shall contain acoustic media type as indicated on the Silencer Schedule, either acoustic quality, shot free glass fibre insulation with long, resilient fibres bonded with a thermosetting resin, or 100% natural cotton fibres treated with an EPA registered, non-toxic borate solution, "flash dried" to provide resistance to mould, mildew and fungi. Media shall not cause or accelerate corrosion of aluminum or steel. Glass fibre, and rockwool will not be permitted as a substitute for cotton fibre media. NOT USED.
- 2.3.3. Acoustic media in media filled silencers shall have density as required to provide specified performance, packed under 15 percent compression and protected from air erosion by perforated sheet metal, gauge as specified below. NOT USED.
- 2.3.4. Acoustic media filled silencers with internal air velocities above 22.9 m/s (4500 fpm) shall have acoustic media wrapped with glass fibre cloth for additional erosion protection. Where indicated on the Silencer Schedule silencers shall have acoustic media wrapped in Tedlar film liner to help prevent shedding, erosion and impregnation of the acoustic media. NOT USED.
- 2.3.5. No media silencers shall contain no absorptive media of any kind. Attenuation shall be achieved with controlled impedance membranes and broadly tuned resonators. NOT USED.
- 2.3.6. Silencer materials, including acoustic media and Tedlar film, shall have the following combustion ratings when tested in accordance with ASTM E84-03: maximum Flamespread Classification 25, maximum Smoke Development Rating 50. NOT USED.
- 2.3.7. Rectangular type silencers for duct systems operating less than 4 in. WG and designated as Class 1 on the Silencer Schedule shall be constructed with a minimum 22 gauge (0.78 mm) lock formed galvanized steel outer casing and 26 gauge (0.47 mm) galvanized perforated steel liner. NOT USED.
- 2.3.8. Rectangular type silencers for duct systems operating greater than 4 in. WG and less than 8 in. WG and designated as Class 2 on the Silencer Schedule shall be constructed with a minimum 18 gauge (1.18 mm) Pittsburgh lock formed galvanized steel outer casing and 22 gauge (0.78 mm) galvanized perforated steel liner. NOT USED.
- 2.3.9. Rectangular type silencers for duct systems operating under more than 8 in. WG and designated as Class 3 on the Silencer Schedule shall be constructed with a minimum 16 gauge (1.46 mm) continuously welded galvanized or hot rolled steel painted with one anti-rust prime coat of paint casing and 22 gauge (0.78 mm) galvanized perforated steel liner. NOT USED.
- 2.3.10. Rectangular type elbow silencers shall have minimum Class 2 construction, 18 gauge (1.18 mm) Pittsburgh lock formed galvanized steel outer casing and 22 gauge (0.78 mm) galvanized perforated steel liner, unless indicated as Class 3 on the Silencer Schedule. All acoustical splitters shall be internally radiused and aerodynamically designed for efficient turning of the air. Half and full splitters are required as necessary to achieve the scheduled insertion loss. All elbow silencers with a turning cross-section dimension greater than 1200 mm (48 in.) shall have at least two half splitters and one full splitter. NOT USED.

- 2.3.11. Circular media filled silencers, unless noted on the Silencer Schedule as Class 3, 16 gauge construction shall have gauges and construction as follows: under 750 mm (30 in.) casing diameter, 20 gauge (0.91mm) lockformed galvanized steel outer casing, under 1350 mm (54 in.) casing diameter, 18 gauge (1.18 mm) lockformed galvanized steel outer casing, otherwise 16 gauge (1.46 mm) stitch welded galvanized steel outer casing. Galvanized steel perforated inner liner shall be 22 gauge (0.78 mm) for all diameters. NOT USED.
- 2.3.12. Circular no-media silencers, unless noted on the Silencer Schedule as Class 3, 16 gauge construction shall have gauges and construction as follows: under 450 mm (18 in.) duct diameter, 22 gauge lockformed galvanized steel outer casing, under 750 mm (30 in.) duct diameter, 20 gauge (0.91 mm) lockformed galvanized steel outer casing, under 1350 mm (54 in.) duct diameter, 18 gauge (1.18 mm) lockformed galvanized steel casing, otherwise 16 gauge (1.46 mm) stitch welded galvanized steel outer casing. Galvanized steel perforated inner liner shall be 26 gauge (0.47 mm) for all diameters. NOT USED.
- 2.3.13. Silencers shall be complete with high transmission loss (HTL) casing where indicated on the silencer schedule. HTL walls shall consist of media, airspace, mass and outer protective metal skin as required to obtain specified room noise criteria. Standard acoustic panels will not be accepted as HTL walls. Where requested by the Engineer's Representative, provide breakout noise calculations for each air handling and fan system with silencer submittal to insure compliance with the room noise criteria. Breakout noise calculations shall be based on the sound power levels of the specified equipment and calculation methods in accordance with ASHRAE HVAC Applications handbook. NOT USED.

3. Execution

3.1. INSTALLATION

- 3.1.1. Obtain one copy of all Shop Drawings of equipment to be isolated showing weights, shaft centres and all dimensions.
- 3.1.2. On system start-up, inspect the complete installation and provide a report in writing.
- 3.1.3. Furnish concrete bases, including concrete fill, on springs or other vibration isolation materials for mechanical isolation.
- 3.1.4. All floor mounted equipment shall be erected on concrete housekeeping pads, with thickness as identified, over the complete floor area of the equipment, unless shown or specified otherwise. Wherever vibration eliminating devices and/or concrete inertia pads are specified, these items shall be mounted on concrete housekeeping pads.
- 3.1.5. Furnish and install neoprene mounting sleeves for hold-down bolts to prevent any metal to metal contact.
- 3.1.6. All equipment shall be provided with lateral restraining isolators as required to limit horizontal motion to 6mm maximum, under all operating conditions. Lateral restraining isolators shall have the same static deflection as equipment being isolated.
- 3.1.7. Seismic snubbers shall be installed on all equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 3.2mm (1/8 in.). Install seismic restraint devices using methods approved by required submittals for component.
- 3.1.8. Unless otherwise indicated, all equipment mounted on vibration isolators shall have a minimum operating clearance of 50 mm (2 in.) between the bottom of the equipment or inertia base (and height-saving bracket) and the concrete housekeeping pad (or bolt heads) beneath the equipment. The clearance shall be checked by the Contractor to ensure that no material has been left to short- circuit the vibration isolators. There shall be a minimum 100 mm (4 in.)

clearance between isolated equipment and the walls, ceiling, floors, columns and any other equipment not installed on vibration isolators.

- 3.1.9. Piping, ductwork, conduit or mechanical equipment shall be supported from building structure, not hung from or supported on other equipment, pipes, or ductwork.
- 3.1.10. Equipment connected to water or other fluid piping shall be erected on isolators or isolated foundations at correct operating heights prior to connection of piping, and blocked-up with temporary shims to final operating height. When the system is assembled and fluid is added, the isolators shall be adjusted to allow removal of the shims.
- 3.1.11. All mechanical equipment not specifically identified in this Section that contains rotating or vibrating elements, and any associated electrical apparatus installed by this Division that contains transformers or inductors shall be installed on Type DDNM, MEP, or EP isolators as appropriate.
- 3.1.12. All wiring connections to mechanical equipment on isolators shall be made with a minimum long flexible conduit installed in a slack "U" shape.
- 3.1.13. Elastomeric isolators that will be exposed to temperatures below 0 deg. C. (32 deg. F.) shall be fabricated from natural rubber instead of neoprene.
- 3.1.14. Springs shall be designed and installed so that ends of springs remain parallel and all springs installed with adjustment bolts.
- 3.1.15. Springs shall be sized to be non-resonant with equipment forcing frequencies or support structure natural frequencies.
- 3.1.16. Fans and air handling units shall be levelled with fans operating before the flexible connectors are attached.
- 3.1.17. All fan bases and isolators shall be sized so that thrust restraints (which would act against turning moment caused by static pressure) are not required.

3.2. EQUIPMENT ISOLATION

- ~~3.2.1. Floor Mounted Centrifugal Fans and axial flow fans less than 0.87 kPa (3-1/2 in. W.G.) static pressure and/or under 29.8 kW (40 hp), shall be mounted on a Type SB base with Type SPNM isolators and shall have static deflection shall not be less than 50mm under actual load conditions unless shown otherwise in the Vibration Isolation Schedule. NOT USED.~~
- ~~3.2.2. Floor Mounted Centrifugal Fans and axial fans 0.87 kPa (3-1/2 in. W.G.) static pressure and over and/or 29.8 kW (40 hp) and larger, shall be mounted on Type CB with Type SPNM isolators and shall have static deflection not less than 50 mm (2 in.) under actual load conditions unless stated otherwise on the Vibration Isolation Schedule. NOT USED.~~
- ~~3.2.3. Ceiling Suspended Centrifugal Fans, and axial flow fans shall be mounted on Type SPNH spring isolators. Static deflection of the isolators shall be 50 mm (2 in.) unless shown otherwise on the Vibration and Isolation Schedule. Fans shall be suspended from above only if expressly noted as such on the Drawings and Schedules. Thrust restraint shall be by pre-compressed springs. NOT USED.~~
 - ~~.1 If the fan to be suspended is not furnished with integral structural frame and external mounting lugs of suitable strength and rigidity, install approved structural base with lugs in the field. NOT USED.~~
- ~~3.2.4. Fans in packaged or custom air handling units shall be mounted on a Type SB base with Type SPNM isolators. The static deflection shall not be less than 50 mm (2 in.) under actual load conditions. NOT USED.~~
 - ~~.1 Structural steel floor supports shall be located beneath the spring isolators and shall be equivalent to the structural perimeter frame of the air handling unit. NOT USED.~~

3.2.5. Floor Mounted Packaged or Custom Air Handling Units less than 0.87 kPa (3-1/2 in. W.G.) static pressure and/or under 29.8 kW (40 hp) without internal fan isolation shall be isolated as follows: NOT USED.

- .1 Where the fan section is separated from the rest of the unit with a flexible connection, mount the fan section as specified for floor mounted centrifugal fans less than 0.87 kPa (3-1/2 in. W.G.) static pressure and/or under 29.8 kW (40 hp): NOT USED.
- .2 Where the fan section forms an integral part of the air handling unit isolate the entire unit as specified for floor mounted centrifugal fans less than 0.87 kPa (3-1/2 in. W.G.) static pressure and/or under 29.8 kW (40 hp).. If the frame is an integral part of the packaged unit no additional frame is required. NOT USED.
- .3 Drain pipe for air handling units shall be supported only from the isolated air handling unit frame. The condensate shall drip into a funnel that is supported from the floor or floor drain. A gap of at least 50 mm (2 in.) shall be maintained between the end of the air handling unit drain pipe and funnel or floor drain. Hot and chilled water pipes shall be connected to the air handlers with flexible connectors. NOT USED.

3.2.6. Floor Mounted Packaged or Custom Air Handling Units 0.87 kPa (3-1/2 in. W.G.) static pressure and over and/or 29.8 kW (40 hp) and larger without internal fan isolation shall be isolated as follows: NOT USED.

- .1 Where the fan section is separated from the rest of the unit with a flexible connection, mount the fan as specified above for floor mounted centrifugal fans 0.87 kPa (3-1/2 in. W.G.) static pressure and over and/or 29.8 kW (40 hp) and larger. NOT USED.
- .2 Where the fan forms an integral part of the air handling unit isolate the entire unit as specified for floor mounted centrifugal fans 0.87 kPa (3-1/2 in. W.G.) static pressure and over and/or 29.8 kW (40 hp) and larger. Isolation includes both the base frame and concrete. NOT USED.
- .3 Drain pipe for air handling units shall be supported only from the isolated air handling unit frame. The condensate shall drip into a funnel that is supported from the floor or floor drain. A gap of at least 50 mm (2 in.) shall be maintained between the end of the air handling unit drain pipe and funnel or floor drain. Hot and chilled water pipes shall be connected to the air handlers with flexible connectors. NOT USED.

3.2.7. Base mounted pumps 3.73 kW (5 hp) and larger except where located on slab-on-grade. Mount each pump with motor on a Type CB inertia base. Minimum base thickness shall be: NOT USED.

Pumps up to 3.73 kw (5 hp)	150 mm (6 in.)
Pumps 5.6 kW (7-1/2 hp) to 18.7 kW (25 hp)	250 mm (10 in.)
Pumps 22.4 kW (30 hp) to 44.8 kW (60 hp)	300 mm (12 in.)
Pumps 56.0 kW (75 hp) to 93.3 kW (125 hp)	400 mm (16 in.)
Pumps 112 kW (150 hp) and larger	600 mm (24 in.)

- .1 Base for horizontally split pumps shall include supports for base elbows for the discharge and suction connections. Vertically split pumps shall include support for base elbow for suction connection. Bolt and grout base elbows to the pump base. NOT USED.
- .2 Mount the base on Type SPNM isolators. Where the base is 'T' shaped or other than rectangular, locate the isolators under the projections as well as the main body of the base. NOT USED.
- .3 Pour bases on roofing felt and elevate a minimum of 50 mm (2 in.) with mounting adjustment bolts after the pumps are grouted to the base. NOT USED.
- .4 No damping or snubbing materials shall be used. Spring deflection shall be as specified in the Vibration Isolation Schedule, but in no case less than 25 mm (1 in.) and

all mountings shall have 6 mm (1/4 in.) thick neoprene vibration isolation pads at the bottom. NOT USED.

3.2.8. Base mounted pumps less than 3.73 kW (5 hp), except where located on slab-on-grade, bolt and grout each pump to a Type CB inertia base. NOT USED.

.1 Mount the base on Type EP isolators. NOT USED.

.2 Minimum base thickness shall be 150 mm (6 in.). NOT USED.

3.2.9. Base mounted pumps On Slab On Grade: Bolt and grout each pump to a Type CB base. The minimum base thickness shall be: NOT USED.

Pumps up to 3.73 kW (5 hp)	150 mm (6 in.)
Pumps 5.6 kW (7-1/2 hp) to 18.7 kW (25 hp)	200 mm (8 in.)
Pumps 22.4 kW (30 hp) to 74.6 kW (100 hp)	250 mm (10 in.)
Pumps 93.3 kW (125 hp) and larger	300 mm (12 in.)

.1 Mount the base on Type MEP isolators. Where the base is 'T' shaped or other than rectangular, locate the isolators under the projections as well as the main body of the base. The isolators shall be in accordance with the manufacturer's instructions for the size and weight distribution of the pump supported. NOT USED.

3.2.10. Vertical in-line pumps floor mounted 6.5 kW (10 hp) and larger except where located on slab-on-grade bolt and grout each elbow support to a Type CB inertia base. The minimum base thickness shall be: NOT USED.

Pumps 6.5 kW (10 hp) to 18.7 kW (25 hp)	200 mm (8 in.)
Pumps 22.4 kW (30 hp) to 74.6 kW (100 hp)	250 mm (10 in.)
Pumps 93.3 kW (125 hp) and larger	300 mm (12 in.)

.1 Mount the base on Type SPNM isolators. NOT USED.

.2 Pour bases on roofing felt and elevate a minimum of 50 mm (2 in.) with mounting adjustment bolts after the pump elbows are grouted to the base. NOT USED.

.3 No damping or snubbing materials shall be used. Spring deflection shall be as specified in the Vibration Isolation Schedule, but in no case less than 25 mm (1 in.) and all mountings shall have 6 mm (1/4 in.) thick neoprene vibration isolation pads at the bottom. NOT USED.

3.2.11. Vertical in-line pumps floor mounted 4.9 kW (7-1/2 hp) and smaller and 6.5 kW (10 hp) and larger where located on slab-on-grade, shall be supported on Type MEP isolation. Refer to Mechanical Standard Details. NOT USED.

3.2.12. Vertical in-line pumps ceiling hung shall be supported by Type SPNH spring isolators. Refer to Mechanical Standard Details. NOT USED.

3.2.13. Fan coil units or heat pumps suspended from overhead structure shall be hung on Type SPNH spring isolators. Unless otherwise specified in the Vibration and Isolation Schedule, the static deflection of the isolators shall be 50 mm (2 in.).

.1 Fan coil units floor mounted shall be supported on concrete housekeeping pads (minimum 4" high) with type MEP isolation.

3.2.14. Refrigeration machines and boilers shall be mounted on a Type SB base with CSNM isolators. Spring deflection shall be 50 mm (2 in.) minimum. If the equipment is suitable and an additional steel base is not required, the equipment can be mounted directly on the isolators. NOT USED.

3.2.15. Expansion tanks, dearators, heat exchangers and water heaters without pumps or motors which are floor mounted shall be supported on Type MEP isolators. Suspended units shall be supported by Type DDNH isolators. Where piping on isolators is connected to these units, the connection shall be made with a neoprene flexible connector.

- 3.2.16. Suspend all piping in Mechanical Rooms on Type SPH or SPNH isolators as required. Where piping is supported from the floor, weld brackets to the piping and support on Type SPNM isolators. Isolators do not replace constant support hangers or mounts.
- 3.2.17. The first isolator both upstream and downstream of equipment on springs shall have a static deflection of 1.5 times the deflection of the vibration isolated equipment to a maximum of 50 mm (2 in.). All other piping supports shall have a static deflection of 25 mm (1 in.) minimum.
- 3.2.18. Where a pipe connects to multiple pieces of equipment in the Mechanical Room the pipe isolators for the entire run shall be chosen to suit the connected equipment of the greatest static deflection.
- 3.2.19. Piping that is connected only to equipment installed on neoprene isolators shall be either supported from the floor by Type DDNM isolators or suspended from the structure on Type DDNH isolators within the Mechanical Equipment Rooms.
- 3.2.20. Flexible piping connectors shall be installed to connect piping of diameter 50 mm (2 in.) or greater to reciprocating or rotating equipment.
- 3.2.21. Piping attached to either coil sections separated from the fan sections of air handling units by flexible connections, or to air handling units with internal isolators meeting the requirements of these specifications is exempt from these requirements and is not considered connected to vibrating equipment.
- 3.2.22. No rigid connections between equipment and the building structure shall be made that degrades the specified noise and vibration control system.
- 3.2.23. Any conflicts with other trades which result in rigid contact with the equipment or piping due to inadequate space or other unforeseen conditions should be brought to the Engineer's Representative's attention prior to installation. If not brought to the attention of the Engineer's Representative prior to installation corrective work necessitated by conflicts shall be at the Contractor's expense.
- 3.2.24. Locate isolation hangers with the housing a minimum of 50 mm (2 in.) below but as close as possible to the structure. Where isolator hangers would be concealed by a non-accessible acoustical sub-ceiling, install the hangers immediately below the sub-ceiling for access.
- ~~3.2.25. Except as noted elsewhere in this specification, outside the Mechanical Room all HVAC, compressed air, and domestic hot and cold water pipes with an inner diameter less than or equal to 50 mm (2 in.) shall be isolated from the structure with sponge neoprene, felt or glass/mineral fibre sleeves between the pipe and pipe clamp or with Type WP pads between the clamp and the structure. When compressed, the sleeve shall be not less than 3 mm (1/8 in.) in thickness. NOT USED.~~
- ~~3.2.26. All piping outside the Mechanical Room with inner diameter greater than 50 mm (2 in.) shall be supported on Type SPNM isolators or suspended by Type SPNH isolators. Where piping is ganged on a trapeze the piping shall rest on the trapeze, which shall be isolated from the structure by the appropriate isolators. Neoprene pipe riser guides shall be used where lateral restraint is required. NOT USED.~~
- ~~3.2.27. Any pipe crossing an acoustical joint shall have a twin-sphere neoprene flexible connector at the joint, with the exception of piping associated with fire protection, natural gas and compressed gases, and shall be suspended by Type SPNH isolators as follows: NOT USED.~~
- ~~.1 Pipes with inner diameters less than 50 mm (2 in.) shall be suspended by Type DDNH isolators for a minimum distance of 6m on each side of the joint. NOT USED.~~
- ~~.2 Pipes with an inner diameter of 50 mm (2 in.) or greater shall be suspended on Type SPNH isolators for a minimum distance of 6m on the non-isolated structure and for the entire pipe length on the isolated structure. NOT USED.~~
- ~~3.2.28. Where pipes rise in a vertical chase and are supported from a structure with type SPNH or DDNH isolators and require lateral bracing, neoprene riser guides shall be mounted around~~

~~the pipe to limit lateral movement and to prevent direct contact with the supporting structure.~~
~~NOT USED.~~

- 3.2.29. Ducts shall be connected to fans, fan casings and fan plenums by means of flexible connectors. Flexible connectors shall be installed to prevent metal-to-metal contact across flexible connection. Flexible duct connectors shall not be used outside the Mechanical Room unless expressly shown on the Drawings. Flexible connectors shall be in accordance with Section 15840 – DUCTWORK AND SPECIALTIES.

- 3.2.30. ~~Kitchen exhaust ducts shall be supported on SPNH and/or SPNM isolators as appropriate. Neoprene riser guides shall be used if lateral restraint is required in shafts.~~ NOT USED.

- 3.2.31. After installation, manufacturer shall verify that the vibration isolation systems are installed and operating properly, and shall submit a certificate so stating. Verify that the isolators are adjusted, with springs perpendicular to bases or housings, adjustment bolts are tightened up on equipment mountings, and hangers are not cocked. ~~In addition, the manufacturer shall certify that Type RTIC isolation curbs are assembled and installed properly.~~

3.3. ~~SILENCERS NOT USED.~~

- 3.3.1. ~~Where silencers are to be installed in stainless steel or aluminum ductwork, the silencer shall be all stainless steel or aluminum construction to match the ductwork gauges used.~~ NOT USED.

- 3.3.2. ~~Silencers for all variable air volume boxes, and fan powered variable volume boxes shall be as scheduled in the Silencer Schedule. Refer to Drawings for specific number required. The Silencer Schedule only indicates type. Receive from VAV box manufacturer dimension and sound data. Adjust silencers as required to match box discharge size. Adjust silencer as required to ensure insertion loss necessary to meet the room noise criteria.~~ NOT USED.

- 3.3.3. ~~Silencers shall have outside dimensions that match the connecting duct size unless indicated otherwise.~~ NOT USED.

- 3.3.4. ~~Submittals shall include certified test data on dynamic insertion loss, self-noise power levels, and pressure drop for reverse or forward flow. Silencer performance must have been substantiated by laboratory testing according to ASTM E477-06a and so certified when submitted for approval. The aero-acoustic laboratory must be NVLAP accredited for the ASTM E477-06a test standard. A copy of the accreditation certificate must be included with the submittals. Data from non-NVLAP accredited test facilities will not be accepted. Shop Drawings submitted without proper certifications will be rejected.~~ NOT USED.

- 3.3.5. ~~The certification of the pressure drop, insertion loss and generated noise data shall be based upon tests of the same silencer for all measurements.~~ NOT USED.

- 3.3.6. ~~For specific silencers indicated on the Silencer Schedule, the manufacturer shall provide Computational Fluid Dynamics (CFD) analysis of each silencer along with the attached ductwork, a minimum of 5 equivalent duct diameters up and downstream of the silencer, as shown on the contract Drawings, to determine silencer pressure drop including system effects. The manufacturer must report and validate the solution domain of the CFD analysis by a) mesh independence, such that two models of different mesh refinement levels produce equivalent results, and b) solution convergence. The manufacturer must report the selection of CFD parameters, including a) mesh type, b) mesh size, c) boundary conditions, d) acceptable error residuals (convergence criteria), e) turbulence model. Each CFD analysis shall also include additional post-processed information including a) number of iterations, b) convergence status, c) resulting y+ values.~~ NOT USED.

- 3.3.7. ~~For specific silencers indicated on the Silencer Schedule, the manufacturer shall provide acoustic analysis for approval showing that this silencer will reduce mechanical fan noise to acceptable levels in the occupied space. Use sound power levels of actual equipment to be installed on project. Analysis shall include breakout noise calculations.~~ NOT USED.

3.4. ACOUSTIC PLENUM NOT USED.

3.4.1. Acoustic plenum shall be supplied and installed where shown. All acoustic panels, doors, windows, steel supports, etc. shall be co-ordinated to provide an integral noise barrier. NOT USED.

3.4.2. Where panels are required between two fan plenums and similar locations, they shall be similar to the wall and roof panels except they shall be perforated on both sides with a central baffle to prevent air crossover and no transmission loss is required. NOT USED.

3.4.3. Make all connections in a way to ensure the integrity of the acoustic performance. Provide flanged or collar openings for ducts, pipes, fan, etc constructed of 1.6129 mm (1/16 in.) thick (16 G.S. gauge) galvanized steel. NOT USED.

3.4.4. Acoustic transmission loss data shall be the results of tests in accordance with ASTM E90-90 or its latest version. Absorption coefficients shall be the results of tests in accordance with ASTM C-423-90 or its latest version. Copies of test data to substantiate the acoustic performance of the panels, published by the Illinois Institute of Technology (formerly Riverbank Acoustical Laboratory) or other acceptable laboratory, shall be furnished by the panel manufacturer. NOT USED.

3.4.5. Acoustic plenums shall not be used as intake and exhaust air plenums that are directly connected to an exterior louvre and where water may infiltrate the plenum. NOT USED.

3.5. ACOUSTICAL LINING OF DUCTS

3.5.1. Ducts, except where noted otherwise, shall be acoustically lined internally, from the fan connection to the terminal. Both supply and return systems shall be lined unless otherwise specified. Exhaust ducts shall be internally lined where shown on the Drawings to reduce sound transmission.

3.5.2. Other ductwork shall be acoustically lined where shown on the Drawings.

3.5.3. Acoustical duct lining shall be 50 mm (2 in.) thick in ducts within Mechanical Rooms, in plenums, and where expressly shown on the Drawings. Acoustical duct lining shall be 25 mm (1 in.) thick in all other internally lined sheet metal ducts, unless otherwise specified or shown on the Drawings.

