National Research Council Canada | Conseil national de recherches Canada

Administrative Services and Property Management Branch | Direction des services administratifs et gestion de l'immobilier

NRC · CNRC

Addendum / Addenda

No./N^{o}
3

Project Description / Description de projet		
M-22 Aircraft Cabin Comfort and Environmental Research Facility		
Solicitation No./ No de sollicitation 15-22004	Project No./N^{o} de projet M-22 3788	W.O. No./N^{o} d'ordre de travail
Departmental Representative / représentant ministériel Maurice Richard		Date July 16, 2015

Notice:	**Nota**:
This addendum shall form part of the tender documents and all conditions shall apply and be read in conjunction with the original plans and specifications.	Cet addenda fait partie intégrale des dossiers d'appel d'offres; toutes les conditions énoncées doivent être lues et appliquées en conjonction avec les plans et les devis originaux.

The bid requirements, contract requirements, specifications, schedules and drawings for

Cabin Comfort & Environmental Research Facility

are amended as follows:

GENERAL

A3.1 **ADDENDUM NUMBER SHOWN ON DRAWINGS**

.1 Where drawings attached to this addendum show "issued for addendum 02" in the revision table, they actually refer to this addendum no 3.

A3.2 **BIDDERS QUESTIONS #1**

.1 Answers for questions received from bidders are issued as an attachment to this addendum.

A3.3 **HAZARDOUS MATERIALS ABATEMENT ERATA FROM ADDENDUM NO 1**

.1 The sketch refered to in Addendum No 1 item A1.2.1 1.2.1, to show the extent of ceiling and bulkhead removal in cross section, was inadvertently omitted. Therfor this sketch, no 3788-SKA01, is attached to this addendum.

.2 The total area of asbestos to be removed around the interior and exterior faces of wall openings, refered to in Addendum No1 item A1.2.1 1.2.2, shall be deemed to be 100 square meters.

A3.4 **CONFLICTS WITHIN THE TECHNICAL SPECIFICATIONS**

.1 Where items within different sections of the specifications are in conflict, Division 00 General Instructions govern overall, and Division 01 General Requirements overrule succeeding divisions.

A3.5 **REVISED SPECIFICATIONS**

.1 The following revised specifications issued with this addendum supersede previously issued specifications of the same title and number

.1 Section No. 01 35 43_R1, Environmental Procedures

.2 Section No. 01 74 11_R1, Cleaning

.3 Section No. 07 52 00_R1, Modified Bituminous Membrane Roofing

.4 Section No. 08 33 23.01_R1, Overhead Coiling Doors and Grilles

.5 Section No. 09 68 13_R1, Tile Carpeting

.6 Section No. 09 91 13_R1, Exterior Painting

.7 Section No. 09 91 23_R1, Interior Painting

.8 Section No. 10 28 10_R1, Toilet and Bath Accessories

.9 Section No. 21 05 01_R1, Common Work Results For Mechanical

.10 Section No. 21 24 00_R1, Dry Chemical Fire Extinguishing Systems

.11 Section No. 22 10 10_R1, Plumbing Pumps

.12 Section No. 22 42 01_R1, Plumbing Specialties and Accessories

.13 Section No. 22 42 03_R1, Commercial Washroom Fixtures

.14 Section No. 23 05 17_R1, Pipe Welding

.15 Section No. 23 07 13_R1, Duct Insulation

.16 Section No. 23 07 15_R1, Thermal Insulation for Piping

.17 Section No. 23 31 13.01_R1, Metal Ducts – Low Pressure to 500 PA

.18 Section No. 23 36 00_R1, Air Terminal Units

.19 Section No. 23 55 01_R1, Duct Heaters

.20 Section No. 23 64 26_R1, Water chillers

.21 Section No. 23 73 10_R1, Air Handling Units

.22 Section No. 25 05 00_R1, Common work for Building Automation

.23 Section No. 25 35 00_R1, Building Automation Instrumentation &Terminal Devices

.24 Section No. 25 95 00 Zone 27_R1, Hot Water Heating System

.2 The following specifications are revised by reference and are not re-issued with this addendum:

.1 Section No. 26.24.01 –SERVICE EQUIPMENT (Revised wording and new items 1 to 8)

.1 All Power Meters shall be UL 508 Listed, CSA approved, and have CE marking. They shall also have certified revenue accuracy as per ANSI C12.16.

.2 Power meter to match existing Schneider ION. 7350. Provide CTs, PTs and all wiring and conduit required for tie-ins to the existing Power Monitoring System as per manufacturer requirements.

.3 The power monitoring system vendor shall make all alterations and changes needed to make the system perform as needed at each location. These changes may include:

.1 Modifications to existing switchgear and equipment.

.2 Communication interface installation and configuration.

.3 Communication network design.

.4 Power meter shall be installed on the main breakers of distribution boards as indicated on the drawings. Provide adequate internal memory to store historic data for a minimum of 30 days for all meters.

.5 The electrical contractor shall install all wiring required to externally connect equipment lineups, meters and any other wiring as required by the PMS vendor including all communications network loops and Ethernet communications wiring to meters.

.6 All wiring external to equipment is to be run in conduit.

.7 The power monitoring system vendor to provide development, integration, and installation services required to complete and turn over a fully functional system. This shall include, but not limited to:

.1 All technical coordination, installation, integration and testing of all components.

.8 The meter shall be able to be used on polyphase services. Wiring includes: connection of the meters to the line voltage, connection of the through-type current transformers/transducers installed at the circuit breakers, connection of network communications (wired or, if applicable, wireless communications devices).

.9 Application Voltages: The metering panel will accommodate all approved North American Distribution voltages up to 600 Volts.

.10 Operating Frequency: 50/60 Hz.

.11 Power Factor Range: 0.5 to 1.0 lead/lag.

.12 Power Supply Requirements: Self-powered.

.13 Current Ranges: 100/200/400 Amps or 5/10 AMP interface (services over 400A or critical loads)

.14 Accuracy: +/- 0.5% of 100% registration @ 1.0 pf, 1% to 100% load to meet: Measurement Canada.

.15 Operating Temperature Range: -40 degrees to +55 degrees C.

.16 Meters and their elements must conform to the Measurement Canada “Standard Drawings for Electrical Metering Installations” to ensure accurate metering.

.2 Section No. 27.05.28 - PATHWAYS FOR COMMUNICATION SYSTEMS (Revise wording for items below as follows:)

3.1.1 Run conduit from wall outlets to 150mm (6") above false ceiling. If accessible ceiling pathway to the telecom room does not exist, provide infrastructure pathway to points indicated on drawings and consolidate runs back with junction boxes where convenient. Use the following information as a minimum when consolidating conduit runs:

.1 two (2) 21mmc = one 27mmc

.2 two (2) 27mmc = one 35mmc

.3 two (2) 35mmc = one 53mmc

.4 two (2) 53mmc = one 78mmc

.5 two (2) 78mmc = one 103mmc

.3 Section No. 28.31.00 – FIRE ALARM SYSTEMS

3.1.2.2 (Delete reference to horns and stroves)

(Revised wording for items below to read as follows)

2.4.5 Provide factory painted red conduits for fire alarm system.

3.2.3 Twisted copper conductors: 300 V CSA FAS minimum 105°C with FT4 rating in mechanical protection i.e. EMT, and in accordance with manufacturer's requirements.

.1 To signal circuits: 16 AWG minimum, and in accordance with manufacturer's requirements.

.2 To control circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.

3.3.3. (Delete requirement to paint junction box covers)

.4 Section No. 26.27.26 – WIRING DEVICES

Revise wording for items below to read as follows:

2.1.7 Hand Dryer:

.1 Wall mount, brushed stainless steel enclosure, hands free operation, 15A, 208V, Dyson Airblade db Hand Dryer.

.5 Section No. 26.05.00 - COMMON WORK RESULTS FOR ELECTRICAL

Revised wording to read as follows:

9.1 Provide factory painted red conduits for fire alarm system.

9.2 Provide factory painted yellow conduits for emergency power circuits.

9.3 Provide factory painted blue conduits for voice/data cables.

9.4 Provide factory painted orange conduits for BAS cables.

9.5 Provide factory painted green conduits for security (CAAS) cables

9.6 Provide factory painted purple covers for junction boxes and conduits of for gas detection cables.

.6 Section No. 27.50.00 - DISTRIBUTED COMMUNICATIONS AND MONITORING

2.21 (Add "training will be video recorded")

.7 Section No. 00.10.00 – GENERAL INSTRUCTIONS
Revised wording to read as follows:

3.1 Complete all work within **(70)** weeks…

.8 Section No. 31.00.99 – EARTH WORK – GRADING
Add new item:

1.3.3 NRC shall bear the cost for compaction tests performed at the request of the NRC Departmental Representative.

A3.6 **NEW SPECIFICATIONS**

.1 Add the following new specifications issued with this Addendum.

.1 Section No. 21 05 03, Mechanical Demolition

.2 Section No. 23 83 16, Radiant Heating Hydronic Piping

A3.7 **DELETED SPECIFICATIONS**

.1 Delete the following specifications in their entirety.

.1 Section No. 25 95 00, Sanitary Exhaust Fan – Zone Misc. Equ.

DRAWINGS

A3.8 **REVISED DRAWINGS**

.1 The following drawings are revised and re-issued with this addendum:

.1 Drawing no. 3788-M03 – HVAC LAYOUT

.1 Replace Rev. No. 0 with Rev. No. 1 drawing.

.2 Drawing no. 3788-M08 – MECHANICAL SCHEDULES

.1 Replace Rev. No. 0 with Rev. No. 1 drawing.

.3 Drawing no. 3788-M09 – MECHANICAL DETAILS

.1 Replace Rev. No. 0 with Rev. No. 1 drawing.

.4 Drawing no. 3788-M11 – ENLARGED MECHANICAL ROOM PLANS

.1 Replace Rev. No. 0 with Rev. No. 1 drawing.

.2 The following drawings are revised by reference, or as indicated on sketches attached with this addendum, but not re-issued:

.1 Drawing no. A01 Assemblies & Fire separation plans

.1 Revise assembly R-1: note to be amended to read “Polyiso insulation, Min 2% gradient, Min 150mm thk”

.2 Drawing no. A02 Window and Door schedules

.1 Revise details 4, 5, 7, 8/A02 to show all doors flush with frames.

.3 Drawing no. A04 Roof Plan, Main level Plan, Lower level plan

.1 Revise plan 1/A04 Lower level plan, to show housekeeping pad beneath AHU 04 in room 025 (currently 6025 x 1505mm) at revised dimensions of 6778 x 1655mm.

.4 Drawing no. A04 Roof Plan, Main level Plan, Lower level plan

.1 Revise plan 1/A04 Lower level plan, to show a floor drain in room 030 WC/Janitor in co-ordination with mechanical

.2 Revise plan 1/A04 Lower level plan, to show a floor drain in room 028 Mechanical in co-ordination with mechanical

.3 Revise plan 2/A04 Main level plan, to show a floor drain in room 136 Janitor in co-ordination with mechanical

.4 Revise plan 2/A04 Main level plan, to show a floor drain in room 121 Vestibule, for the floor grille in co-ordination with mechanical

.5 Drawing no. A07 Stair plans, sections & details

.1 Section 13/A07 - Stair D: Revise total rise to = 1360mm. No of risers to be amended to 8 at 170mm rise each. All in co-ordination with civil. 7/A07 to be revised to reflect this change – an additional tread to be added. Final total flight length to be 1960mm (7 treads)

Final exterior grade levels to be verified on site.

.6 Drawing no. A08 Washroom plans & Elevations & Millwork

.1 Revise elevation 5/A08 to include note cut off by viewport “floor to be recessed to take floor mounted urinals – refer to manufacturer’s instructions”

.7 Drawing no. A09 Exterior details

.1 Detail 13/A09: Revise note “repair all damaged plaster and apply new plaster to jambs” to read “make good and repair existing wall and apply GWB return to jamb”

.8 Drawing no. A10 Plan Details

.1 Detail 9/A10: add note “exact depth of existing insulation to be confirmed on site and infill insulation to be sized to match”

.9 Drawing no. A11 Reflected ceiling plans & finishes plans

.1 Revise plan 2/A11 Main level RCP, to show rooms 133 & 134 -Washrooms with revised ceiling height of 2700mm.

.10 Drawing no. A12 Millwork plans, sections and elevations

.1 Revise Detail 15/A12 to include note cut off by viewport “‘provide sealant where countertop meets sink”

.11 Drawing no. 3788-M02- PLUMBING LAYOUT

.1 Relocate compressed air riser (Note 19) located between gridlines 2 and 3 and A and C clear of Roller Door entrance and towards gridline 2. Verify exact location on site.

.2 Add floor drain to lower level W/C and connect to 75Ø sanitary main. Verify exact location on site.

.3 Drawing Note 14 should read: "Sanitary vacuum waste receiver provided by NRC. Contractor to install tank and vacuum accessories and service connections including drain, water and vacuum waste piping. Allow space for future second receivers."

.4 Drawing Note 22 has been added and should read: "Connect drain from high roof and provide concrete paver splash pad on low roof. Refer to architectural drawing 7/A06 for details."

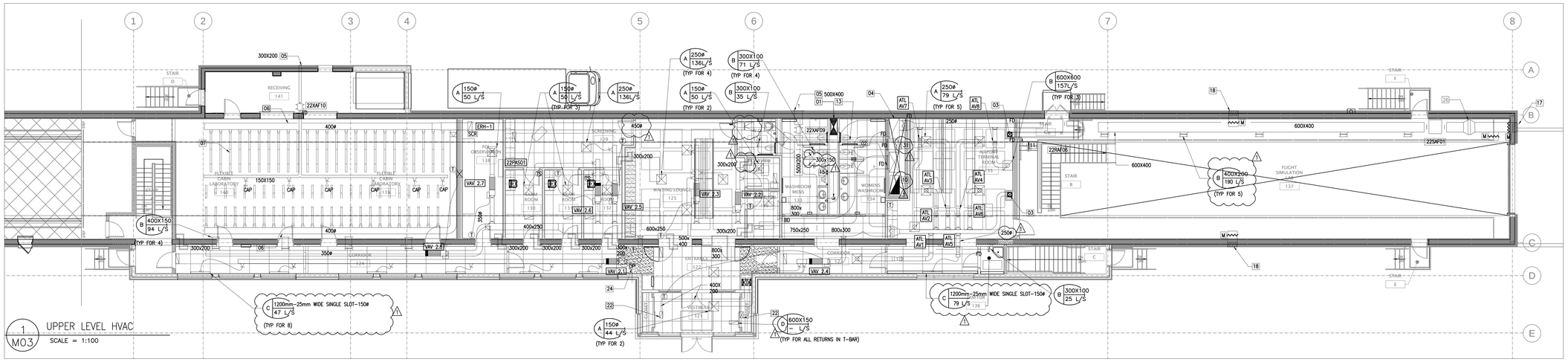
.5 Connect 100mm drain to trench drain by others at gridline B8/C8. Coordinate connection location with architectural and structural.

.12 Drawing no. 3788-M04- PIPING LAYOUT

.1 Relocate In-Floor Radiant Heating manifold and pump package from Airport Terminal Room-135 on the upper level to Mechanical Room-025 on the lower level. Approximate location of the manifold and pump package is between 22AHU04 and 22AHU06 and along the mechanical room wall. Exact location to be determined on site.

.2 Provide and run 32Ø BHSS and BHSR piping connections to the manifold within Mechanical Room-025.