3.5.4. The acoustical liner shall be fixed to the duct with a minimum of 50% coverage of a fire-resistant adhesive. Where the duct width exceeds 300 mm (12 in.) or the height 600 mm (24 in.), the liner shall be additionally secured with mechanical fastening on maximum 450 mm (18 in.) centers on all sides. Mechanical fasteners that pierce the duct are unacceptable. Mechanical fasteners shall be in accordance with Section 15250 – MECHANICAL INSULATION. All ends of the liner shall be coated with a fire resistant cementing material to prevent delamination, leakage or erosion. All joints shall be firmly butted and ends coated with an adhesive to ensure that the lining is smooth across all joints.

3.5.5. Where acoustical duct lining is installed, the dimensions of the sheet metal shall be increased to include the thickness of the lining material. Dimensions shown on the Mechanical Drawings are the clear internal dimensions after the liner has been installed.

3.6. FLOATING FLOORS NOT USED.

3.6.1. For floating floors being installed by separate Architectural Sections, coordinate locations of drains, curbs, equipment supports, and other mechanical items penetrating or making contact with such floors. NOT USED.

3.6.2. Reinforcement and concrete for floating floor shall be provided under the Concrete Section – other materials shall be under this section as specified below. NOT USED.

3.6.3. Formwork on which concrete is poured shall be 12 mm (1/2 in.) thick, exterior grade douglas fir plywood and butted together with gusset plates where corners meet. Over the plywood

shall be laid a layer of 4 mil polyethylene sheet, lapped 150mm (6 in.) at all joints and taped.
NOT USED.

3.6.4. Isolation pads under the plywood form shall be 50 mm (2 in.) minimum thickness neoprene or compressed glass fibre with a natural frequency of 10 cycles per second. NOT USED.

3.6.5. Where the fan operating frequency is within 30 percent of this frequency, the pads shall be selected to have a natural frequency 30 percent larger than the fan operating frequency. Pads shall also have a relatively constant natural frequency over the total operating load range.
NOT USED.

3.6.6. Isolate the floating floor from sidewalls and from columns, pipes, etc. with 25 mm (1 in.) thick rigid glass fibre board or other material acceptable to the Engineer's Representative. Glass fibre board shall be adhered to the sidewalls, columns, etc. with an adhesive and sealed to prevent penetration of wet concrete. After concrete is poured the top of the glass fibre board shall again be sealed to prevent entrance of moisture. Adhesive and sealant shall be recommended by the manufacturer of the glass fibre and shall be the product of a recognized manufacturer of caulking, sealants and adhesives. NOT USED.

3.6.7. It shall be the responsibility of this section to prepare Shop Drawings showing the location of all glass fibre isolation pads and to correctly place these on the site. NOT USED.

3.6.8. Mechanical equipment shall rest on curbs poured and keyed to the structural slab and not on the floating floor. Refer to details shown on the Drawings. NOT USED.

3.6.9. Floor drains shall be installed as detailed. Particular care must be taken to ensure free movement of vibration isolation and sealing of membranes to drain and accessories for a waterproof installation. NOT USED.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.1.2. Provide shop drawings with technical data on all types of insulation to be installed.
 - 1.1.3. Provide two samples of each type of insulation indicating where each is to be used and a sample of a typical vapour barrier dam. Samples shall be mounted on boards. One shall be kept at the Contractor's site office and the other shall be turned over to the Engineer's Representative.
2. Products
 - 2.1. MATERIALS
 - 2.1.1. Fibreglass insulation shall be Owens-Corning, Certainteed, Manson, Johns Manville, Knauf or Fibrex.
 - .1 Duct insulation shall be rigid board vapour seal 48 kg/cu.m. (3 lbs/cu.ft.) density duct insulation with factory applied vapour barrier. Flexible duct insulation shall be 24 kg/cu.m. (1-1/2 lbs/cu.ft.) type with vapour barrier.
 - .2 Pipe insulation shall be preformed sectional fibreglass or mineral fibre insulation with factory applied all service jacket.
 - .3 Insulation for linear radiant heating panels shall be 12 kg/cu.m. (3/4 lb.cu.ft.) density fibreglass batt insulation with foil back.
 - 2.1.2. Flexible elastomeric insulation shall be Armacell or Nomaco with adhesive applied to both surfaces to be joined. Flexible elastomeric insulation shall not be used on pipes that are electrically traced.
 - 2.1.3. Corner beads and channels at floor line shall be 0.4 mm (28 ga.) galvanized sheet metal.
 - 2.1.4. Fire retardant lagging coating shall be Chil-Seal CP-50 by Childers Products Company or Monsey Bakor equivalent.
 - 2.1.5. Vapour barrier dam shall be Chil-perm CP30 with fibreglass cloth reinforcing.
 - 2.1.6. All cements and adhesives shall be as recommended by the manufacturer of the insulation. Insulation, insulation jacket, canvas and adhesive shall be fire retardant with a flame spread rating not to exceed 25 and a smoke developed rating not to exceed 50 when tested in accordance with CAN/ULC-S102-M.
 - 2.1.7. P.V.C. fitted jackets and covers shall have a flame spread rating not to exceed 25 and a smoke developed rating not to exceed 50 when tested in accordance with CAN/ULC-S102-M.
 - 2.1.8. Aluminum Jacket shall be 0.51mm (24 B&S Gauge - 0.0201 in) this sheet, embossed finish, with longitudinal slip joints and 50mm (2 in.) laps, die shaped fitting covers with factory applied moisture barrier.
 - 2.1.9. Fire resistant duct insulation shall be Royal Quickstop Quickwrap, 3M Fire Barrier Duct Wrap, CL4Fire, or Unifrax Corporation FyreWrap to meet the requirements of NFPA 96. Product shall meet flame spread rating of 25 and smoke developed rating of 50. Insulation product shall be complete with all manufacturers standard fastenings, including (where applicable) aluminum foil tape, filament tape, banding materials, pins, cup-head weld pins, and speed clips for a ULC listed installation.

3. Execution

3.1. INSTALLATION

- 3.1.1. Install insulation in accordance with the manufacturer's printed installation instructions unless noted otherwise.
- 3.1.2. Insulation thicknesses and conductivities shall meet or exceed the minimum standards set out in ASHRAE 90.1 (refer to Table 1 following) and as specified herein for the services covered.
- 3.1.3. Apply insulation to clean, dry surfaces only while ambient temperature is at least 10 deg. C. (50 deg. F.).
- 3.1.4. Commence application of insulation following required testing of piping, ductwork, and apparatus where such items are to be covered.
- 3.1.5. Recover all insulation, where exposed to view and not concealed in ceiling spaces or pipe spaces with 6 oz. canvas pasted on. Apply two coats of fire retardant lagging finish.
- 3.1.6. Where approved by the Engineer's Representative, as an alternative to the above, recover all piping insulation with a PVC jacket and preformed PVC elbows and fittings sealed with adhesive. PVC shall not be used on steam, medium and high temperature hot water piping or piping services that will be painted.
- 3.1.7. Cover all piping insulation external to the building and where specifically shown with field applied mesh reinforced mastic.
- 3.1.8. Ground source system piping shall be considered as a dual temperature service.
- 3.1.9. Where vapour barrier dams are called for, terminate the insulation and seal the vapour barrier to the pipe or ductwork using a mesh embedded in a vapour barrier mastic. Provide dams at valves, fittings used for servicing, groups of other types of fittings, irregular shaped objects at floor and wall penetrations, and at 15 m (50 ft.) intervals of straight pipe or straight ductwork for the following services: water piping that is less than 80 deg. F., including but not limited to the following:
 - .1 Domestic cold water piping
 - .2 Glycol piping
- 3.1.10. Terminate insulation on pipes passing through fire rated walls or floors, and fit tight to the fire stop material.
- 3.1.11. Irregular shaped objects such as strainers, pipe system filters, cyclone separators, blowdown valves and other accessories requiring servicing, on insulated piping, shall be insulated with removable caps or sections. All edges shall be sealed between pipe and vapour barrier and held in place with stainless steel straps. Finish all insulation smooth, making the outline of pipe insulation a true circular and concentric shape. Shape the outline of fitted insulation to blend with adjacent covering.
- 3.1.12. On piping systems specified to be insulated, include insulation on valves, flanges, couplings and unions.
- 3.1.13. Do not use staples to secure joints of insulation jackets.
- 3.1.14. Hot Services
 - .1 Heating water services, heating glycol, low pressure steam and condensate piping shall have glass fibre preformed pipe insulation. Refer to Table 1 for required insulation thicknesses.
 - .2 On hot services, insulate valves, fittings, couplings, unions, flanges and all other appurtenances through which water or steam passes, using mitred sections of preformed insulation of a thickness equal to the adjoining pipe insulation, and securely wire in place. Over mitred section, apply one coat of field applied mesh reinforced

mastic. Finish services with a vapour barrier using two full brush coats of vapour seal adhesive. Cover with canvas or PVC jacket.

- .3 Apply glass fibre or mineral fibre (RN to check) preformed vapour barrier jacket pipe insulation to domestic hot water piping. Refer to Table 1 following for required insulation thickness. Apply with all joints butted firmly together, and bond securely, sealing flaps by pasting down to give a smooth finish.
- .4 Apply 50 mm (2 in.) thick mineral fiber tank wrap insulation (wired on) to the following:
 - .1 All domestic hot water tanks
 - .2 Heating water tanks
 - .3 Shell and tube heat exchangers
 - .4 Condensate receivers
 - .5 Continuous and intermittent blow down tanks
 - .6 Steam generator drum heads
 - .7 Deaerator heaters.

Recover with canvas. Provide removable sections at access doors/manholes and all components requiring servicing.

- .5 High pressure steam piping 204 deg. C. (400 deg. F.) and less shall be covered with fibre glass or mineral fibre pipe insulation. Steam piping over 204 deg. C. (400 deg. F.) shall be covered with calcium silicate applied in two layers with staggered joints and wired on. Finish shall be 2 coats of cement covering and recovered with canvas. Refer to the table following for required insulation thicknesses.
- .6 Insulate all hot gas piping in conditioned spaces with preformed glassfibre insulation. Cover exterior piping with field applied mesh reinforced mastic.

3.1.15. Cold Services

- .1 Protect insulation by means of sheet steel shields at each hanger or support on the following:
 - .1 All sizes of chilled water
 - .2 All sizes of chilled glycol
 - .3 All sizes of spray coil
 - .4 All sizes of dual temperature
 - .5 All sizes of condenser water pipes.
 - .6 Domestic cold water piping 75 mm (3 in.) and larger
- Provide foamglass, Thermo-12 or calcium silicate insulation inserts the full length of shields at all hangers and supports.
- .2 For domestic cold water piping less than 75 mm (3 in.) where hangers on cold water lines penetrate vapour barrier make sure the penetration is properly sealed with insulation and vapour barrier continued up hanger a further 75 mm (3 in.).
 - .3 Where sheet metal shields are used refer to Section 15094 – HANGERS AND SUPPORTS.
 - .4 Apply 12 mm (1/2 in.) thick, preformed glass fibre pipe insulation with vapour barrier jacket or 12 mm (1/2 in.) thick flexible elastomeric insulation to all domestic cold water and chilled drinking water piping. Insulate the first 4500 mm (15 ft.) of the standpipe and/or sprinkler main.
 - .5 On cold water service valves, water meters, drain valves, vent connections, thermometer wells, pressure gauges and other irregular shaped objects, apply flexible elastomeric sheet insulation, thickness to suit service, cut and mitre as necessary, and

attach with adhesive and stainless steel banding. Bond and seal edges of insulation to the adjacent surfaces and finish with field applied mesh reinforced mastic.

- .6 Apply 50 mm (2 in.) thick rigid glass fibre insulation tank wrap by wiring or banding onto all chilled water storage tanks. Apply vapour barrier of foil faced flame resistant Kraft paper or aluminum foil, and recover with canvas. Apply insulation to legs/supports. Provide removable sections at access doors/manholes and all components requiring servicing. As an alternative to the above, provide 50 mm (2 in.) thick Flexible elastomeric sheet insulation.
- .7 The following cold service piping shall have glass fibre dual temperature pipe insulation:
 - .1 Chilled water
 - .2 Dual temperature glycol
 - .3 Spray coils
 - .4 Dual temperature water piping
 - .5 Dual temperature condenser water piping.
 - .6 Chemical feed piping for evaporative fluid cooler basin.Refer to the Table 1 for required insulation thicknesses.
- .8 Piping in air handling or air conditioning units. Insulate with 25 mm (1 in.) thick flexible elastomeric insulation and cover with field applied mesh reinforced mastic.
- .9 Insulate refrigerant suction lines with 12 mm (1/2 in.) flexible elastomeric insulation. Cover exterior piping with field applied mesh reinforced mastic.

3.1.16. Drainage Piping

- .1 Cover cast iron bell and spigot drainage pipe 75 mm (3 in.) and smaller with 12 mm (1/2 in.) preformed glass fibre pipe insulation, and finish with vapour barrier jacket. Cover the bell and spigot joint with a 12 mm (1/2 in.) thick flexible elastomeric insulation band that overlaps the fibreglass insulation 300 mm (12 in.) beyond joint in each direction. Seal band to the fibreglass insulation. Apply 25 mm (1 in.) thick insulation for all larger pipes.
- .2 Storm Drainage piping to be insulated:
 - .1 Roof drain sump
 - .2 All horizontal or sloping storm piping
 - .3 All elbows connecting the horizontal storm drainage piping to the vertical leaders
 - .4 Where the roof drain is less than 3000 mm (10 ft.) from the vertical leader, insulate the first 3000 mm (10 ft.) of pipe closest to the roof drain and the exposed portion of the roof drain.
- .3 Sanitary drainage piping to be insulated:
 - .1 Sanitary drainage pipes from urinals
 - .2 Direct and indirect drains from drinking fountains
 - .3 Floor drains from air conditioning apparatus
 - .4 Carrying chilled condensate to closest branch or main.
 - .5 All piping passing through high humidity area
 - .6 Sanitary drainage pipe from barrier free lavatories

3.1.17. Electrically Traced Piping

- .1 Insulated for the entire length of the piping. Insulation type shall be as specified for the service being traced. For services not specifically designated insulate as specified for heating water. The minimum thickness of insulation shall be:

- .1 25 mm (1 in.) for up to 150 mm (6 in.) pipe
- .2 38 mm (1-1/2 in.) for 200 mm (8 in.) pipe
- .3 250 mm (10 in.), 50 mm (2 in.) for pipes larger than 250 mm (10 in.) in size.

Thickness of insulation over fittings, valves and other appurtenances shall match the pipe insulation.

3.1.18. Ductwork and Equipment

- .1 Ductwork and equipment internal to the building within conditioned spaces shall have 25 mm (1 in.) thick rigid glass fibre duct insulation with vapour barrier. In concealed spaces and on round duct smaller than 600 mm (24 in.) insulation may be 38mm (1-1/2 in.) flexible type with vapour barrier. Flexible duct connections do not require insulation except where a factory applied insulation has been specified with the flexible duct connection.
- .2 Butt join insulation and attach with pins and speed washers, one per 0.186 sq.m. (2 sq.ft.), but not more than 450 mm (18 in.) apart in any direction. Apply fire resistive adhesive in 100 mm (4 in.) wide strips on 300 mm (12 in.) centres. Seal all joints with adhesive and apply vapour barrier tape. Install pins of suitable length for the thickness of insulation and clip flush after final installation of washers. Tack weld pins to sheet metal.
- .3 On exposed insulation in mechanical rooms, increase thickness as necessary to give 12 mm (1/2 in.) thickness over flanges and angles. Provide corner beads to protect corners to a height of 2135 mm (84 in.) above floor and provide channels at floor line to finish off insulation on apparatus.
- .4 Insulation Contractor to coordinate with sheet metal contractor to ensure duct insulation is applied prior to ductwork being installed to underside of slabs, beams or other services or behind other duct risers and shafts.

3.1.19. The following ductwork and equipment shall be insulated:

- .1 Apparatus casings
- .2 Outside and mixed air plenums
- .3 Outside and mixed air ductwork, including ducts to and from independent ERVs
- .4 Heating and cooling coil sections of ductwork and plenums
- .5 Casings of supply fans in equipment rooms
- .6 Supply ductwork in equipment rooms.
- .7 Exhaust and relief air ductwork. Plenums and/or casings from 1500 mm (60 in.) upstream of shut-off dampers to connection to exterior wall or roof
- .8 Exhaust, relief and supply and return air ductwork, plenums and/or casings through non-air conditioned or unheated internal space. Use 50 mm (2 in.) thickness.
- .9 For non-LEED projects, all supply ductwork from fans to VAV box for variable volume systems and all supply ductwork on constant volume systems.
- .10 Silencers and fan capacity monitors. Insulate to suit the service and location.

3.1.20. Apply 2 layers of 50mm (2 in.) flexible elastomeric insulation on all ductwork which is external to the building. Exterior insulation shall be coated with factory applied coating. Provide sloped extruded polystyrene insulation support on top of ductwork to maintain slope at a minimum of 5%. All flanges shall be covered by a minimum of 12mm (1/2 in.).

3.1.21. As an alternative to the above, apply 2 layers of 50 mm (2 in.) thick rigid extruded polystyrene board insulation. Insulation on top of ductwork shall slope a minimum of 5% and all flanges shall be covered by a minimum of 12mm (1/2 in.). Install field applied mesh reinforced mastic jacket on all insulated ductwork which is external to the building in accordance with the

- manufacturers recommended installation. The mastic shall be trowelled, sprayed, or wet brushed to a smooth even finish. There shall be no voids or holidays.
- 3.1.22. Plate type heat exchangers. Enclose hot surfaces in a removable galvanized steel box using 25 mm (1 in.) thick rigid insulation board. Construct box using flanged, bolted and gasketed joints, with sections removable for servicing the heat exchanger. Bolt box to floor base around the heat exchanger. Construction shall be similar to built-up air plenums. For cold surfaces use 25 mm (1 in.) thick Flexible elastomeric insulation, installed in sections with all joints sealed, using an installation method similar to that used on chillers. Insulate plate heat exchangers when both services are insulated. Insulate shell and tube heat exchangers when the service in the shell is insulated.
- 3.1.23. Fire resistant duct insulation shall be applied directly onto the ductwork and plenums in strict accordance with the manufacturer's instructions and Listing. Tested to ULC Standard for Internal Grease Duct Testing and ISO standard 6944 as a gypsum shaft alternative per NFPA 96 guidelines.

3.1.24. TABLE 1: MINIMUM PIPE INSULATION THICKNESS/PERFORMANCE (BASED ON ASHRAE 90.1 AND MODEL NATIONAL ENERGY CODE FOR BUILDINGS)

Minimum Pipe Insulation – mm (in.)

<u>Fluid Design Operating Temp. range deg. C. (deg. F.)</u>	<u>Insulation Conductivity [W(m-K)] [h-cu.ft. – deg. F. (Btu- in.)]</u>	<u>Mean Rating Temp deg. C. (deg. F.)</u>	<u>Nominal Pipe Diameter – mm (in.)</u>					
			<u>Runouts Up to 32 (1-1/4)</u>	<u>Less than 25 (1)</u>	<u>25-32 (1 to 1- 1/4)</u>	<u>38-75 (1-1/2 to 3)</u>	<u>100- 150 (4- 6)</u>	<u>200 (8) and up</u>

Heating Systems (Steam, Steam Condensate, Heating Glycol and Heating Water)

<u>Above 177</u>	<u>0.049</u>	<u>121</u>	<u>87</u>	<u>114</u>	<u>125</u>	<u>125</u>	<u>125</u>	<u>125</u>
<u>Above (350)</u>	<u>(0.34)</u>	<u>(250)</u>	<u>(3.5)</u>	<u>(4.5)</u>	<u>(5.0)</u>	<u>(5.0)</u>	<u>(5.0)</u>	<u>(5.0)</u>
<u>122-177</u>	<u>0.045</u>	<u>93</u>	<u>50</u>	<u>75</u>	<u>100</u>	<u>114</u>	<u>114</u>	<u>114</u>
<u>(251-350)</u>	<u>(0.32)</u>	<u>(200)</u>	<u>(2.0)</u>	<u>(3.0)</u>	<u>(4.0)</u>	<u>(4.5)</u>	<u>(4.5)</u>	<u>(4.5)</u>
<u>94-121</u>	<u>0.043</u>	<u>66</u>	<u>38</u>	<u>65</u>	<u>65</u>	<u>75</u>	<u>75</u>	<u>75</u>
<u>(201-250)</u>	<u>(0.30)</u>	<u>(150)</u>	<u>(1.5)</u>	<u>(2.5)</u>	<u>(2.5)</u>	<u>(2.5)</u>	<u>(3.0)</u>	<u>(3.0)</u>
<u>61-93</u>	<u>0.042</u>	<u>52</u>	<u>25</u>	<u>38</u>	<u>38</u>	<u>50</u>	<u>50</u>	<u>50</u>
<u>(141-200)</u>	<u>(0.29)</u>	<u>(125)</u>	<u>(1.0)</u>	<u>(1.5)</u>	<u>(1.5)</u>	<u>(2.0)</u>	<u>(2.0)</u>	<u>(2.0)</u>
<u>41-60</u>	<u>0.040</u>	<u>38</u>	<u>25</u>	<u>25</u>	<u>25</u>	<u>38</u>	<u>38</u>	<u>38</u>
<u>(105-140)</u>	<u>(0.28)</u>	<u>(100)</u>	<u>(1.0)</u>	<u>(1.0)</u>	<u>(1.0)</u>	<u>(1.5)</u>	<u>(1.5)</u>	<u>(1.5)</u>

Domestic and Service Hot Water Systems ^c

<u>41-60</u>	<u>0.040</u>	<u>38</u>	<u>25</u>	<u>25</u>	<u>25</u>	<u>38</u>	<u>38</u>	<u>38</u>
<u>(105 -140)</u>	<u>(0.28)</u>	<u>(100)</u>	<u>(1.0)</u>	<u>(1.0)</u>	<u>(1.0)</u>	<u>(1.5)</u>	<u>(1.5)</u>	<u>(1.5)</u>

Cooling Systems (Chilled Water, Chilled Glycol, Brine and Refrigerant)

<u>5-13</u>	<u>0.039</u>	<u>24</u>	<u>25</u>	<u>25</u>	<u>25</u>	<u>25</u>	<u>25</u>	<u>25</u>
<u>(40-60)</u>	<u>(0.27)</u>	<u>(75)</u>	<u>(1.0)</u>	<u>(1.0)</u>	<u>(1.0)</u>	<u>(1.0)</u>	<u>(1.0)</u>	<u>(1.0)</u>
<u>Below 4.4</u>	<u>0.039</u>	<u>10</u>	<u>25</u>	<u>25</u>	<u>38</u>	<u>38</u>	<u>38</u>	<u>38</u>
<u>Below (40)</u>	<u>(0.27)</u>	<u>(50)</u>	<u>(1.0)</u>	<u>(1.0)</u>	<u>(1.5)</u>	<u>(1.5)</u>	<u>(1.5)</u>	<u>(1.5)</u>

^a Piping installed exterior to the building shall meet the minimum insulation requirements of Heating Systems with a fluid design operating temperature above 177 Deg. C. (350 Deg. F.).

^b Runouts to individual terminal units not exceeding 3.7 m (12 ft.) in length located within Partitions within Conditioned Spaces.

^c Applies to recirculating sections of service or domestic hot water systems and first 2.4 m (8 ft.) from storage tank for non-recirculating systems.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
2. Products
 - 2.1. MATERIALS
 - 2.1.1. Piping shall be standard weight black steel pipe with 1035 kPa (150 psi) malleable iron fittings or welded as accepted by authority having jurisdiction.
 - 2.1.2. Valves shall be plug cocks and shall be acceptable to the authorities having jurisdiction.
 - 2.1.3. Electrically operated solenoid valves shall be normally closed, 2-position valve in accordance with CSA Z21.21 and SCA C22.2 suitable for 120 Volt operation with general purpose actuator.
3. Execution
 - 3.1. INSTALLATION
 - 3.1.1. Connect to the metering station and provide all downstream pipe and appurtenances.
 - 3.1.2. supply and install pressure reducing valve, with relief pipes to atmosphere, in Boiler Room.
 - 3.1.3. Weld all distribution piping within the building, and utilize screwed and/or flanged fittings at equipment only.
 - 3.1.4. Paint all gas piping in its entirety in an approved colour in accordance with the Code.
 - 3.1.5. Provide thermal expansion control for gas piping on the roof as required by CSAB149.1.
 - 3.1.6. Provide normally closed electronically operated solenoid valve (s) in the incoming natural gas distribution pipe upstream of all natural gas fired boilers. Valve assembly shall include one or more valves as required to suit service size with no appreciable pressure drop and isolation and lockable bypass valve for emergency operation.
 - .1 Installation shall be complete with push/pull emergency stop switch with red mushroom operator with normally closed contact wired in series with solenoid valve. Solenoid valve shall be powered by emergency power where available. Depression of mushroom operator shall interrupt power to the solenoid valve until manually reset. Mushroom operator shall be located at the boiler room entrance. Where entrance is not enclosed to the elements, the mushroom operator may be located on the inside at the door where it may be depressed without complete entry into the room. Provide all interconnected wiring as required for a complete and operational system. Mushroom operator shall be installed with tamper-proof enclosure to avoid unintended depression of operator and subsequent termination of gas supply.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
2. Products
 - 2.1. MATERIALS
 - 2.1.1. Pipes and fittings shall be in accordance with the following unless specified otherwise by local authorities.
 - 2.1.2. All city and domestic water, above grade, 75 mm (3 in.) and smaller, less than 1380 kPa (200 psi) working pressure:
 - .1 Pipe: Copper Tubing, Type “L”, Hard Drawn, ASTM B88. Fittings: wrought copper solder joint pressure fittings, ANSI/ASME B16.22 or cast copper alloy solder joint pressure fittings, ANSI/ASME B16.18.
 - .2 Joints made with 95-5 tin antimony, 96-6 tin silver, or 96-4 tin silver solder, ASTM B32.
 - .3 Grooved end copper fittings conforming to ASTM B75 etc.
 - .4 Couplings to be designed with angle bolt pads to provide a rigid joint.
 - .1 Installation ready for direct stab installation without field disassembly, complete with grade EHP gasket, rated for -35 deg. C. to 121 deg. C. (-30 deg. F. to 250 deg. F. Victaulic 607.
 - .2 Copper tubing standard coupling complete with EPDM flush seal gaskets rated for -35 deg. C. to 110 deg. C. (-30 deg. F. to 230 deg. F.) Victaulic 606.
 - .5 Butterfly valves, bubble-tight service up to 2065 kPa (300 psi) with bronze body Victaulic 608.
 - .6 Gate valves, 860 kPa (125 psi) WSP or 1380 kPa (200 psi) non-shock WOG with bronze body, rising stem screwed. Crane #428, Jenkins #810J, Toyo 293 or Kitz 24, for threaded ends or Crane #1334, Jenkins #813J, Toyo 299 or Kitz 44 for solder ends.
 - .7 Globe valves, 860 kPa (125 psi) WSP or 1380 kPa (200 psi) non-shock WOG with bronze body, solder ends or with screwed to solder adapter and composition disc for water service. Crane #1310, Jenkins #106BPJ, Toyo 222 or Kitz 10.
 - .8 Check valves 860 kPa (125 psi) WSP or 1380 kPa (200 psi) non-shock WOG with bronze body, swing check, solder ends. Crane #1342, Jenkins #4093J, Toyo 237 or Kitz 23.
 - .9 Non-slam check valves downstream from pumps, ANSI Class 150, 1032 kPa (150 psi) WSP pressure rating, dual flapper design with 316 stainless steel body and stainless steel check, renewable disc and resilient seat for flanged installation. Non-slam check valves shall be Velan-ProQuip Model DDD11-1D, Duo CHEK II H15CMF3-14.
 - .10 Strainers shall be Bronze Y body equal to Colton Industries Model 125YTB, Mueller 351M.
 - .11 Drain valves and blow-off valves shall be 4137 kPa (600 psi) WG 19 mm (3/4 in.) ball valves with bronze body or forged brass body, solid ball, male threaded garden hose end, brass cap and chain equal to Watts B-6000, Toyo 5046, Kitz 58CC or Apollo 78-100.