End of Addendum No.3



1 / M03 UPPER LEVEL HVAC
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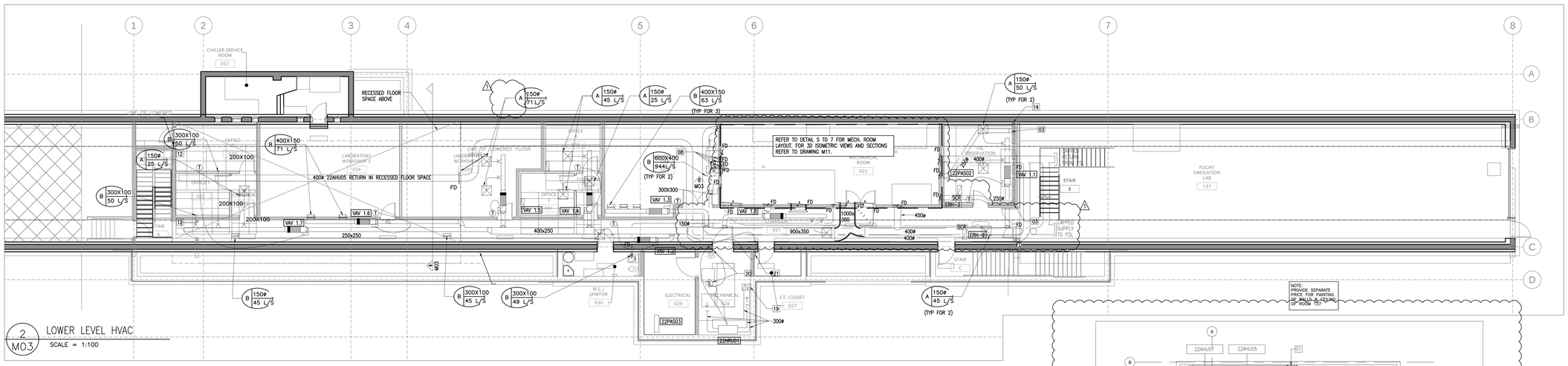

2 / M03 LOWER LEVEL HVAC
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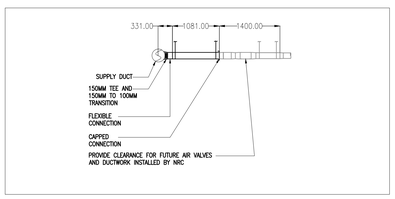

3 / M03 FLEXIBLE CABIN LAB AIR VALVE INSTALLATION
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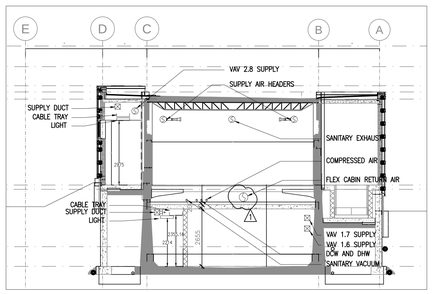

4 / M03 FLEXIBLE CABIN LAB SECTION
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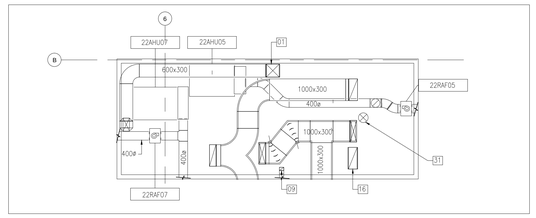
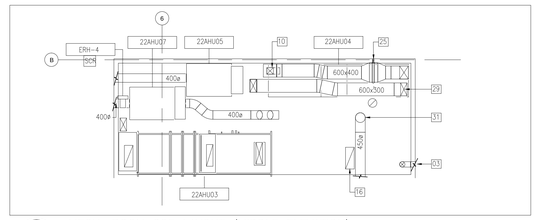
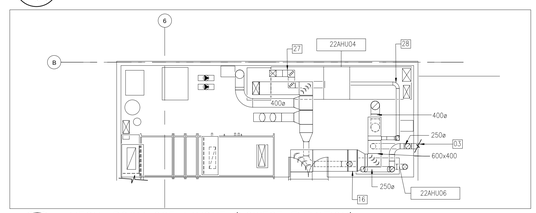


5 / M03 MECH. ROOM 025 LAYOUT (HIGHEST ELEVATION)
SCALE = 1:100



6 / M03 MECH. ROOM 025 LAYOUT (MIDDLE ELEVATION)
SCALE = 1:100



7 / M03 MECH. ROOM 025 LAYOUT (LOWEST ELEVATION)
SCALE = 1:100

MECHANICAL GENERAL NOTES:

01 DUCT RUNOUTS TO DIFFUSERS TO BE SAME SIZE AS DIFFUSER NECK SIZE
02 MAXIMUM LENGTH OF FLEXIBLE DUCTWORK TO BE 1M.
03 VAV INLET DUCTWORK SHALL ONE BIGGER THAN THE INLET SIZE OF BOX AS INDICATED ON SCHEDULE ON DWG M05.

MECHANICAL PLAN NOTES:

01 OUTDOOR AIR RISER TRANSITIONING TO 1000X400 THROUGH WASHROOM CHASE AND UP THROUGH ROOF C/W GOOSENECK AND BIRDSCREEN. C/W FIRE DAMPER AT FLOOR.
02 1000X400 BUILDING SUPPLY AIR RISER
03 AIRPORT TERMINAL LAB DUCT RISER COMPLETE WITH FIRE DAMPERS.
04 1000X400 BUILDING RETURN DUCT RISER
05 EXHAUST AIR LOUVRE AND 300MM DEEP PLENUM WITH INSULATED ISOLATION DAMPER.
06 400ø DUCT HEADER WITH 100ø CAPPED TEES AT 300MM CENTRES. EAST AND WEST AIR VALVES TO BE OFFSET.
07 AIR VALVES FOR FLEXIBLE CABIN SETUP. REFER TO DETAIL 3/M03
08 100ø SUPPLY RIGID DUCT SLEEVES AND FIRE DAMPERS FOR OWNER SUPPLIED BLOWERS. DUCT SLEEVES AT FLOOR LEVEL.
09 200x150 EXHAUST DUCT UP
10 EXHAUST DUCT THROUGH ROOF. PROVIDE GOOSENECK WITH BIRDSCREEN.
11 PROVIDE EXTERNAL THERMAL INSULATION.
12 DUCT INTO 300X100 FACE SIDEWALL GRILLE IN SIDE OF BULKHEAD.
13 750X250 SUPPLY AIR DUCT TO RUN BELOW 800x300 RETURN AIR DUCT AT CROSSOVER.
14 PROVIDE SIX RALSTON METAL N1-362407 600X800 BAG CONTROL BINS. COORDINATE WITH ELECTRICAL PANELS ON THIS WALL.
15 EXHAUST DUCT FROM LOWER LEVEL
16 1000X400 EXHAUST AIR DUCT RISER
17 500X400 AIR INTAKE LOUVRES WITH 300 DEEP PLENUMS C/W INSULATED ISOLATION DAMPERS.
18 500X400 EXHAUST AIR LOUVRE WITH 300 DEEP PLENUM C/W INSULATED ISOLATION DAMPER.
19 REFRIGERATION VENTILATION SUPPLY AND EXHAUST UP. PROVIDE FIRE DAMPERS IN SLAB.
20 PROVIDE WALL-MOUNTED REFRIGERANT VAPOUR DETECTOR AND RELAY MODULE TO SOUND AUDIBLE ALARM AND ENGAGE 22HRU01 TO HIGH SPEED AT REFRIGERANT CONCENTRATIONS ABOVE 1000PPM
21 PROVIDE READILY ACCESSIBLE INDEPENDENT FAN SWITCHES INSIDE AND OUTSIDE REFRIGERATION EQUIPMENT ROOM CAPABLE OF STARTING BUT NOT STOPPING HRV-1.
22 400x200 OUTDOOR AIR GOOSENECK WITH BIRDSCREEN AND INSULATED ISOLATION DAMPER HARD WIRE INTERLOCKED WITH HRV-1.
23 22HRU01 TO RUN CONTINUOUSLY AT 1/2 SPEED. REFRIGERANT SENSOR SIGNAL OR LOCAL SWITCH TO ENGAGE HRV TO HIGH SPEED.
24 BUILDING DIFFERENTIAL PRESSURE SENSOR
25 STEAM PREHEAT COIL FOR 22AHU04 IN DUCT ABOVE UNIT. REFER TO DUCT HEATING COIL SCHEDULE.
26 GLYCOL HEATING COIL FOR 22SAF01. REFER TO DUCT HEATING COIL SCHEDULE.
27 300x300 OUTDOOR AIR DUCT DOWN FROM 600x600 RISER AND CONNECT TO 22AHU04, REACTIVATE AIR INLET.
28 150x200 EXHAUST AIR DUCT FROM 22AHU04 REACTIVE AIR OUTLET TO CONNECT TO 600x400 EXHAUST AIR DUCT.
29 600x300 BYPASS DUCT FROM 22AHU04 SUPPLY PLENUM TO FRESH AIR INTAKE INLET.
30 600x300 SUPPLY DUCT FROM 22AHU04 TO 22AHU05, 06, 07, FRESH AIR INTAKE.
31 450ø SUPPLY AIR RISER UP AND TRANSITIONING TO 750x250 INSIDE MECHANICAL SHAFT.

0 10 20mm 40 60 80 100 120 140 160 180 200mm

ASPM A0 (1189x841)

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GENERAL NOTES

- CONTRACTORS TO CHECK AND VERIFY ALL DIMENSIONS ON SITE PRIOR TO DEMOLITION OR CONSTRUCTION AND REPORT ANY ERRORS OR OMISSIONS TO DEPARTMENTAL REPRESENTATIVE.
- CONTRACTORS MUST VISIT THE SITE & FULLY FAMILIARIZE THEMSELVES WITH THE SCOPE OF THE WORK.
- PREVENT THE SPREAD OF DUST & DEBRIS BEYOND THE WORK AREA AND CLEAN ALL SURFACES AT COMPLETION.
- MAKE GOOD ALL SURFACES AFFECTED BY THIS WORK.
- COORDINATE ALL SHUTDOWNS WITH THE DEPARTMENTAL REPRESENTATIVE.
- PROVIDE ALL LABOUR AND MATERIAL REQUIRED TO FORM A COMPLETE, FUNCTIONAL SYSTEM AS DESCRIBED ON DRAWINGS.

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KEY PLAN

No.	Date	Revision	By/Par
1	30 06 2015	ISSUED FOR ADDENDUM 02	
0	29 05 2015	ISSUED FOR TENDER	

Date Printed 18 MAY 2011 — Date Imprimée

- Verify all dimensions and site conditions and be responsible for same
- Vérifier toutes les dimensions et l'etat des lieux et en assumer la responsabilité

A/C — A Detail no. / No. du détail; B Location drawing no. / sur dessin no.; C Drawing no. / dessin no.

A/B/C

project / projet
NRC CABIN COMFORT + ENVIRONMENTAL RESEARCH FACILITY

MONTREAL ROAD CAMPUS

drawing / dessin
HVAC LAYOUT

designed / conçu	date / date
KC	MAY '15
drawn / dessiné	scale / échelle
ALM	AS SHOWN
checked / vérifié	sheet / feuille
KC	of/de
approved / approuvé	W.O.no. / D.T.no.

dwg.no. / dessin no.
3788-M03

PUMP SCHEDULE

No.	Service	Model	L/s	GPM	kPa	FT WC	BHP	MOTOR HP	Min. Effy	VFD	EMERG. POWER	V/PH/HZ - Speed	Comments
22GLP01	BUILDING CHILLER PRIMARY LOOP PUMPS DUTY	B&G SERIES 80-SC 1.5X1.5X9.5	5	80	180	60	2.37	3		N		575/3/60 - 1750	2
22GLP02	BUILDING CHILLER PRIMARY LOOP PUMPS STANDBY	B&G SERIES 80-SC 1.5X1.5X9.5	5	80	180	60	2.37	3		N		575/3/60 - 1750	2
22GLP03	BUILDING CHILLED WATER SECONDARY DISTRIBUTION DUTY	B&G SERIES e-90 1.25AAB	3.78	60	165	55	1.27	2		Y		575/3/60 - 1750	2
22GLP04	BUILDING CHILLED WATER SECONDARY DISTRIBUTION STANDBY	B&G SERIES e-90 1.25AAB	3.78	60	165	55	1.27	2		Y		575/3/60 - 1750	2
22GLP05	LABS CONDENSER WATER PUMPS DUTY	B&G 2.5BB SERIES e-1510	14	225	165	55	4.17	5		N		575/3/60 - 1750	2
22GLP06	LABS CONDENSER WATER PUMPS STANDBY	B&G 2.5BB SERIES e-1510	14	225	165	55	4.17	5		N		575/3/60 - 1750	2
22GLP07	LABS CHILLER PRIMARY LOOP PUMP DUTY	B&G 2AD-es SERIES e-1510	9.5	150	120	40	1.89	2		N		575/3/60 - 1750	2
22GLP08	LABS CHILLER PRIMARY LOOP PUMP STANDBY	B&G 2AD-es SERIES e-1510	9.5	150	120	40	1.89	2		N		575/3/60 - 1750	2
22GLP09	LABS SECONDARY CHILLED WATER DISTRIBUTION DUTY	B&G 2AD-es SERIES e-1510	9.14	145	120	40	1.86	2		Y		575/3/60 - 1750	2
22GLP10	LABS SECONDARY CHILLED WATER DISTRIBUTION STANDBY	B&G 2AD-es SERIES e-1510	9.14	145	120	40	1.86	2		Y		575/3/60 - 1750	2
22GLP11A	FUSELAGE CONDENSER WATER PUMP	B&G 1.5AB SERIES e-90	2.8	45	150	50	0.76	1.5		N		575/3/60 - 1750	2
22GLP11A	FUSELAGE CONDENSER WATER PUMP	B&G 1.5AB SERIES e-90	2.8	45	150	50	0.76	1.5		N		575/3/60 - 1750	2
22GLP12	AIRPORT TERMINAL ROOM COOLING	B&G PL-55	0.63	10	105	35	0.21	0.4		N		120V/1/60 - 3250	2
22GLP13A	FUSELAGE PRIMARY CONDENSER PUMP	B&G 1.5AB SERIES e-90	2.8	45	150	50	0.76	1.5		N		575/3/60 - 1750	2
22GLP13A	FUSELAGE PRIMARY CONDENSER PUMP	B&G 1.5AB SERIES e-90	2.8	45	150	50	0.76	1.5		N		575/3/60 - 1750	2
22GLP14	BUILDING GLYCOL DISTRIBUTION DUTY	B&G 2AAC SERIES e-90	7.9	125	164	55	2.41	3		Y		575/3/60 - 1750	2
22GLP15	BUILDING GLYCOL DISTRIBUTION STANDBY	B&G 2AAC SERIES e-90	7.9	125	164	55	2.41	3		Y		575/3/60 - 1750	2
22GLP16	AIRPORT TERMINAL ROOM HEATING	B&G PL-55	0.63	10	105	35	0.21	0.4		N		120V/1/60 - 3250	2
22SHP01	SANITARY SUMP PUMP DUTY	HYDROMATIC SHEF 50	3.15	50	60	20		0.5		N		120V/1/60 - 3250	6
22SHP02	SANITARY SUMP PUMP STANDBY	HYDROMATIC SHEF 50	3.15	50	60	20		0.5		N		120V/1/60 - 3250	6
22SVP02	WEEPING TILE SUMP PUMP DUTY	HYDROMATIC SHEF 50	3.15	50	60	20		0.5		N		120V/1/60 - 3250	6
22SVP03	WEEPING TILE SUMP PUMP STANDBY	HYDROMATIC SHEF 50	3.15	50	60	20		0.5		N		120V/1/60 - 3250	6
22SVP03	TRENCH DRAIN SUMP PUMP DUTY	HYDROMATIC SHEF 50	3.15	50	60	20		0.5		N		120V/1/60 - 3250	6
22SVP04	TRENCH DRAIN SUMP PUMP STANDBY	HYDROMATIC SHEF 50	3.15	50	60	20		0.5		N		120V/1/60 - 3250	6

Notes:

1 ALL BRONZE CONSTRUCTION
2 COMPLETE WITH FLOWTREX VALVE AND SUCTION GUIDE
3 EXTRA HIGH EFFICIENCY MOTOR
4 INTERNAL FLOAT SWITCH
5 EMERGENCY POWER
6 COMPLETE SUMP PIT CONTROLLER PACKAGE WITH FLOATS
7 PART OF DOMESTIC WATER BOOSTER PACKAGE C/W CONTROLLER
8 PART OF COMPLETE PUMP PACKAGE C/W CONTROLLER, STRAINER, RELIEF VALVE AS PER (TSSA / NFPA) REQUIREMENTS

AIR VALVES

TAG	TYPE	SERVICE		MAKE	MODEL	SIZE (INLET)		AIR FLOW						NOTES:
FLOOR		ZONE	ROOM#					MAX		MIN		OFF		
						mm	(IN.)	L/S	(CFM)	L/S	(CFM)	L/S	(CFM)	
CD01	VENTURI	AHU06 SUPPLY		PHOENIX	LOW PRESSURE SHUT-OFF	125	5	472	1,000	0	-		0	
CD02	VENTURI	AHU06 RETURN		PHOENIX	LOW PRESSURE SHUT-OFF	175	7	472	1,000	0	-		0	
CD03	VENTURI	AHU05RETURN		PHOENIX	LOW PRESSURE SHUT-OFF	150	6	944	2,000	0	-		0	
CD04	VENTURI	AHU05 SUPPLY		PHOENIX	LOW PRESSURE SHUT-OFF	125	5	944	2,000	0	-		0	
CD11	VENTURI	AHU05 EXHAUST		PHOENIX	LOW PRESSURE SHUT-OFF	150	6	944	2,000	0	-		0	
CD12	VENTURI	AHU06 EXHAUST		PHOENIX	LOW PRESSURE SHUT-OFF	150	6	472	1,000	0	-		0	
CD20	VENTURI	AHU07 SUPPLY		PHOENIX	LOW PRESSURE SHUT-OFF	125	5	944	2,000	0	-		0	
CD23	VENTURI	AHU07 RETURN		PHOENIX	LOW PRESSURE SHUT-OFF	125	5	944	2,000	0	-			
CD24	VENTURI	AHU07 EXHAUST		PHOENIX	LOW PRESSURE SHUT-OFF	125	5	944	2,000	0	-			
ATLAV1	VENTURI	AIRPORT TERMINAL LOUNGE		PRICE	VVA	250	10	79	167	24	50		0	
ATLAV2	VENTURI	AIRPORT TERMINAL LOUNGE		PRICE	VVA	250	10	79	167	24	50		0	
ATLAV3	VENTURI	AIRPORT TERMINAL LOUNGE		PRICE	VVA	250	10	79	167	24	50		0	
ATLAV4	VENTURI	AIRPORT TERMINAL LOUNGE		PRICE	VVA	250	10	79	167	24	50		0	
ATLAV5	VENTURI	AIRPORT TERMINAL LOUNGE		PRICE	VVA	250	10	79	167	24	50		0	
ATLAV6	VENTURI	AIRPORT TERMINAL LOUNGE		PRICE	VVA	250	10	79	167	24	50		0	
ATLAV7	VENTURI	AIRPORT TERMINAL LOUNGE		PRICE	VVA	250	10	157	333	71	150		0	
ATLAV8	VENTURI	AIRPORT TERMINAL LOUNGE		PRICE	VVA	250	10	157	333	71	150		0	

Note: to be provided complete with all required accessories and components to constitute a complete and working installation in accordance with manufacturer's recommendation

AIR HANDLING UNITS SCHEDULE

GENERAL INFO / FAN SECTION

TAG	SYSTEM	LOCATION	MANUF.	TYPE	SUPPLY BHP	SUPPLY MOTOR HP	EXHAUST BHP	EXHAUST MOTOR HP	ELECT. V/P/C	FLOW L/S	FLOW CFM	E.S.P. Pa	E.S.P. IN WC
22AHU03	GENERAL BUILDING CONDITIONING	BASEMENT MECH ROOM	AAON	PACKAGED CHILLED GLYCOL/HOT GLYCOL	7.47	10.0	3.9	5.0	575/3/60	3,070	6,500	500	2
22AHU04	LABS PRE-CONDITIONING	BASEMENT MECH ROOM	MUNTERS	STEAM DESICCANT CHILLED WATER PRE AND POST COOL, STEAM HEAT	3.9	5.0			575/3/60	940	2,000	500	2
22AHU05	FLEXIBLE CABIN / FUSELAGE LAB	BASEMENT MECH ROOM	AAON	HORIZONTAL AHU		8			575/3/60	940	2,000	875	3.5
22AHU06	AIRPORT TERMINAL LAB	BASEMENT MECH ROOM	AAON	HORIZONTAL AHU	1.76	2.3			575/3/60	470	1,000	875	3.5
22AHU07	VIBRATION LAB	BASEMENT MECH ROOM	AAON	HORIZONTAL AHU	1.76	8			575/3/60	940	2000	875	3.5

HEATING COIL SECTION

TAG	COIL DUTY	SENSIBLE LOAD MBH	SENSIBLE LOAD KW	Ent Air Temp db Deg. F.	Leaving Air Temp db Deg. F.	Fluid Type	Ent Fluid Temp Deg. F.	Ent Fluid Temp Deg. C.	Lv Fluid Temp Deg. F.	Lv Fluid Temp Deg. C.	FLOW GPM	FLOW L/S	PRESSURED ROP KPA
22AHU03	PRE-HEAT COIL	251	73.50	20	55	GLYCOL	180.0	82.0	160.0	71.1	25.10	1.584	11.350
22AHU04	PRE-HEAT COIL	133.92	39.21	-12	50	STEAM	175.0	79.4	160.0	71.1	17.86	1.127	
22AHU05	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
22AHU06	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
22AHU07	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

COOLING COIL #1

TAG	COIL DUTY	SENSIBLE LOAD MBH	SENSIBLE LOAD KW	LATENT LOAD MBH	LATENT LOAD KW	COIL Ent Air Temp wb/db Deg. F.	COIL Leaving Air Temp wb/db Deg. F.	Fluid Type	Ent Fluid Temp Deg. F.	Ent Fluid Temp Deg. C.	Lv Fluid Temp Deg. F.	Lv Fluid Temp Deg. C.	FLOW GPM	FLOW L/S
22AHU03	COOLING COIL	181.47	53.17	80.44	23.57	80/67	54.5/53.9	GLYCOL	46.0	7.8	56.0	13.3	52.10	3.287
22AHU04	PRE-COOLING COIL	218099				95	45	GLYCOL	35.0	1.7	45.0	7.2	43.10	2.719
22AHU05	COOLING COIL	126.6223	37.1	21	6	75/62	55/54	GLYCOL	35.0	1.7	45.0	7.2	30	1.89
22AHU06	COOLING COIL	11.9455	3.5	10.239	3	75/62	55/54	GLYCOL	35.0	1.7	45.0	7.2	4.6	0.29
22AHU07	COOLING COIL	85	25	0	0	75/62	55/54	GLYCOL	35.0	1.7	45.0	7.2	18	1.13

DESICCANT SECTION

TAG	MOISTURE REMOVAL LB/HR	MOISTURE REMOVAL KG/HR	SA HUMID %RH	REACTIVATION ENERGY MBH	REACTIVATION ENERGY KW	REACTIVATION AIRFLOW CFM	REACTIVATION AIRFLOW L/S	HP	ENTERING AIR TEMP Deg. F.	ENTERING AIR TEMP Deg. C.	LEAVING AIR TEMP Deg. F.	LEAVING AIR TEMP Deg. C.
22AHU03	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
22AHU04			5	120,288.000	35.200	601.000	284.000	3.000	45.000		89.000	
22AHU05	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
22AHU06	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
22AHU07	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

COOLING COIL #2

TAG	COIL DUTY	SENSIBLE LOAD MBH	SENSIBLE LOAD KW	LATENT LOAD MBH	LATENT LOAD KW	COIL Ent Air Temp wb/db Deg. F.	COIL Leaving Air Temp wb/db Deg. F.	Fluid Type	Ent Fluid Temp Deg. F.	Ent Fluid Temp Deg. C.	Lv Fluid Temp Deg. F.	Lv Fluid Temp Deg. C.	FLOW GPM	FLOW L/S
22AHU03	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
22AHU04	POST-COOLING COIL	97442	28.55			94	65/40	GLYCOL	46.0	7.8	56.0	13.3	19.00	1.199
22AHU05	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
22AHU06	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
22AHU07	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

ENERGY RECOVERY SECTION

TAG	AIRFLOW CFM	AIRFLOW L/S	SUMMER RETURN AIR DB/WB(F)	WINTER RETURN AIR DB/WB(F)	UMMER O DB/WB(F)	WINTER OA DB/WB(F)	TOTAL EFFECTIVENESS
22AHU03	3200	1510	75/63	72/55	87/71	-17	72%
22AHU04	N/A	N/A	N/A	N/A	N/A	N/A	N/A
22AHU05	N/A	N/A	N/A	N/A	N/A	N/A	N/A
22AHU06	N/A	N/A	N/A	N/A	N/A	N/A	N/A
22AHU07	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Note:
1 to be provided complete with all required accessories and components to constitute a complete and working installation in accordance with manufacturer's recommendation

VAV BOX / BOOSTER COILS

TAG	TYPE	SERVICE		MAKE	MODEL	STYLE	SIZE (INLET)		AIR FLOW						RE-HEAT COIL												NOTES:
FLOOR		ZONE	ROOM#						MAX		MIN		OFF		CAPACITY		EAT		EWT		LWT		FLOW		WPD		
							mm	(IN.)	L/S	(CFM)	L/S	(CFM)	L/S	(CFM)	TYPE	MBTU	°C	(°F)	°C	(°F)	°C	(°F)	L/S	(GPM)	KPa	(FT)	
VAV 1.1	VAV	FSL OBSERVATION	26	PRICE	SDV		125	5	100	212	50	106		0													
VAV 1.2	VAV	CORRIDOR	21	PRICE	SDV		175	7	230	487	69	146		0		60	13	55	82	180	71	160	0.4	6.7			
VAV 1.3	VAV	VIBRATION LAB	24	PRICE	SDV		150	6	188	398	56	119		0		24	13	55	82	180	71	160	0.2	2.7			
VAV 1.4	VAV	OFFICES	22,31,32	PRICE	SDV		125	5	115	244	35	74		0		7.1	13	55	82	180	71	160	0	0.79			
VAV 1.5	VAV	WORKSHOP	33	PRICE	SDV		150	6	142	301	106	225		0		18	13	55	82	180	71	160	0.1	2			
VAV 1.6	VAV	WORKSHOP	34	PRICE	SDV		150	6	142	301	106	225		0		18	13	55	82	180	71	160	0.1	2			
VAV 1.7	VAV	OFFICES	23,35,36	PRICE	SDV		125	5	115	244	35	74		0		7.1	13	55	82	180	71	160	0	0.79			
VAV 1.8	VAV	CORRIDOR	21	PRICE	SDV		125	5	90	191	27	57				25	13	55	82	180	71	160	0.2	2.8			
VAV 2.1	VAV	CORRIDOR	124	PRICE	SDV		225	9	376	797	113	240		0		51	13	55	82	180	71	160	0.4	5.7			
VAV 2.2	VAV	INTERVIEW	127	PRICE	SDV		150	6	120	254	36	76		0													
VAV 2.3	VAV	WAITING	125	PRICE	SDV		300	12	544	1,153	408	865		0													
VAV 2.4	VAV	ENTRANCE	121,122	PRICE	SDV		125	5	88	186	26	56		0													
VAV 2.5	VAV	SCREENING	129	PRICE	SDV		150	6	136	288	41	86		0													
VAV 2.6	VAV	EXAM	130,131,132	PRICE	SDV		150	6	150	318	52	111		0		6.9	13	55	82	180	71	160	0.04	0.69			
VAV 2.7	VAV	FCL OBSERVATION	138	PRICE	SDV		125	5	50	200	47	100		0													
VAV 2.8	VAV	FLEXIBLE CABIN LAB	139	PRICE	SDV		225	9	376	797	113	239		0		42	13	55	82	180	71	160	0.3	4.7			

Note: to be provided complete with all required accessories and components to constitute a complete and working installation in accordance with manufacturer's recommendation

SPLIT SYSTEM AC SCHEDULE

TAG	SERVICE	MAKE	EER	EVAPORATOR DIM. (W X L X H)			CONDENSER DIM. (W X L X H)			TOTAL CAPACITY (KW)	ELECTRICAL			MEDIUM	WEIGHT		NOTE:
				mm	mm	mm	mm	mm	mm		MCA	POWER	V/PH		KG	LBS	
22PAS01	OBSERVATION RM	DAIKIN	12	1000	225	300				4.4	15	1.29	208/1	R410a		93	INDOOR UNIT POWERED FROM CONDENSING UNIT. LOW AMBIENT COOLING
22PAS02	OBSERVATION RM	DAIKIN	12	1000	225	300				4.4	15	1.29	208/1	R410a		93	INDOOR UNIT POWERED FROM CONDENSING UNIT. LOW AMBIENT COOLING
22PAS03	ELECTRICAL RM	MITSUBISHI					950	330	1350	7.00	28	2.45	208/1	R410a	120	265.00	INDOOR UNIT POWERED FROM CONDENSING UNIT. LOW AMBIENT COOLING

Note: to be provided complete with all required accessories and components to constitute a complete and working installation in accordance with manufacturer's recommendation

HEAT RECOVERY VENTILATOR SCHEDULE

UNIT PERFORMANCE							FAN PERFORMANCE															
TAG	SYSTEM	LOCATION	MANUF.	TYPE	MOTOR	ELECT. V/P/C	TAG	FLOW		E.S.P.		TAG	FLOW		E.S.P.		WEIGHT		DIMENSIONS			REMARKS
								L/S	CFM	Pa	IN WC		L/S	CFM	Pa	IN WC	KG	LB.	L	W	H	
22HRV01	REFRIGERANT RM VENTN	BSMT JANITOR RM	VENMAR	HRV700i	2 X 1/6HP	120/1/60	SUPPLY	330	700	50	0.2	EXHAUST	330	700	50	0.2	95	210	660	1372	1168	POLYPROPYLENE CORE

Note: to be provided complete with all required accessories and components to constitute a complete and working installation in accordance with manufacturer's recommendation

CHILLER SCHEDULE

TAG	MAKE	TYPE	LOCATION	MODEL	APPLICATION	CAPACITY		POWER INPUT	MCA	EMERGENCY POWER	EVAPORATOR					WATER CONDENSER					REFRIGERANT	IPLV	PHYSICAL DATA					
											EWT	LWT	FLOW	RESS DROP		EWT	LWT	FLOW		PRESS DROP			HEIGHT	WIDTH	LENGTH	WEIGHT		
						KW	TONS	KW			Deg. F	Deg. F	GPM	KpA	Ft WC	Deg. F	Deg. F	L/S	GPM	FT NWC		COP	Inches	Inches	Inches	kg	Lb.s	dBA
22CCH04	DAIKIN	Packaged air-cooled chiller	Outdoors on Grade	AGZ030E	BUILDING COOLING	96.6	27.5	32.7	63.9	NO	54	44	78	51	17	N/A	N/A	N/A	N/A	N/A	R410a	15.1	100	88	94	1346	2960	88
22CCH05	AERMEC	Screw - Water Cooled	East Mech Rm	NXW0900Y	LABS COOLING	179.2	51	67.5	22.3	NO	44	34	148	40.7	13.6	85	95	12.4	196	9.43	R410a	19.8	74.2	31.5	95	1265	2789	82
22CCH06	REFPLUS	Screw - Water Cooled	FSL	WCS-250-5L4-8	FUSELAGE COOLING	35.1	10		38.38	NO	-21	-30				85	95	2.52	40	21	R404A		100	50	100	460	1009	85

Note: to be provided complete with all required accessories and components to constitute a complete and working installation in accordance with manufacturer's recommendation

DRY COOLER SCHEDULE

REF. NO.	MAKE	TYPE	MODEL	LOCATION	CAPACITY		FAN	FLA	POWER	EMERGENCY	WATER					AIR		PHYSICAL DATA				SOUND LEVEL
											EWT	LWT	FLOW	PRESS DROP		EAT(wb)	FLOW	HEIGHT	WIDTH	LENGTH	WEIGHT	dBA
					KW	TONS	HP		V/PH/HZ	POWER	Deg. F	Deg. F	GPM	Ft WC		Deg. F	CFM	Inches	Inches	Inches	Lb.s	
22DRY01	REFPLUS	FLUID COOLER		GRADE		51	2	2.7	575/3/60	NO	95	85	196	5.8				52	93	237.5	3,412	

to be provided complete with all required accessories and components to constitute a complete and working installation in accordance with manufacturer's recommendation

HEATER SCHEDULE

TAG	SERVICE	MAKE	MODEL	STYLE	VOLTAGE	SIZE (W X H X D)		AIR FLOW		FAN SPEED	MOTOR POWER		EAT		EWT		LWT		FLOW		WPD		CAPACITY	
						mm	(IN.)	L/S	(CFM)		KW	(HP)	°C	(°F)	°C	(°F)	°C	(°F)	L/S	(GPM)	KPa	(FT)	KW	(MBH)
22UNH11	WEST STAIRWELL	ROSEMEX	F300-A	RW-2	115	1000X750X20	40X30X8		200					70		170		150		2.24				22.4
22UNH12	EAST STAIRWELL	ROSEMEX	F300-A	RW-2	115	1000X750X20	40X30X8		200					70		170		150		2.24				22.4
22UNH13	NORTH ENT. VESTIBULE	ROSEMEX	F300-A	RW-2	115	1000X750X20	40X30X8		200					70		170		150		2.24				22.4
22UNH14	PENTHOUSE MECH	ROSEMEX	HORIZONTAL	H18	115	1000X750X20	40X30X8		460					70		170		155		2.4				18

Note: to be provided complete with all required accessories and components to constitute a complete and working installation in accordance with manufacturer's recommendation

HEAT EXCHANGER SCHEDULE

TAG	SERVICE	MAKE	MODEL	STYLE	CAPACITY (KW)	SIZE (W X H X D)		SHELL SIDE							TUBE SIDE									NOTES
								PD		MEDIUM	PRESS		FLOW		MEDIUM	EWT		LWT		FLOW		WPD		
						mm	(IN.)	KPA	FT		KPA	PSI	G/H	LB/HR		°C	(°F)	°C	(°F)	L/S	(GPM)	KPa	(FT)	
HX-1	BUILDING HOT WATER			SHELL AND TUBE	180		4.9 X 12.2 X 8.8		1.2	STEAM		50		694	WATER		190		165		49		10	
HX-2	LABS GLYCOL			SHELL AND TUBE	160				1.2	STEAM		50		564	GLYCOL		180		155		50			

Note: to be provided complete with all required accessories and components to constitute a complete and working installation in accordance with manufacturer's recommendation

TANK SCHEDULE

No.	SERVICE	LOCATION	MAKE	MODEL	STORAGE	TYPE	ELEMENTS	VOLTAGE	HEIGHT	DIAMETER	ORIENT	NOTES
					Litre				mm	mm		
22HWT04	DOMESTIC HOT WATER	JANITOR ROOM	AO SMITH	DRE-80	300	ELECTRIC	3x3000W	600V/3PH	1530	648	VERTICAL	

Note:

FANS SCHEDULE

TAG	SYSTEM	LOCATION	MANUF.	MODEL	TYPE	BHP	MOTOR HP	ELECTRICAL		FLOW		E.S.P.		SONES
								V/P/C	VFD	L/S	CFM	Pa	IN WC	
22XAF09	BUILDING SANITARY EXHAUST	UPPER LEVEL W/RM CEILING	GREENHECK	SQ-120	INLINE CABINET DIRECT DRIVE	0.14	0.5	120/1/60	NO	401	850	125	0.5	5.9
22XAF10	FLEX CABIN SAN EXHAUST	FCL CEILING	GREENHECK	SQ-80	INLINE CABINET DIRECT DRIVE	0.06	0.25	120/1/60	NO	94	200	125	0.5	7.6
22RAF06	AIRPORT TERMINAL RETURN	LOWER LEVEL	GREENHECK	BSQ-130HP	INLINE CABINET BELT DRIVE	1	1	575/3/60	YES	472	1,000	560	2.25	16.8
~~22RAF05~~	~~FCL/FSL RETURN~~	~~LOWER LEVEL~~	~~GREENHECK~~	~~BSQ-140~~	~~INLINE CABINET BELT DRIVE~~	~~1.7~~	~~2~~	~~575/3/60~~	~~YES~~	~~944~~	~~2000~~	~~585~~	~~2.35~~	~~25~~
22SAF01	FSL VENTILATION/HEATING	FSL	GREENHECK	BSQ-140	INLINE CABINET BELT DRIVE	0.43	0.5	120/1/60	NO	944	2000	125	0.5	13
~~22RAF07~~	~~VIBRATION LAB RETURN~~	~~LOWER LEVEL~~	~~GREENHECK~~	~~BSQ-140~~	~~INLINE CABINET BELT DRIVE~~	~~1.7~~	~~2~~	~~575/3/60~~	~~YES~~	~~944~~	~~2000~~	~~585~~	~~2.35~~	~~25~~