- .12 Hose bibs shall be for 860 kPa (125 psi) non-shock, bronze body with composition disc and 19 mm (3/4 in.) garden hose thread, complete with a U.L.C. vacuum breaker.
- 2.1.3. Storm and sanitary drains and vents above grade shall be cast iron or copper pipe installed as in regulations, except where copper pipe is used, joints to be made with 95-5 solder. ABS and PVC pipes are not acceptable.
- 2.1.4. Vent stack covers shall be equal to Thaler Metal Industries SJ-24/SJ-25 and shall be 1100-0T alloy aluminum with vandal proof removable cap and EPDM base seal, pvc coated deck flange or bituminous deck flange as required to suit roof membrane.
- 2.1.5. Buried storm and sanitary inside the building shall be Class 4000 grey cast iron soil pipe, black bituminous coating, fittings and means of joining to meet the requirements of CAN/CSA B70. Mechanical couplings for drain, waste, vent pipe and sewer pipe to meet the requirements of CAN/CSA B602. Bituminous fibre, vitrified clay, ABS and PVC pipe are not acceptable.
- 2.1.6. Buried storm and sanitary inside the building shall be SDR 28 rigid for 100mm (4 in.) to 150mm (6 in.), SDR 35 for 200mm (8 in.) and larger, green PVC gasketed hub and spigot pattern sewer pipe and injection molded and fabricated gasketed fittings to meet the requirements of CAN/CSA B182.2 with assembled with PVC pipe lubricant.
- 2.1.7. All embedded pipe and materials in parking structures and ramps shall meet the requirements of CAN/CSA S413-94 for corrosion resistant materials or shall have a corrosion resistant coating.
- 2.1.8. Sump and sewage pump discharge shall be Schedule 40 galvanized steel pipe with galvanized malleable iron fittings or Type "L" copper.
- 2.1.9. Butterfly valves may be used in lieu of gate valves in size 65 mm (2-1/2 in.) and over in systems 1380 kPa (200 psi) and less. Where specifically shown on drawings, butterfly valves must be used. Install between 860 kPa (125 psi) flanges.
 - .1 Valves shall have iron body, one piece or split alloy steel shaft, top and bottom bearings, bronze disc or iron disc with stainless steel trim and resilient elastomer replaceable seat with integral reinforcing ring or keyed to body.
 - .2 Body shall have threaded lugs.
 - .3 Valve shall have bubble tight shut-off to 1035 kPa (150 psi) pressure in either direction when the piping and connecting flange is removed from one side of the valve.
 - .4 Valves 100 mm (4 in.) and smaller shall have lever operator with lock.
 - .5 Valves larger than 100 mm (4 in.) shall have worm gear manual operator with indication of valve opening.
 - .6 Butterfly valves shall be equal to Keystone Model 222-784, Dezurik Model BGS, Challenger Model 20-CN4E, Bray Series 31, Apollo 143 Series, Kitz 61 Series, Centreline 200 or Crane 44.
 - .7 Butterfly valves for grooved end systems shall be Victaulic 608.
- 2.1.10. Back-flow preventers for connection to wall hydrants, hose bibbs, hot water heating systems, and similar uses, shall be Watts No. 9 or 909 or Hersey-Beeco with C.S.A. listing.
- 2.1.11. Ball valves 50 mm (2 in.) and smaller shall be bronze body or forged brass 4137 kPa (600 psi) WOG, virgin Teflon seat, TFE stem packing and thrust washer, 1/4 turn open-closed operation with solid ball. Ball valves shall be Watts No. B-6000, Toyo 5044A/5049A, Kitz 58/59 or Apollo 70-100/200. Stem extensions shall be provided on all ball valves. Ball valves may be substituted for gate valves only.

- 2.1.12. Except where special feature are required or unless otherwise approved or noted, all valves shall be of one manufacturer with the manufacturer's name and the pressure rating clearly marked on the outside of the valve body. Valves shall be manufactured by Crane, Jenkins, Toyo or Kitz. Butterfly valves shall be by Keystone, DeZurik, Bray, Challenger, Centerline, Crane, Apollo, Kitz or Victaulic. Non-slam check valves shall be Pro-Quip, Duo CHEK II, Centerline, Mueller or Victaulic. Ball valves shall be Apollo Watts, Crane, Jenkins, Toyo or Kitz. Valves shall be equal to the model numbers specified.
- 2.1.13. Pressure reducing valves 65 mm (2-1/2 in.) and larger shall be equal to Cla-Val 90-01 with capacity shown and a pressure drop not exceeding 70 kPa (10 psi) under full flow. Valve shall maintain downstream pressure within a range of plus or minus 35 kPa (5 psi). Required outlet pressure, inlet pressure and flow rate as shown. Alternate manufacturers will not be accepted.
- .1 This valve shall maintain a constant downstream pressure regardless of fluctuations in demand and shall also prevent a pressure rise when demand is zero.
 - .2 Valve shall be single-seated, hydraulically operated, pilot controlled diaphragm type globe valve. Valve stem shall be top and bottom guided and shall be actuated by a resilient diaphragm. Valve body and cover shall be cast iron, flanged. Trim shall be bronze type. Valve seat shall be replaceable. There shall be no external packing glands.
 - .3 Pilot control shall be a direct acting, adjustable, spring-loaded valve with bronze body and stainless steel trim.
 - .4 Main valve, pilot control valve and all trim shall be factory-assembled into one unit.
 - .5 Valve shall be Class 125 for low pressure systems less than 1380 kPa working pressure and Class 250 for high pressure systems greater than 1380 kPa (200 psi) working pressure.
 - .6 Pressure reducing valves 50 mm (2 in.) and smaller shall be Cash Acme or Watts to Watts UB5 bronze body, screwed. Rating of valve shall be 2070 kPa (300 psi) at 71 deg. C. (160 deg. F.).
 - .7 See drawing for capacities and operating pressures.
- 2.1.14. Combination pressure reducing and check valve shall be Cla-Val 790-01-D and shall be as specified for the pressure reducing valve, but with an integral check valve.
- 2.1.15. Water hammer arresters shall be stainless steel bellows type and shall bear the Plumbing and Drainage Institute seal of approval. JR Smith 5000 Series, Zurn Z-1700, Mifab WHB, Watts SS Series. Piston type shall not be acceptable.
- 2.1.16. Gate valves in sanitary drains shall be equal to Seguro rubber sealed, cast iron, Class 150, ASA B16.10, with ASA B16.1 flanged ends, with OS&Y rising stem operation.
- 2.1.17. Exterior site PVC pressure piping shall be Iplex or Canron Blue-Brute conforming to AWWA-C900 and CSA B 137.3 standards laid in accordance with the manufacturers instructions and in accordance with Sub-section 3.5 of Regulation 815/84 of the O.W.R.A. (Ontario Plumbing Code).
- 2.1.18. Storm drainage piping from manhole outside building to creek, drainage course, may be corrugated galvanized steel using Armco standard round corrugated steel culvert.
- 2.1.19. Thermostatic mixing valves
- .1 Thermostatic mixing valves shall be Lawler Series High-Low Water Mixer 804 combination thermostatic and pressure balanced water controller, 38mm (1-1/2 in.) inlet and 50 mm (2 in.) outlet, liquid filled motor. The valve shall maintain output temperature for changes in inlet pressure and temperature. Valve construction shall be bronze body and stainless steel piston and liner. Mixing valve shall include a union end

stop and check valve with removable strainer on each inlet. Complete with 0 – 200 deg. F. dial thermometer and shut off valve on tempered water outlet.

2.1.20. Backwater valves shall be “normally open” design by Mainline, J.R. Smith, Zurn, Mifab, or Watts.

.1 Unit up to 300 mm (12 in.) below grade, shall be complete with access cover at grade and extension sleeve between cover and valve casing.

.2 Unit more than 300 mm (12 in.) below grade, shall be complete with minimum 600 mm (24 in.) dia. galvanized steel, concrete or vitrified clay tile access pit with 600 mm (12 in.) dia. heavy duty scoriated manhole cover and frame.

3. Execution

3.1. INSTALLATION

3.1.1. Valves shall be provide as shown and as required for the satisfactory operation and control of all equipment and shall be installed to enable each piece of equipment to be isolated.

3.1.2. Gate valves shall be installed at the base of each riser and at each branch take-off. Where the equipment is to be isolated within easy view of and not more than 6000 mm (20 ft.) from the main, at the branch take-off, then the branch take-off valve may serve as the equipment isolating valve.

3.1.3. Drain valves shall be installed at each low point in the piping systems and at each tank.

3.1.4. Blow-off valves shall be provided on each 65 mm (2-1/2 in.) strainer and larger.

3.1.5. Globe valves shall be installed as shown and in each bypass.

3.1.6. Back-flow preventers shall be installed for connections to wall hydrants, hose bibbs, hot water heating systems, as shown on drawings, and any other connection to potable water systems in which backflow may occur, shall be Watts No. 9 or 909 or Hersey-Beeco with CSA listing. Where hose bibbs and wall hydrants are provided with an approved vacuum breaker the back-flow preventer is not required. An approved double check valve device may be used in lieu of a back-flow preventer where approved by CSA.

3.1.7. Check valves shall be installed as shown and where required to prevent backflow.

3.1.8. Buried piping shall be of a class and type and laid in a bedding as noted and/or as recommended by the manufacturer and any authority having jurisdiction. Class of pipe and bedding shall take into consideration location, size of pipe, type, width and depth of trench and type of soil.

.1 Bedding types shall be Class A or Class B as detailed Standard Drawings for concrete, vitrified clay or asbestos cement pipes or the manufacturer's equivalent with minimum load bearing factors of 2.8 and 1.9 respectively.

3.1.9. The following publications shall be used to establish class of bedding and class of piping for installation other than the above. They shall also serve as guide for preparation of bedding, installation and testing.

.1 Installation manual of the Ontario Concrete Pipe Association.

.2 Design data of the American Concrete Pipe Association as distributed by the Ontario Concrete Pipe Association.

.3 Cast iron soil pipe and fittings handbook of the cast iron soil pipe institute.

.4 Sewer pipe manual of Canron.

.5 Sewer Design & Construction of the Water Pollution Control Federation.

.6 The Blue Brute and Ring Tite PVC gravity sewer pipe installation Guide by Manville.

- 3.1.10. Pipe passing under a driveway or parking lot with less than 1.5 m (5 ft.) of cover shall be encased in 150 mm (6 in.) of 13800 kPa (2000 psi) concrete on top, bottom and sides.
- 3.1.11. Provide thrust blocks of 20 mPa (3000 psi) concrete at each tee, elbow, valve and other fitting where thrust forces could occur. Thrust blocks shall be sized to suit the local authorities requirements, but in no case be smaller than 150 mm (6 in.) greater on all sides than the pipe served.
- 3.1.12. PC4 jointing material shall not be used on underground piping. PC4 or similar jointing material shall be used for caulking waste pipes from sinks or dishwashers and other waste pipes carrying hot discharge liquids.
- 3.1.13. Connections between copper and steel pipe shall be made with brass or bronze fittings where other type of connection is not specified in regulations.
- 3.1.14. All piping shall run parallel with closest wall.
- 3.1.15. Piping in walk-in pipe spaces shall be installed as close to one wall as possible.
- 3.1.16. Each water hammer arrester shall be accessible for service and replacement. They shall be installed in compliance with the recommendations of the Plumbing and Drainage Institute as found in Standard PD1-WH201.
- 3.1.17. Slope all drains and vents in accordance with the plumbing code but not less than the minimum slopes shown on the drawings. Slope all water lines 25 mm in 12 m (1 in. in 40 ft.) unless shown otherwise.
- 3.1.18. Vent stack covers shall be properly sized for each vent penetrating the roof. Division 15 shall supply vent stack covers for installation and flashing by the roofing contractor.
- 3.1.19. Provide a thermostatic mixing valve on discharge of domestic hot water systems.
- 3.1.20. Provide a backwater valve on every fixture drain or common branch from fixture drains where the fixtures are located below the level of the adjoining street as required by the Ontario Building Code.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
2. Products
 - 2.1. MATERIALS
 - 2.1.1. Floor drains shall be J. R. Smith, Mifab, Watts, or Zurn.
 - 2.2. FINISHED AREAS
 - 2.2.1. Floor drains in finished areas shall be all coated cast iron body, flashing clamp with seepage openings and adjustable 127 mm (5") diameter nickel bronze 6.35 mm (1/4") thick strainer, secured with S.S. screws, 100 mm (4") throat on strainer. Drain shall be complete with trap primer connection. J.R. Smith 2005A, Zurn ZN-415-B5, Mifab F1100C-5-1, Watts FD-100-C-A5-1.
 - 2.2.2. Floor drains in finished areas and stainless steel top shall be all coated cast iron body, flashing clamp with seepage openings and adjustable 127 mm (5") diameter stainless steel heavy duty strainer with No. 4 satin finish, secured with S.S. screws, 100 mm (4") throat on strainer. Drain shall be complete with trap primer connection. J.R. Smith 2005ASS, Zurn ZXSS-415-B5, Mifab F1000C-5-3, Watts FD-1100-C-5-3.
 - 2.2.3. Floor drains in quarry or mosaic tiled areas shall be similar to floor drains in finished areas but with 127 mm x 127 mm (5" x 5") square nickel bronze strainer. J.R. Smith 2005B, Zurn ZN-415-Y5, Mifab F1100C-S5-1, Watts FD-100- C-L5-1.
 - 2.2.4. Floor drains in quarry or mosaic tiled areas and stainless steel top shall be similar to floor drains in finished areas but with 127 mm x 127 mm (5" x 5") square stainless steel strainer with No. 4 satin finish. J.R. Smith 2005BSS, Zurn ZN-415-Y5, Mifab F1000C-S5-3, Watts FD-1100- C-L5-3.
 - 2.2.5. Funnel floor drains in finished areas shall be similar to floor drains in finished areas but with minimum nominal 127 mm (5") dia. strainer, full opening for funnel and nominal 75 mm x 225 mm (3 in. x 9 in.) oval funnel. J.R. Smith 2005A-A6-3591 NB, Zurn ZN-415-BF, Mifab F1100C-EG-1, Watts FD-100-C-EG-1.
 - 2.2.6. Floor drains in Safety Sheet Vinyl Flooring Areas shall be similar to floor drains in finished areas but with 2 piece flashing clamp collar. JR Smith 2051, Zurn ZN-415-R9, Mifab F1100C-FC9-1, Watts FD-100-C-FC9-1.
 - 2.2.7. Hub drains shall be similar to floor drains in finished areas but with cast iron hub. J.R. Smith 2005-2645, Zurn ZN-415-S, Mifab F1100C-DD-50, Watts FD-100-DD-50.
 - 2.3. NON-FINISHED AREAS
 - 2.3.1. Floor drains in non-finished areas shall be coated cast iron body, drainage flange, adjustable nominal 200 mm (8 in.) dia. heavy-duty strainer. J.R. Smith 2320, Zurn Z-536, Mifab F1320C-4, Watts FD320-4.
 - 2.3.2. Funnel floor drains in non-finished area shall be similar to floor drains in non-finished areas but with nominal 75 mm x 225 mm (3 in. x 9 in.) oval funnel. J.R. Smith 2320-3591, Zurn Z-536-FO, Mifab 1320C-4-G-50, Watts FD320-4-G-50.

- 2.3.3. Plenum drains (Plenum Floor Drains) for use in suspended sheet metal plenums shall nominally be 225 mm (9 in.) overall dia. strainer with screwed attachment for sheet metal pan. J.R. Smith SQ4-1753-F, Zurn ZN-211-R9, Mifab F1100-FC9-1, Watts FD-200-FC9-1.
- 2.3.4. Floor drains in floating floor areas shall be cast iron body, drainage flange, nominal 200 mm (8 in.) dia. heavy-duty strainer, movement compensator and vibration isolator. J.R. Smith 9340, Zurn Z-556-FS, Mifab F1600C-4, Watts FD-620-C.
- 2.3.5. Funnel floor drains in floating floors shall be similar to floor drains in floating floors but with nominal 75 mm x 225 mm (3 in. x 9 in.) oval funnel. J.R. Smith 9340-3591, Zurn Z-556-FS-FO, Mifab F1600C-4-G-50, Watts FD-620-C-G-50.
- 2.3.6. Floor drains in transformer vaults shall be coated cast iron or steel body, with heavy duty 300 mm x 300 mm (12 in. x 12 in.) tractor grate. Drain body shall have grounding screw. Drain shall have side outlet connection, bronze backwater valve/flame arrestor assembly and gasketed internal cleanout cover. J.R. Smith 2235 EVFAHQ, Zurn ZZ-HQ-605-1-HVV, Mifab F1560-4-8-GS, Watts FD-460-F-9-46-4.
- 2.3.7. Floor drains in parking structures and ramps shall meet all requirements of CAN/CSA-S413-94 for materials and corrosion resistance and shall have double drainage, anti-ponding top, sediment bucket and membrane clamp. Supply drain complete with membrane extension as required. J.R. Smith SQ-2-2347, Zurn ZAL-625-HY, Mifab F1510-CSA, Watts FD-490-F-80.
- 2.3.8. Garage floor drains at slab on grade shall be heavy duty, coated cast iron, with heavy duty 300 mm x 300 mm (12 in. x 12 in.) tractor type grate and sediment bucket. Drainage flange shall be non-adjustable and clamp shall be provided where moisture proof membrane is installed. J.R. Smith SQ2-1717-B, Zurn Z-610-H-Y, Mifab F1440C-4-5, Watts FD-460-AF-C-4-5.
- 2.3.9. Garage floor drains at slab on grade shall be heavy duty, coated cast iron, with heavy duty 300 mm x 300 mm (12 in. x 12 in.) tractor type grate and sediment bucket. Drainage flange shall be adjustable to suit topping depths and clamp shall be provided where moisture proof membrane is installed. J.R. Smith SQ2-1717-B, Zurn Z-610-H-ADJ-Y, Mifab F1440C-4-5, Watts FD-460-AF-C-4-5.
- 2.3.10. Catch basin floor drains shall be heavy duty coated top with coated steel sump with side outlet for sand storage. Top shall be nominal 600 mm x 600 mm (24 in. x 24 in.) tractor grate. J.R. Smith 8930-TR-E-M, Zurn ZF-799-75, Mifab 1570, Watts FD-410.
- 2.3.11. Trench drain systems shall be precast polymer concrete, nominal 125 mm (5 in.) wide sloped modular system with interlocking components and extra heavy duty class "E" ductile iron grates and integral channel rail frame, catch basin, foul air trap as required. Provide minimum 100 mm (4 in.) bedding of concrete around trench. J.R. Smith 9818, Zurn Z-886, ACO S100K.
- 2.3.12. Trench drain shall be all stainless steel body, frame and grate. Grate shall be nominal 150 mm (6 in.) and designed for class "E" traffic loading. J.R. Smith SQ2-1744-SS-M, Zurn Z-890-SBG.
- 2.3.13. Elevator pit drains shall be vertical wall or angled pit drain type, coated cast iron body, flashing clamp, integral backwater valve and cast iron secured grate. J.R. Smith 7000-C, Zurn Z-629-C, Mifab BV1210, Watts BV-600.
- 2.3.14. Pressure activated automatic trap seal primer serving 1 or 2 drains shall have 12 mm (1/2 in.) connections and shall have integral backflow preventer and vacuum breaker. Provide manufacturer recommended distribution unit for trap primers serving more than one drain. Mifab M-500 series, Zurn 1022 series or PPP PR-500 series.
- 2.3.15. Electronic automatic trap seal primer system shall have 12 mm (1/2 in.) connection be complete with integral ball valve, backflow preventer and vacuum breaker. The unit shall be pre-piped with a copper manifold and distribution system suitable for the number of drains served. Electrical components to require a single point power connection at 120V. Unit shall include a manual override switch and 24 hour timer with relay and adjustable delay. All

components shall be factory assembled and installed into a coated steel box with access door for recessed [surface] mounted installation. Mifab MI 100-UA series, Zurn Z1020 series or PPP PT or MPB-500 series.

2.4. INSTALLATION

- 2.4.1. Provide floor drains in air plenums on the suction and discharge side of fans with deep seal traps. Traps connected to Vestibule air plenums shall be connected to an electronic automatic trap seal primer system.
- 2.4.2. Provide a trap seal primer for all floor drain traps. Trap primer shall be installed at the nearest cold water served fixture or faucet, except drinking fountains. Provide access to primer for repair or replacement. Provide a globe valve on the water supply for regulation and shut-off.
- 2.4.3. Provide a running trap and cleanout for each pit drain.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 2. Products
 - 2.1. MATERIALS
 - 2.2. FINISHED AREAS
 - 2.2.1. Cleanouts in finished areas with membrane floors shall be coated cast iron body with adjustable nickel bronze frame and round scoriated gas tight access cover with secondary gas tight plug. J.R. Smith 4020-F-C, Zurn ZN 1400-KC, Mifab C1100C-R-1-34, Watts CO-100-C-R-1-34G.
 - 2.2.2. Cleanouts with recess for terrazzo shall be similar to cleanouts in finished areas with membrane floors but shall have terrazzo recess. J.R. Smith 4180-F-C, Zurn ZN 1400-Z-KC, Mifab C1100C-UR-1-34, Watts CO-100-C-U-1-34G.
 - 2.2.3. Cleanouts with recess for tile shall be similar to cleanouts in finished areas with membrane floors but shall have 3 mm (1/8 in.) tile recess. J.R. Smith 4140-F-C, Zurn ZN 1400-X-KC, Mifab C1100C-UR-1-34, Watts CO-100-C-T-1-34G.
 - 2.2.4. Cleanouts for carpeted areas shall be similar to cleanouts in finished areas but shall have stamped stainless steel carpet marker. J.R. Smith 4020-Y, Zurn ZN 1400-CM, Mifab C1100-RC-1-34, Watts CO-200-RC-1-34G.
 - 2.3. NON-FINISHED AREAS
 - 2.3.1. Cleanouts in non-finished areas shall be all coated cast iron body with heavy duty cast iron or ductile iron top. J.R. Smith 4220-F-C, Zurn Z-1400-KC, Mifab C1100-XR-4-34, Watts CO-100-C-RX-4-34G.
 - 2.3.2. Cleanouts at the base of each vertical stack and rain water leader shall be either Daisy or Barrett type.
 3. Execution
 - 3.1. INSTALLATION
 - 3.1.1. Cleanouts in furred ceiling spaces shall extend up through floor slab above, except where the Engineer's Representative gives specific approval to its location in the ceiling space.
 - 3.1.2. Cleanouts shall be installed in horizontal drains at each change of direction and as required.
- END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to the Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.1.2. Refer to Laboratory Furniture and Fittings section for supply, installation, connection requirements for laboratory systems.
 - 1.2. SUBMITTALS
 - 1.2.1. Submit Shop Drawings and/or catalogue cuts of all items supplied in accordance with requirements of Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
2. Products
 - 2.1. MATERIALS
 - 2.1.1. Plumbing fixtures shall be as indicated and specified with all required supports, accessories, drainage, vent and water connections to make the fixtures complete.
 - 2.1.2. The flow rates of fittings that supply water to a fixture shall not exceed the maximum flow rates listed in Part 7 of the O.B.C. under the Water Efficiency section.
 - 2.1.3. Fixtures shall be American Standard, Crane, Eljer or Kohler, equivalent to the fixtures specified. Fixtures shall be white.
 - 2.1.4. Fittings and trim shall be American Standard, Crane, Kohler, Sloan, Chicago Faucets, Symmons, or Delta/Cambridge except where specified otherwise. All exposed valves, fittings, escutcheons, trim, etc., at each fixture shall be polished chrome plated brass, unless specified otherwise.
 - 2.1.5. Fittings and trim shall be American Standard, Crane, Delta/Cambridge, Kohler, Sloan, Chicago Faucets, Symmons, or Moen equivalent to the trim specified. All exposed valves, fittings, escutcheons, trim, etc., at each fixture shall be polished chrome plated brass unless specified otherwise.
 - 2.1.6. Carriers shall be furnished for all wall hung water closets, urinals, and lavatories. Carriers shall be in conformance with Section 15451 – FIXTURE CARRIERS.
 - 2.2. WATER CLOSETS AND URINALS
 - 2.2.1. All tanks of water closets shall be internally lined with anti-sweat insulation except pressure assist water closets.
 - 2.2.2. Water closets shown as type 'WC-6 – Floor mounted pressure-assist (Barrier free design)' shall be a "Low Consumption" tank toilet, floor mounted, vitreous china, elongated siphon jet flush action bowl, fully glazed 50 mm (2 in.) internal trapway, 250 mm x 300 mm (10 in. x 12 in.) large water surface, "Speed Connect" P.A. tank complete, 6 L (1.6 gal.) flush, with cast sanitary guard on bowl for china to china tank assembly, and bolt caps. Provide floor flange, flange bolts and gasket. American Standard Cadet Elongated 2333.100, Crane Economizer 3838, Eljer Aqua-Saver 091-7045, Kohler Highline Pressure Lite K-3544.