1

DUCT HEATING COIL SCHEDULE

TAG	SYSTEM	LOCATION	TYPE	COIL DUTY	AIRFLOW		SENSIBLE LOAD		Power	Ent Air Temp		Leaving Air Temp		PRESS DROP		NOTES
					cfm	L/s	btu/hr	KW	V/PH/HZ	DEG C	DEG F	DEG C	DEG F	KPa	in WC	
ERH-1	FLEX CABIN	UPPER LEVEL	ELECTRIC	HEATING	2000	944	21600	6.33	600/3/60	35	95	41	105	24.9	0.1	SCR CONTROLLER, AIRFLOW PROVING SWITCH, HIGH LIMIT STAT
ERH-2	FUSELAGE	LOWER LEVEL	ELECTRIC	HEATING	2000	944	21600	6.33	600/3/60	35	95	41	105	24.9	0.1	SCR CONTROLLER, AIRFLOW PROVING SWITCH, HIGH LIMIT STAT
ERH-3	AIRPORT TERMINAL	LOWER LEVEL	ELECTRIC	HEATING	1000	472	10800	3.16	600/3/60	35	95	41	105	24.9	0.1	SCR CONTROLLER, AIRFLOW PROVING SWITCH, HIGH LIMIT STAT
ERH-4	VIBRATION LAB	MAIN MECH RM	ELECTRIC	HEATING	2000	944	21600	6.33	600/3/60	35	95	41	105	24.9	0.1	SCR CONTROLLER, AIRFLOW PROVING SWITCH, HIGH LIMIT STAT
	22SAF01	FSL	GLYCOL	HEATING	2000	944	110160	32.28	N/A	21	70	49	121	57.27	0.23	180F - 160F GLYCOL EWT/LWT
	22AHU04	MAIN MECH RM	STEAM	PREHEAT	2000	944	144720	42.40	N/A	-27	-17	10	50			50 PSI STEAM

Note: to be provided complete all required accessories and components to constitute a complete and working installation

HUMIDIFIER SCHEDULE

(METRIC)

HUM	L/sec	SERVES	ENTERING CONDITIONS ENTERING AIR TEMP / RH	LEAVING CONDITIONS LEAVING AIR TEMP / RH	REQUIRED KG/HR	TYPE	ELECTRICAL POWER INPUT (KW)	ELECTRICAL V/PH/HZ	ELECTRICAL AMPS	MOUNTING	
22HUM04	944	AHU-04	40 C / 10%	40 C / 30%	54	ELECTRODE STEAM	42	600/3/60	40	WALL	DRISTEEM XTP-042

Notes
1 c/w: controller, modulating valve (suitable for DDC control), s/s distributor(s), high limit switch, air proving switch, & mounting hardware.
2 to be provided complete with all required accessories and components to constitute a complete and working installation in accordance with manufacturer's recommendation

BASEBOARD HEATER SCHEDULE

TAG	LOCATION	MAKE	MODEL	STYLE	LENGTH (MM)		EAT		AVGWT		FLOW		CAPACITY	NOTES
					ENCLOSURE	ACTIVE	°C	(°F)	°C	(°F)	L/S	(GPM)	KW	
22BBH01	WOMEN'S WASHROOM 1	ROSEMEX	RVS 44C3	D	900	800	21	70	77	170	0.03339	0.53	1.5KW/M	PROVIDE END CAP
22BBH02	MEN'S WASHROOM 133	ROSEMEX	RVS 44C3	D	900	800	21	70	77	170	0.03339	0.53	1.5KW/M	PROVIDE END CAP
22BBH03	SINGLE WASHROOM 128	ROSEMEX	RVS 44C3	H	2400	1000	21	70	77	170	0.02268	0.36	1KW/M	APPROXIMATE WALL-TO-WALL LENGTH OF ENCLOSURE LISTED. SITE VERIFY BEFORE ORDERING
22BBH04	JANITOR 136	ROSEMEX	RVS 44C3	H	1440	900	21	70	77	170	0.02016	0.32	1KW/M	APPROXIMATE WALL-TO-WALL LENGTH OF ENCLOSURE LISTED. SITE VERIFY BEFORE ORDERING
22BBH05	AIRPORT TERMINAL 135	ROSEMEX	RVS 44C3	H	5666	2X1500	21	70	77	170	0.06741	1.07	1KW/M	APPROXIMATE WALL-TO-WALL LENGTH OF ENCLOSURE LISTED. SITE VERIFY BEFORE ORDERING

Note: to be provided complete with all required accessories and components to constitute a complete and working installation in accordance with manufacturer's recommendation

EXPANSION TANKS

TAG	SYSTEM	TANK VOLUME (GAL)	ACCEPT VOLUME (GAL)	DIMENSIONS HEIGHT (IN)	DIAMETER (IN)	SYSTEM VOLUME (GAL)	MEDIUM	INITIAL TEMP (F)	MAX DESIGN TEMP (F)	INITIAL PRESSURE (PSI)	MAX DESIGN PRESURE (PSI)	DESIGN BASIS
22PVE02	BUILDING HEATING SYSTEM	11	5	28	14	62.5	50% ETH GLY	80	180	35	65	TACO CBX-42
22PVE03	BUILDING COOLING SYSTEM	4	2.5	15	14	126.3	50% ETH GLY	40	75	35	65	TACO CBX-15
22PVE04	PROCESS COOLING SYSTEM	4	2.5	15	14	133.5	50% ETH GLY	35	75	35	65	TACO CBX-15
22PVE05	DOMESTIC HOT WATER	8	5	25	14	25	POTABLE WATER	40	120	12	65	TACO PAX-30

GRILLES AND DIFFUSER SCHEDULE

TAG	TYPE	MATERIAL	BALANC. DAMPER	FINISH	MAKE	MODEL	REMARKS
A	SQUARE DIFFUSER	ALUMINUM	YES	TO MATCH SURFACE	EH PRICE	SCD	600 X 600mm UNLESS INDICATED OTHERWISE
B	GRILLE	ALUMINUM	YES	TO MATCH SURFACE	EH PRICE	620	
C	LINEAR DIFFUSER	ALUMINUM	YES	TO MATCH SURFACE	EH PRICE	ASP	1200MM LONG/25MM WIDE SINGLE SLOT/150ø COMPLETE WITH PLENUM
D	GRILLE	ALUMINUM	YES	TO MATCH SURFACE	EH PRICE	630	

to be provided complete with all required accessories and components to constitute a complete and working installation in accordance with manufacturer's recommendation and Volume 2 - Part 2 RFP PWGSC Federal Office Bld Standards

1

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Division des services administratifs et gestion de l'immeubler

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KEY PLAN

No.	Date	Revision	By: Par:
1	30 06 2015	ISSUED FOR ADDENDUM 02	
0	29 05 2015	ISSUED FOR TENDER	

Date Printed 30 OCT 2014 Date imprimée

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A Detail no.
No. du détail
B Location drawing no.
sur dessin no.
C Drawing no.
dessin no.

project projet
NRC CABIN COMFORT + ENVIRONMENTAL RESEARCH FACILITY

MONTREAL ROAD CAMPUS

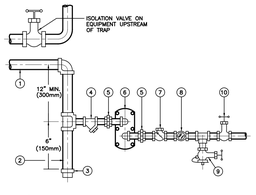
drawing dessin
MECHANICAL SCHEDULES

designed conçu: KC
date date: OCT '14
drawn dessiné: ALM
scale échelle: AS SHOWN
checked vérifié: KC
sheet feuille: of/de
approved approuvé
W.O.no.
D.T.no.

dwg.no. dessin no.
3788-M08

ASPM A0 (1189x841)

C
0 10 20mm 40 60 80 100 120 140 160 180 200mm

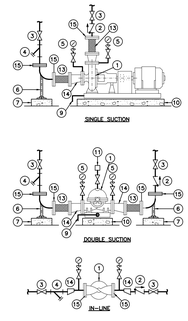


1. RETURN FROM EQUIPMENT. FULL SIZE OF OUTLET CONNECTION.
2. DIRT LEG.
3. REMOVABLE CAP.
4. STRAINER. DO NOT INSTALL ON FRESH AND MIXED AIR COIL OR AFTER A CONTROL VALVE.
5. UNION.
6. TRAP.
7. SWING CHECK VALVE, REQUIRED ONLY WHEN CONDENSATE IS LIFTED. DO NOT LIFT FROM FRESH OR MIXED AIR COILS OR FROM EQUIPMENT SERVED BY MODULATING CONTROL VALVE.
8. SIGHT GLASS.
9. TEST VALVE 3/4" (20mm) HOSE END WITH CAP AND CHAIN.
10. GATE VALVE.

01 M09 EQUIPMENT TRAPPING
N.T.S.

1. PUMP
2. CHECK VALVE IF PUMPS IN PARALLEL
3. GATE VALVE
4. STRAINER
5. PRESSURE GAUGE WITH ANTI-PULSATION SNUBBERS
6. BASE ELBOW SUPPORT
7. CONCRETE SUPPORT PAD
8. COUPLING GUARD
9. DRAIN LINE TO FLOOR DRAIN
10. FOUNDATION PAD
11. AIR VENT
12. PRESSURE GAUGE CONNECTION PLUGGED
13. FLEXIBLE CONNECTION
14. REDUCER
15. FLANGE

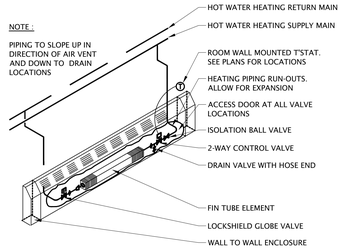
NOTE:
CHECK VALVES ARE NOT REQUIRED ON SINGLE PUMP SYSTEM. STRAINERS ARE NOT REQUIRED ON DOMESTIC WATER SYSTEMS.



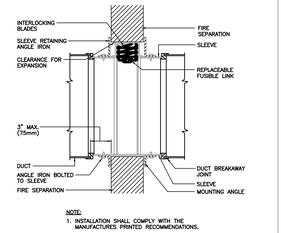
02 M09 PUMPS
N.T.S.

NOTE :

PIPING TO SLOPE UP IN DIRECTION OF AIR VENT AND DOWN TO DRAIN LOCATIONS

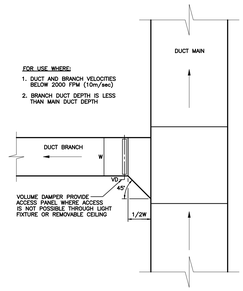


03 M09 BASEBOARD CONVECTOR PIPING SCHEMATIC
N.T.S

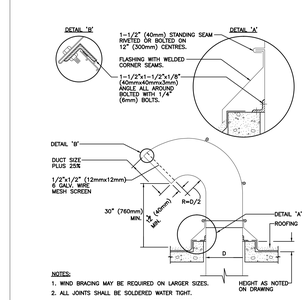


NOTE:
1. INSTALLATION SHALL COMPLY WITH THE MANUFACTURERS PRINTED RECOMMENDATIONS.

04 M09 FIRE DAMPER INSTALLATION
N.T.S.

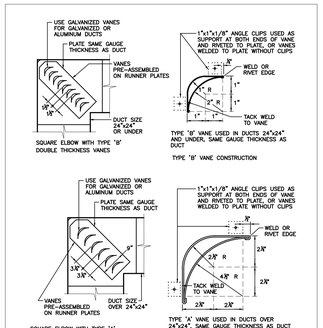


05 M09 DUCT BRANCH CONNECTION FROM DUCT MAIN
N.T.S.

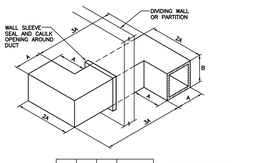


NOTES:
1. WIND BRACING MAY BE REQUIRED ON LARGER SIZES.
2. ALL JOINTS SHALL BE SOLDERED WATER TIGHT.
3. FOR DUCT & GOOSENECK SIZES SEE DRAWINGS.

06 M09 GOOSENECK DETAIL
N.T.S.



07 M09 TURNING VANES IN SQUARE ELBOWS
N.T.S.

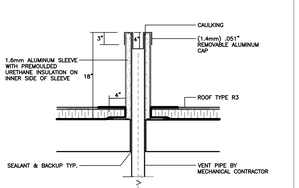


CFM	A (MIN.)	B (MIN.)	INTERNAL ACOUSTICAL LINING
100	250	250	25mm TH
200	400	250	25mm TH
300	500	300	25mm TH
400	500	300	25mm TH
500	500	400	25mm TH

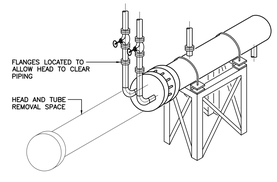
"2" CONFIGURATION SHOWN. DIMENSIONS SIMILAR FOR "C" CONFIGURATION.

MAX AIR VELOCITY THROUGH SILENCER 2.5 m/s

08 M09 CROSS TALK SILENCER
N.T.S.

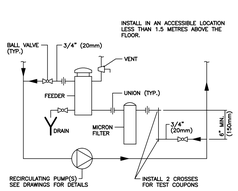


09 M09 TYPICAL PLUMBING VENT STACK
N.T.S.



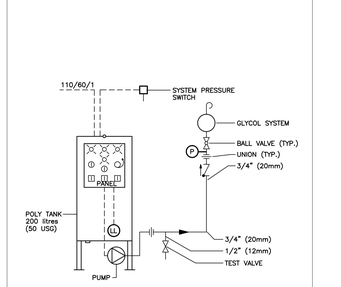
CONNECTIONS TO SHELL AND TUBE HEAT EXCHANGER INCLUDES CONVERTORS, CHILLERS, CONDENSERS, OR OTHER DEVICES WITH REMOVABLE HEADS.

10 M09 HEAT EXCHANGER CONNECTIONS
N.T.S.

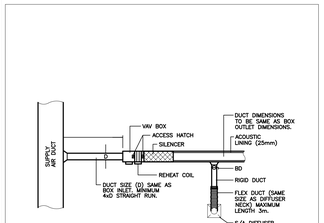


NOTE: FOR PIPE SIZE SEE DRAWINGS.

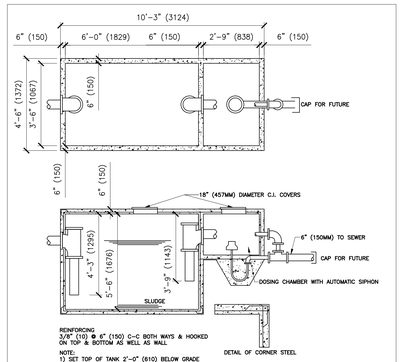
11 M09 CHEMICAL TREATMENT FOR CLOSED WATER SYSTEMS
N.T.S.



12 M09 GLYCOL FEED SYSTEM
N.T.S.

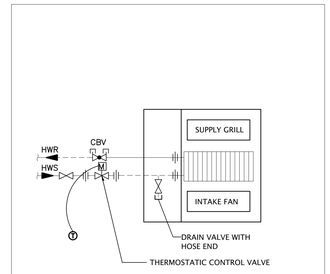


13 M09 TYPICAL V.A.V. INSTALLATION DETAIL
N.T.S.

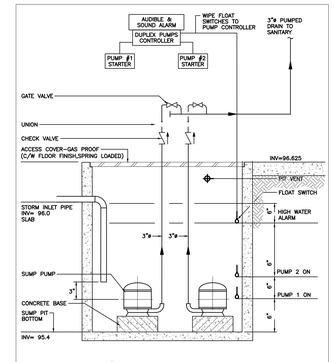


NOTE:
1) SET TOP OF TANK 2'-0" (610) BELOW GRADE
2) PROVIDE LOCATION MARKERS AT GRADE

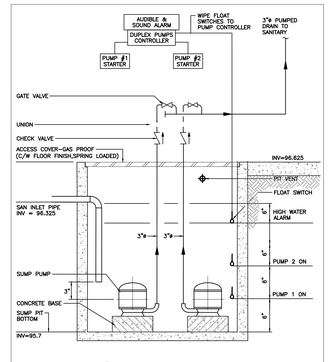
14 M09 SANITARY INTERCEPTOR
N.T.S



15 M09 CABINET UNIT HEATER PIPING SCHEMATIC
N.T.S



16 M09 TRENCH DRAIN SUMP PUMPS SCHEMATIC DETAIL
N.T.S.



17 M09 SANITARY SUMP PUMPS SCHEMATIC DETAIL
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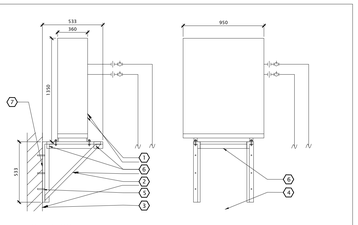
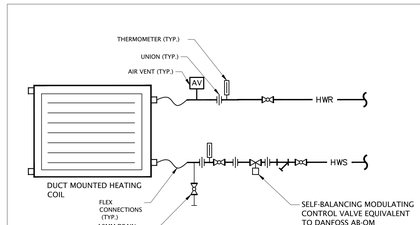
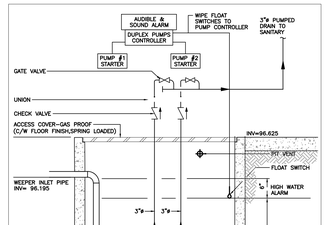


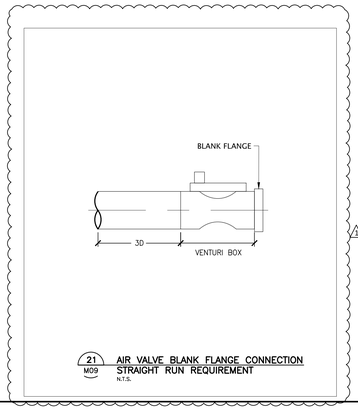
18 M09 CONDENSING UNIT MOUNTING
N.T.S



19 M09 TERMINAL UNIT RE-HEAT COIL PIPING DETAIL
N.T.S.



20 M09 WEEPER DRAIN SUMP PUMPS SCHEMATIC DETAIL
N.T.S.



21 M09 AIR VALVE BLANK FLANGE CONNECTION STRAIGHT RUN REQUIREMENT
N.T.S.

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No.	Date	Revision	By/Par.
1	30 06 2015	ISSUED FOR ADDENDUM 02	
0	29 05 2015	ISSUED FOR TENDER	