- .1 Seat for WC unit above shall be elongated heavy-duty solid plastic toilet seat, open front with cover, with stainless steel check hinge and stainless steel posts, washers, and nuts. Bemis 1950SS, Centoco 820STS, Kohler Lustra K-4650-EB, Olsonite 46SS.
- .2 Supplies for WC unit above shall be chrome plated, heavy pattern angle lavatory supplies, lockshield, screw driver slot, stuffing box cartridge, 3/8 in. IPS brass inlet supply nipple, flexible riser tubes, and stainless steel wall flange. Delta Commercial 47T1316SD, McGuire H166 LKN3, Zurn Z-8820-CR-LK-3.

2.3. LAVATORIES

- 2.3.1. Lavatories shown as type 'L-6 – Wall hung (Barrier free design)' shall be 560 mm x 533 mm x 127 mm – 190 mm (22 in. x 21 in. x 5 in. – 7½ in.) deep with 200 mm (8 in.) centres. Basin to be wall hung, vitreous china, rear overflow, for concealed arm carrier. American Standard Murro 0958.0900, Crane Serena 129S, Eljer Freestyle 051-2208, Kohler Pinoir K-2035-8.
 - .1 Faucet for lavatory unit above shall be 200 mm (8 in.) centre, two handle widespread lavatory faucet, polished chrome plated finish trim, cast brass bodies, and ¼ turn ceramic disk cartridges, brass spout and trim, color indexed metal handles with vandal resistant screws, heavy duty goose neck spout less pop-up, 1.9 USGPM laminar flow control moderator, and 100 mm (4 in.) OBC compliant cast brass handles. Chicago Faucet 786-FC-XK-317, Delta Commercial 27C2922, Kohler K-7303-K/K-16012-4, Zurn Z-831A4.
- 2.3.2. Drain for all lavatory units with exposed under counter installation shall be 32 mm (1¼ in.) size, polished chrome plated offset open grid, and cast brass lavatory waste strainer, 17 gauge tubular offset. Safety covers are to be supplied as per local codes. Delta Commercial 33T290, Kohler K-13885, McGuire 155WC, Zurn Z-8746.
- 2.3.3. Drain for all lavatory units with concealed under counter installation shall be 32 mm (1¼ in.) size, polished chrome plated inline open grid and cast brass lavatory waste strainer, 17 gauge straight tubular tailpiece. Delta Commercial 33T260, Kohler K-7715, McGuire 155A, Zurn Z-8743.
- 2.3.4. "P" trap for all lavatory units shall be polished chrome plated cast brass, adjustable body 32 mm (1¼ in.) size with cleanout plug, 17 gauge tubular wall bend. Safety covers are to be supplied as per local codes for exposed under counter installation. Delta Commercial 33T311, McGuire 8872C, Zurn Z-8700-D, Kohler K8998.
- 2.3.5. Supplies for all lavatory units shall be a pair of chrome plated, heavy pattern angle lavatory supplies, lockshield, screw driver slot, stuffing box cartridge, 3/8 in. IPS brass inlet supply nipple, flexible braided stainless steel risers, and stainless steel wall flange. Delta Commercial 47T2512SD, McGuire H165LKN3RB, Zurn ZH-8820-LR-LK-3.

3. Execution

3.1. INSTALLATION

- 3.1.1. Provide necessary plates, brackets, cleats, supports, etc, for rigidly securing fixtures in place. Accurately lay out all roughing piping, avoiding offsets.
- 3.1.2. Examine fixtures for defects. Remove and replace any fixture which, in the opinion of the Engineer's Representative, is damaged. Make necessary adjustments to ensure fixtures function as per manufacturer's operating criteria. Clean and polish all fixtures and trim upon completion.
- 3.1.3. Ensure wall-mounted fixtures with back water connections have an adjacent access door, unless the pipe space is sufficiently wide to allow the water connection to be made from within the pipe space. For this, pipe space shall be 600 mm (24 in.) minimum clear width.

- 3.1.4. Fixtures shall be installed symmetrical with wall tile pattern, unless otherwise dimensioned or shown on Architectural Drawings.

END OF SECTION

1. General
- 1.1. WORK INCLUDED
- 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
2. Products
- 2.1. MATERIALS
- 2.1.1. Fixtures carriers shall be J.R. Smith, Zurn, Mifab or Watts.
- 2.1.2. Carriers shall be furnished for all wall hung water closets, urinals, lavatories, service sinks and drinking fountains. Carriers shall be floor mounted and supported independently of the wall. Carriers shall be suitable for each particular fixture. Carrier feet shall not project beyond finished wall.
- 2.1.3. All fixture carriers with integral cast iron fittings shall be certified to CSA B70 as required by authority having jurisdiction.
- 2.2. WATER CLOSET CARRIERS
- 2.2.1. Carriers for water closets shown as **WC-6** shall be as described herein. Refer to Drawings for installation arrangement.
- 2.2.2. Carriers for water closets with single adjustable horizontal discharge shall be 100 mm (4") all coated cast iron fittings, rear anchor bolt factory assembled, face plate with rear anchor support, heavy duty legs, adjustable short cast iron nipple, plated hardware, cap nuts, test plug and protection cap. J.R. Smith 0210Y-2-M51-95, Zurn Z-1203-N(L/R)4-29, Mifab MC-10-3-6, Watts CA-101-(L/R)-M3-M12.
- 2.2.3. Carriers for back to back water closets with adjustable horizontal discharge shall be 100 mm (4") all coated cast iron fittings, factory assembled face plate with heavy duty legs, adjustable short cast iron nipple, plated hardware, cap nuts, test plug and protection cap. J.R. Smith 0210YD-2-95, Zurn Z-1203-ND4-29, Mifab MC-10D-6, Watts CA-101-D-M3..
- 2.2.4. Carriers for water closets with single adjustable vertical stack discharge shall be 100 mm (4") all coated cast iron fittings, factory assembled face plate with rear anchor support, heavy duty legs, adjustable cast iron nipple, plated hardware, cap nuts, test plug and protection cap. J.R. Smith 0230Y-2-M51-95, Zurn 1204-N4-29, Mifab MC-12-3-6, Watts CA-121-M3-M12.
- 2.2.5. Carriers for back to back water closets with adjustable vertical stack discharge shall be 100 mm (4") all coated cast iron fittings, factory assembled face plate with heavy duty legs, adjustable cast iron nipple, plated hardware, cap nuts, test plug and protection cap. J.R. Smith 0230DY-2-95, Zurn 1204-ND4-29, Mifab MC-12D-3, Watts CA-121-D-M3-M12.
- 2.2.6. Carriers for water closets with single adjustable vertical stack discharge and offset fittings for compact installation shall be 100 mm (4") all coated cast iron fittings, factory assembled face plate with rear anchor support, heavy duty legs, adjustable cast iron nipple, plated hardware, cap nuts, test plug and protection cap. J.R. Smith 0410(L/R)Y-2-M51-95, Zurn 1209-N(L/R)4-29, Mifab MC-15-3-6, Watts CA-151-(L/R)L-M3-M12.
- 2.2.7. Carriers for back to back water closets with adjustable vertical stack discharge and offset fittings for compact installation shall be 100 mm (4") all coated cast iron fittings, factory assembled face plate with heavy duty legs, adjustable cast iron nipple, plated hardware, cap nuts, test plug and protection cap. J.R. Smith 0410DY-2-95, Zurn 1209-ND4-29, Mifab MC-15D-6, Watts CA-151-DL-M3.

2.2.8. Carriers for wheelchair use shown as (FILL IN LIST OF TYPES HERE) shall be mounted 400 mm (16") above finished floor to rim of toilet.

2.3. LAVATORY CARRIERS

2.3.1. Carriers for wall-hung lavatories shown as (FILL IN LIST OF TYPES HERE) shall be all coated with rectangular steel uprights and welded block base feet support and plate. J.R. Smith 800-M31, Zurn Z-1224, Mifab MC-31, Watts CA-421. NOT USED.

2.3.2. Carriers for wall-hung lavatories shown as (FILL IN LIST OF TYPES HERE) shall be all coated with rectangular steel uprights, welded block base feet support and concealed arms with locking device and levelling screws. J.R. Smith 700-M31, Zurn Z-1231, Mifab MC-41, Watts CA-411.

2.3.3. Carriers for barrier free wall-hung lavatories shown as L-6 shall be all coated with rectangular steel uprights, welded block base feet support and extended concealed arms with locking device and levelling screws. J.R. Smith 700-27-M31, Zurn Z-1231-79, Mifab MC-42, Watts CA-411-WC.

2.4. MISCELLANEOUS CARRIERS

2.4.1. Carrier for clinic flushing rim service sink shown as (FILL IN LIST OF TYPES HERE) shall be all coated factory assembled complete, with rectangular steel uprights with welded block base feet support with positioning frame 16 mm (5/8") bolts and C.P. bolt caps, 100 mm (4") 'TY' and adjustable cast iron nipple with bowl gasket. J.R. Smith 0631Y-M31, Zurn Z-1218-F4-CC, Mifab MC-62-4-V4-6, Watts CA-550-4-V4-M3.

3. Execution

3.1. INSTALLATION

3.1.1. Rigidly secure all fixture carriers to the floor using approved anchor bolts and inserts.

3.1.2. Verify the finished wall location and type of wall construction and elevation of finished floor before installation of carriers.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.1.2. Submit radiant and standby losses for each boiler for review during the shop drawing stage.
 - 1.2. RELATED WORK SPECIFIED ELSEWHERE
 - 1.2.1. ~~Supply and installation of concrete boiler base – under Division 3. NOT USED.~~
 - 1.2.2. Electrical hard wire supply [and connections to electrical components] – under Electrical Division.
 - 1.2.3. ~~Supply and install category IV venting as per Section 15620 – CHIMNEY AND BREECHING FOR FORCED DRAFT EQUIPMENT. NOT USED.~~
2. Products
 - 2.1. MATERIALS
 - 2.1.1. ~~Boilers shall be wall-mounted Lochinvar KNIGHT as has been delivered to site.~~ Boilers shall be forced draft, direct vent, natural gas fired, condensing type, having a minimum thermal efficiency of 92% with a return water temperature of 27 deg. C., (80 deg. F.), at 100% output.
 - 2.1.2. Boilers shall be A.S.M.E. rated, suitable for a maximum 80 psi (550 kPa) working pressure at 82 deg. C. (180 deg. F.) and complete with the following:
 - .1 Heat exchanger shall be 439 Stainless Steel
 - .2 High temperature limit control set at 82 deg. C. (180 deg. F.)
 - .3 Fully modulating flame control
 - .4 ~~Positive pressure vent discharge NOT USED.~~
 - .5 Thermometers
 - .6 Pressure gauge
 - .7 Burner for operation on natural gas up to 3.5 kPa (14 in. WG) supply to gas train
 - .8 A.S.M.E. safety relief valve
 - .9 Gas pressure regulator
 - .10 Flame monitoring system shall incorporate CSA/UL combustion safeguard
 - .11 100% independent shut-off pilot control
 - .12 Manual gas shut-off valve
 - .13 Electric type low water fuel cut-off and test and manual reset in accordance with ASME Section IV and CSE-1 requirements. Low water fuel cut-out shall be suitable for lowest flow available to boiler with a consistent repeatability.
 - .14 Pre-wired control panel interconnected to all controls and wired to terminal strip
 - .15 Stainless Steel or baked enamelled jacket
 - .16 Neutralization kit supplied by manufacturer
 - 2.1.3. Boilers shall be capacity shown in the Boiler Schedule.

- 2.1.4. Boilers shall be completely jacketed and insulated as a packaged unit, designed for minimal radiant and standby losses. Complete boiler casing and insulation shall be easily removable for inspection of the heat exchanger.
- 2.1.5. Burner shall be full modulation, low NOx, natural gas burner. NOx emissions shall be less than 20ppm.
- 2.1.6. Boiler shall be equipped with automatic temperature controller and shall be capable of continuously supplying hot water in order to achieve set point temperature. Outlet temperature should be continuously monitored.
- 2.1.7. Boilers shall be started and stopped, cycled, and sequenced for efficiency optimization by the boiler control panel.
- 2.1.8. Boiler control panel shall be based on open system communication protocol either BACnet as defined by ANSI/ASHRAE standard 135-2001 or LONWorks as defined by ANSI/CEA standard 709.1 for seamless integration with Section 15900 – BUILDING AUTOMATION SYSTEM (BAS). Boiler manufacturer to provide any necessary conversion utilities. NOT USED.
- 2.1.9. As a minimum, the following hardware points shall be available for direct connection to Section 15900 – BUILDING AUTOMATION SYSTEM (BAS): NOT USED.
- .1 Boiler Enable NOT USED.
 - .2 Hot Water Supply Temperature Set Point NOT USED.
 - .3 Boiler supply temperature at outlet NOT USED.
 - .4 Boiler status NOT USED.
 - .5 Boiler output firing rate NOT USED.
 - .6 Boiler General Alarm NOT USED.
- 2.1.10. Valves shall be in accordance with Section 15410 – PIPES, VALVES AND FITTINGS.
- 2.1.11. The boiler shall be complete with standalone controls with an electronic display for boiler set-up, boiler status, and boiler diagnostics.
- 2.1.12. The boiler shall be equipped with two terminal strips for electrical connection.
- .1 A low voltage connection board for safety and operating controls, (e.g., Auxiliary Relay, Auxiliary Proving Switch, Alarm Contacts, Runtime Contacts, Manual Reset Low Water Cutoff, Flow Switch, High and Low Gas Pressure Switches, Tank Thermostat, Three Wall Thermostat/Zone Controls, System Supply Sensor, Outdoor Sensor, Building Management System Signal, Modbus, Control Contacts and Cascade Control Circuit.)
 - .2 A high voltage terminal strip shall be provided for supply voltage. The high voltage terminal strip plus integral relays are provided for independent pump control of the System pump and the Boiler pump.
- 2.1.13. The boiler shall be installed and vented with a Direct Vent Sidewall system with a horizontal sidewall termination of both the vent and combustion air. The flue shall be PVC, CPVC or Stainless Steel sealed vent material terminating at the sidewall with the manufacturer's specified vent termination. A separate pipe shall supply combustion air directly to the boiler from the outside. The air inlet pipe may be PVC, CPVC, ABS, Galvanized, Dryer Vent, or Stainless Steel sealed pipe. The air inlet must terminate on the same sidewall with the manufacturer's specified air inlet cap. The boiler's total combined air intake length shall not exceed 100 equivalent feet. The boiler's total combined exhaust venting length shall not exceed 100 equivalent feet. Foam Core pipe is not an approved material for exhaust piping.

3. Execution

3.1. INSTALLATION

- 3.1.1. All gas equipment shall be installed to and meet the requirements of the Ontario Department of Energy and Resources Management and be labelled accordingly.
- 3.1.2. Boilers shall be installed in accordance with Section 15200 – VIBRATION AND NOISE CONTROL. Furnish anchor bolts and setting diagrams to Work of Division 3 for correct setting in place.
- 3.1.3. Pipe condensate trap to closest floor drain complete with inline neutralization kit. Each boiler to have separate drain piping.
- 3.1.4. At time of start-up the manufacturer shall check the efficiency, instruct the Owner and provide a written report to the Engineer's Representative detailing all work undertaken. The manufacturer's representative shall instruct the Owner's operators on the care, operation and maintenance of the units. Final report shall include output from the gas analyzer which shall identify values for efficiency, related inlet and outlet temperatures, percentage of effluent contents, etc.

END OF SECTION 15618

1. General
- 1.1. WORK INCLUDED
- 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
- 1.2. SUBMITTALS
- 1.2.1. Shop Drawings: Submit Shop Drawings of all components of the system in accordance with SECTION 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS. Include all wiring diagrams.
- 1.2.2. Manufacturer's Data: Submit details of all testing equipment to be provided.
- 1.3. QUALITY ASSURANCE
- 1.3.1. Qualifications of Manufacturers: Work under this section shall be limited to the following companies:
 - .1 Ashland Drew
 - .2 GE Water and Process Technologies
 - .3 Chem-Aqua Inc
 - .4 Norkem Inc
 - .5 Klenzoid
- 1.4. MATERIALS
- 1.5. CLOSED RECIRCULATING LOOP FOR HEATING SYSTEM
- 1.5.1. For each heating system provide an adequately sized pot feeder for the entire system but not less than a 7.6 L (2 gallon) pot feeder. Pot feeder shall have a maximum working pressure of 300 psi at 200 deg F. Tank shell shall be 10 gauge steel, tank heads shall be 9 gauge steel, and cap shall be cast iron with Buna N seal ring, equal to Ashland Drew PN 9233-03-2 or Neptune DBF-2HP. Pot feeder assembly shall be complete with valved inlet and outlet, screen, drain and pot feeder.
- ~~1.5.2. For each heating system provide an adequately sized pot feeder for the entire system but not less than a 19 L (5 gallon) pot feeder. Pot feeder shall have a maximum working pressure of 300 psi at 200 deg F. Tank shell and heads shall be 11 gauge steel, and cap shall be cast iron with Buna N seal ring, equal to Ashland Drew PN 9233-04-0, or Neptune DBF-5HP. Pot feeder assembly shall be complete with valved inlet and outlet, screen, drain and pot feeder.~~
NOT USED.
- 1.5.3. Provide two (2) corrosion test coupons, one copper equal to Drew PN 7721-01-3 and one steel equal to Ashland Drew PN-7722-01-1. Corrosion coupons to be installed in 19 mm (3/4 in.) tee fittings on the upstream side of the pot feeder.
- 1.5.4. Corrosion and scale inhibitor for closed loop heating systems shall be equal to GE W&P Technologies CORRSHIELD MD4102 or Ashland Drew CSW 311.
- 1.5.5. Provide an adequate quantity of chemical treatment for 6 months of operation after Substantial Completion of the Contract.
- 1.5.6. Provide bypass filter as specified in Section 15179 – PIPE SYSTEM FILTERS.

2. Execution

2.1. INSTALLATION

- 2.1.1. Pot feeder is to be installed in parallel with filter on supply and return line headers. Headers shall be in an accessible location, less than 1.5 m (5 ft.) above the floor.
- 2.1.2. The water treatment supplier shall provide a service program for a period of 1 year from Substantial Completion of the Contract. Service visits shall be conducted on regular frequency suitable to meet system stability requirements. A report containing findings and recommendations shall be submitted to the Owner following each visit.
- 2.1.3. Provide two days service (7-1/2 hours per day) of manufacturer's representative to add chemicals to the systems until properly protected, adjust the equipment and the blow down rates. Representative shall also, during this time, instruct the Owner's representative in the correct use of the treatment, show the Owner the test results for the systems, how to test the systems, and how often.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.1.2. All gate, globe and check valve shall be approved under Canadian Interprovincial Regulations for the Construction and Inspection of Boilers, Tanks, and Appurtenances.
 - 1.1.3. Provide submittal drawings in accordance with Section 15031 – SHOP DRAWINGS for all valves, appurtenances, and grooved components.
 - 1.1.4. All steel pipe and fittings shall be manufactured in North America. Off-shore pipe shall not be accepted on site. Pipe shall be clearly marked as being manufactured in North America or it shall be removed from site.
2. Products
 - 2.1. MATERIALS
 - 2.1.1. Use pipes, fittings and valves as shown below unless specifically shown or specified otherwise.
 - 2.2. HIGH TEMPERATURE HOT WATER NOT USED.
 - 2.2.1. High temperature heating water 121 deg. C. (250 deg. F.) at 1035 kPa (150 psi) and over, and heating water at 93.3 deg. C. (200 deg. F.) at 1138 kPa (165 psi) and over and chilled and condenser water less than 66 deg. C. (150 deg. F.) above 1380 kPa (200 psi). NOT USED.
 - 2.2.2. Pipe 300 mm (12 in.) and larger, black steel ASTM A53, 12 mm (1/2 in.) wall, plain ends, ANSI B36.10. NOT USED.
 - 2.2.3. Pipe 65 mm (2-1/2 in.) to 250 mm (10 in.), black steel ASTM A53, Schedule 80, plain ends, ANSI B36.10. NOT USED.
 - 2.2.4. Pipe 50 mm (2 in.) and smaller, black steel ASTM A53, Schedule 80, threaded, ANSI B36.10. NOT USED.
 - 2.2.5. Fittings 300 mm (12 in.) and larger, black steel ASTM A234, 12 mm (1/2 in.) wall, butt-welding, ANSI B16.9. NOT USED.
 - 2.2.6. Fittings 65 mm (2-1/2 in.) to 250 mm (10 in.), black steel ASTM A234, Schedule 80, butt-welding ends, ANSI B16.9. NOT USED.
 - 2.2.7. Fittings 50 mm (2 in.) and smaller, malleable iron ASTM A197, 2070 kPa (300 psi) WSP, threaded, ANSI B16.3. NOT USED.
 - 2.2.8. Flanges 65 mm (2-1/2 in.) and larger, forged steel ASTM A181, 2070 kPa (300 psi) WSP ANSI B16.5. Use only weld neck flanges with butterfly valves. NOT USED.
 - 2.2.9. Union 50 mm (2 in.) and smaller, malleable iron ASTM A197, 2070 kPa (300 psi) WSP, with bronze to iron ground joint, ANSI B16.3. NOT USED.
 - 2.2.10. Flange accessories for high temperature hot water: NOT USED.
 - 2.3. Gasket, 1.5 mm (1/16 in.) Asbestos free, Aramid fibres with nitrile binder suitable for 205 deg. C. (400 deg. F.) continuous maximum temperature at 6880 kPa (1000 psi), equal to Garlock Blue-Gard 3000. NOT USED.

- .2 Bolts, alloy steel ASTM A193, ANSI B16.5, nuts, hexagonal, steel ASTM A307. NOT USED.
- 2.2.11. Strainers 65 mm (2-1/2 in.) and larger, cast iron 1720 kPa (250 psi) WSP flanged. NOT USED.
- 2.2.12. Strainers 50 mm (2 in.) and smaller, cast iron 1720 kPa (250 psi) WSP, threaded. NOT USED.
- 2.2.13. Gate valves 65 mm (2-1/2 in.) and larger, 2060 kPa (300 psi) WSP, cast steel O.S. and Y, ANSI B16.5 Flanges, shall be Crane #33XUF, Kitz 300 SCLS, Bonney Forge 3-11-RF, or Jenkins J1010B8F. NOT USED.
- 2.2.14. Gate valves 50 mm (2 in.) and smaller, bronze 1380 kPa (200 psi) WSP, rising stem, threaded shall be Crane #424, Jenkins #2270UJ, Toyo 314 or Kitz 37. NOT USED.
- 2.2.15. Globe valves 65 mm (2-1/2 in.) and larger, 2060 kPa (300 psi) WSP, cast steel metal disc, renewable seat, ANSI B16.5 Flanges, shall be Crane 151XU, Kitz 300 SCJS, Bonney Forge 3-31-RF, or Jenkins J1042B2. NOT USED.
- 2.2.16. Globe valves 50 mm (2 in.) and smaller, bronze 1380 kPa (200 psi) WSP, renewable seat and plug, threaded shall be Crane #212P, Jenkins #2050J, Toyo 214 or Kitz 17S. NOT USED.
- 2.2.17. Check valves 65 mm (2-1/2 in.) and larger, 2060 kPa (300 psi) WSP, cast steel, swing check, ANSI B16.5 Flanges, shall be Crane #159XU, Kitz 300SCOS, Bonney Forge 3-61-RF, Jenkins J1025B2. NOT USED.
- 2.2.18. Check valves 65 mm (2-1/2 in.) and smaller, bronze 1380 kPa (200 psi) WSP swing check, threaded shall be Crane #36, Jenkins 4449J, Toyo 360 or Kitz 19. NOT USED.
- 2.2.19. Drain valves for blow-off of sediment from strainers, pipe drainage and tank drainage, shall be 19 mm (3/4 in.) size 250 WSP or 4130 kPa (600 psi) WOG ball valve with bronze body, stainless steel ball and stem, multifilled seats and packing, male threaded garden hose end, brass cap and chain shall be Apollo 70-140-64. NOT USED.
- 2.2.20. Butterfly valves maybe used as an alternative to gate valves only and shall be carbon steel body, one-piece shaft, top and bottom bearings, stainless disc with stainless steel trim with combination TFE and Titanium seat. Body with threaded lugs suitable for 2070 kPa (300 psi) flanges. Bubble-tight shut-off to 1965 kPa (285 psi) pressure in either direction when the piping and connecting flange is removed from one side of the valve. NOT USED.
- .1 Valves 100 mm (4 in.) and smaller with lever operator with lock. Valves 150 mm (6 in.) and larger with worm gear manual operator with indication of valve opening. NOT USED.
- .2 Valves shall be shall be Dezurik Model BHP, WKM, Keystone Model K-LOK, Flowseal or Hills-McCanna Model McCannalock. NOT USED.
- 2.2.21. Butterfly valves maybe used as an alternative to gate valves only and shall be ANSI Class 300, carbon steel body, one-piece 17-4 shaft, top and bottom bearings, stainless disc, RTFE packing and seats. Body with threaded lugs suitable for 2070 kPa (300 psi) flanges. Bubble-tight shut-off to 5102 kPa (740 psi) pressure in either direction when the piping and connecting flange is removed from one side of the valve. NOT USED.
- .1 Valves 100 mm (4 in.) and smaller with lever operator with lock. Valves 150 mm (6 in.) and larger with worm gear manual operator with indication of valve opening. NOT USED.
- .2 Valves shall be shall be WKM B5313-02-S02-11-HL, Flowseal 3DA121RTG-40J for lever operator and WKM B5313-02-S02-11-WG, Flowseal 3DA121RTG-30J for gear operator. NOT USED.

2.3. LOW TEMPERATURE AND/OR PRESSURE WATER

- 2.3.1. Heating water less than 121 deg. C. (250 deg. F.) at 1035 kPa (150 psi), or heating water less than 93.2 deg. C. (200 deg. F.) at 1139 kPa (165 psi), and chilled and condenser water less than 65.6 deg. C. (150 deg. F.) at 1380 kPa (200 psi).
- 2.3.2. Pipes 300 mm (12 in.) and larger, black steel ASTM A53, 9.5 mm (0.375 in.) wall, plain ends, ANSI B36.10.
- 2.3.3. Pipes 65 mm (2-1/2 in.) to 250 mm (10 in.) ASTM A53, Schedule 40, plain ends, ANSI B36.10.
- 2.3.4. Pipes 50 mm (2 in.) and smaller, black steel ASTM A53, Schedule 40, threaded, ANSI B36.10.
- 2.3.5. Pipes 100 mm (4 in.) and smaller, alternative for entire system for heating water, chilled water and condenser water in hard-tempered copper ASTM B88, Type L, plain ends. All joints made with 95-5 tin-antimony or tin-silver solder.
- 2.3.6. Pipe runouts to all induction and fan coil units and similar equipment soft temper copper ASTM B88, Type L, plain ends, size as shown, but minimum size of runouts 19 mm (3/4 in.). All joints made with 95-5 tin-antimony or tin-silver solder.
- 2.3.7. Fittings 300 mm (12 in.) and larger, black steel ASTM A234, 9.5 mm (0.375 in.) wall, butt-welding ends, ANSI B16.9.
- 2.3.8. Fittings 65 mm (2-1/2 in.) to 250 mm (10 in.) black steel ASTM A234, Schedule 40, butt-welding ends, ANSI B16.9.
- 2.3.9. Fittings 50 mm (2 in.) and smaller, cast iron ASTM A126, 860 kPa (125 psi) WSP threaded, ANSI B16.4.
- 2.3.10. Flanges 65 mm (2-1/2 in.) and larger, forged steel ASTM A181, 1035 kPa (150 psi) WSP, ANSI B16.1. Use only weld neck flanges with butterfly valves.
- 2.3.11. Fittings alternative for entire system for heating water, chilled water and condenser water: wrought copper or cast bronze, solder, joint, ANSI B16.22.
- 2.3.12. Unions 50 mm (2 in.) and smaller malleable iron ASTM A197, 1035 kPa (150 psi) WSP, with bronze to iron ground joint, ANSI B16.3.
- 2.3.13. Flange accessories for heating water and condenser water:
- .1 Gasket, 1.5 mm (1/16 in.) Synthetic fibres with rubber binder suitable for 205 deg. C. (400 deg. F.) continuous maximum temperature at 3440 kPa (500 psi), equal to Garlock Multi-Swell 3760.
 - .2 Bolts, square head machine with hexagonal nut, steel ASTM A307, ANSI B18.2.
- 2.3.14. Flange accessories for chilled water, gasket, cloth inserted rubber ring, bolts, square head machine with hexagonal nut, steel ASTM A307, ANSI B18.2.
- 2.3.15. Strainers 65 mm (2-1/2 in.) and larger, cast iron 860 kPa (125 psi) WSP, flanged.
- 2.3.16. Strainers 50 mm (2 in.) and smaller, cast iron 1720 kPa (250 psi) WSP, threaded.
- 2.3.17. Strainers 50 mm (2 in.) and smaller, for copper pipes bronze 860 kPa (125 psi) WSP, threaded. Mueller #351M.
- 2.3.18. Gate valves 65 mm (2-1/2 in.) and larger, cast iron 860 kPa (125 psi) WSP, bronze mounted, O.S. and Y A.N.S.I B16.1 Flanges, shall be Crane #465 1/2, Jenkins #454J, Toyo 421 or Kitz 72.
- 2.3.19. Gate valves 50 mm (2 in.) and smaller, bronze 1035 kPa (150 psi) WSP rising stem, threaded shall be Crane #431, Jenkins #2810J, Toyo 298 or Kitz 42.
- 2.3.20. Globe valves 65 mm (2-1/2 in.) and larger, cast iron 860 kPa (125 psi) WSP, bronze mounted, renewable composition disc, A.N.S.I B16.1 Flanges shall be Crane #351, Jenkins #2342, Toyo 400A or Kitz 76.

- 2.3.21. Globe valves 50 mm (2 in.) and smaller, bronze 1035 kPa (150 psi) WSP, renewable composition disc, threaded shall be Crane #7TF, Jenkins #106-B, Toyo 221 or Kitz 9.
- 2.3.22. Butterfly valves maybe used as an alternative to gate valves only and shall be iron body, one-piece alloy steel shaft, top and bottom bearings, bronze disc or iron disc with stainless steel trim, resilient elastomer replaceable seat with integral reinforcing ring or keyed to body. Body with threaded lugs. Bubble-tight shut-off to 1035 kPa (150 psi) pressure in either direction when the piping and connecting flange is removed from one side of the valve.
- Valves 100 mm (4 in.) and smaller with lever operator with lock.
- Valves 150 mm (6 in.) and larger with worm gear manual operator with indication of valve opening.
- Butterfly valves shall be shall be DeZurik Model BGS, Keystone Model 222-784, Bray Series 31, Challenger Model 20-CN4E, Apollo 143, Kitz 6122EL/G, Centerline 200, or Crane 44.
- 2.3.23. Eccentric plug valves may be used as an alternative to Globe valves and shall be cast iron body, split alloy steel shaft, top and bottom bearings, resilient elastomer plug. Body with flanged ends. Bubble-tight shut-off to 1035 kPa (150 psi) pressure in either direction when the piping and connecting flange is removed from one side of the valve.
- Valves 100 mm (4 in.) and smaller with lever operator with lock. Valves 150 mm (6 in.) and larger with worm gear manual operator with indication of valve opening.
- 2.3.24. Check valves 50 mm (2 in.) and smaller bronze 860 kPa (125 psi) WSP, swing check, screwed cover, screwed shall be Crane #37, Jenkins #4092, Toyo 236 or Kitz 22.
- 2.3.25. Check valves 65 mm (2-1/2 in.) and larger ANSI Class 150, 1030 kPa (150 psi) WSP, dual flapper retainers design with carbon steel body and stainless steel check, renewable disc and seat for flanged installation, shall be Velan-Proquip model BDD10-1B or DUO CHEK II H15SMF-201, Mueller 72-DHH-3-H.
- 2.3.26. Drain valves for blow-off of sediment from strainers and tank drainage shall be 19 mm (3/4 in.) size 4140 kPa (600 psi) WOG ball valve with bronze or forged brass body, solid ball, virgin Teflon seat and packing, male threaded garden hose end, brass cap and chain shall be Watts B6000, Toyo 5046, Kitz 58CC or Apollo 78-100.
- 2.3.27. Float type eliminators, designed for a minimum of 1035 kPa (150 psi) water pressure with steel or cast iron body having removable flanged top, stainless steel or copper float and stainless steel valve and level mechanism.
- 2.3.28. As an alternative on vertical in-line pumps suction elbow may be combination elbow and strainer. Strainer perforations shall be as specified for Y strainers. Blow-off valves shall be provide in all sizes. Sizes of elbow strainer shall suit the pump suction size. Elbow shall be cast iron. Elbow shall be sized to suit pipe.
- 2.3.29. Radiation and fan coil shut off valves shall be Dahl Model 11042FXUN radiator valve suitable for 1720 kPa (250 psi) at 121 deg. C. (250 deg. F.). Lockshield balance valves shall be Dahl Model 13.013M.
- 2.3.30. Ball valves for heating water and chilled water 50 mm (2 in.) and smaller shall be bronze body 4140 kPa (600 psi) WOG, virgin Teflon seat, solid ball, TFE stem packing and thrust washer, 1/4 turn open-closed operation. All components to be replaceable in-line. Solder end valves are not acceptable. All ball valves shall be complete with stem extensions. Ball valves shall be Watts No. B-6800, Toyo 5050, Kitz 62, or Apollo 82-100-04.
- 2.3.31. Ball valves for heating water and chilled water 50 mm (2 in.) and smaller shall be bronze or forged brass 4140 kPa (600 psi) WOG, virgin Teflon seat, solid ball, TFE system packing and thrust washer, 1/4 turn open-close operation. All ball valves shall be complete with stem extensions. Ball valves shall be Watts B6000, Toyo 5044A, Kitz 58/59, or Apollo 70-100/200-04.

- 2.3.32. Flow balancing valves shall have meter connection for attaching to a portable meter. Each connection shall have positive shut-off valves. Each valve shall be capable of precise flow measurement, accurate flow balancing and positive shut-off. Adjustment shall be by multiple turns of the handle for Vernier type setting and shall have a hidden memory feature for tamper-proof setting. All valves 65 mm (2-1/2 in.) and larger shall be flanged or grooved and shall be Tour Anderson Model STA-F, valves 50 mm (2 in.) and smaller shall be screwed and shall be Tour-Anderson Model STA-D.
- .1 Provide a portable flow measuring meter, complete with hoses and carrying case to suit each size of valve provided. Meter shall be computerized, differential pressure type for direct reading of flow rate in either G.P.M. or L/s.
- 2.3.33. As an alternative to Standard Details (MSD-7654 and MSD-7655) for reheat coil installation provide Tour-Anderson Series 78K Koil-Kit complete with 78K-STADK flow balancing valve, 78-UP union plus air vent and PT port, and 78K-SBV with 20 mesh Y-strainer/ball valve & PT port. Automatic air vent piped to drain shall be used if branch take-off is above the main.
- 2.4. GROOVED PIPE AND FITTINGS
- 2.4.1. For systems less than 93.2 deg. C. (200 deg. F.) at 1139 kPa (165 psi) or less than 65.6 deg. C. (150 deg. F.) at 1380 kPa (200 psi).
- 2.4.2. Grooved pipe and fittings may be used for hot water, chilled water, hot or chilled glycol, and condenser water systems.
- 2.4.3. Pipes 50 mm (2 in.) to 250 mm (10 in.) black steel ASTM A53, Schedule 40 cut or roll grooved.
- 2.4.4. Pipes 300 mm (12 in.) and larger black steel ASTM A53, 9.5 mm (0.375 in.) wall, cut or grooved.
- 2.4.5. Couplings shall consist of two ASTM A536 grade 65-45-12 ductile iron housing segments, ASTM D2000 pressure responsive elastomer gasket, and ASTM A449 zinc-electroplated steel bolts and nuts.
- .1 Sizes 300 mm (12 in.) and smaller:
- .1 Rigid Type: Housings shall be cast with offsetting angle-pattern bolt pads to prove rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9
- .1 50 mm (2 in.) through 150 mm (6 in.): Installation-Ready, for direct stab installation without field disassembly, with grade EHP gasket rated to 121 deg C. (250 deg. F). Victaulic Style 107.
- .2 As an alternative provide Victaulic Zero-Flex Style 07.
- .2 Flexible Type: For use in locations where vibration attenuation and stress relief are required. Three flexible couplings may be used in lieu of a flexible connector. The couplings shall be placed in close proximity to the source of the vibration. Victaulic Style 77.
- .2 Size 350 mm (14 in.) through 600 mm (24 in.): Victaulic AGS Series with lead-in chamfer on housing key and wide width flush seal gasket.
- .1 Rigid Type: Housing key shall fill the wedged shape AGS groove and provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9. Victaulic Style W07.
- .2 Flexible Type: Housing key shall fit into the wedge shaped AGS groove and allow for linear and angular
- 2.4.6. Fittings 50 mm (2 in.) to 250 mm (10 in.) cast ductile iron ASTM A536 grade 65-45-12 or malleable iron ASTM A47.

- 2.4.7. Fittings 300 mm (12 in.) and larger full flow cast fitting. Fabricated steel fittings to ASTM Grade B may only be used with the approval of Engineer's Representative.
- .1 350 mm (14 in.) and larger shall be complete with Victaulic 'AGS' grooved ends.
- 2.4.8. Branch connections: ductile iron ASTM A535 or malleable iron ASTM A47; Victaulic Style 920, 921 or 72.
- 2.4.9. Flanges; ductile iron ASTM A536 or malleable iron ASTM A47 for sizes 50 mm (2 in.) to 600 mm (24 in.); Victaulic Style 741.
- 2.4.10. Gaskets: EPDM conforming to ASTM D-2000, temperature range -34 deg. C. to 110 deg. C. (-30 deg. F. to 230 deg. F.).
- .1 EHP conforming to ASTM D-2000, temperature range -34 deg. C to 121 deg. C. (-30 deg. F. to 250 deg. F.).
- 2.4.11. Valves 40 mm (1-1/2 in.) to 150 mm (6 in.): ductile iron ASTM A-536, aluminum bronze disc, and EPDM liner for service up to +110 deg. C. (+230 deg. F.). Valves 40 mm to 100 mm (1-1/2 in. to 4 in.) size shall have lever lock handle, and 150 mm (6 in.) shall be gear operated. Valves shall be for bubble-tight service to 1400 kPa (200 psi). Victaulic Series 700.
- 2.4.12. Valves 50 mm (2 in.) to 300 mm (12 in.): ductile iron Body to ASTM A536, EPDM coated ductile iron disc for temperatures up to +110 deg. C. (+230 deg. F.), for bubble-tight service to 2065 kPa (300 psi). Victaulic Vic-300 MasterSeal.
- .1 Butterfly Valves 350 mm (14 in.) to 600 mm (24 in.): Ductile iron body to ASTM A536, EPDM disc mounted seal, PPS (polyphenylene sulphide) coated ductile iron disc, and stainless steel stem. (Stem shall be offset from the disc centerline to provide full 360-degree circumferential seating). Rated for temperatures up to + 110 deg. C. (+230 deg. F.), for bubbletight service to 2065 kPa (300 psi). Victaulic AGS-Vic300.
- 2.4.13. Check valves 65 mm (2-1/2 in.) to 300 mm (12 in.): ductile iron ASTM A536 EPDM coated disc spring loaded design for non-slam operation. Victaulic Series 716.
- .1 Check valves 350 mm (14 in.) to 600 mm (24 in.): Ductile iron body to ASTM A395, dual stainless steel disc(s), with stainless steel spring and shaft, rated for temperatures up to +110 deg. C. (+230 deg. F.), for service to 1575 kPa (230 psi) Victaulic Series W715.
- 2.4.14. Strainers 50 mm (2 in.) to 300 mm (12 in.): ductile iron ASTM A536 with type 304 stainless steel screen. Victaulic Style 730/732.
- 2.4.15. As an alternative on vertical in-line pumps, suction elbow may be suction diffusers. Victaulic 731-I.
- 2.4.16. All grooved products, including couplings, fittings, valves and specialty items shall be Victaulic.
- 2.4.17. For other system components refer to Low Temperature and/or Pressure Water Article.
- 2.5. REQUIREMENTS
- 2.5.1. Where a branch at least two pipe sizes smaller connects into a main, welding fittings of Bonney Forge, full flow fittings or other approved manufacturer may be used.
- 2.5.2. For chilled, condenser and low temperature heating water, where a branch at least two pipe sizes smaller connects into a main, branch may be mitred and welded to main.
- 2.5.3. Use Y pattern strainers with screens of type 304 stainless steel or Monel with approximately 1 mm (1/32 in.) perforations for sizes 100 mm (4 in.) and smaller, and approximately 3 mm (1/8 in.) perforations for larger sizes. Provide a valved blow-off connection in all caps 65 mm (2-1/2 in.) and larger. Maximum pressure drop with clean screen shall not exceed 7 kPa (1 psi) with water velocity through inlet pie of 1.5 m/s (5 ft./s). For 50 mm (2 in.) and larger pipe size all heads retaining the basket shall be bolted. For 38 mm (1-1/2 in.) and smaller pipe heads shall be gasketed with straight threads.

- 2.5.4. Solder end globe, angle and gate valves, sizes 50 mm (2 in.) and smaller, are acceptable if it can be shown that they are similar in design and construction to the valves specified.
- 2.5.5. Except where special features are required or unless otherwise approved, all globe, gate and check valves shall be of one manufacturer, with the manufacturer's name and the pressure rating clearly marked on the outside of the valve body.
- 2.5.6. Strainers shall be Colton Industries or Mueller.
- 2.5.7. Air vents shall be Bell and Gosset, Taco, Sarco, or Maid-O-Mist.
- 2.5.8. Air Separators shall be manufactured in an ISO recognized facility. Each unit shall be factory tested per Hydraulic Institute standards at the factory of origin. Tangential type air separator shall have flanged or grooved inlet and outlet connections. The vessel shell diameter shall be three times the nominal inlet/outlet pipe diameter. The inlet and outlet connections must be of the same size. The unit will be designed, constructed and stamped for the system design pressure Class in accordance with ASME Boiler and Pressure Vessel Code. Supply the separator with automatic air vent when used in an air elimination system, and connect the vent connection into the bottom of the compression tank for air control systems. Provide micro-bubble air and dirt separators where shown on the schematic piping diagrams and as necessary to remove free oxygen and dirt in the water and glycol systems. Air separators shall equal to "Spirotherm" model "VDR" for pipes sizes up to 2"Ø and model "VDT" for pipes sizes larger than 2"Ø (Ontor Ltd., 416-781-5286). The air separator is to be equipped with an automatic air vent to release all air from the system.
- .1 Unit shall include elements filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100% free air, 100% entrained air, and 99.6% dissolved air at the installed location.
 - .2 Dirt separation efficiency shall be a minimum of 80% of all particles 30 micron and larger within 100 passes.
 - .3 The elements must consist of a copper core tube with continuous wound copper wire medium permanently attached and followed by a separate continuous wound copper wire permanently affixed.
 - .4 Each unit shall have a separate venting chamber to prevent system contaminants from harming the float and venting valve operation.
 - .5 At the top of the venting chamber shall be an integral full port float actuated brass venting mechanism. Units shall include a valved side tap to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill.
3. Execution
- 3.1. INSTALLATION
- 3.1.1. For pipe 65 mm (2-1/2 in.) and larger, use flanges, and for smaller pipe, use unions at all valves and equipment.
- 3.1.2. Flare connections may be used on soft copper tubing where one end of the flare connection is an integral part of the equipment or valve.
- 3.1.3. Provide automatic air eliminators at all high points on piping mains for hot and chilled water systems. Where venting a horizontal pipe, grade pipe up in direction of flow with vent at high point. Provide gate valve at the float inlet. Pipe outlets to drain using copper pipe. Drain pipe shall be run such that its route is visible.
- 3.1.4. Provide manual air vents on all hot water heating units where air may be trapped. Use screw-driver operated vents of chrome plated brass. Vents shall be accessible without removing cover of heating unit.

- 3.1.5. Provide vacuum breakers on all equipment having modulating steam control valves and locate between valve and equipment, unless directed otherwise by equipment manufacturer.
- 3.1.6. Pipe vacuum breakers to condensate lines on high pressure systems. Where not piped to condensate lines, install with a pigtail to prevent leakage of steam flashed from the condensate.
- 3.1.7. Make reduction in steam main size with eccentric reducing coupling.
- 3.1.8. Arrange all runs of piping to prevent interference and to achieve a satisfactory and workmanlike installation of neat appearance. Run all piping parallel to walls. All valves, controls, equipment, expansion compensators, flexible connections and, as far as possible, all piping shall be easily accessible for inspection, maintenance and operation.
- 3.1.9. Pitch all lines 25 mm in 12 m (1 in. in 40 ft.–0 in.) unless shown otherwise.
- 3.1.10. Install drain valves at all low points for draining and locate where easily accessible. In order to achieve this, install remote from system where necessary, clearly marked. Typical marking similar to the following:
 - .1 Heating system
 - .2 Danger, authorized personnel only
- 3.1.11. Carefully ream threaded joints and join with compound on the male thread only. Re-tighten flanged connections after the installation has been brought up to its service. Following testing, apply insulation. Take care not to overstress the material during construction.
- 3.1.12. Pipe welding operations shall be performed by welders Provincial Certification for the class of piping to be welded. Ensure the internal opening of pipes and fittings are not restricted by superfluous material.
- 3.1.13. When welding or cutting with a torch, take precautions to prevent fire by maintaining fully charged 4.5 kg (10 lbs.) carbon dioxide extinguisher immediately adjacent to the operation. Protect wooden structure with asbestos blankets.
- 3.1.14. Arrange piping to permit ease of equipment removal. Provide flanges or unions on all pipe connections to each piece of equipment.
- 3.1.15. Connect all multi-row water coils in counter flow.
- 3.1.16. Drains from packaged air handling unit drain pans shall be of same size as connection on unit. Provide traps on all drains and deep seal traps on both sides of the fan and coil sections.
- 3.1.17. Connect bases of all pumps with packed glands to drain with 12 mm (1/2 in.) O.D. copper tubing.
- 3.1.18. Provide on the discharge line of each spray pump, a 12 mm (1/2 in.) valved bleed-off. Connect to discharge line above sump water level and run to drain.
- 3.1.19. Provide strainers upstream of each pump suction, steam control valve and steam trap not preceded by a control valve, and where shown.
- 3.1.20. Provide butterfly valves where shown; these are permitted in lieu of gate valves in sizes 65 mm (2-1/2 in.) and larger.
- 3.1.21. Install all valves in Equipment Rooms in accessible locations from the floor. Where valves are not accessible from the floor, equip with chain operators at the discretion of the Engineer's Representative.
- 3.1.22. Provide gate, globe and check valves in all piping systems as shown and as required for satisfactory operation and control of equipment. Provide shut-off valves wherever piping is connected to all equipment. Provide one flow balancing valve and one shut-off valve on water coils.

- 3.1.23. Provide for the expansion and Contraction of all pipes. Install with sufficient flexibility to prevent end-thrust and movements caused by thermal expansion or Contraction causing detrimental distortion or damage of connection equipment. Provide offsets between mains and equipment of sufficient length to safely absorb the expansion of the main.
- 3.1.24. Install all control devices, valves and any other appurtenances as directed by the controls and/or BAS trades.
- 3.1.25. Make connections between copper and steel with brass or bronze fittings.
- 3.1.26. Ball valves may be used in low temperature and/or pressure systems only in lieu of gate valves in 50 mm (2 in.) and smaller. Provide union downstream of ball valves for servicing if ball valve is not a three piece design.
- 3.1.27. For grooved piping ensure ends are clean and free from indentations, projections, and roll marks in the area from the pipe end to the groove for proper gasket sealing.
- 3.1.28. Install all grooved products as per manufacturers latest recommended instructions. The Contractor is responsible to establish training for proper pipe end preparation and assembly by the manufacturer.
- 3.1.29. Install flow balancing valves in sections of straight pipe as recommended by the manufacturer, but in no case with less than 10 pipe diameters upstream of the valve.
- 3.1.30. Install flow balancing valves in the following locations:
 - .1 at each heating, chilled or condenser water riser, or main floor branch
 - .2 each heating water and cooling water coils including unit heaters, fan coils and force flow heaters.
 - .3 Each heat exchanger
 - .4 Each wall fin, radiant ceiling or similar heating device
 - .5 Each main building or secondary heating or cooling circuit
 - .6 And where shown

END OF SECTION

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.1.2. Hangers, supports, anchors, guides and restraints shall be selected to withstand all static and dynamic loading conditions which act upon the piping system and associated equipment. The Mechanical Division shall prepare detailed shop drawings showing all anchors and guides for all systems with the potential for thermal expansion/contraction and/or loads due to weight or thrust. The drawings shall bear the signed seal of a Professional Engineer licensed to practice in the appropriate discipline and place of work. The drawings shall include all details of construction, static and dynamic forces at points of attachment, etc. necessary for review and acceptance by the project Structural Engineer's Representative. Make adjustments as necessary to satisfy the requirements of the Structural Division. No anchor points shall be permitted without reviewed shop drawings and, where installed prior to review, shall be removed and replaced to the satisfaction of the Engineer's Representative.

2. Products

2.1. MATERIALS

2.1.1. Expansion joint, guides and anchors: United Flexible, Flexonics or Hydroflex, specifically design for the system in which they are installed.

2.1.2. Expansion joints for 65 mm (2-1/2 in.) diameter pipe and smaller: packless bellows type with stainless steel bellows, anti-torque device, limit stops, guides and threaded pipe ends.

2.1.3. Unless otherwise specified, expansion joints shall have a sufficient number of corrugations to absorb the expansion between anchors in the pipe plus not less than 25% safety factor for a temperature range from -17.8 deg. C. (0 deg. F.) ambient temperature to the maximum operating temperature of the pipe.

3. Execution

3.1. INSTALLATION

3.1.1. Provide for the expansion and Contraction of all pipes, and install with sufficient flexibility to prevent end thrust and movements caused by thermal expansion or Contraction causing detrimental distortion or damage of connected equipment. Provide offsets between mains and equipment of sufficient length to safely absorb the expansion of the main.

3.1.2. Guides shall be as shown and shall be located as follows:

- .1 distance from expansion joint to first guide shall be maximum 4 pipe diameters.
- .2 distance from first to second guide shall be maximum 14 pipe diameters
- .3 Maximum spacing between additional guides:
 - 3.7 m for 65 mm (12 ft. for 2-1/2 in.) pipe
 - 7.3 m for 75 mm and 100 mm (24 ft. for 3 in. and 4 in.) pipe
 - 11 m for 125 mm and 150 mm (36 ft. for 5 in. and 6 in.) pipe
 - 14.6 m for 200 mm (48 ft. for 8 in.) pipe

18.3 m for 250 mm (60 ft. for 10 in.) pipe

22 m for 300 mm and 350 mm (72 ft. for 12 in. and 14 in.) pipe

3.1.3. Anchors shall be as shown

END OF SECTION

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. MATERIALS

2.1.1. Pipe connectors, where shown, for water, shall be Hydroflex Hose, Flexonics or Vibro-Flo or corrugated metal with braided sheath.