Date Printed 30 OCT 2014 — Date Imprimée

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A Detail no. No. du détail
B Location drawing no. sur dessin no.
C Drawing no. dessin no.

project / projet: WTA-OCER

MONTREAL ROAD CAMPUS

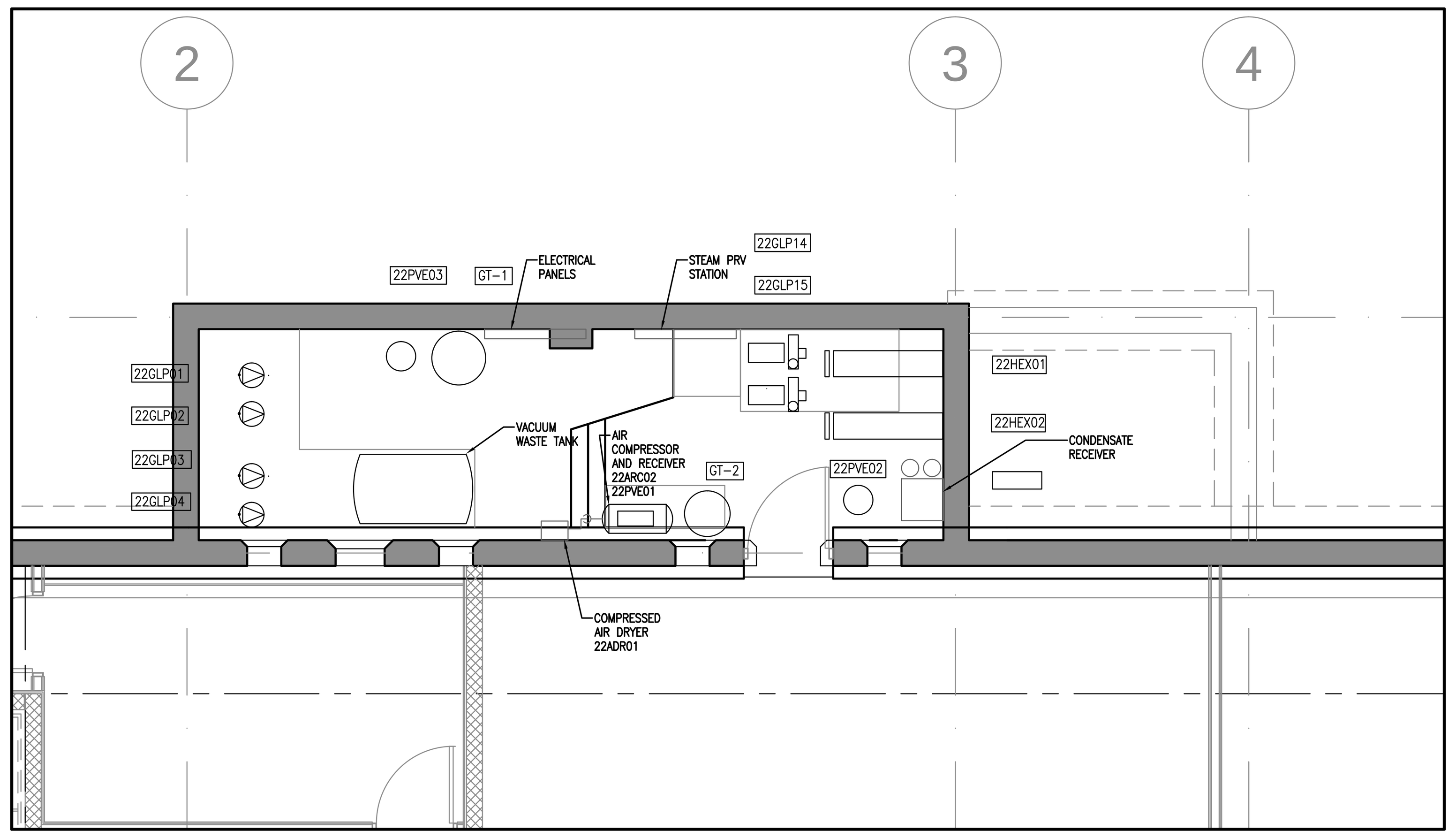
drawing / dessin: MECHANICAL DETAILS

designed / conçu	date / date
KC	OCT '14
drawn / dessiné	scale / échelle
ALM	AS SHOWN
checked / vérifié	sheet / feuille
KC	of/de
approved / approuvé	W.O.no. / D.T.no.

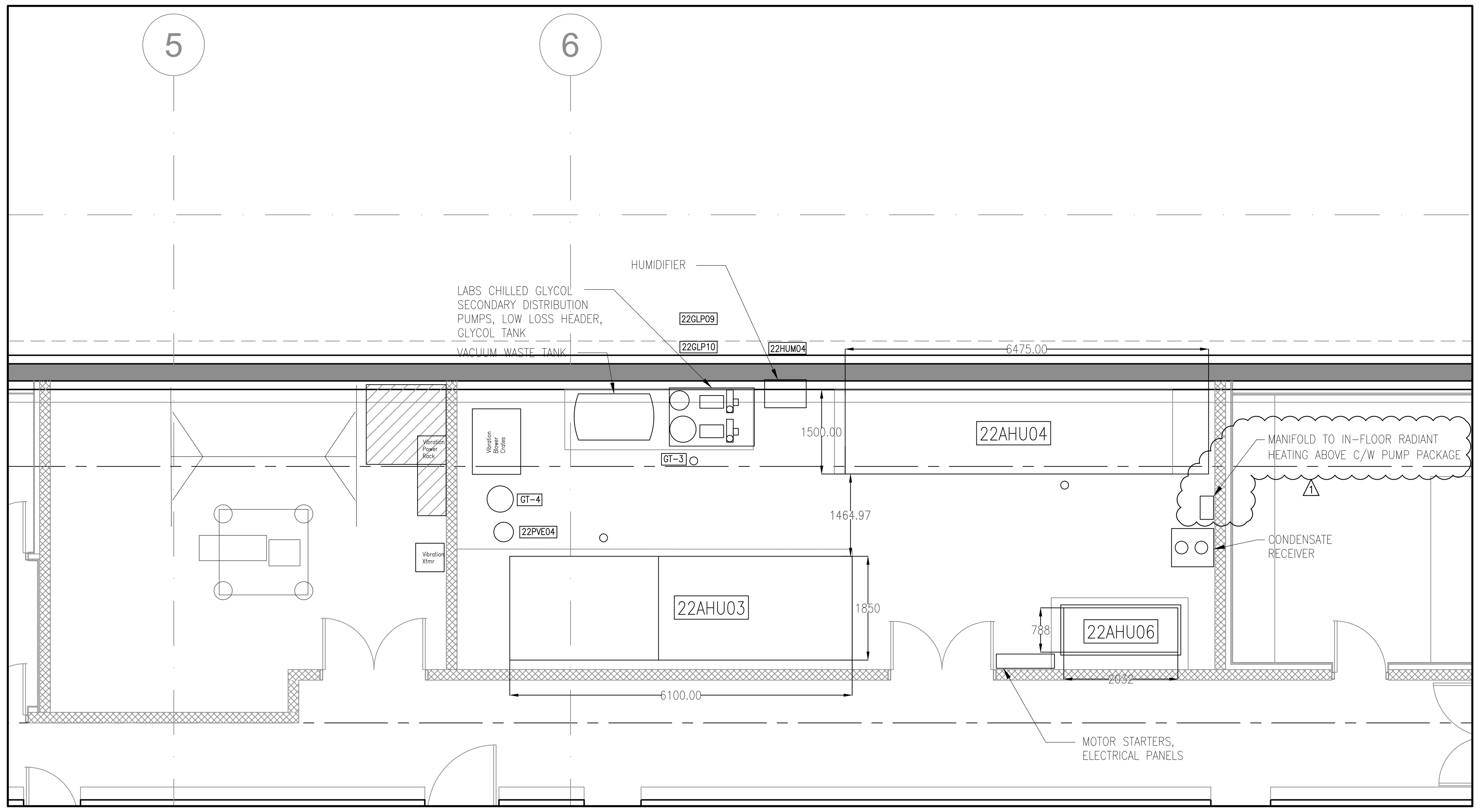
dwg.no. / dessin no.: 3788-M09

ASPM A0 (1189x841)

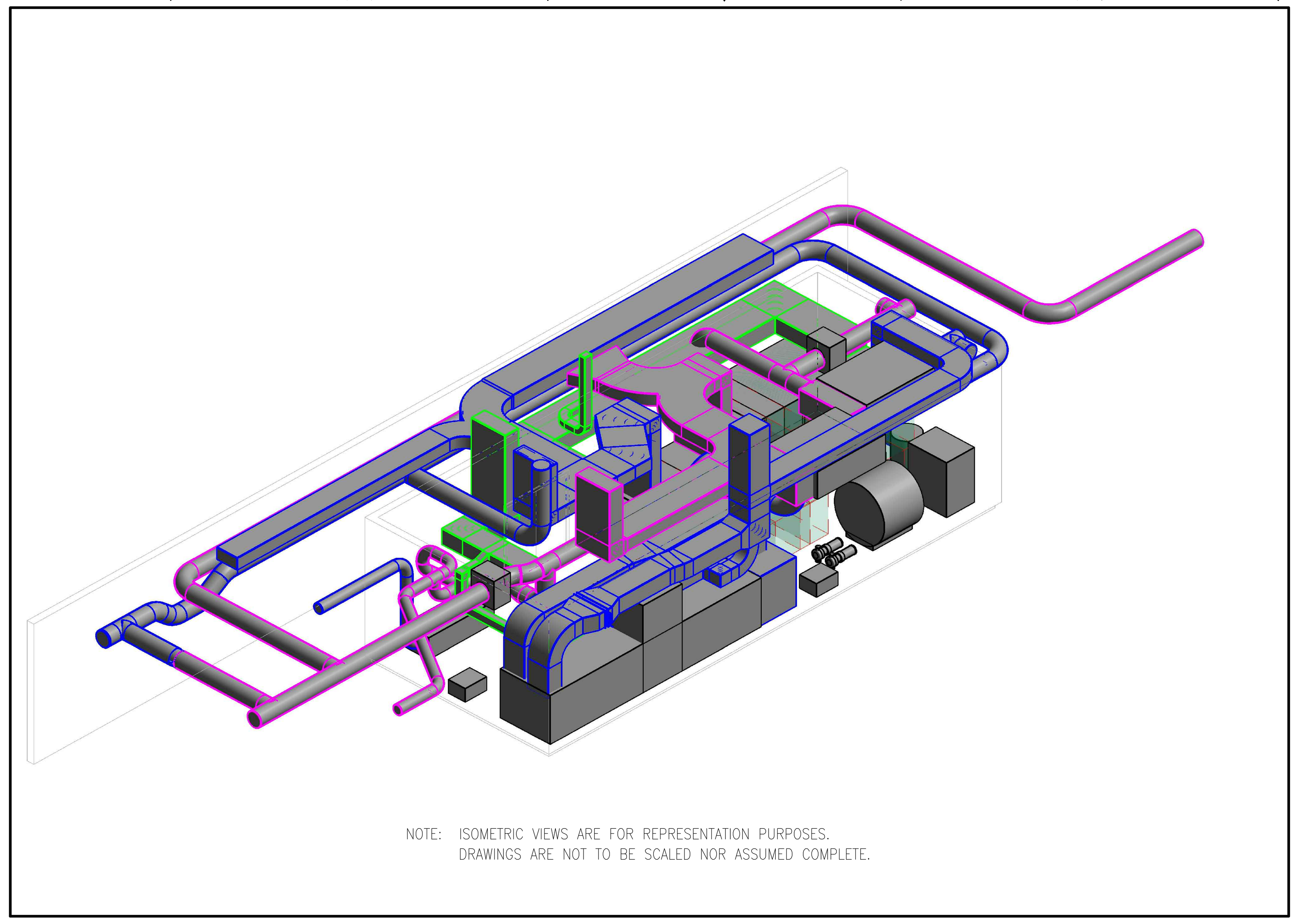
0 10 20mm 40 60 80 100 120 140 160 180 200mm



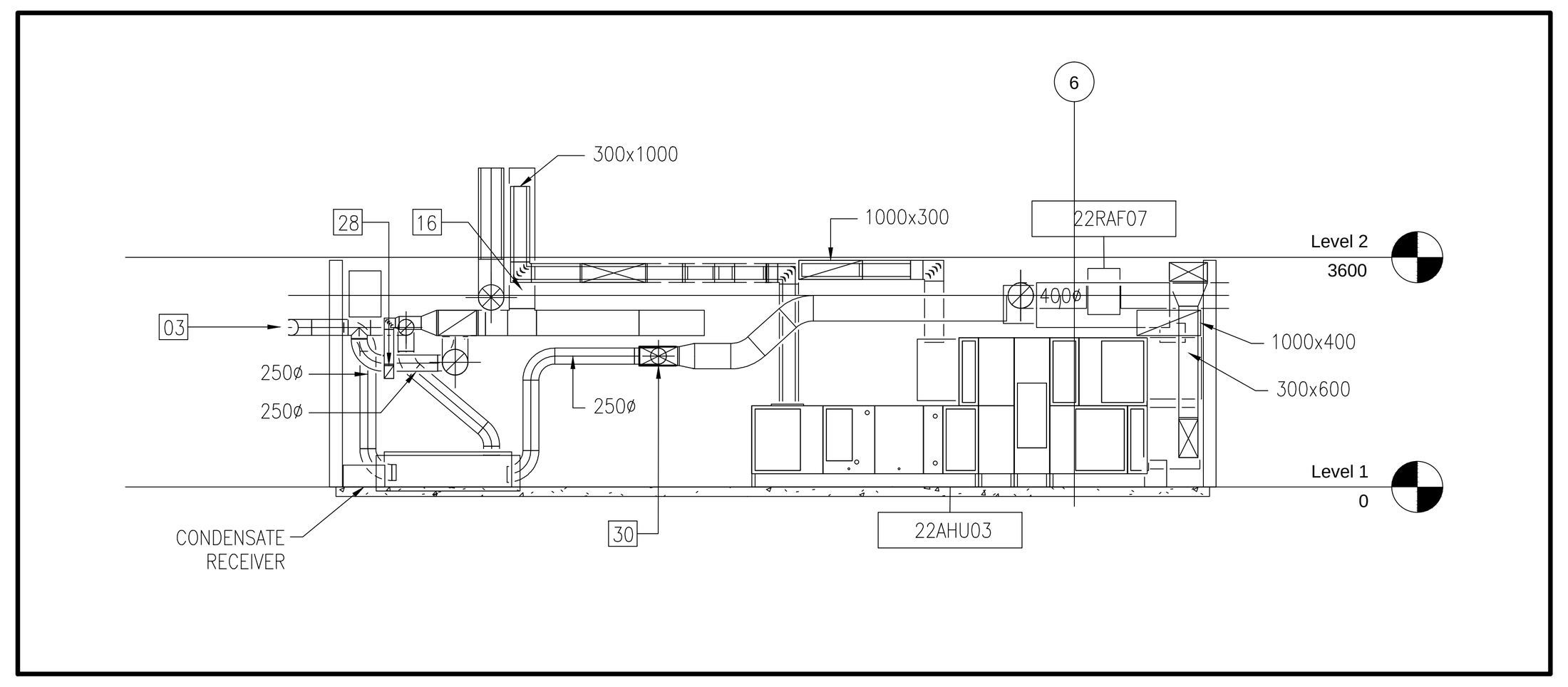
1 / M11 — MECHANICAL ROOM 037 ENLARGED PLAN
SCALE = 1:50



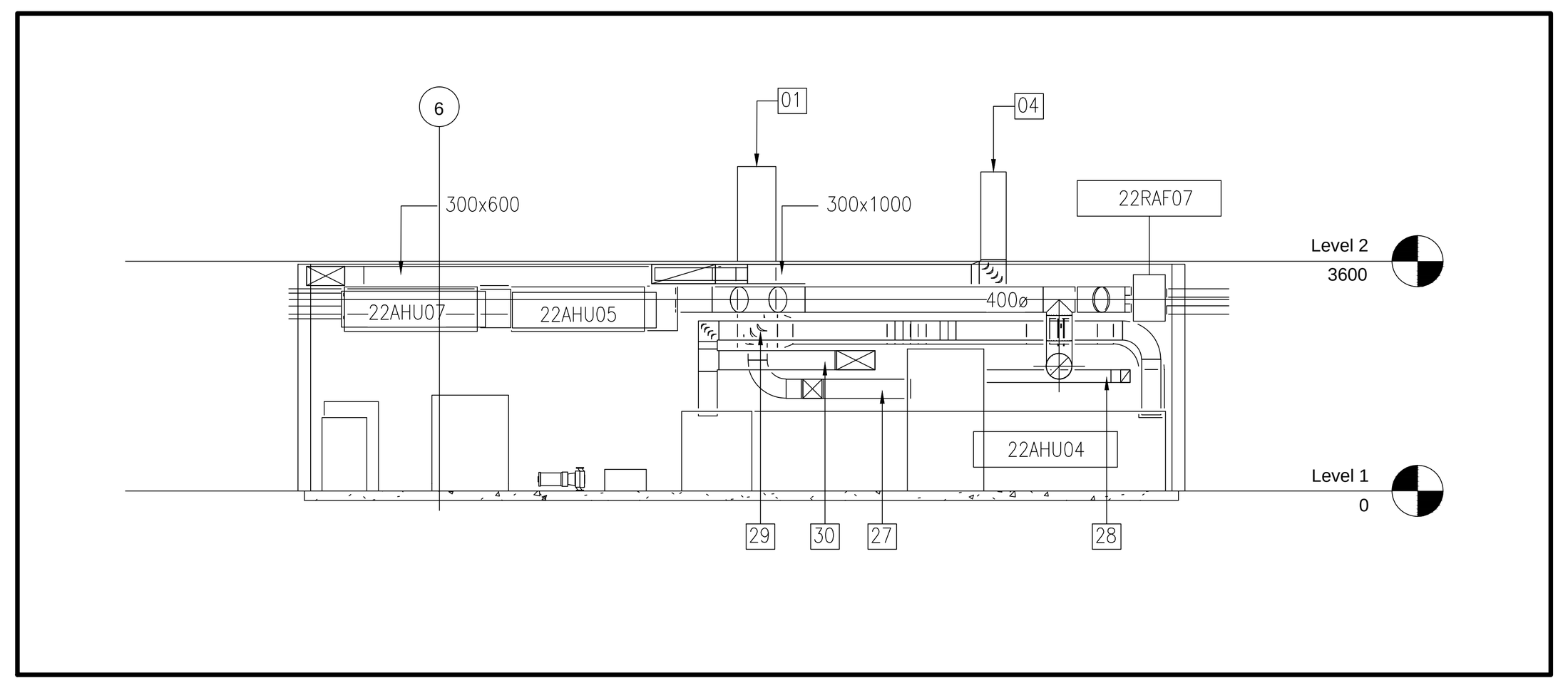
2 / M11 — MAIN MECHANICAL ROOM 025 AND VIBRATION LAB EQUIPMENT LAYOUT
SCALE = 1:50