2.1.2. Corrugated metal and sheath shall be of bronze or stainless steel with threaded ends for 50 mm (2 in.) pipe size and smaller and flanged ends for larger sizes.

2.1.3. Total length of connector shall vary from a minimum of 300 mm (12 in.) for 25 mm (1 in.) deflection, and up to 350 mm (18 in.) for 50 mm (2 in.) or greater deflection.

2.1.4. Minimum working pressure at 21.1 deg. C. (70 deg. F.) shall be 1200 kPa (175 psi) based on maximum working pressure not exceeding burst pressure.

3. Execution

3.1. NOT USED

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.2. SUBMITTALS
 - 1.2.1. Shop Drawings: Submit Shop Drawings of the tank support frames for structural review, and tank Drawings, including details and catalogue cuts of any standard components being incorporated into the system.
2. Products
 - 2.1. MATERIALS
 - 2.1.1. Replaceable bladder type expansion tanks shall be pre-charged replaceable bladder type equal to Explanflex Type 'AL', ITT Series 'B', Armstrong Type 'L', or Amtrol Extrol Series 'L' stamped 800 kPa (125 psi) operating pressure. NOT USED.
 - .1 Tanks shall be constructed in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code. NOT USED.
 - .2 Tanks shall be all steel construction and replaceable bladder shall be heavy duty butyl rubber compound. NOT USED.
 - .3 Tank shall include 38mm (1-1/2 in.) threaded bottom inlet, air pressure gauge, 19mm (3/4 in.) drain valve, and air inlet connection to facilitate adjusting of pre-charge pressure to meet actual system conditions. NOT USED.
 - .4 Tanks shall be complete with ring base, and lifting rings. NOT USED.
 - .5 Tanks shall have capacities as indicated in the Expansion Tank Schedule. NOT USED.
 - .6 Tanks shall have capacities as indicated on the Drawings. NOT USED.
 - 2.1.2. Diaphragm type expansion tanks shall be pre-charged diaphragm type equal to Explanflex Type 'OT', ITT Series 'D' or Armstrong Type 'AX' stamped 800 kPa (125 psi) operating pressure.
 - .1 Tanks shall be constructed in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code.
 - .2 Tanks shall be all steel construction with integral heavy duty butyl rubber diaphragm.
 - .3 Tanks shall be complete with lifting rings, NPT system connection, and air inlet connection to facilitate adjusting pre-charge pressure to meet actual system conditions.
 - .4 Tanks shall be complete with saddles.
 - .5 Tanks shall have capacities as indicated in the Expansion Tank Schedule.
 - .6 Tanks shall have capacities as indicated on the Drawings. NOT USED.
 - 2.1.3. Water Pressure Reducing Valve: Watts, or Cash Acme, equal to Watts UB5, screwed with bronze body for operating pressures up to 2070 kPa (300 psi) at 71 deg. C. (160 deg. F.). Upstream from pressure reducing valve, provide a backflow preventer equal to Watts No. 9 or 909 acceptable under the requirements of the Ontario Water Resources Act. Downstream from pressure reducing valve, provide a pressure relief valve. All components of valves in contact with water shall be non-ferrous. Set pressure reducing valve at 140 kPa (20 psig) and pressure relief valve at 210 kPa (30 psig). Pipe pressure relief valve to nearest floor drain.

2.1.4. Expansion tanks used for Glycol systems shall not have a cold water make-up connection.

3. Execution

3.1. INSTALLATION

3.1.1. Expansion tanks shall be self-supporting and shall be placed on 100mm housekeeping pads.

3.1.2. Provide 19 mm (3/4 in.) drain line to nearest floor drain.

3.1.3. Hang expansion tanks from roof structure on angle iron frame. Support tank below each saddle. Refer to Drawings for additional details.

3.1.4. Support expansion tank on angle iron frame welded to base plate anchored to floor with self drilling anchor bolts cross brace with angle irons.

END OF SECTION

- 1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.2. SUBMITTALS
 - 1.2.1. Shop Drawings: Submit Shop Drawings of wall fin convectors, including unit capacities, sizes, piping, connections, and construction details. Shop Drawing shall clearly show amount of expansion on each section, and method of control.
- 2. Products
 - 2.1. MATERIALS
 - 2.1.1. Wall fin convectors shall be Sterling, Dunham-Bush, Engineered Air, Sigma, Rittling or Rosemex.
 - 2.1.2. Wall fin convectors shown as type “A” shall be complete with:
 - .1 Convector elements consisting of 48, 70 mm x 102 mm (2.75 in. x 4 in.) aluminum fins per foot on 19 mm (3/4 in.) copper tubes, one tier high, as required to obtain capacities shown.
 - .2 Wall fin shall be “bare element” with cabinet/enclosure provided by Architect.
 - .3 Manually operated air vent, accessible through access door.
 - .4 19 mm (3/4 in.) tube and element shall be supported on maximum 1220 mm (48 in.) centres, with elements supported on rollers to allow for expansion.
 - .5 Coordinate element support with the special unit enclosures.
 - 2.1.3. Elements shall be of finned lengths shown.
 - 2.1.4. Wall fin convectors shall have capacity shown when supplied with water entering at 71.1 deg. C. (160 deg. F.) leaving at 60.0 deg. C. (140 deg. F.) and with air entering at 18.3 deg. C. (65 deg. F.).
- 3. Execution
 - 3.1. INSTALLATION
 - 3.1.1. Install fin elements so that every section of the perimeter wall is covered. Take special care in locating control valves and other such equipment to ensure that the maximum fin element length is obtained.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
2. Products
 - 2.1. MATERIALS
 - 2.1.1. Fan Coil Units: McQuay, York, Carrier, Engineered Air, Dunham-Bush or Rittling.
 - 2.2. HEATING UNITS
 - 2.2.1. Heating/cooling fan coil units shall be complete with all components specified.
 - 2.2.2. Base unit shall be minimum 1.56 mm thick (0.0614 in – 16 GSG gauge) galvanized steel reinforced and welded. Interior parts exposed to moisture shall be zinc coated steel. Casing shall be acoustically and thermally insulated with glass fibre blanket.
 - 2.2.3. Coils shall be A.R.I rated, copper tubes aluminum fins suitable for 1725 kPa (250 psig) working pressure. Drain pan shall be insulated and shall extend beyond coil to serve connections.
 - 2.2.4. Fans shall be forward curved centrifugal direct driven type.
 - .1 Direct drive fan (FCU-02) motors shall be permanent split capacitor suitable for multi-speed control from manual selector.
 - .2 Belt drive fan (FCU-01) motors shall be single-phase, open drip proof, resilient mounted, NEMA frame motors.
 - .1 Motors shall be single speed, UL recognized or equivalent, Class B, continuous duty rated.
 - .2 Factory wired to unit junction or control box.
 - .3 Motor protected with internal thermal overload.
 - .4 Motor bearings shall be provided pre-greased (permanently lubricated).
 - .5 Motor mounted on adjustable base for belt tensioning and alignment.
 - .6 Motor and drive installed on same end as coil connections for ease of service.
 - 2.2.5. Cabinet enclosure shall be minimum 1.2141 mm thick (0.0478 in – 18 gauge) phosphatized steel panels prime coated. Provide panels with concealed fixings for full width access. Supply grilles and return grilles shall be integral stamped metal type. Grilles and cabinet enclosure shall be baked enamel finish to the Engineer's Representative's requirements.
 - 2.2.6. Provide a three-speed, on/off selector switch and manual starter for each unit. On horizontal units, switch shall be suitable for remote flush mounting. On vertical units, mount switch beneath access door.
 - 2.2.7. Permanent type filters of cleanable aluminum shall be concealed from sight.
 - 2.2.8. Temperature controls specified under Section 15910 – STANDALONE CONTROLS.
 - 2.2.9. Units shall be of the type and of capacity as shown in the Fan Coil Unit Schedule on Drawings (in the Fan Coil Unit Schedule) when selected on medium (low) speed when supplied with cooling water entering at ... deg. C. (... deg. F.) leaving at ... deg. C. (... deg. F.) with 26.7 deg. C. (80 deg. F.) ambient air and supplied with heating water entering at ... deg. C. (...

deg. F.) with 18.3 deg. C. (65 deg. F.) ambient air. Maximum sound power level with reference to 10 to the -12 power watts, shall not exceed 56 db at 250 cps.

2.3. HEATING UNITS NOT USED.

2.3.1. Low flow forced air units shall be complete with all components specified. NOT USED.

2.3.2. Trench fan coil units shall be suitable for installation within the trench dimensions shown. All parts of the units shall be serviceable through the top of the unit. NOT USED.

2.3.3. Element shall be copper tube, aluminum fin 2 row design. NOT USED.

2.3.4. Motors shall be three-speed with thermal overload, permanently lubricated type. NOT USED.

2.3.5. Fans shall be aluminum tangential blowers statically and dynamically balanced. NOT USED.

2.3.6. Provide three-speed, on/off switch and manual starter for each unit located behind access door. NOT USED.

2.3.7. Temperature control specified under Section 15900 — BUILDING AUTOMATION SYSTEM (BAS). NOT USED.

2.3.8. Units shall have the capacities shown when selected on low speed with heating water entering at 82.2 deg. C. (180 deg. F.) and leaving at 65.6 deg. C. (150 deg. F.) and ambient air entering at 18.3 deg. C. (65 deg. F.). NOT USED.

3. Execution

3.1. NOT USED

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.2. SUBMITTALS
 - 1.2.1. Shop Drawings: Submit Shop Drawings of all chemicals used in the system in accordance with SECTION 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
2. Products
 - 2.1. MATERIALS
 - 2.1.1. Water piping cleaning solution for closed loop systems shall be equal to GE W&P Technologies FERROQUEST FQ7103 or Ashland Drew CSW 600. Refer to manufacturers instructions for chemical concentrations.
 - 2.1.2. Boiler system cleaning formulation shall be equal to GE W&P Technologies OPTISPERSE ADJ0346 or Ashland Drew LAC PN 0057-40-7. Refer to manufacturers instructions for chemical concentrations.
 - 2.1.3. Glycol system solution shall be 40% by volume of factory, pre-mixed solution of inhibited ethylene glycol. Ethylene glycol shall be Dow Chemical Co. "Dowtherm SR-1", Interstat Chemical Co. "Intercool NFE", or Recochem Inc. "Recotherm IG"..
 - 2.1.4. Glycol system solution shall be 50% by volume of factory, pre-mixed solution of inhibited propylene glycol. Propylene glycol shall be Dow Chemical Co "Dowfrost", Interstat Chemical Co. P-323" or Recochem Inc. "Recofreeze PG". NOT USED.
 - 2.1.5. Alcohol Anti-freeze solution shall be 40% by volume of Anchem Sales "Ancool-100" NOT USED.
 - 2.1.6. Glycol make-up packages shall be provided for glycol water make-up. Each glycol make up package shall be equal to Ashland Drew Chemical E5800; PN 9243-01-5, Expanflex model GMP-2-50, GE W&P Technologies AGS-2045, or Armstrong GLA-STD-LP-1 for 1.8 gpm make-up at 50 psig with a 110v (1/3 hp) motor and 50 gallon polyethylene storage tank complete with hinged cover. Unit shall be complete with cut-off and (audible and visual) alarm in case of high pressure or low solution level. The pumping assembly shall be mounted in a sturdy steel frame, complete with legs to keep it off the floor. The package shall include a motor, a pump, a magnetic starter, a pressure tank, a priming valve, a PRV, a shut-off valve and a pressure gauge. NOT USED.
 - 2.1.7. The glycol make-up package for the glycol system shall be an Axiom Industries Ltd. Model MF200. Packages by Ashland Drew, Expanflex, GE W&P Technologies, and Armstrong where the meet the specification shall also be accepted.
 - .1 System shall include:
 - .1 25 litre (6.6 U.S. gallon) storage/mixing tank with molded-in level gauge, 125 mm (5") fill/access opening and cover;
 - .2 Pump suction hose with inlet strainer and check valve; pressure pump with fuse protection; low fluid level pump cut-out float switch; manual diverter valve for purging air and agitating contents of storage tank; pressure switch with snubber, and two sets of SPST dry contacts, each individually adjustable from 70 kPa (10

psig) to 170 kPa (25 psig) cut-out pressure; factory cut-out pressure set to 115 kPa (17psig); and liquid filled pressure gauge.

.2 Unit to be c/w UL listed and fused power supply adapter with LED power indicator light, 115/60/1 to 24 VDC 50 watts AC, supplied loose for field installation.

.3 Feeder shall be compatible with glycol solutions of up to 50% concentration. Pump shall be capable of running dry without damage. Unit shall be completely assembled.

3. Execution

3.1. INSTALLATION

3.1.1. All systems shall have been hydrostatically tested prior to cleaning.

3.1.2. Thoroughly flush all systems with raw water to remove loose mill scale and debris. Remove and clean all strainers and flush low points before chemical cleaner is added.

3.1.3. All coils shall be disconnected and flow shall be by-passed.

3.1.4. A temporary pump shall be installed in the system and shall be capable of pumping adequate discharge at adequate head.

3.1.5. A temporary heater shall be installed in the system and shall be capable of maintaining the circulating water temperature as required for chemical treatment.

3.1.6. Systems shall be filled with city water and approved chemical cleaner introduced by a small temporary chemical injector pump at the temporary circulating pump section. Cleaner shall be introduced to maintain concentrations as per the manufacturer's recommendations.

3.1.7. All systems shall be cleaned in accordance with manufacturer's instructions and under the supervision of the chemical supplier's representative. Minimum cleaning procedures shall be to fill all water piping cleaning solution, circulate at 1.5 times specified system flow rate and maintain at highest possible temperature for 72 hours. During this period heavy blowdown of all low points shall be carried out every 6 hours. Strainers shall be cleaned as necessary to permit maximum flow possible and, in any event, at least every 6 hours. Drain the solution, all strainers, and flush entire system with clean water for a minimum of 24 hours. Repeat fill and flush procedure as often as required, adding inhibitor with each fill, to achieve acceptable contaminant levels. Systems shall then be refilled, ready for use. Temperature of system for cleaning shall be to suit chemical supplier's requirements.

3.1.8. Take samples of system from a series of representative drains as directed by the Engineer's Representative. If system is still dirty repeat cleaning procedure specified above until acceptable. Acceptable samples shall indicate that alkalinity and pH have returned to potable water levels. Copies of all test reports shall be submitted by the water treatment supplier to the Engineer's Representative for verification prior to final filling.

3.1.9. Add chemical treatment immediately after cleaning has been completed and accepted. Acceptable control parameters shall be as follows:

- .1 Nitrite: 1000 – 1500 ppm
- .2 pH: 8.5 – 10
- .3 Iron: Less than 2.0 ppm
- .4 Copper: Less than 0.3 ppm
- .5 Molybdate: 100 – 150 ppm

3.1.10. Steam boiler manufacturer shall supervise alkaline boil out of the boilers on site in the presence of Engineer's Representative and before thermal efficiency test. Isolate boilers, meter cleaning chemicals into treated water, and fire the boiler according to standard procedures provided by the boiler manufacturer. Blow down through intermittent valves at

least one half of the gauge glass every eight hours through the bottom blowdown line. Add make-up as required after each blow down. Boil out for 24 hours, drain and wash thoroughly. Do not allow boiler to cool below 93.33 deg. C. (200 deg. F.) Flush with hot water for two hours, drain and inspect. If oil or grease is present, repeat boil out procedure.

- 3.1.11. For glycol systems install glycol make-up system as per manufacturer's instructions and in accordance with Section 15708 – EXPANSION TANKS. Fill system with specified glycol product to achieve the required glycol concentration. Glycol systems shall be provided with a Freezing Point Glycol Test Kit equal to Ashland Drew PN 7729-01-7.
- 3.1.12. For tenant work the base building Contractor shall drain and fill the base building system. Arrange and pay for this work.
- 3.1.13. The Mechanical Contractor shall supply the Engineer's Representative with certified documentation from the water treatment supplier that the systems have been properly equipped, chemically cleaned and that they are maintaining sufficient levels of scale/corrosion inhibitor. The contractor shall request such documentation from the water treatment supplier within one week of presentation to the Engineer's Representative.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.2. RELATED WORK SPECIFIED ELSEWHERE
 - 1.2.1. Electrical hard wire supply and primary connections to electrical components – under Electrical Division.
 - 1.3. SUBMITTALS
 - 1.3.1. Shop Drawings:
 - .1 Submit Shop Drawings of all fans with catalogued components to be supplied. Include manufacturer's data sheets for, performance criteria, ratings, and physical dimensions and finishes. Provide fan curves for each fan at the specified operation point, with the flow, static pressure and horsepower clearly plotted. Provide outlet velocity and both inlet and outlet sound power readings for the eight octave bands.
 - 1.3.2. Manufacturer's Data
 - .1 Conform to AMCA standard 205, 211 and 311. Fans shall be tested in accordance with ANSI/AMCA Standard 210 and AMCA Standard 300 in an AMCA accredited laboratory and shall be certified to bear the AMCA seal for air and sound performance.
 - .2 Classification for Spark Resistant Construction Conform to AMCA 99.
2. Products
 - 2.1. MATERIALS
 - 2.1.1. Except as otherwise indicated, all centrifugal inline fans shall be Carnes, Cook, Greenheck, PennBarry, or Twin City.
 - 2.1.2. All fans shall comply with UL/cUL 705.
 - 2.1.3. All fans used to convey grease laden air shall comply with UL/cUL 762, meet NFPA 96A and have a grease collection device.
 - 2.1.4. All fans used for smoke control shall be UL/cUL listed and tested for operation at 260 Deg. C. (500 Deg. F.) for a minimum of four hours, and 520 Deg. C. (1000 Deg. F.) for a minimum of fifteen minutes.
 - 2.1.5. Housing shall be heavy gauge galvanized steel complete with integral duct collars. Bolted access doors shall be provided on a minimum of two sides. Housing shall be pre-drilled to accommodate universal mounting feet for vertical or horizontal installation.
 - 2.1.6. Wheel shall be centrifugal backward inclined, constructed of aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. The assembled wheel shall be electronically balanced both statically and dynamically to balance grade G6.3 per ANSI S2.19.
 - 2.1.7. Motor shall be direct drive or belt drive mounted on outside of casing as shown in the Fan Schedule.
 - .1 Direct drive motor shall have external electrical terminal box.

- .2 Belt drive motor shall have adjustable motor plate utilizing threaded studs for positive belt tensioning.
- .3 Belts shall be oil and heat resistant, non-static type.
- .4 Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts.
- .5 Drives shall be sized for 150% of the installed motor horsepower.
- .6 Motors shall be in accordance with the requirements of Section 15054 – ELECTRIC MOTORS. See Schedule for hp (wattage) ratings.
- 2.1.8. Bearings shall be heavy duty, grease lubricated, anti-friction ball or spherical roller, self-aligning, block type and selected for a minimum L50 life in excess of 200,000 hours at maximum load. All inaccessible bearings shall be provided with prefilled factory extended lubrication lines fitted with grease fittings terminating at the case exterior. Permanently lubricated bearings are not acceptable.
- 2.1.9. All fans, without ducts or dampers on the inlet or outlet, including fans in plenums, shall have protective screens on the openings.
- 2.1.10. Vibration isolation shall be provided as specified in Section 15200 – VIBRATION AND NOISE CONTROL.
- 2.1.11. Fans shall be suitable for operation with variable frequency drives where indicated in the Fan Schedule or as required to meet the requirements of Section 15951 – SEQUENCES OF OPERATION.
- 2.1.12. Centrifugal inline fans shall be in accordance with the Fan Schedule.
- 3. Execution
 - 3.1. INSTALLATION
 - 3.1.1. Install fans in locations shown on plans.
 - 3.1.2. Align shafts, belt drive and motor, adjust belt tension, ensure all set screws are tight and check motor rotation before start-up.
 - 3.1.3. Protect motors and fans during construction.
 - 3.1.4. Duct transitions shall be rigidly connected directly to the fan inlet and outlet flanges. Flexible connections required for isolation from the duct system shall be located on the inlet and outlet of the transition piece representing the greatest cross sectional area and lowest velocity. Vibration isolation shall include for the weight of the transitions.

END OF SECTION

- 1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.2. SUBMITTALS
 - 1.2.1. Shop Drawings
 - .1 Submit Shop Drawings of all catalogued components to be supplied. Include manufacturer's data sheets for certification, performance criteria, ratings, and physical dimensions and finishes.
 - .2 Submit Shop Drawings of each supporting structural assembly required in the ductwork systems, designed by an engineer licensed to practice in the place of work in the appropriate discipline. Same design engineer stamps each and every Shop Drawing.
 - 1.2.2. Samples: Submit samples as required.
 - 1.2.3. Submit marked up prints showing detailed locations of all devices mounted in or on ductwork, dimensioning their locations.
- 2. Products
 - 2.1. MATERIALS
 - 2.1.1. Fabricate all ductwork unless specifically noted otherwise, of galvanized sheet steel with Z180 coating to A.S.T.M. A653/A653M-98.
 - 2.1.2. Sealing compound: Minnesota Mining and Manufacturing or other approved manufacturer. Duct tape shall be Duro-Dyne or other approved manufacturer.
 - 2.1.3. Flexible ducting:
 - .1 Flexible metal ducting shall be Flexmaster Triple-Lock Aluminum Flexible ducting T/L. ULC listing S110
 - .2 Acoustic flexible metal ducting shall be Flexmaster Triple-Lock Acoustic Flexible ducting T/L-A-T/L consisting of perforated aluminum inner core, 38 mm (1-1/2 inch) insulation, and aluminum outer covering. ULC listing S110.
 - 2.1.4. Access Ports shall be Lawson-Taylor or other approved manufacture of 32 mm (1-1/4 in.) dia. ports.
 - 2.1.5. Flexible Connections:
 - .1 Ventfabrics, Duro Dyne or Dyne-Air.
 - .2 For fans less than 0.5 kPa (2 in. wg.) connections shall be minimum 680 gm/sq.m. (20 oz./sq.yd.) fire retardant polyvinyl-chloride polyester fabric equal to Vinyl-Flex.
 - .3 For all systems where the temperature may exceed 112 deg. C. (235 deg. F.) silicone rubber coated fibreglass shall be used, and shall be equal to Silicone H1-T. Submit flexible connections for review before installation.
 - 2.1.6. Dampers:
 - .1 Dampers: For right angle branch duct take-off from vertical riser; Air vector Vectrol or other approved manufacturer.

- .2 Fire Dampers: Underwriters' Laboratories Classified to ANSI/UL 555 Standard for Fire Dampers and CAN/ULC S112 Standard Method of Fire Test of Fire Damper Assemblies or ANSI/UL 555C Standard for Ceiling Dampers as applicable.
 - .1 Fire dampers shall be curtain type, rated as 'Dynamic', and shall have the blades clear of the air stream. Fire dampers shall be Type B or Type C as required to suit system air velocity and pressure. Fire dampers in return and exhaust systems may be Type A with the blades in the air stream where permitted by the Engineer's Representative. Dampers shall be multi-sectional as required to suit size and UL/ULC Listing requirements. Where the specified curtain fire dampers are limited by the UL/ULC Listing for maximum size, they shall be substituted with multi-blade type complete with power actuation and/or fusible link as required to satisfy the fire rating of the partition.
 - .2 Fire-stop flaps or ceiling mounted fire dampers shall be as shown in the Underwriters' Laboratories Listing for the specific ceiling assembly used.
 - .3 Combination balancing/fire damper: Price VCS4
 - .4 Combination Smoke and Fire Dampers: Multi-blade type complete with operating shaft, stainless steel side seals and fire resistant insulating blade seals. Dampers shall bear U.L.C. label for 1-1/2 hours and shall be of the same manufacturer as noted for fire dampers. Damper shall be open/closed from motor operator and fully closed on melting of fusible link. Limit switches shall be provided to show position of damper blades. Leakage through dampers shall not exceed 0.506 L/s (10 cfm/sq.ft.) of damper area at 1.0 kPa (4.0 in. wg.) of differential pressure when tested in accordance with AMCA Standard 500. Submit test data with Shop Drawings.
 - .5 Smoke Dampers: Similar to dampers described above but without fusible link.
 - .6 Fabricate manual duct dampers as shown on Standard Details from galvanized steel 1.26 mm thick (0.048 in – 18 GSG gauge) or heavier. Dampers for ducts up to 300 mm (12 in.) deep shall be one blade carried on a 9 mm (3/8 in.) square steel rod mounted inside the duct. Dampers for ducts of greater depth than 300 mm (12 in.) shall be multi-blade, opposed-acting type, and shall have blades mounted in 38 mm (1-1/2 in.) steel channel frame, and interconnected for operation from one locking type hand quadrant. Dampers for right angle take-off of branch from vertical riser shall have operator extended to an accessible location. For externally insulated ducts, mount quadrant on a bracket, designed to clear the insulation. All dampers shall have indicator to show position of damper blade.
 - .7 Fabricate splitter dampers as shown on Standard Details from at least the same thickness of galvanized steel as the duct in which it is installed, down to a minimum of 0.95 mm thick (0.0374 in – 20 GSG gauge). Fabricate of double thickness so that the entering edge presents a round nose to the air flow, and mount securely on hinges at the air leaving edge. Length of splitter shall be at least 1-1/2 times the width of the smaller branch duct, but in no case less than 300 mm (12 in.) long. Attach splitter hinge near the air entering edge with support passing through a clamp on the side of the duct, located where it is most accessible for external adjustment and locking of the damper.
 - .8 Gravity backdraft dampers shall be multi-blade louver type, constructed of light grade aluminum. Blades shall be joined with a tie bar and have rust-proof shafts rotating in bronze bushings.
 - .9 Motorized dampers for Control Operation: In accordance with applicable requirements control systems (pneumatic) or central energy management systems section.
- 2.1.7. Acoustic Insulation: 25 mm (1 in.) thick rigid coated glass fibre.
 - 2.1.8. Interior Duct Protective Coating: Chlorinated rubber base paint or Eisenheiss Black.
 - 2.1.9. Plenums serving floor grilles from below shall be fabricated of stainless steel and provided complete with drain connections. Plenums shall be constructed to be water-tight. Bottom

surface of plenum shall be sloped toward drain. Drain, plenum, and connected piping shall be insulated with vapour barrier to minimise condensation.

2.1.10. Hardware and Accessories:

- .1 Spin-in connections shall be specifically built for that purpose. Dampers shall be a minimum 1 gauge heavier than the ductwork in which it is installed and shall have a full length shaft pivoted at two diametrically opposed points. An indicator shall be attached to the shaft to indicate the damper position.
- .2 Hardware for balancing or splitter dampers shall be rattle-free and leak resistant. Bearing rods shall be sized to suit the damper size. Neoprene seals shall be used to minimize leaks. Hardware shall be Dyn-Air or equal.
- .3 Turning vanes shall be either double thickness or single thickness with extended leading and trailing edges as specified in ASHRAE and SMACNA Standards. Rails shall be securely set in the elbow so that they cannot loosen. Turning vanes shall be Dyn-Air or equal.

2.2. FABRICATION

2.2.1. Fabricate ductwork in accordance with applicable duct construction requirements of SMACNA.

3. Execution

3.1. INSTALLATION

- 3.1.1. Make all laps in the direction of air flow. Use no sheet metal screws in the duct where it is possible to use rivets and bolts. Hammer down all edges and slips so as to leave smooth finished surface inside the ducts.
 - 3.1.2. Brace and stiffen all ducts, and make tight so that they will not breathe, rattle, vibrate or sag. Cross-break all rectangular ducts with heights or widths of 300 mm (12 in.) or larger.
 - 3.1.3. Where rectangular ducts are shown, round ducts may be substituted at the Contractor's option, provided there is sufficient room. Conversion from rectangular to round duct, sizing shall be as shown on charts in ASHRAE.
- Hang all ductwork securely and in a rigid manner. Provide hangers as follows:

TABLE 1: HANGERS

DUCT DIMENSION	HANGER CONSTRUCTION
Horizontal rectangular duct	
Up to 1500 mm (60 in.) for Low Pressure Ductwork Only	Two 25 mm (1 in.) x 16 US gauge straps with two screws on side of duct one screw on bottom. Hangers shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.
For all sizes of Medium and High Pressure Ductwork up to 3000 mm (120 in.) and Low Pressure Ductwork from 1525 mm to 3000 mm (61 in. x 120 in.)	50 mm x 50 mm x 6 mm (2 in. x 2 in. x 1/4 in.) trapeze hanger with two 9 mm (3/8 in.) dia. rods. Hangers shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.
3000 mm to 6000 mm (120 in. to 240 in.)	65 mm x 65 mm x 5 mm (2-1/2 in. x 2-1/2 in. x 3/16 in.) trapeze hanger with two 9 mm (3/8 in.) dia. rods. Hangers shall be at each joint but in no case more than a maximum 1200 mm (48 in.) on centres.
Horizontal round duct	
Up to 450 mm (18 in.)	One 25 mm (1 in.) x 16 US gauge hanger ring supported from one 25 mm (1 in.) x 16 US gauge hanger strap. Hanger shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.
475 mm to 900 mm (19 in. to 36 in.)	One 25 mm (1 in.) x 12 US gauge hanger ring supported from 25 mm (1 in.) x 12 US gauge hanger strap. Hanger shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.
925 mm to 1250 mm (37 in. to 50 in.)	One 25 mm (1 in.) x 12 US gauge hanger ring supported from 25 mm (1 in.) x 12 US gauge hanger strap. Hanger shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.
1275 mm to 2100 mm (51 in. to 84 in.)	Two 38 mm (1-1/2 in.) x 12 US gauge hanger connected to the 32 mm x 32 mm x 3 mm (1-1/4 in. x 1-1/4 in. x 1/8 in.) angle girth reinforcing of duct hanger. Hangers shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.

- 3.1.4. Support all vertical ducts at each floor, on all sides, with angle riveted to the ducts.
- 3.1.5. The following low pressure, medium pressure and high pressure duct construction is based on an ASHRAE method of construction, and gives a minimum standard of construction. Alternative ASHRAE or SMACNA duct construction is acceptable, provided it meets the

minimum standards as outlined by these Specifications. Submit proposed alternatives for review prior to fabrication.

- 3.1.6. Construct low pressure rectangular ducts for systems less than 0.5 kPa (2 in.) static pressure and under 10.2 m/s (2000 fpm) velocity as follows:

TABLE 2: LOW PRESSURE DUCT CONSTRUCTION

MAX. DUCT DIMENSION	SHEET METAL US GAUGE	TRANSVERSE JOINT CONNECTION AND BRACING
Up to 300 mm (12 in.)	26	Flat drive or flat 'S' no bracing
325 mm to 425 mm (13 in. to 18 in.)	24	Flat drive or flat 'S' no bracing
475 mm to 750 mm (19 in. to 30 in.)	24	25 mm (1 in.) standing 'T' bracing 25 mm x 25 mm x 3 mm (1 in. x 1 in. x 1/8 in.) at maximum 1500 mm (60 in.) centres.
775 mm to 1050 mm (31 in. to 42 in.)	22	25 mm (1 in.) standing 'T' bracing 25 mm x 25 mm x 3 mm (1 in. x 1 in. x 1/8 in.) at maximum 1500 mm (60 in.) centres.
1075 mm to 1200 mm (43 in. to 48 in.)	22	38 mm (1-1/2 in.) standing 'T' bracing 38 mm x 38 mm x 3 mm (1-1/2 in. x 1-1/2 in. x 1/8 in.) at maximum 1500 mm (60 in.) centres.
1225 mm to 1350 mm (49 in. to 54 in.)	22	38 mm (1-1/2 in.) standing 'T' bracing 38 mm x 38 mm x 3 mm (1-1/2 in. x 1-1/2 in. x 1/8 in.) at maximum 1200 mm (48 in.) centres.
1375 mm to 1500 mm (55 in. to 60 in.)	20	38 mm (1-1/2 in.) standing 'T' bracing 38 mm x 38 mm x 3 mm (1-1/2 in. x 1-1/2 in. x 1/8 in.) at maximum 1200 mm (48 in.) centres.
1525 mm to 2100 mm (61 in. to 84 in.)	20	38 mm (1-1/2 in.) standing 'T' bracing 38 mm x 38 mm x 3 mm (1-1/2 in. x 1-1/2 in. x 1/8 in.) at maximum 1200 mm (48 in.) centres.
2125 mm to 2400 mm (85 in. to 96 in.)	18	50 mm (2 in.) standing 'T' bracing 38 mm x 38 mm x 5 mm (1-1/2 in. x 1-1/2 in. x 3/16 in.) at maximum 600 mm (24 in.) centres.
2425 mm to 3000 mm (97 in. to 120 in.)	18	50 mm (2 in.) standing 'T' bracing 50 mm x 50 mm x 6 mm (2 in. x 2 in. x 1/4 in.) at maximum 600 mm (24 in.) centres.
3025 mm and over (121 in. and over)	18	As above with addition of tie rods at 300 mm (120 in.) centres for joint bracing.

- .1 Bracing spacing shown is maximum spacing between two bracings or between bracing and joint.

- .2 Locate bracings mid-way between joints.
- .3 Make longitudinal joints Pittsburgh lock seam at edge of duct, and grooved seam on face of duct.
- 3.1.7. Seal all joints of all ducts. Brush joints with the compound before and again after assembly.
- 3.1.8. Seal the bottom and side joints of outside air ducts or plenums water-tight.
- 3.1.9. Flexible hose shall be connected to sheet metal duct and diffusers using duct sealer, minimum of two screws separated by 180 degrees and metal draw bands. Duct tape is not acceptable.
- 3.1.10. Flexible ductwork may be used under the following conditions:
 - .1 Flexible ductwork shall be used where shown to allow easy location of diffusers.
 - .2 Minimum length of flexible duct used to connect diffusers and interior troffers shall be 2,400 mm (84 inches).
 - .3 Maximum length of flexible duct shall be 3,000 mm (120 inches).
 - .4 Flexible ductwork shall not pass through floors or fire walls,
 - .5 Flexible ductwork shall be a single section of duct (no joints). In the event that building construction requires connection between lengths of flexible duct use a rigid section of duct as the joint. Flexible duct shall be secure to the rigid section using ties and sealant.
 - .6 Flexible duct lengths greater than 2,400 mm (84 inches) shall be supported at the midpoint with strap hangers.
- 3.1.11. Where ductwork passes through a wall or floor, other than when a fire damper is required, pack around the duct using a fire resistant material to ensure a sound and airtight joint.
- 3.1.12. If changes of size of ducts are necessary because of building construction, maintain the same circular equivalent for the new size. Ratio of the longest side of the duct to the least shall not exceed 4 to 1 unless specifically authorized by the Engineer's Representative.
- 3.1.13. Select the gauge of metal and method of construction for the new size. Notify the Engineer's Representative of any change before such changes are incorporated into the work.
- 3.1.14. If changes of location of duct, are required because of building construction, review with the Engineer's Representative before the locations indicated are changed in any way.
- 3.1.15. Make changes of direction of horizontal ducts with elbows having an inside radius not less than 3/4 the width of the duct. Make change of direction from horizontal to vertical duct with elbows having an inside radius equal to the depth of the duct. Where this is not possible due to the building construction, use turning vanes.
- 3.1.16. Provide access ports at convenient locations in all main ducts and main branch take-offs with airtight covers and extension sleeves through insulation to allow air meter readings. Access ports shall be approved by the Engineer's Representative and the testing company before installation.
- 3.1.17. Provide flexible connections at each air handling unit and fan duct connection.
- 3.1.18. Install manual duct dampers as shown on Standard Details. Ensure dampers for right angle take-off of branch from vertical riser have operator extended to an accessible location. Adjust quadrants to clear duct insulation.
- 3.1.19. Provide splitter dampers as shown on Standard Details.
- 3.1.20. Incorporate gravity backdraft dampers where shown.
- 3.1.21. Install motorized dampers where directed.
- 3.1.22. Install fire dampers where shown and at all penetrations through all fire rated assemblies. Where fire dampers are shown in grilles or diffusers at ceiling level they shall be firestop flap. Obtain local authorities approvals for all damper locations and keep one set of marked-up prints on site. Approvals shall be obtained before installation of fire dampers.

- 3.1.23. Where fire dampers for ducts shown on Drawings require a change of type and/or powered actuation due to dimension limitations to satisfy the cUL Classification requirements, provide transitions as required to adjust duct dimensions while maintaining the equivalent circular duct diameter to avoid exceeding any specific listed maximum dimension. Where transitions are not possible or dimensions cannot be adjusted to avoid powered actuation, provide power from the closest available emergency power source as required. Review all conditions with the Engineer's Representative in advance of fabrication.
- 3.1.24. Install combination smoke and fire dampers and smoke dampers where shown. Ensure operators are accessible for maintenance.
- 3.1.25. Receive automatic dampers from separate Section on site, and set in place under the supervision of the control manufacturer.
- 3.1.26. Provide access panels at all fire dampers, gravity dampers, motorized dampers, coils, heaters, humidifiers, fan bearings or similar equipment requiring occasional maintenance or inspection. Panels shall be 600 mm x 450 mm (24 in. x 18 in.) or full width of duct if less than 450 mm (18 in.) wide. Panels shall be of double wall construction and shall be internally insulated on insulated ducts. Frame shall be of structural angle with welded corners, gasketed to receive the panel. Panel shall be held in place with 4 window sash locks.
- 3.1.27. Paint visible internal surface behind each grille or register flat black.
- 3.1.28. Where duct is acoustically lined, duct dimensions shown are net, inside of lining.
- 3.1.29. Acoustic lining
- .1 Apply acoustic insulation internally to ductwork where shown. In addition, internally line all low or medium pressure supply air ductwork in mechanical rooms, fan rooms, or equipment rooms.
 - .2 Install using both pins and adhesive. Pins shall be maximum 450 mm (18 in.) centres and shall be tack welded to the duct or plenum. Seal all edges of acoustic insulation to prevent air erosion with sheet metal nosing that overlaps the insulation by 19 mm (3/4 in.) minimum.
- 3.1.30. Air wells shall be 1.95 mm thick (0.0767 in – 14 GSG gauge) galvanized steel construction with all joints welded. Clean all welds so that no water traps occur. Touch-up all welds with zinc rich primer. Suitably brace the entire assembly with steel angle to prevent flexing and drumming. Coat the entire surface exposed to the outside air with 2 coats of rustproofing finish. Submit sample of rustproofing for review. Provide a structural supporting frame to support the entire unit plus an additional live loading of 4.2 kg/sq.m. (100 lbs/sq.ft.).
- 3.1.31. Spin-in connections shall only be used downstream of variable volume boxes.
- 3.1.32. Ductwork shall be run parallel to the closest wall. Coordinate with piping and structural elements.
- 3.1.33. All open ends of ductwork that do not have a diffuser, grille or register shall have a protective screen mounted in a suitable frame to connect the screen securely to the duct, wall and floor as applicable. Where a duct terminates at a supply, return or exhaust air opening provided by other sections and located less than 2000mm (79 in.) Above the finished floor, the screen shall be installed and painted matte black and shall not be capable of passage of anything larger than a 15mm (1/2 in.) Sphere through the openings.
- 3.1.34. Supply air ductwork to variable volume boxes shall be rigid duct of size shown in schedules. If the length exceeds 3000 mm (10 ft.) or if there are 2-45 deg. elbows or 1-90 deg. elbow or more increase in supply air ductwork to the variable volume box one size. If the length exceeds 6000 mm (20 ft.) increase the duct by two sizes. Under no conditions shall be supply ductwork exceed 9000 mm (30 ft.) or have more than 3-90 deg. elbows or the equivalent.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.2. RELATED WORK SPECIFIED ELSEWHERE
 - 1.2.1. Continuous air slot in ceiling – under Division 9 – Finishes.
 - 1.2.2. Door grilles – under Architectural Division – Grilles.
 - 1.3. SUBMITTALS
 - 1.3.1. Shop Drawings: Submit detailed Shop Drawings of all components furnished under this Section. Manufacturer to indicate ceiling installation type for each type of diffuser specified.
 - 1.3.2. Manufacturer's Data: Submit test results of type "B", "T1", "E", "G" diffuser models to be used on the project, including air pattern and noise levels for air quantities from 10% to 110% of the required maximum air flow.
 - 1.3.3. Sample of exposed duct detail. See mechanical standard details on the drawings.
2. Products
 - 2.1. MATERIALS
 - 2.1.1. Diffusers, registers and grilles shall be Price, Nailor, Krueger, Titus or Carnes equal to the units specified.
 - 2.1.2. Select all diffusers to provide uniform air coverage without overlap. Air velocity up to a height of 1800 mm (6 ft.) above the floor shall be 0.127 to 0.254 m/s (25 to 50 fpm).
 - 2.1.3. Noise generated by diffusers shall be such that room sound pressure level does not exceed noise criteria 32 with an 8 db room attenuation, the sound power level reference to 10 to -12 power watts.
 - 2.1.4. All volume and air pattern devices shall be fully adjustable from the face of the diffuser, register or grille.
 - 2.1.5. In gypsum board or plaster ceiling applications, provide matching mounting frame. Finish shall be prime painted, off-white in plaster and gypsum board ceilings. .
 - 2.1.6. In T-bar ceilings, manufacturer shall coordinate diffuser compatibility with t-bar ceiling specified by the architectural division. Colour shall match colour of ceiling tile in lay-in ceilings. Diffusers to suit ceiling grid as required imperial or metric.
 - 2.1.7. Diffusers shall meet test requirements of A.S.H.R.A.E. Standard 36B-63, including air pattern and noise levels for air quantities from 10% to 110% of the required maximum air flow. Sound power tests shall be measured in accordance with ASHRAE Standards 36B-63 and NC ratings shall be determined using an 8 db room attenuation factor
 - 2.2. LINEAR SUPPLY AND RETURN DIFFUSERS
 - 2.2.1. All diffusers shown as type "T1" shall be T-bar plug-in, 1 slot diffuser modified with square ends to limit side spread, and of lengths shown. Diffuser shall be installed with manufacturer plenum to match the length of the diffuser shown. Provide diffuser with mounting clips to suit

in continuous T-bar openings. Pattern controllers shall be split mid length to allow each half of diffuser shall be set for different throw patterns. Throw patterns shall be fully adjustable from vertical to horizontal and variations in between. Provide blank-off panels between diffusers. Pattern controllers and blank-off panels shall be finished matte black. Plenum shall be fabricated from coated steel. Refer to Architectural Details for installation of continuous supply air slot. Duct connection to diffuser shall be of sufficient height to allow for 175 mm (7 in.) clearance from ceiling to underside of duct. EH-Price TBD3 series, Nailor 5800, Krueger PTBA, Carnes DASC.

2.3. SILL, SIDEWALL AND FLOOR GRILLES

2.3.1. Floor grilles shown as type "G" shall be heavy duty linear floor grille type with 3 mm x 19 mm (1/8 in. x 3/4 in.) extruded heavy duty aluminum bars on 6 mm (1/4 in.) centers for zero deflection. Diffusers shall be in floor frame. Blades shall run parallel to the long dimension of the grille. The grille border shall be heavy duty extruded aluminum construction with precise factory mitered corners and reinforcing support bars for extra support for the Mandrel tubes. The support bars and Mandrel tubes shall not exceed 12 in. on center. The core shall be held into the border with removable core clips allowing the removal of the core without special tools. Core shall be removable to allow servicing. Set frame high enough to suit architectural floor covering. E.H. Price LBMH-15A. Krueger 1850 Series, Carnes CTLB.

2.3.2. Wall grilles shown as type "H" shall be linear bar grilles with 3 mm (1/8 in.) fixed 15 degree blades, spaced 6 mm (1/4 in.) on center. The outlet shall have extruded aluminum blades mechanically locked into a heavy extruded aluminum receiving bar. Blades shall run parallel to the long dimension of the grille. The 500 (13 mm, 1/2 in.) grille border shall be extruded aluminum construction with precise factory mitered corners. The core shall be held into the border with Type D spring clips. The grille shall be complete with finish specified by the Architect and directional vanes mounted behind the core to provide directional air pattern. The core shall be oriented to direct air upwards as per the plans. E.H. Price LBPH-16A. Krueger 1600, Carnes CTP.

2.4. WALL AND DUCT GRILLES

2.4.1. All supply registers shown as type "B" shall be standard double deflection type with adjustable horizontal face bars and vertical rear bars. Frame shall be gasketed. Construction shall be aluminum with prime coat. Registers larger than listed sizes shall be shop fabricated in Sections such that the Sections will appear as one integral register when installed. The integral volume control damper shall be of the opposed blade type and shall be constructed of cold rolled steel. The damper shall be operable from the register face. The damper shall be coated or galvanized steel. E.H. Price 520D, Nailor 6100 Series, Krueger 880 Series, Carnes RWDBH.

2.5. RETURN, EXHAUST AND TRANSFER GRILLES

2.5.1. All return grilles shown as type "E" shall be steel single deflection type of the sizes indicated on the plans. Grilles shall be 45 degree deflection fixed louver type with blades spaced 19 mm (3/4 in.) on center. The blades shall run parallel to the horizontal dimension of the grille. The grille shall be complete with finish specified by the Architect. E.H. Price 530. Krueger AFCS80, Carnes RSAB.

3. Execution

3.1. INSTALLATION

- 3.1.1. Refer to the architectural drawings for actual locations of diffusers, grilles and registers and install to suit these drawings. The mechanical drawings show intent and number of diffusers, grilles and registers required.
- 3.1.2. Provide transfer grilles in all finished spaces where air is transferred through a ceiling or partition. Provide transfer grille on both sides of the finished areas.
- 3.1.3. For exposed ductwork installations, all connections to grilles shall be oversized and shall have in-turned flanges to meet the flange of the grilles and the duct. Out-turned or exposed flanges with screw mounting shall not be accepted.
- 3.1.4. For special mounting of diffusers, grilles and registers refer to Architectural Drawings.
- 3.1.5. Where rigid duct is connected to the diffuser, grille or register all devices used for flow pattern adjustment, flow balancing and flow equalizing shall be accessible from the face of the diffuser.
- 3.1.6. Install mounting frame tied into plaster and gypsum board ceilings to allow lay in type diffusers to rest on the frame.
- 3.1.7. Diffusers for installation in lay-in ceiling shall lay on inverted T-bars spaced on ... mm (... in.) centers.
- 3.1.8. Contractor shall be responsible for mounting concealed flange linear diffusers in heated environment and following manufacturers' instructions.
- 3.1.9. Contractor shall caulk around edges of linear diffusers in installations with imperfect walls.

END OF SECTION

- 1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Provide all labour, materials, products, equipment and services to supply, install, test and commission Standalone Controls with Direct Digital Control (DDC) for building mechanical and electrical systems as indicated on drawings and described herein.
 - 1.2. PROJECT SCOPE
 - 1.2.1. Provide fully functioning standalone control system for the new hydronic boiler, circulating pumps, fan coil units, and hydronic wall-fin radiators included in the scope of work.
 - 1.3. SYSTEM OUTLINE
 - 1.3.1. General
 - .1 The documentation contained in this section and other contract documents pertaining to Controls is schematic in nature. The contractor shall provide all required hardware necessary to implement the functions shown or implied in the contract documents.
 - .2 Control system to consist of microprocessor based DDC controllers.
 - .3 DDC controllers shall be based on open type protocols, either BACnet as defined by ANSI/ASHRAE standard 135-2012 or LONWorks as defined by ANSI/CEA standard 709.1 for potential future connection to Building Automation System (BAS).
 - 1.3.2. Functional Principals
 - .1 Controls to control mechanical and electrical equipment as specified in 15951 – SEQUENCE OF OPERATION.
 - .2 System architecture to be modular permitting expansion of system peripherals and field hardware.
 - .3 Each controller to operate independently by performing its own specified control, receiving information from input field devices and controlling output field devices to perform the control sequences.
 - .4 DDC controller may control more than one system provided that points associated with those systems are connected to that same controller.
 - .5 DDC controllers to be configured so that main inputs and outputs from any control loop are located in that same controller.
 - .6 DDC controllers to be capable of operating with local closed loop programming.
 - .7 Where PID control loops are called for in the sequences, they are to be implemented within the controller.
 - 1.4. EQUIPMENT SUPPLIED FOR INSTALLATION UNDER OTHER SECTIONS
 - 1.4.1. Automatic control valves except otherwise noted.
 - 1.4.2. Temperature sensor wells.

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- 1.4.3. Motorized dampers except otherwise noted. Verify damper sizes and connection type with sheet metal contractor prior to ordering.
 - 1.5. SUBMITTALS
 - 1.5.1. Product Data and Shop Drawings:
 - .1 Before start of construction, submit completely engineered and coordinated shop drawing package.
 - 1.5.2. Project Record Documents:
 - .1 Operation and Maintenance Manuals:
 - .1 Provide three copies of manuals in printed format and three copies on CD within three weeks following completion of Demonstration under Part 3: Execution. Provide manuals in hard cover three-ring binders with index page and indexing tab per section.
 - .2 As-built Product Data and Shop Drawings:
 - .1 Provide three copies in printed format and three copies on CD for approval by the Consultant within three weeks following the successful completion of Demonstration under Part 3: Execution.
 - 1.6. WARRANTY
 - 1.6.1. Warrant the Work free from defects for a period of 12 months and in accordance with the General Conditions and as amended below.
 - 1.6.2. Warranty start date will be the date the Work is accepted under Part 3: Execution, Demonstration.
 - 2. PRODUCTS
 - 2.1. MATERIALS
 - 2.1.1. Existing Products: To Part 3: Execution, Existing Products.
 - 2.1.2. New Products: Non-beta versions currently under manufacture and have been applied in similar installations for a minimum period of one year.
 - 2.1.3. Revisions: Latest available revision for Controller Resident Software and controller firmware at start of Warranty.
 - 2.2. DDC CONTROLLERS
 - 2.2.1. General
 - .1 Input/Output Interface:
 - .1 Minimum Spare I/O Capacity: Controllers to have minimum 20% spare capacity or at least one of each type of I/O available on the controller. This does not apply to Application Specific Controllers.
 - .2 Controllers to be swappable without disconnecting the wiring.
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2.3. POWER SUPPLIES AND LINE FILTERING

- 2.3.1. Provide a separate power supply for every controller with the exception of application specific controllers.

2.4. CABINETS

- 2.4.1. Type: NEMA rated and suitable for installed environment.

2.5. CONTROL DEVICES

2.5.1. Motorized Control Dampers:

- .1 Sizing:
 - .1 Dimensions: As indicated. Maximum damper section size: 1200 mm x 1500 mm (48 in. x 60 in.). For dampers larger than the section maximum, use an assembly of multiple, equally sized sections.
 - .2 Two-position: Parallel blade.
 - .3 Modulating: Opposed blade. Parallel blade dampers may be used for return air and bypass applications.
- .2 Frame: 125 mm x 25 mm x 3 mm (5 in. x 1 in. x 0.125 in.) 6063T5 extruded aluminum with mounting flanges on both sides.
- .3 Blades: Airfoil shape, 6063T5 extruded aluminum, maximum 150 mm (6 in.) depth.
- .4 Seals:
 - .1 Blade Edge: Extruded thermoplastic rubber (TPR) suitable for -58 deg. C to 135 deg. C (-72 deg. F to 275 deg. F), mechanically locked in place and easily replaceable in the field.
 - .2 Blade Jamb: Spring-loaded stainless steel.
- .5 Bearings: Moulded synthetic.
- .6 Linkage: Corrosion resistant steel and concealed in the frame.
- .7 Drive Shaft: Corrosion resistant steel of square or hexagon shape.
- .8 Axle: Corrosion resistant steel.
- .9 Leakage: Maximum 0.35 L/s/sq m (8 CFM/sq ft) at 1.0 kPa (4 in. w.g.) of differential pressure across fully closed damper when tested to AMCA Standard 511.
- .10 Make and Model: Ruskin CD-50 or equivalent.