3 / M11 — MECHANICAL ROOM 025 – ISOMETRIC VIEW 1
SCALE = NTS



5 / M11 — MECH. ROOM 025 SECTION 1
SCALE = 1:100



6 / M11 — MECH. ROOM 025 SECTION 2
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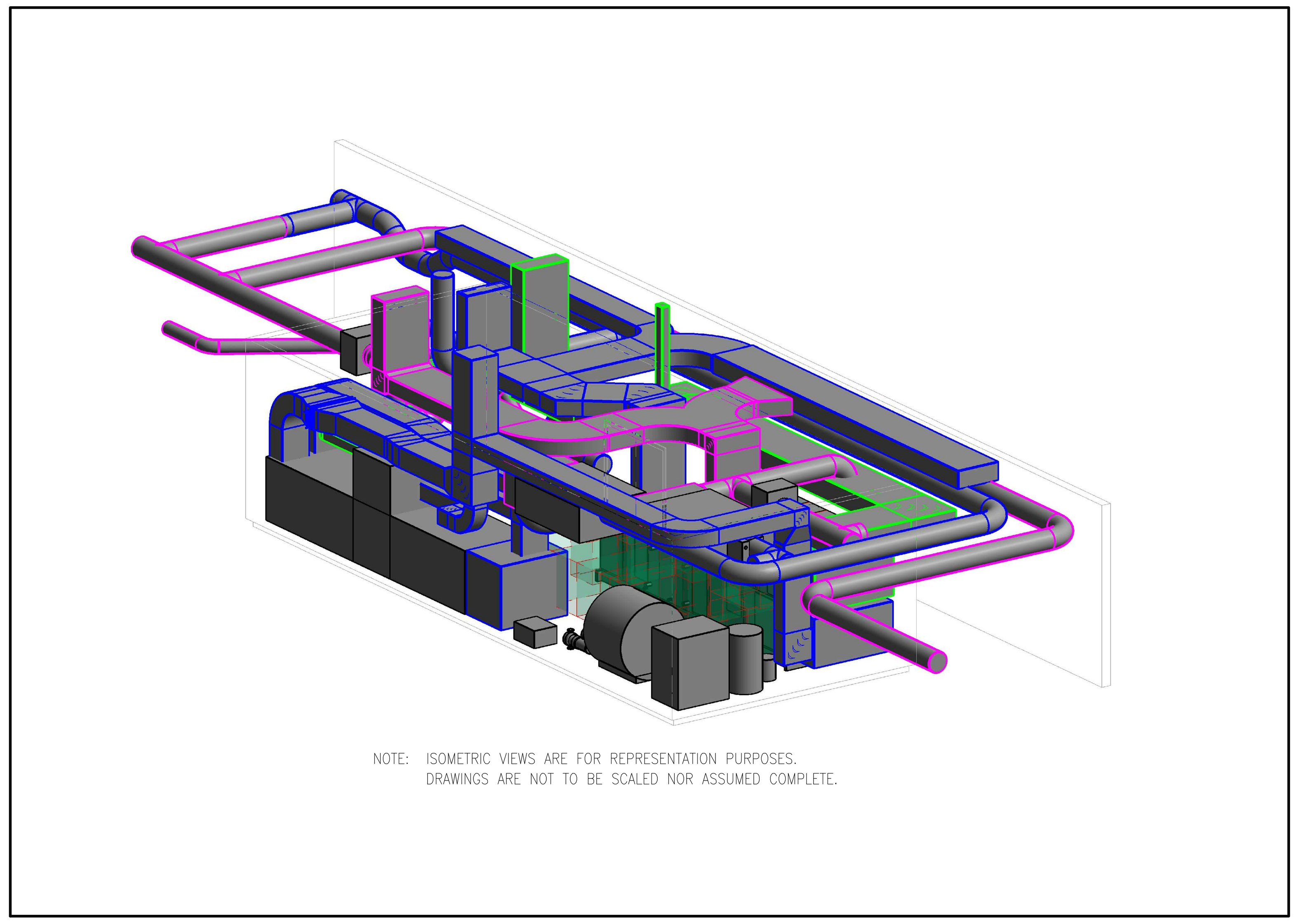
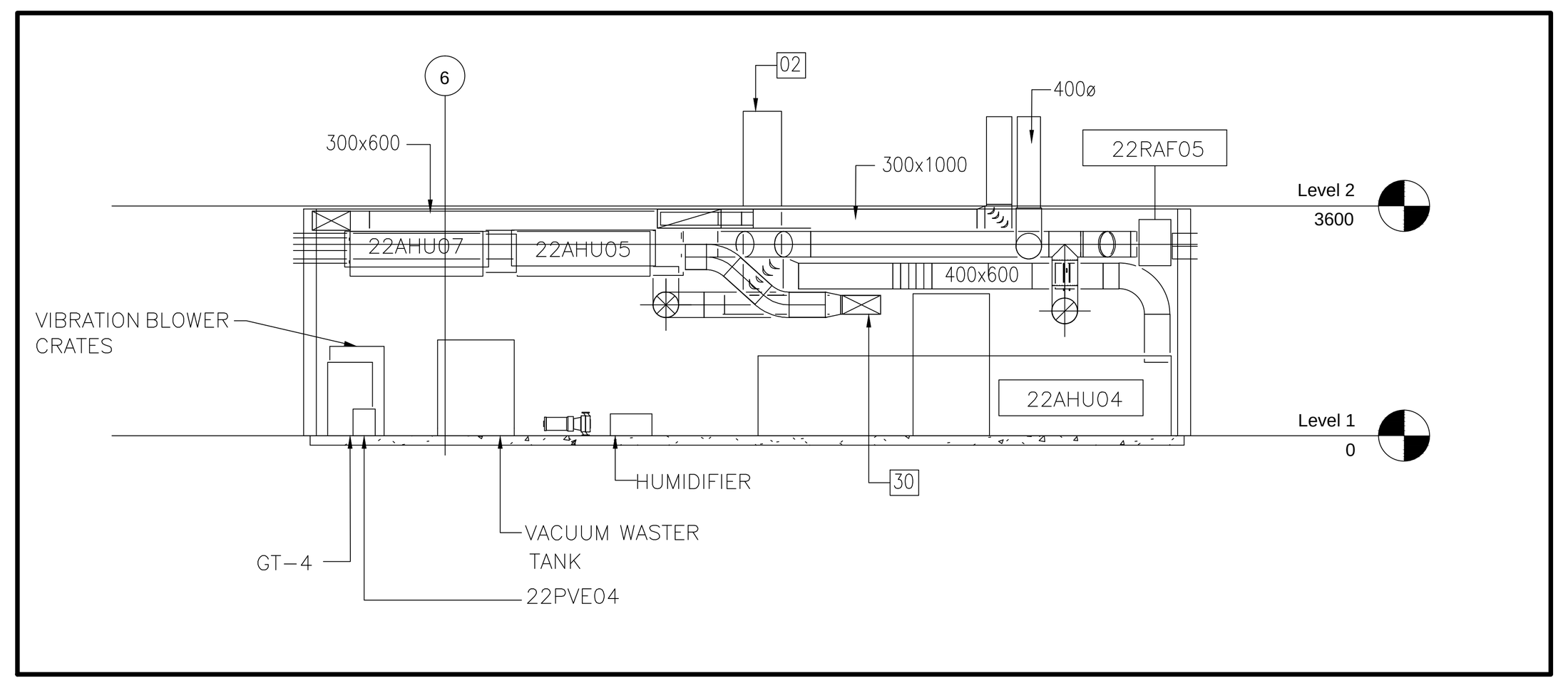


4 / M11 — MECHANICAL ROOM 025 – ISOMETRIC VIEW 2
SCALE = NTS.



7 / M11 — MECH. ROOM 025 SECTION 3
SCALE = 1:100

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Administrative Services and Property Management Branch / Division des services administratifs et gestion de l'immobilier

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0	29 05 2015	ISSUED FOR TENDER	AM

Date Printed 10 APR 2015 Date imprimée

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A Detail no. / No. du détail
B Location drawing no. / sur dessin no.
C Drawing no. / dessin no.

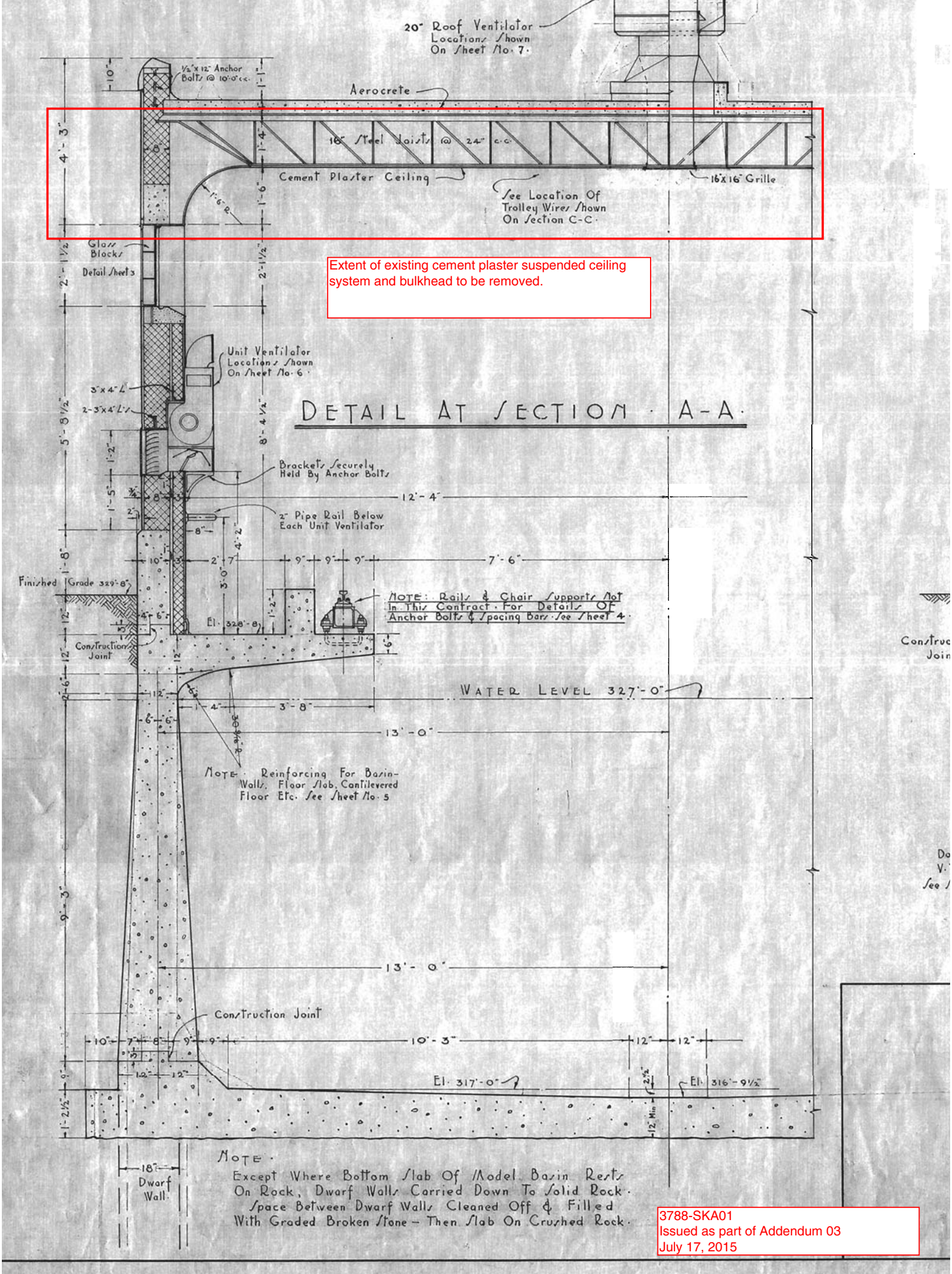
project / projet
NRC CABIN COMFORT + ENVIRONMENTAL RESEARCH FACILITY
MONTREAL ROAD CAMPUS

drawing / dessin
ENLARGED MECHANICAL ROOM PLANS

designed / conçu: KC	date / date: MAY '15
drawn / dessiné: ALM	scale / échelle: AS SHOWN
checked / vérifié: KC	sheet / feuille: of/de
approved / approuvé:	W.O.no. / D.T.no.:

dwg.no. / dessin no.
3788-M11

ASPM A0 (1189x841)


20" Roof Ventilator Locations Shown On Sheet No. 7.
½"x 12" Anchor Bolts @ 10'-0" c.c.
Aerocrete
16" Steel Joists @ 24" c.c.
Cement Plaster Ceiling
16"x16" Grille
See Location Of Trolley Wires Shown On Section C-C.
Glass Blocks
Detail Sheet 3
Extent of existing cement plaster suspended ceiling system and bulkhead to be removed.
Unit Ventilator Locations Shown On Sheet No. 6.
3"x4"L
2-3"x4"L's
DETAIL AT SECTION A-A.
Brackets Securely Held By Anchor Bolts
2" Pipe Rail Below Each Unit Ventilator
12'-4"
7'-6"
Finished Grade 329'-8"
El. 328'-8"
NOTE: Rails & Chair Supports Not In This Contract. For Details Of Anchor Bolts & Spacing Bars See Sheet 4.
Construction Joint
WATER LEVEL 327'-0"
3'-8"
13'-0"
NOTE: Reinforcing For Basin-Walls, Floor Slab, Cantilevered Floor Etc. See Sheet No. 5
13'-0"
Construction Joint
10'-3"
El. 317'-0"
El. 316'-9½"
12" Min.
18" Dwarf Wall
NOTE.
Except Where Bottom Slab Of Model Basin Rests On Rock, Dwarf Walls Carried Down To Solid Rock. Space Between Dwarf Walls Cleaned Off & Filled With Graded Broken Stone - Then Slab On Crushed Rock.
3788-SKA01
Issued as part of Addendum 03
July 17, 2015

This document is issued to address requests for information and/or clarifications received from the bidders.

1. Q According to the General Conditions, item 14 it states to carry the costs of the building permit in our tender price. Is this really a requirement?
   A **NRC does not insist that the contractor obtain a Municipal building permit.**
2. Q Upon review of Section 00 10 00, item 8.1.2 it make mention to a designated substance report. Unfortunately, I cannot locate this document. Would you please issue a copy of the report?
   A **This was provided in Addendum No 1.**
3. Q According to Section 01 52 00, item 1.7.1 we are required to pay for security personnel. Is this really a requirement on this project?
   A **This will be addressed by an Addendum.**
4. Q According to Section 00 10 00, item 3.1 we have 42 weeks to be substantially completed the project. Upon quick review of the project scope it appears that this timeline is not long enough. Is it a possibility that the construction timeline be extended?
   A **This will be extended under Addendum No 3.**
5. Q According to Section 01 56 00, item 1.3 we are required to erect a wood hoarding. Referencing the civil drawings. Where is this item to be installed?
   A **This section does not reference the civil drawings; and is in regard to general site hoarding which may be either of the types listed.**
6. Q Upon review of Foundation note # 1 of drawing # 3788-S00 it mentions a soils report. Unfortunately, I cannot locate this document. Would you please issue a copy of the report.
   A **A copy of the report will be issued with an Addendum.**
7. Q Is the existing building going to be occupied during construction activities?
   A **Parts of the building will be occupied, but not the area of work.**
8. Q What is the bid bond amount?
   A **Bid bond is as per Article 5 of Instructions to Tenderers, 10% of tender price up to a maximum of 250K**
9. Q Who is the Obligee?
   A **Her Majesty the Queen In right of Canada represented by the National research Council of Canada**
10. Q According to drawing C01 we are to provide a H.K. pad for the fluid cooler however this is noted on the structural drawings. Please provide structural details of this pad.
    A **Refer to 1/A03 and 4/S07**
11. Q According to drawings C01 we are required to provide a new trench drain. Please provide specifications on this drain.
    A **Sizes and invert provided. Contractor to provide shop drawing for review/approval accordingly.**
12. Q According to drawing C01 we are required to move the existing precast wall to an on site storage facility. What is the distance of this facility?
    A **The distance will not be greater than one kilometer.**

13. Q Please confirm that all concrete and compaction testing requirements will be paid for by the NRC.

    A **Cost for concrete testing will be paid by NRC in accordance with spec section 033000 article 3.4.4. Cost for compaction testing will be addressed by an Addendum.**

14. Q Upon review of the drawings there appears to be no wood doors on this project however there is a specification for wood doors. Please confirm that wood doors are not a requirement.

    A **Wood doors are not a requirement. This section will be removed in the next addendum.**

15. Q Please provide quantities for items 2.2, 2.3, 2.4 and 2,5 under Section 12 50 00.

    A **Refer to 1 and 2/A04. All furniture items are labelled. For clarity the quantities are as follows: 2.2 Desks = 3**

    2.3 Free standing mobile storage units = 2

    2.4 Free standing mobile check in counter = 3 (per spec and A04)

    2.5 Steel shelving unit = 1

16. Q They show a new sanitary interceptor as per note 7 on drawing M-02. They also show a detail on drawing M-09- 14. I can't find a model number in the specifications for this interceptor. Is this a manufactured item or is it built on site by the general contractor?

    A **Model and manufacturer will be clarified in addendum. As per client's suggestion we accept Boyd Brothers or any equivalent manufacturer as an acceptable alternate.**

17. Q I see in the specs a section for hydronic systems for copper but it doesn't tell me for what system it applies. Is this for all piping, heating, chilled water and process water? Is black pipe acceptable for these systems?

    A **Normally black pipe is acceptable. Will be confirmed by an addendum.**

18. Q What would be the pipe size that picks up a heating coil on drawing M-04, lower level near column B-8?

    A **40mm (1 ½"). Item will be confirmed by an addendum.**

19. Q This interceptor is shown on my plumbing drawing located outside. I have no specs for it and I looked at your structural drawings and couldn't see anything. I need to know who supplies it and a model number would be required if we supply this item.

    A **See answer to question 16.**

20. Q I have a question regarding the steam and condensate on drawing M-05. Between column 2 and 6 we see a few steam traps which connect to the "pumped condensate" line. The schematic shows the traps connecting to a "low pressure condensate" and running from air handling unit # 4 back to the condensate receiver located in the mechanical room. Do we install this low pressure condensate line which is not shown on the floor plan?

    A **Yes. All schematics or specifications identified requirements to be included.**

21. Q Section 25 95 00 zone sump pump Page 1. CS 412 22-SVP-03 sump pump, Sump level control: pumps operate under OEM built-in float control and hi level float and audible alarm. *BAS to remotely enable or disable pumps to run.* (what device are they using to interface) How are they going to tell the panel when and how to start and stop the pumps? BAS to Monitor high level float alarm.

A **Remove "BAS to remotely enable/disable pumps to run." Sump pumps are to operate based on standalone controller and switches. BAS shall monitor high level float alarm. Section will be clarified in addendum.**

22. Q Who is the contact person at Airtron, the specified controls contractor?

A **The contact for this project is:**

Aaron Dobson
Airtron Canada
100-2935 Conroy Road
Ottawa, ON K1G 6C6
Phone office: (613) 247-7938

Part 1 General

1.1 REFERENCES

.1 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions "C", In Effect as Of: May 14, 2004.

1.2 PROJECT CLEANLINESS

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by NRC Departmental Representative or other Contractors.

.2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by NRC Departmental Representative. Do not burn waste materials on site, unless approved by NRC Departmental Representative.

.3 Clear snow and ice from loading dock ramp, staging area, roof, and all access points to building, and remove from site.

.4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.5 Provide on-site containers for collection of waste materials and debris.

.6 Provide and use marked separate bins for recycling. Refer to Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.7 Dispose of waste materials and debris off site.

.8 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.

.9 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

.10 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

.11 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

.12 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.3 FINAL CLEANING

.1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.

.2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.

.3 Prior to final review remove surplus products, tools, construction machinery and equipment.

.4 Remove waste products and debris other than that caused by NRC Departmental Representative or other Contractors.

.5 Remove waste materials from site at regularly scheduled times or dispose of as directed by NRC Departmental Representative. Do not burn waste materials on site~~, unless approved by NRC Departmental Representative~~.

.6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.

.8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.

.9 Clean lighting reflectors, lenses, and other lighting surfaces.

.10 Vacuum clean and dust building interiors, behind grilles, louvres and screens.

.11 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.

.12 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

.13 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.

.14 Remove dirt and other disfiguration from exterior surfaces.

.15 Clean and sweep roofs, gutters, areaways, and sunken wells.

.16 Sweep and wash clean paved areas.

.17 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.

.18 Clean roofs, downspouts, and drainage systems.

.19 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

.20 Remove snow and ice from access to building.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

Not Used.

Part 3 Execution

Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 ASTM International Inc.

.1 ASTM C1177/C1177M-08, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

.2 Canadian General Standards Board (CGSB)

.1 CGSB 37-GP-9Ma-83, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.

.2 CGSB 37-GP-56M-85, Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.

.3 CAN/CGSB-51.33-M89, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.

.3 Canadian Roofing Contractors Association (CRCA)

.1 CRCA Roofing Specifications Manual-1997.

.4 Canadian Standards Association (CSA International)

.1 CSA A123.21-04, Standard Test Method for the Dynamic Wind Uplift Resistance of Mechanically Attached Membrane-Roofing Systems

.2 CSA-A123.3-05, Asphalt Saturated Organic Roofing Felt.

.3 CSA-A123.4-04 (R2008), Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems.

.4 CSA O121-08, Douglas Fir Plywood.

.5 Factory Mutual (FM Global)

.1 FM Approvals - Roofing Products.

.6 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.7 Underwriters Laboratories' of Canada (ULC)

.1 CAN/ULC-S702.2-09, Standard for Mineral Fibre Thermal Insulation for Buildings.

.2 CAN/ULC-S704-03, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Convene pre-installation meeting one week prior to beginning waterproofing Work, with roofing contractor's representative and NRC Departmental Representative to:

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Provide two copies of most recent technical roofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide two copies of WHMIS MSDS, and indicate VOC content for:

.1 Primers.

.2 Asphalt.

.3 Sealers.

.4 Filter fabric.

.3 Provide shop drawings:

.1 Indicate flashing, control joints, tapered insulation details.

.2 Provide layout for tapered insulation.

.4 Samples: submit two (2) samples of membrane cap sheet.

.5 Manufacturer's Certificate: certify that products meet or exceed specified requirements.

.6 Test and Evaluation Reports: submit laboratory test reports certifying compliance of bitumens and roofing felts and membrane with specification requirements.

.7 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.

.8 Manufacturer's field report: in accordance with Section 01 45 00 - Quality Control.

.9 Reports: indicate procedures followed, ambient temperatures and wind velocity during application.

1.4 QUALITY ASSURANCE

.1 Installer qualifications: company or person specializing in application of modified bituminous roofing systems with 5 years documented experience approved by manufacturer.

.2 Sustainability Standards Certification:

.1 Recycled Content: provide listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.

.2 Regional Materials: provide evidence that project incorporates required percentage of regional materials/products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.5 FIRE PROTECTION

.1 Fire Extinguishers:

.1 Maintain one cartridge operated type or stored pressure rechargeable type with hose and shut-off nozzle,

.2 ULC labelled for A, B and C class protection.

.3 Provide one fire extinguisher on roof per torch applicator, within 6 m of torch applicator.

.2 Maintain fire watch for 1 hour after each day's roofing operations cease.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

.2 Storage and Handling Requirements:

.1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.

.2 Provide and maintain dry, off-ground weatherproof storage.

.3 Store rolls of felt and membrane in upright position. Store membrane rolls with salvage edge up.

.4 Remove only in quantities required for same day use.

.5 Place plywood runways over completed Work to enable movement of material and other traffic.

.6 Store sealants at +5 degrees C minimum.

.7 Store insulation protected from daylight and weather and deleterious materials.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, paddling and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.2 Fold up metal banding, flatten and place in designated area for recycling.

1.7 FIELD CONDITIONS

.1 Ambient Conditions

.1 Do not install roofing when temperature remains below -18 degrees C for torch application, or to manufacturers' recommendations for mop application.

.2 Minimum temperature for solvent-based adhesive is -5 degrees C.

.2 Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.

1.8 WARRANTY

.1 For Work of this Section 07 52 00 - Modified Bituminous Membrane Roofing, 12 months warranty period is extended to 60 months.

Part 2 Products

2.1 PERFORMANCE CRITERIA

.1 Compatibility between components of roofing system is essential. Provide written declaration to NRC Departmental Representative stating that materials and components, as assembled in system, meet this requirement.

.2 Roofing System: to CSA A123.21 for wind uplift resistance.

2.2 ACCEPTABLE MANUFACTURERS

.1 Manufacturers: Subject to compliance with requirements, provide products by one of the following, or equivalent approved by the NRC Departmental Representative::

.1 Soprema.

.2 Henry Company.

.3 IKO.

2.3 DECK PRIMER

.1 Asphalt primer: to CGSB 37-GP-9Ma.

2.4 VAPOUR RETARDER

.1 Self adhesive air/vapour barrier modified bitumen membrane.

2.5 MEMBRANE

.1 Base sheet: to CGSB 37-GP-56M, Type 2, Class C, Grade 1, minimum 2.0 mm thick, non-woven fibrous glass reinforcement and thermofusible elastomeric

asphalt, thermofusible plastic film top face and lightly sanded bottom face, applied by mopping only.

.2 Cap sheet membrane: to CGSB 37-GP-56M, Type 1, Class A, Grade 2, minimum 3.5 mm thick, non-woven 250 g/sq.m. polyester reinforcement and thermofusible elastomeric asphalt, coloured ceramic or mineral granules top face and thermofusible plastic film bottom face, applied by torching only

2.6 ADHESIVE

.1 Adhesive for securing overlay board and insulation: asphalt extended vulcanized adhesive, two component unit, consisting of two liquids mixed on site to produce pourable adhesive.

2.7 OVERLAY BOARD

.1 Overlay Board: 6 mm thick asphalt based recovery board with non-woven glass facers, as recommended by the membrane manufacturer.

.1 Install over insulation to provide torch safe surface.

2.8 BITUMEN

.1 Asphalt: to CAN/CSA A123.4, Type 2.

2.9 INSULATION

.1 Polyisocyanurate Insulation

.1 To CAN/ULC-S704, flame spread classification: less than 500, thickness as indicated.

.2 Tapered Insulation

.1 To CAN/ULC-S702.2, taper cut to provide slopes indicated, on computer controlled machine and sequence packed with detailed installation instruction. Thickness shall not be less than 13 mm.

2.10 SEALERS

.1 Plastic cement: asphalt.

.2 Sealing compound: rubber asphalt type.

2.11 WALKWAYS

.1 Walkways to consist of one additional ply of cap sheet membrane. Colour to be different from field membrane as selected by NRC Departmental Representative.

2.12 CANT STRIPS

.1 Cut from prefabricated fibreboard material, to measure 140 mm on slope.

2.13 FASTENERS

.1 Covering to steel deck: No. 10 flat head, self tapping, Type A or AB, cadmium plated screws. Recommend FM Approved screw and plate assemblies.

.2 Insulation to deck: coated insulation fasteners and galvanized plates must meet FM Approval for wind uplift and corrosion resistance, as recommended by insulation manufacturer.

Part 3 Execution

3.1 QUALITY OF WORK

.1 Do examination, preparation and roofing Work in accordance with Roofing Manufacturer's Specification Manual and CRCA Roofing Specification Manual.

.2 Do priming in accordance with manufacturers written recommendations.

.3 The interface of the walls and roof assemblies will be fitted with durable rigid material plywood providing connection point for continuity of air barrier.

.4 Assembly, component and material connections will be made in consideration of appropriate design loads, with reversible mechanical attachments.

3.2 EXAMINATION OF ROOF DECKS

.1 Verification of Conditions:

.1 Inspect with NRC Departmental Representative deck conditions including parapets, construction joints, roof drains, plumbing vents and ventilation outlets to determine readiness to proceed.

.2 Evaluation and Assessment:

.1 Prior to beginning of work ensure:

.1 Decks are firm, straight, smooth, dry, free of snow, ice or frost, and swept clean of dust and debris. Do not use calcium or salt for ice or snow removal.

.2 Curbs have been built.

.3 Roof drains have been installed at proper elevations relative to finished roof surface.

.4 Plywood and lumber nailer plates have been installed to deck, walls and parapets as indicated.

.3 Do not install roofing materials during rain or snowfall.

3.3 PROTECTION OF IN-PLACE CONDITIONS

.1 Cover walls, walks, slopped roofs and adjacent work where materials hoisted or used.

.2 Use warning signs and barriers. Maintain in good order until completion of Work.

.3 Clean off drips and smears of bituminous material immediately.

.4 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.

.5 Protect roof from traffic and damage. Comply with precautions deemed necessary by NRC Departmental Representative.

.6 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.

.7 Metal connectors and decking will be treated with rust proofing or galvanization.

3.4 PRIMING DECK

.1 Apply deck primer to roofing substrate at the rate recommended by manufacturer.

3.5 VAPOUR RETARDER (CONCRETE/GYPSUM BOARD/PLYWOOD DECK)

.1 Modified bituminous vapour retarder sheet.

3.6 (EXPOSED) CONVENTIONAL MEMBRANE ROOFING (CMR) APPLICATION

.1 Insulation: fully adhered, adhesive application:

.1 Adhere insulation to laminated vapour barrier using solvent-based adhesive.

.2 Place boards in parallel rows with ends staggered, and in firm contact with one another.

.3 Cut end pieces to suit.

.4 Apply adhesive in continuous ribbons at 300 mm on centre.

.5 Separate the membrane and insulation with a drainage layer or slipsheet.

.2 Insulation: fully adhered, bitumen application:

.1 Embed insulation in 1 to 1.5 kg/m^2 mopping of bitumen.

.2 Place boards in parallel rows with ends staggered, and in firm contact with one another.

.3 Cut end pieces to suit.

.3 Insulation: mechanically fastened application:

.1 Mechanically fasten insulation using screws and pressure distribution plates.

.2 Fasten insulation as per manufacturer's written recommendations.

.3 Number and pattern of screws per board to meet Factory Mutual requirements.

.4 Place boards in parallel rows with ends staggered, and in firm contact with one another.

.5 Cut end boards to suit.

.4 Tapered insulation application:

.1 Mop insulation to vapour retarder with hot asphalt at rate of 1 kg/m^2.

.2 Install tapered insulation as firstinsulation layer, in accordance with shop drawings. Stagger joints between layers 150 mm minimum.

.5 Overlay Board: adhesive application:

.1 Adhere overlay board to insulation with vulcanized adhesive at the rate of one litre per m^2.

.2 Place boards in parallel rows with end joints staggered. Cap joints approximately 25 mm.

.3 Cut ends to suit and apply adhesive in continuous ribbons at 300 mm on centre.

.6 Base sheet application:

.1 Starting at low point of roof, perpendicular to slope, unroll base sheet, align and reroll from both ends.

.2 Unroll and embed base sheet in uniform coating of asphalt applied at rate of 1.2 kg/m^2, at 230 degrees C.

.3 Lap sheets 75 mm minimum for side and 150 mm minimum for end laps.

.4 Application to be free of blisters, wrinkles and fishmouths.

.7 Cap sheet application:

.1 Starting at low point on roof, perpendicular to slope, unroll cap sheet, align and reroll from both ends.

.2 Unroll and torch cap sheet onto base sheet taking care not to burn membrane or its reinforcement.

.3 Lap sheets 75 mm minimum for side laps and 150 mm minimum for end laps. Offset joints in cap sheet 300 mm minimum from those in base sheet.

.4 Application to be free of blisters, fishmouths and wrinkles.

.5 Do membrane application in accordance with manufacturer's recommendations.

.8 Flashings:

.1 Complete installation of flashing base sheet stripping prior to installing membrane cap sheet.

.2 Torch base and cap sheet onto substrate in 1 metre wide strips.

.3 Lap flashing base sheet to membrane base sheet minimum 150 mm and seal by mopping or torch welding.

.4 Lap flashing cap sheet to membrane cap sheet 250 mm minimum and torch weld.

.5 Provide 75 mm minimum side lap and seal.

.6 Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.

.7 Do work in accordance with manufacturer's recommendations.

.9 Roof penetrations:

.1 Install roof drain pans, vent stack covers and other roof penetration flashings and seal to membrane in accordance with manufacturer's recommendations and details.

.2 Ensure all roof penetrations are sealed, are watertight, and prevent air quality issues within the building.

3.7 CANTS

.1 Install prefabricated fibre cants over rigid insulation.

.2 Apply hot bitumen to receiving surface and embed cant firmly by hand.

.3 Angle cut cants to fit tightly on back and bottom where roof to wall angle varies from 90 degrees.

3.8 WALKWAYS

.1 Install walkway membrane in accordance with manufacturer's instructions and as indicated.

.1 Apply primer to cap sheet membrane and torch apply, ensuring selvage edge is removed.

.2 Install pavers, level on insulation pads, as indicated.

3.9 FIELD QUALITY CONTROL

.1 Inspections:

.1 Inspection and testing of roofing application will be carried out by testing laboratory designated by NRC Departmental Representative.

.2 NRC Departmental Representative will pay for tests as specified in Section 01 45 00 - Quality Control.

3.10 CLEANING

.1 Remove bituminous markings from finished surfaces.

.2 In areas where finished surfaces are soiled caused by work of this section, consult manufacturer of surfaces for cleaning advice and complying with their documented instructions.

.3 Repair or replace defaced or disfigured finishes caused by work of this section.

.4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 ~~19~~ **21** - Construction/Demolition Waste Management **and Disposal**.

.1 Place materials defined as hazardous or toxic in designated containers.

.2 Clearly label location of salvaged material's storage areas and provide barriers and security devices.

.3 Ensure emptied containers are sealed and stored safely.

.4 Unused adhesive, sealant and asphalt materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

.5 Dispose of unused adhesive material at official hazardous material collections site approved by NRC Departmental Representative.

.6 Dispose of unused sealant material at official hazardous material collections site approved by NRC Departmental Representative.

.7 Dispose of unused asphalt material at official hazardous material collections site approved by NRC Departmental Representative.