2.5.2. Actuators For Dampers, Electronic:

- .1 Control Signal: Compatible with controller outputs.
- .2 Floating control signal is acceptable only for VAV damper application.
- .3 Operating Time: Maximum 120 seconds throughout the full rotation.
- .4 Angle of Rotation: Adjustable between 0° to 90°.
- .5 Stall protection: Mechanical or electronic.
- .6 Actuators shall have electronic overload protection or digital rotation sensing circuitry to prevent actuator damage throughout the entire rotation.

- .7 Failsafe: Non-spring return for VAV terminals; spring return for other applications. Spring return to normal position within 15 seconds.
- .8 Manual Override: Crank type. External gear release for non-spring return actuators.
- .9 Position Indicator: Reversible for clockwise or counter-clockwise rotation; set the 0 degrees mark to the failsafe position.
- .10 Torque: To damper manufacturer's requirements to provide complete compression of seals between frame and blades and for smooth control.
- .11 Provide UL555S listed damper actuators for all dampers used in smoke control.

2.5.3. Control Valves:

- .1 Characteristics, materials and pressure ratings suitable for the application; refer to schedules.
- .2 Flow Characteristic:
 - .1 Water:
 - .1 Two-way: Equal percentage.
 - .2 Three-way: A Port: Equal percentage. B Port: Linear or modified linear.
 - .2 Steam: Linear.
- .3 Sizing Water Valves:
 - .1 Two-position: Line size with full ports.
 - .2 Two-way Modulating: Non Radiation: Pressure drop equal to the pressure drop through the coil or 27 kPa (4 psi), whichever is greater. Radiation: Pressure drop equal to 7 kPa (1 psi).
 - .3 Three-way Modulating: Non Radiation: Pressure drop equal to the pressure drop through the coil or 27 kPa (4 psi), whichever is greater. Radiation: Pressure drop equal to 7 kPa (1 psi).
 - .4 Butterfly Valves:
 - .1 Type: High-performance (HPBV).
 - .2 Make and Model: Dezurik BHP or equivalent.
 - .3 Tee-fitting: Provide for three-way application; with motor mounting bracket and linkage hardware.
 - .5 Valves 12 mm (1/2 in.) through 50 mm (2 in.):
 - .1 Screwed ANSI Class 250 bronze body.
 - .6 Valves 62 mm (2-1/2 in.) and Larger:
 - .1 Water temperature less than 121 deg. C (250 deg. F) at 1035 kPa (150 psi) or less than 93.2 deg. C (200 deg. F) at 1139 kPa (165 psi): Flanged ANSI Class 125 cast iron body.
 - .2 Water temperature greater than 121 deg. C (250 deg. F) at 1035 kPa (150 psi) or greater than 93.9 deg. C (200 deg. F) at 1138 kPa (165 psi): Flanged ANSI Class 250 cast iron body or ANSI Class 300 cast steel body.
- .4 Sizing Steam Valves:
 - .1 Two-position: Pressure drop equal to 10% to 20% of inlet pressure.
 - .2 Modulating: Pressure drop equal to 50% of inlet pressure.
- .5 Leakage: ANSI Class IV.

- .6 Materials:
 - .1 Stems: Stainless steel.
 - .2 Plugs and Seats: Brass or steel.
 - .3 Packing: PTFE for steam.
- .7 Rangeability: 40:1 minimum.

2.5.4. Pressure Independent Control Valves:

- .1 Factory fabricated of type, body material, and pressure class based on maximum pressure and temperature rating of the piping system, unless otherwise indicated.
- .2 Calibrated Balancing Valves and Automatic Flow-Control Valves shall not be required on devices where pressure independent control valves are installed.
- .3 The control valves shall accurately control the flow from 0 to 100% full rated flow with an equal percentage flow characteristic.
- .4 Each control valve shall be individually flow tested and factory verified to deviate no more than $\pm 5\%$ through the operating pressure range. A calibrated performance tag shall be provided with each valve (optional for $\frac{1}{2}$ " [15mm]) listing the measured flow rate in 10° rotation increments.
- .5 Valve bodies 2" [50mm] and smaller shall be brass. Valve bodies 3" [80mm] thru 8" [200mm] shall be ductile iron. All internal parts shall be brass, carbon steel, stainless steel or Teflon®. Plastic internal parts are not acceptable
- .6 Control valve rangeability shall be 100:1 minimum.
- .7 The manufacturer shall warrant all components for a period of 5 years from the date of production.
- .8 The actuator shall be the same manufacturer as the valve, integrally mounted to the valve at the factory, or shall be provided with universal mounting plate to allow installation of actuators meeting system electrical and valve torque requirements.

2.5.5. Actuators for Control Valves, Electronic:

- .1 Control Signal: Compatible with controller outputs.
- .2 Floating control signal is not acceptable.
- .3 Operating Time: Maximum 120 seconds throughout the full rotation.
- .4 Mounting: Corrosion resistant hardware.
- .5 Stall Protection: Electronic overload or digital rotation sensing.
- .6 Failsafe: Non-spring return for radiation and terminal reheat coils; spring return for others. Spring returns to normal position within 15 seconds.
- .7 Manual Override: Crank type. External gear release for non-spring return actuators.
- .8 Position Indicator: Provide. Indicate valve open and closed positions.
- .9 Close-off Pressure:
 - .1 Water:
 - .1 Two-way: 150% of total system head.
 - .2 Three-way: 300% of the pressure differential between ports A and B at design flow, or 100% of total system head.
 - .2 Steam: 150% of inlet pressure.

2.5.6. Electric Relays:

- .1 Type: General purpose; enclosed coil; diodes provided for inductive switched loads; override button; LED "energized" indicator; plug-in type base.
 - .2 Contact rating, configuration and coil voltage suitable for application.
 - .3 Regulatory: UL listed.
- 2.5.7. Damper End Switches:
- .1 Type: Lever operated activated by blade position.
 - .2 Electrical Contacts: Rated for 10 A resistive, 6 FLA at 120 VAC.
 - .3 Regulatory: UL listed.
- 2.5.8. Low Limit Electromechanical Thermostat:
- .1 Type: Vapour Pressure; minimum 6000 mm (20 ft.) of capillary; actuated by any 300 mm (12 in.) of capillary element; manual reset upon activation.
 - .2 Electrical Contacts: Double-pole double-throw (DPDT), snap-acting; rated for 10 A resistive, 6 FLA at 120 VAC.
 - .3 Adjustable Set Point: Range: -1 deg. C to 13 deg. C (30 deg. F to 55 deg. F) and set to 1.67 deg. C (35 deg. F).
 - .4 Regulatory: UL listed.
- 2.5.9. High Limit Electromechanical Thermostat:
- .1 Type: Bimetallic sensing; manual reset upon activation.
 - .2 Mounting: Air stream.
 - .3 Electrical Contacts: Single-pole single-throw (SPST), normally closed, snap-acting; rated for 10 A resistive, 6 FLA at 120 VAC.
 - .4 Adjustable Set Point: Range: 38 deg. C to 66 deg. C (100 deg. F to 150 deg. F) and set to 57 deg. C (135 deg. F).
- 2.5.10. Electromechanical Thermostat:
- .1 Wall Mount:
 - .1 Low Voltage:
 - .1 Type: 24 VAC, bimetal-operated, mercury-switch; adjustable or fixed anticipation heater; vented ABS plastic concealed cover.
 - .2 Set Point: Range: 13 deg. C to 30 deg. C (55 deg. F to 85 deg. F); 1 deg. C (2 deg. F) maximum differential.
 - .2 Line Voltage:
 - .1 Type: Bimetal-actuated open contact, or bellow-actuated enclosed snap-switch type, or equivalent solid state type; anticipation heater; vented metal concealed cover.
 - .2 Electrical Contacts: Rated for 10 A resistive, 6 A FLA at 120 VAC.
 - .3 Set Point: Range: 13 deg. C to 30 deg. C (55 deg. F to 85 deg. F); 1 deg. C (2 deg. F) maximum differential.
 - .4 Regulatory: UL listed.
- 2.5.11. Digital Thermostat:
- .1 Digital thermostats shall be 7-day programmable digital type suited for the application.

- .2 Standalone terminal units shall utilize a digital thermostat where shown on drawings.
- .3 Digital thermostat shall have user selectable engineering units (deg. F or deg. C and set point adjustment).
- .4 Digital thermostat shall support automatic daylight savings time switchover.
- .5 Digital thermostat shall support automatic and manual heat/cool changeover when applicable.
- .6 Digital thermostat shall support temporary set point adjustment with automatic return to normal operation.

2.5.12. Temperature Sensors:

- .1 General Requirements:
 - .1 Temperature sensors shall be of the resistance type, two-wire 1000 ohm nickel RTD, two-wire 1000 ohm platinum RTD or two-wire 10,000 ohm thermistor.
- .2 Space Temperature Sensors:
 - .1 For installation throughout the facility unless otherwise noted.
- .3 Space Temperature Sensors With Adjustable Set-Point, Override and Display:
 - .1 Key pad or slider for temperature set-point adjustment.
 - .2 LED display.
 - .3 Timed override request push button with LED status for activation of after-hours operation.
 - .4 For installation only where indicated on drawings, controls diagrams or sequences of operations.
- .4 Covers for Wall Mount Sensors:
 - .1 Overrides: Exposed set point adjustment and override button.
 - .2 Communication Port: For communication between Portable Operator Terminals and ASC controllers.
- .5 Averaging Temperature Sensors:
 - .1 Minimum 1.5 m (5 ft) of capillary per 1 sq m (10 sq ft) of duct cross-section.
 - .2 Provide multiple sensors where single averaging element is unable to be positioned to provide complete duct or plenum traverse.
- .6 Outside Air Temperature Sensors:
 - .1 Outside air temperature sensors shall be designed to withstand the environmental conditions to which they will be exposed.
 - .2 The sensors shall be provided with a solar shield.
 - .3 Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.
- .7 Duct Temperature Sensors:
 - .1 Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
 - .2 Probe length shall be no less than 1/3 of the duct width or diameter.
 - .3 For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.
- .8 Thermowells:

- .1 Brass or Type 316 stainless steel suitable for the application.
 - .2 Heat transfer compound compatible with sensing element.
- 2.5.13. Guards for Sensors and Thermostats:
 - .1 Materials: Heavy gauge steel.
- 2.6. WIRE AND CONDUIT
 - 2.6.1. Conduit: Electrical metallic tubing EMT with compression type fittings in dry locations; cold rolled steel zinc coated or zinc coated rigid steel with threaded fittings in wet locations or where exposed to weather.
 - 2.6.2. Outlet boxes: Dry locations: sheradized or galvanized drawn steel 100 mm (4 in.) square or octagon with suitable raised cover; Exposed to Weather: threaded hub cast aluminum boxes with gasket plate.
 - 2.6.3. Junction boxes: Sized according to number, size and position of entering raceway; type: suitable for the environment.
 - 2.6.4. Wire:
 - .1 Analog Input, Output: Stranded 18 gauge copper twisted shielded.
 - .2 Binary Input, Output: 18 gauge, minimum insulation rating of 600 volts.
 - .3 Class 2: FT-6 without conduit in ceiling plenums; FT-4 in conduit for all other cases.
- 3. Execution
 - 3.1. GENERAL WORKMANSHIP
 - 3.1.1. Install all controllers, cabinets, control devices and power supplies in readily accessible locations providing adequate ambient conditions for its specified application and to the Canadian Electrical Code.
 - 3.1.2. Install products to manufacturer's installation instructions.
 - 3.1.3. Install parallel to building walls and floors unless indicated or specified or required by manufacturer's installation instructions.
 - 3.1.4. Mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.
 - 3.2. COORDINATION
 - 3.2.1. Integrate and coordinate work under this section to controls and control devices provided or installed by others.
 - 3.3. EXISTING PRODUCTS
 - 3.3.1. Apply reused existing products to the same requirements for new products.

- 3.3.2. Performance: During construction check and verify reused existing products are operational. For existing product that is not operational submit a proposal to replace existing product for approval by the Consultant.
- 3.4. WIRING AND CONDUIT
- 3.4.1. Wire shall be neatly tie wrapped to conduit mounted to the building structure but must be installed at right angles or parallel to the building. Loose wiring shall only be allowed over a distance of 1500 mm (5 ft.) but must not pass over lighting fixtures.
- 3.4.2. Wiring in Equipment Room, between floors, or between concrete walls shall be installed in conduit. Exposed wiring will not be accepted. Conduit shall be installed at right angles or parallel to the building walls.
- 3.5. POWER WIRING
- 3.5.1. Power for Section 15910 – STANDALONE CONTROLS shall be provided under Electrical Division 16 at 120 VAC 60 Hz single phase and shall terminate in junction boxes installed where shown on electrical and mechanical drawings. Wiring and conduit from these boxes to control devices being electrically powered to be provided by Section 15910 – STANDALONE CONTROLS).
- 3.6. CONTROL DEVICES
- 3.6.1. Provide or furnish control devices as indicated on the drawings and to the requirements of this Section and to execute sequence of operation.
- .1 Provide each fan coil with thermostat installed in Storage Room (B31). Each thermostat complete with remote temperature sensor installed where shown on the plans and coordinated with the Architectural plans.
 - .2 Provide hydronic wall-fin radiator with thermostat installed in Storage Room (B31). Thermostat complete with remote temperature sensor installed on the vertical face of the Architectural enclosure that conceals the wall-fin radiator, located away from solar or thermal effects.
- 3.7. IDENTIFICATION
- 3.7.1. All wires shall be tagged at both ends. The tagging shall identify the device it is connected to. Use of the point object name is acceptable.
- 3.7.2. Label wires, control devices, controllers.
- 3.8. TESTING AND COMMISSIONING
- 3.8.1. Test and commission the controls prior to the Demonstration.
- 3.8.2. Prepare test forms which shall identify each test. The forms shall be sub-divided into points, controllers, programs and loops.
- 3.9. DEMONSTRATION

- 3.9.1. When all tests have been completed and the documentation completed, request a meeting with the Consultant and Owner. Provide at this meeting a demonstration that all systems on the controls are operating.

3.10. INSTRUCTION AND TRAINING

- 3.10.1. Provide one day of instruction that shall cover the operation and maintenance of the control systems.

END OF SECTION

1. General
 - 1.1. WORK INCLUDED
 - 1.1.1. Conform to Section 15010 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.1.2. The locations of all sensors shall be discussed with and approved by the Owner and/or Engineer's Representative, before installation. Locations shown are approximate only, and are given to assist the Contractor in pricing only, and shall not be construed as being the final approved location.
 - 1.1.3. The control sequence descriptions are complementary. Provide detailed sequences of operation and all points required to implement the sequences.
 - 1.1.4. All settings and set points listed in this Section shall be variable and Operator adjustable without the need to create or modify Custom Application Programs.
 - 1.1.5. All set points and reset schedules shall be visual on the associated dynamic graphic.
2. Products
 - 2.1. GENERAL APPLICATION PROGRAMS
 - 2.1.1. Provide a specific set of programs to achieve automated, operator independent control of facility sub-systems.
3. Execution
 - 3.1. BOILER (B-1) AND CIRCULATING PUMPS (P-1 & P-2), (BOILER ROOM)
 - 3.1.1. System Start:
 - .1 Boiler and Secondary Heating Circulation Pump (P-02) shall be enabled when Outside Air Temperature (OAT) is less than 15.5°C (60 deg F) for more than 30 minutes.
 - 3.1.2. Normal Operation:
 - .1 On a call for heat from one of the heat demands (FCU-01, FCU-02, or hydronic wall-fin radiators):
 - .1 The Secondary Heating Circulation Pump (P-02) shall run continuously to maintain the glycol loop pressure when the outside air temperature is below system enable set-point. The glycol loop pressure shall be adjustable from the built-in pump controls.
 - .2 Primary/Boiler Circulation Pump (P-01) shall operate continuously.
 - .3 The boiler shall cycle and/or modulate to maintain the glycol supply temperature (GST) based on the most demanding set point from each heat demand's reset curve.
 - 3.1.3. System Stop:
 - .1 The system shall be disabled when Outside Air Temperature (OAT) rises above 18.3°C (65 deg F).
 - 3.1.4. Alarms (provided on boiler's electronic display):
 - .1 Boiler status.

.2 Boiler diagnostics.

3.2. FAN COILS (FCU-01; FCU-02) (CHURCH ALTERATION – STORE ROOM)

3.2.1. Applicable Systems:

3.2.2. System Start:

- .1 System start shall be initiated by operator command or through time schedule. Upon signal to start the system supply fan shall start. Heating coil valves shall be enabled.

3.2.3. Normal Operation:

- .1 Supply Fan (SFSS) shall run continuously in occupied mode.
.2 On a call for heat, heating coil valve (HCV) shall open to maintain Space Temperature (SPCT) at set-point (adjustable). System shall signal the call for heating to the boiler.
.3 When in unoccupied mode, the unit shall cycle if necessary to maintain the night set-back space temperature set-point.

3.2.4. System Stop:

- .1 System stop is initiated by operator command or through time schedule. Upon signal to stop the system the supply fan shall stop. Heating coil valves shall be closed.

3.2.5. Schedule:

- .1 To be determined by the owner.

3.3. EXHAUST FAN (EF-1) (BASEMENT – FEMALE WASHROOM)

3.3.1. Applicable systems:

3.3.2. System Start:

- .1 System start shall be initiated by light switch or occupancy sensor either in the female washroom or new access free washroom. Upon signal to start the system, the exhaust damper shall open, when the damper end switch makes the fan shall start.

3.3.3. Normal Operation:

- .1 Exhaust fan shall run continuously during the washrooms occupied time or light is on in either female washroom or new access free washroom.

3.3.4. System Stop:

- .1 System stop is initiated after prescheduled time limit when lighting switched off in the female washroom and new access free washroom. Upon signal to stop the system, the exhaust fan shall stop and the exhaust damper shall close.

3.3.5. Schedule:

- .1 To be determined by the owner.

3.3.6. Alarms:

- .1 Exhaust Fan Status (EFST) from current sensor.

3.4. HYDRONIC WALL-FIN RADIATORS (CHURCH ALTERATION – STORE ROOM)

3.4.1. Applicable Systems:

3.4.2. System Start:

- .1 Hydronic wall-fin radiator heating shall be enabled when Outside Air Temperature (OAT) is less than 15.5°C (60 deg F).

3.4.3. Normal Operation:

- .1 Heating Control Valve (HCV) shall modulate to maintain clerestory glazing temperature at set point. System shall signal the call for heating to the boiler.
- 3.4.4. System Stop:
 - .1 The system shall be disabled when Outside Air Temperature (OAT) rises above 18.3°C (65 deg F). Heating control valve shall be closed.

END OF SECTION

EQUIPMENT NO.			B-01												
Make			Knight												
Model			WH-199												
Output	MBH	kW	185	54	--	--	--	--	--	--	--	--	--	--	--
Working Pressure	psig	kPa	80	552	--	--	--	--	--	--	--	--	--	--	--
Entering Water Temperature	°F	°C	140.0	60.0	--	--	--	--	--	--	--	--	--	--	--
Leaving Water Temperature	°F	°C	160.0	71.1	--	--	--	--	--	--	--	--	--	--	--
FUEL															
Gas Pressure	in. w.g.	kPa	7.0	1.7	--	--	--	--	--	--	--	--	--	--	--
No. 2 Oil	USgpm	L/min	--	--	--	--	--	--	--	--	--	--	--	--	--
Motor	hp	kW	--	--	--	--	--	--	--	--	--	--	--	--	--
Equipment Weight	Lbs	kg	175	79	--	--	--	--	--	--	--	--	--	--	--
Remarks			Boiler has already been delivered to site; 120/1/60.												
EQUIPMENT NO.															
Make															
Model															
Output	MBH	kW	--	--	--	--	--	--	--	--	--	--	--	--	--
Working Pressure	psig	kPa	--	--	--	--	--	--	--	--	--	--	--	--	--
Entering Water Temperature	°F	°C	--	--	--	--	--	--	--	--	--	--	--	--	--
Leaving Water Temperature	°F	°C	--	--	--	--	--	--	--	--	--	--	--	--	--
FUEL															
Gas Pressure	psig	kPa	--	--	--	--	--	--	--	--	--	--	--	--	--
No. 2 Oil	USgpm	L/min	--	--	--	--	--	--	--	--	--	--	--	--	--
Motor	hp	kW	--	--	--	--	--	--	--	--	--	--	--	--	--
Equipment Weight	Lbs	kg	--	--	--	--	--	--	--	--	--	--	--	--	--
Remarks															

EQUIPMENT NO.			EF-1													
System			New Washroom and Female Washroom Exhaust													
Location																
Service			New Washroom and Female Washroom													
Airflow Rate	cfm	L/s	490	231		--		--		--		--		--		--
External Static Pressure	In H2O	Pa	0.4	104		--		--		--		--		--		--
Total Static Pressure	In H2O	Pa	0.4	104		--		--		--		--		--		--
Brake	hp	kW	0.08	0.06		--		--		--		--		--		--
Motor	hp	kW	0.17	0.12		--		--		--		--		--		--
SOUND DATA																
2nd Band	Inlet	Outlet	73	75												
3rd Band	Inlet	Outlet	71	65												
4th Band	Inlet	Outlet	63	57												
5th Band	Inlet	Outlet	59	54												
Make			GREENHECK													
Model			SQ-90-VG													
Type			Inline													
Size			15"x15"x19"													
Fan RPM			1654													
Variable Inlet Vanes	Yes/No		No													
Variable Frequency Drive	Yes/No		No													
Remarks																

Page 1 of 1

EQUIPMENT NO.			FCU-01		FCU-02											
Make			IEC		IEC											
Model			VBA08		VEY14											
Size																
Maximum Air Flow Rate	cfm	L/s	1000.0	472	1200.0	566		--		--		--		--		--
Air Pressure Drop	In H2O	Pa	0.50	124.4	0.50	124.4		--		--		--		--		--
HEATING CAPACITY	MBH	kW	33,943.0	9945.3	47,668.0	13966.7		--		--		--		--		--
Entering Water Temperature	°F	°C	160.0	71.1	160.0	71.1		--		--		--		--		--
Leaving Water Temperature	°F	°C	130.0	54.4	130.0	54.4		--		--		--		--		--
Water Flow Rate	USgpm	L/min	2.5	9.5	3.5	13.2		--		--		--		--		--
Water Pressure Drop	ft H2O	kPa	3.2	10	1.2	4		--		--		--		--		--
COOLING CAPACITY	MBH	kW	N/A	N/A	N/A	N/A		--		--		--		--		--
Entering Air Temperature (db)	°F	°C	N/A	N/A	N/A	N/A		--		--		--		--		--
Entering Air Temperature (wb)	°F	°C	N/A	N/A	N/A	N/A		--		--		--		--		--
Leaving Air Temperature (db)	°F	°C	N/A	N/A	N/A	N/A		--		--		--		--		--
Leaving Air Temperature (wb)	°F	°C	N/A	N/A	N/A	N/A		--		--		--		--		--
Entering Water Temperature	°F	°C	N/A	N/A	N/A	N/A		--		--		--		--		--
Water Flow Rate	USgpm	L/min	N/A	N/A	N/A	N/A		--		--		--		--		--
Water Pressure Drop	ft H2O	kPa	N/A	N/A	N/A	N/A		--		--		--		--		--
Motor	hp	kW	1/2	0.37		--		--		--		--		--		--
Remarks			Belt drive vertical fan		Vertical fan coil c/w											
			coil c/w ducted return;		ECM motor; 4.3 MCA;											
			240/1/60		240/1/60											
EQUIPMENT NO.																
Make																
Model																
Size																
Maximum Air Flow Rate	cfm	L/s		--		--		--		--		--		--		--
Air Pressure Drop	In H2O	Pa		--		--		--		--		--		--		--
HEATING CAPACITY	MBH	kW		--		--		--		--		--		--		--
Entering Water Temperature	°F	°C		--		--		--		--		--		--		--
Leaving Water Temperature	°F	°C		--		--		--		--		--		--		--
Water Flow Rate	USgpm	L/min		--		--		--		--		--		--		--
Water Pressure Drop	ft H2O	kPa		--		--		--		--		--		--		--
COOLING CAPACITY	MBH	kW		--		--		--		--		--		--		--
Entering Air Temperature (db)	°F	°C		--		--		--		--		--		--		--
Entering Air Temperature (wb)	°F	°C		--		--		--		--		--		--		--
Leaving Air Temperature (db)	°F	°C		--		--		--		--		--		--		--
Leaving Air Temperature (wb)	°F	°C		--		--		--		--		--		--		--
Entering Water Temperature	°F	°C		--		--		--		--		--		--		--
Water Flow Rate	USgpm	L/min		--		--		--		--		--		--		--
Water Pressure Drop	ft H2O	kPa		--		--		--		--		--		--		--
Motor	hp	kW		--		--		--		--		--		--		--
Remarks																

EQUIPMENT NO.			P-01	P-02													
System			Boiler Circulator	System Circulator													
Location			Boiler Room B04	Boiler Room B04													
Service			Primary Glycol Htg.	Secondary Glycol Htg.													
Fluid			40% Ethylene Glycol	40% Ethylene Glycol													
Fluid Flow	USgpm	L/min	20	76	20	76	--	--	--	--	--	--	--	--	--	--	--
Head	ft H2O	kPa	8.00	23.87	18.00	53.71	--	--	--	--	--	--	--	--	--	--	--
Brake	hp	kW	-	#VALUE!	--	--	--	--	--	--	--	--	--	--	--	--	--
Motor	hp	kW	1/6	0.12	1/6	0.12	--	--	--	--	--	--	--	--	--	--	--
RPM			-	-													
Make			Grundfos	Bell & Gossett													
Model			UPS 26-99FC	ecocirc XL 36-45													
Variable Frequency Drives	Yes / No		No	Yes - Pump Mounted													
Remarks			Three-speed circulator shipped with boiler; 230/1/60	Variable speed circulator c/w constant and proportional pressure controls, relay for control from boiler terminal strip; 240/1/60													
EQUIPMENT NO.																	
System																	
Location																	
Service																	
Fluid																	
Fluid Flow	USgpm	L/min	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Head	ft H2O	kPa	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Brake	hp	kW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Motor	hp	kW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RPM																	
Make																	
Model																	
Variable Frequency Drives	Yes / No																
Remarks																	