.8 Divert unused gypsum materials from landfill to recycling facility as reviewed by NRC Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Division 26, Electrical

1.2 REFERENCES

.1 ASTM International

.1 ASTM A 653/A 653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.3 Green Seal Environmental Standards (GS)

.1 GS-36-00, Commercial Adhesives.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for door components and grilles and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Indicate each type of door, arrangement of hardware, required clearances, electrical characteristics including voltage, size of motors, auxiliary controls and wiring diagrams.

.3 Indicate assembly details and dimensions of fabrication, required clearances and electrical connections.

.4 Samples:

.1 Submit for review and acceptance of each unit.

.2 Samples will be returned for inclusion into work.

.5 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

1.4 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: submit operation and maintenance data for overhead coiling doors, and hardware for incorporation into manual.

1.5 QUALITY ASSURANCE

.1 Certifications: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect overhead coiling doors from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

Part 2 Products

2.1 DESIGN CRITERIA

.1 Design rolling door curtain and assembly to withstand wind load of 960 Pa within door opening area.

2.2 MATERIALS

.1 Galvanized steel sheet: to ASTM A653/A653M, commercial quality with Coating Designation Z275.

.2 Doors:

.1 Door face sheets to interior doors 0.9 mm minimum base thickness.

.2 Door face sheets to exterior doors 1.2 mm minimum base thickness.

.3 Adhesives and Sealants: VOC limit to GS-36.

2.3 DOOR FABRICATION

.1 Coiling door curtain interlocking flat slat sections:

.1 Roll formed steel: 75 mm wide, galvanized.

.2 Ensure bottom bar is equipped with tubular neoprene weatherstrip.

.3 Where wind locks are required:

.1 Rivet alternate end locks to slat ends.

.2 Rivet alternate wind locks to slat ends.

.4 Where wind locks are not required:

.1 Rivet continuous end locks to slat ends.

.5 Non-fire rated doors, up to 4800 mm wide:

.1 Provide bottom bar of extruded aluminum section, equipped with tubular neoprene weatherstrip.

.6 Non-fire rated doors, more than 4800 mm wide:

.1 Provide bottom bar of double equal weight steel angles, equipped with tubular neoprene weatherstrip.

.7 Form guides of metal angles of sections of 4.8 mm minimum thickness for between jambs or face of wall installation. Equip guides of non-fire rated doors with tubular neoprene weatherstrip.

.8 Construct counterbalance assembly of heat treated torsion spring with 25% overload factor.

.1 Enclose spring in steel pipe to support door curtain and counterbalance mechanism with maximum deflection of 1/360th of opening width.

.2 Include ball bearings at rotating points and spring tension adjusting wheel, accessible for setting.

.9 Support counterbalance assembly on 5 mm minimum thickness steel plate brackets, forming end enclosures.

.10 Enclose counterbalance assembly with galvanized steel sheet formed hood, equipped with weatherstripping.

~~.11 Equip door for locking from inside with slide bolt and lockset.~~

2.4 OPERATION

.1 Equip door for operation by:

.1 Electric motor operator.

2.5 ELECTRICAL OPERATOR

.1 Electrical motors, controller units, remote pushbutton stations, relays and other electrical components: to CSA and ULC approval with EEMAC enclosures.

.2 Motor: high starting torque, instant reversing, capacity to operate grille at 200 mm per second, removable without affecting emergency chain device or setting of limit switches. Equip motor with overload protection, centrifugal clutch and electric brake.

.3 Motor size matching gear reducer with gears running in oil bath.

.4 Controller units with integral motor reversing starter, 3 heater elements for overload protection, including pushbuttons and control relays as applicable.

.5 Operation:

.1 Remote push button stations: surface mounted, in locations indicated, with OPEN-STOP-CLOSE push buttons.

.6 Design brake to stop and hold doors in any position.

.7 Include hand chain interlocked auxiliary operator to disconnect motor mechanically and electrically when engaged and allow manual operation of door.

.8 Safety switch: electro mechanical or electro pneumatic device full length of bottom rail of bottom section of door, to reverse door to open position when coming in contact with object on closing cycle.

.9 Mounting brackets: galvanized steel, size and thickness to suit conditions.

.10 Control circuit: 24 VAC.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for overhead coiling doors and grilles installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform NRC Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Departmental Representative.

3.2 INSTALLATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.2 Install doors in accordance with manufacturer's printed instructions.

.3 Install electrical motors, controller units, pushbutton stations, relays and other electrical equipment required for door operation.

.4 Install electric wiring from power supply located near door.

.5 Adjust door operating components to ensure smooth opening and closing of doors.

3.3 FIELD QUALITY CONTROL

.1 Test coiling door in presence of NRC Departmental Representative.

.2 Have manufacturer of products supplied under this Section review Work involved in handling, installation, protection and cleaning of its products, and submit written reports in acceptable format to verify compliance of Work with Contract.

.3 Manufacturer's Field Services:

.1 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product within 3 days.

.4 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.5 Ensure manufacturer's representative is present before and during critical periods of installation construction of field joints and testing.

.6 Schedule site visits to review Work at stages listed:

.1 After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.

.2 Twice during progress of Work at 25% and 60% complete.

.3 Upon completion of Work, after cleaning is carried out.

3.4 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.1 Remove traces of primer, caulking; clean doors and frames.

.4 Waste Management: separate waste materials for reuse and recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by overhead coiling door and grille installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Association of Textile Chemists and Colorists (AATCC)

- .1 AATCC Test Method 16-2004, Colorfastness to Light.
- .2 AATCC Test Method 134-2006, Electrostatic Propensity of Carpets.
- .3 AATCC Test Method 171-2005, Carpets: Cleaning of; Hot Water Extraction Method.
- .4 AATCC Test Method 175-2008, Stain Resistance: Pile Floor Coverings.
- .5 AATCC Test Method 189-2007, Fluorine Content of Carpet Fibers.

.2 ASTM International

- .1 ASTM D 297-93(2006), Standard Test Methods for Rubber Products-Chemical Analysis.
- .2 ASTM D 1335-05, Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings.
- .3 ASTM D 3574-08, Standard Test Methods for Flexible Cellular Materials - Slab, Bonded, and Molded Urethane Foams.
- .4 ASTM D 3936-05, Standard Test Method for Resistance to Delamination of the Secondary Backing of Pile Yarn Floor Covering.

.3 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-4.2 No. 22-2004, Textile Test Methods – Colour fastness to Rubbing (Crocking).
- .2 CAN/CGSB-4.2 No.27.6M-2004, Textile Test Methods - Flame Resistance - Methemine Tablet Test for Textile Floor Coverings.
- .3 CAN/CGSB-4.2 No.77.1-94/ISO 4919:2000, Textile Test Methods - Carpets - Determination of Tuft Withdrawal Force.
- .4 CAN/CGSB-4.129-93(R1997), Carpets for Commercial Use.

.4 Carpet and Rug Institute (CRI)

- .1 CRI Carpet Installation Standard 2009.
- .2 CRI Green Label Indoor Air Quality Testing Program.
- .3 CRI Green Label Plus Indoor Air Quality Testing Program.

.5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).

.6 National Floor Covering Association (NFCA)

- .1 National Floor Covering Specification Manual 2007.

.7 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1113-A2007, Architectural Coatings.

.2 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

.8 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102-07, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S102.2-07, Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for each carpet tile, adhesive carpet protection subfloor patching compound and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit 2 copies of WHMIS MSDS.

.2 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Information on shop drawings to indicate:

.1 Nap: direction, open edges, special patterns.

.2 Cutouts: show locations where cutouts are required.

.3 Edgings: show location of edge moldings and edge bindings.

.3 Samples:

.1 Submit for review and acceptance of each unit.

.2 Samples will be returned for inclusion into work.

.3 Submit duplicate samples of each type of carpet tile specified and duplicate tiles for each colour selected.

.4 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.5 Test and Evaluation Reports:

.1 Certified test reports showing compliance with specified performance characteristics and physical properties.

.6 Manufacturer's Instructions: submit manufacturer's installation and storage instructions.

1.3 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: submit operation and maintenance data for installed products for incorporation into manual.

.2 Warranty Documentation: submit warranty documents specified.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra stock materials: deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels.

.1 Quantity: provide minimum 5% of:

.1 Carpet tile.

.2 Carpet base.

.3 Adhesives.

.2 Delivery, storage and protection: comply with Owner's requirements for delivery and storage of extra materials.

1.5 QUALITY ASSURANCE

.1 Qualifications:

.1 Manufacturer: capable of providing field service representation during construction and approving application method.

.2 Flooring Installer:

.1 Experienced in performing work of this Section who has specialized in installation of work similar to that required for this project.

.2 Certified by carpet manufacturer prior to tender or bid submission.

.3 Must not sub-contract labour without written approval of NRC Departmental Representative.

.4 Responsible for proper product installation, including floor testing and preparation as specified and in accordance with carpet manufacturer's written instructions.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

.3 Store and protect carpet tile and adhesive in original containers or wrapping with manufacturer's seals and labels intact.

.4 Store and protect carpet tile and accessories in location as directed by NRC Departmental Representative.

.5 Store carpet and adhesive at minimum temperature of 18 degrees C and relative humidity of maximum 65% for minimum of 48 hours before installation.

.6 Prevent damage to materials during handling and storage. Keep materials under cover and free from dampness.

.7 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.

.8 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

1.7 SITE CONDITIONS

.1 Ambient Conditions:

.1 Moisture: ensure substrate is within moisture limits and alkalinity limits recommended by manufacturer. Prepare moisture testing and provide report to NRC Departmental Representative.

.2 Temperature: maintain ambient temperature of not less than 18 degrees C from 48 hours before installation to at least 48 hours after completion of work.

.3 Relative humidity: maintain between 10% and 65% for 48 hours before, during and 48 hours after installation.

.4 Ventilation:

.1 NRC Departmental Representative will co-ordinate operation of ventilation system during installation of carpet.

.2 Ventilate enclosed spaces. Provide fans with HEPA filters.

.3 Provide continuous ventilation during and after carpet application. Run ventilation system 24 hours per day during installation; provide continuous ventilation for 7 days after completion of carpet installation.

.5 Install carpet after space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete.

1.8 WARRANTY

.1 Manufacturer's warranty: submit, for NRC Departmental Representative's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to and does not limit other rights Owner may have under Contract Documents.

.2 Warranty period: 1 year, commencing on date of substantial performance of work.

.1 Warranty covers labour and repair or replacement of defective components for 1 year after date of substantial performance.

Part 2 Products

2.1 MATERIALS

.1 Manufacturers:

.1 Ensure manufacturer has minimum 5 years experience in manufacturing components similar to or exceeding requirements of project.

.2 Description:

~~.1 Sustainability Characteristics:~~

~~.2~~**.1** Adhesives: VOC limit 50 g/L maximum to SCAQMD Rule 1168 GS-36.

~~.3~~**.2** Primer, Sealer: in accordance with manufacturer's recommendations for surface conditions:

.1 VOC limit: 100 g/L maximum to SCAQMD Rule 1113

.3 Basis of Design – Carpet Tile Products: Refer to Section 00 01 30, List of Materials for complete list of carpet tile products, designations, manufacturers, sizes and colour.

.1 Products by other manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to NRC Departmental Representative's acceptance, in accordance with the Contract substitution procedures.

2.2 PERFORMANCE

.1 Flammability: certified for flammability to Health Canada regulations under "Hazardous Products - Carpet Regulations", Part II of Schedule 1.

.2 Flame Spread: maximum flame spread rating 300, maximum smoke developed classification 500, when tested to CAN/ULC-S102.2.

.3 Smoke Development: 450 or less per ASTM E 662.

.4 Dry Breaking Strength: to ASTM D 2661, minimum acceptable tear strength in both length and width:

.1 11.3 kg for carpets installed by glue down installation.

.5 Wear: maximum 10% of pile face fiber by weight for 10 years.

.6 Edge Ravel: none for 10 years.

.7 Static Resistance: permanent static control to AATCC 134, 3000 V maximum at 20% RH and 22 degrees C.

.8 Static Generation: less than 3.0 kV per AATCC 134 for 10 years.

.9 Tuft Bind: Tuft Lock: to ASTM D 1335 CAN/CGSB-4.129, minimum acceptable 1.6 kilograms for cut pile product 3.6 for loop pile product.

.10 De-lamination of Secondary Backing: Lamination Strength of Secondary Backing: to ASTM D 3936, minimum acceptable peel strength of 1.6 kg/25 mm.

.11 Stain resistance: to AATCC 175, 8.

.12 Soil Resistance: 350 ppm fluorine minimum Fluorine Durability Level to AATCC 189.

.13 Colourfastness to light: to CAN/CGSB-4.2 No.18.3 AATCC 16.

.14 Colourfastness to atmosphere: to AATCC 129 and AATCC 23.

.15 Colourfastness to crocking: to CAN/CGSB-4.2 No. 22.

.16 Indoor Air Quality Certification: certified to CRI Green Label Plus IAQ requirements.

2.3 TILE CUSHION BACKING

.1 Density: urethane 224 kg/m^3; EVA and PVC 240 kg/m^3 to ASTM D 3574.

.2 Compression force deflection, minimum: urethane 34.5 kN/m^2 to ASTM D 3574.

.3 Compression deflection, minimum: EVA and PVC 48.3 kN/m^2 to ASTM D 1667.

.4 Compression set at 50%, maximum: urethane 15% to ASTM D 3574.

.5 Compression set at 25%, maximum: EVA and PVC 10% to ASTM D 3574.

.6 Ash content, maximum: urethane 50%; EVA and PVC 50% to ASTM D 297.

2.4 ACCESSORIES

.1 Base WB1:

.1 Resilient Base: Johnsonite.

.2 Edge Strips:

.1 Metal:

.1 Designed for carpet being installed.

.2 Floor flange minimum 38 mm wide, face minimum 16 mm wide.

.3 Finish: clear anodic coating.

.3 Adhesive:

.1 Multi-purpose Adhesive Type: recommended by carpet tile manufacturer for direct glue down installation.

.2 On site application VOC limit: 50g/L maximum to SCAQMD Rule 1168.

.3 Adhesive in compliance with CCD-152.

.4 Carpet protection: non-staining heavy duty kraft paper.

.5 Concrete floor sealer, primer:

.1 As recommended by manufacturer.

Part 3 Execution

3.1 INSTALLERS

.1 Use experienced and qualified technicians to carry out assembly and installation of tile carpet.

3.2 EXAMINATION

.1 Examine conditions, substrates and work to receive work of this Section.

.2 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for carpet tile installation in accordance with manufacturer's written instructions.

.1 Inform NRC Departmental Representative of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Departmental Representative.

3.3 PREPARATION

.1 Subfloor Preparation:

.1 Inspect concrete and determine special care required to make it a suitable for carpet.

.2 Fill and level cracks 3 mm wide or protrusions over 0.8 mm with appropriate and compatible patching compound.

.3 Comply with manufacturer's written recommendations for maximum patch thickness.

.4 Prime large patch areas with compatible primer.

.5 Ensure concrete substrates are cured, clean and dry.

.6 Ensure concrete substrates are free of paint, dirt, grease, oil, curing or parting agents, and other contaminates, including sealers, that interfere with the bonding of adhesive.

.7 Where powdery or porous concrete surface is encountered, apply primer compatible with adhesive to provide a suitable surface for glue-down installation.

.2 Surface Preparation: prepare surface in accordance with manufacturer's written recommendations.

.1 Prepare floor surfaces in accordance with CRI Carpet Installation Standard.

.3 Tile Carpeting Preparation:

.1 Pre-condition carpeting: following manufacturer's written instructions.

3.4 INSTALLATION

.1 Install carpet tiles in accordance with manufacturer's written instructions, and CRI Carpet Installation Standard.

.2 Co-ordinate tile carpeting work with work of other trades, for proper time and sequence to avoid construction delays.

.3 Install carpet tile after finishing work is completed but before demountable office partitions and telephone and electrical pedestal outlets are installed.

.4 Install carpet tile as per manufacturer's recommendation: horizontal ashlar.

.5 Snugly join carpet tiles in completed installation.

.1 Measure distance covered by 11 carpet tiles (10 joints) and ensure distance is in compliance with manufacturer specifications.

.2 Do not trap yarn between carpet tiles.

.6 Ensure finished installation presents smooth wearing surface free from conspicuous seams, burring and other faults.

.7 Use material from same dye lot.

.1 Ensure colour, pattern and texture match within visual areas.

.2 Maintain constant pile direction.

.8 Fit around architectural, mechanical, electrical and telephone outlets, and furniture fitments, around perimeter of rooms into recesses, and around projections.

.9 Extend carpet tiles into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

.10 Install carpet tiles smooth and free from bubbles, puckers, and other defects.

.11 Protect exposed carpet tile edges at transition to other flooring materials with suitable transition strips.

3.5 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.1 Vacuum carpets clean immediately after completion of installation.

.2 Waste Management: separate waste materials for reuse and recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Prohibit traffic on carpet for period of 24 hours minimum after installation and until adhesive is cured.

.3 Install carpet protection to satisfaction of NRC Departmental Representative.

.4 Repair damage to adjacent materials caused by tile carpeting installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Environmental Protection Agency (EPA)

.1 Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 (for Surface Coatings).

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.3 The Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual - February 2004.

.2 Standard GPS-1-05, MPI Green Performance Standard for Painting and Coatings.

.4 National Fire Code of Canada.

.5 Society for Protective Coatings (SSPC)

.1 Systems and Specifications, SSPC Painting Manual 2005.

1.2 QUALITY ASSURANCE

.1 Qualifications:

.1 Contractor: to have a minimum of five years proven satisfactory experience. When requested, provide list of last three comparable jobs including, job name and location, specifying authority, and project manager.

.2 Qualified journeypersons as defined by local jurisdiction to be engaged in painting work

.3 Apprentices: may be employed provided they work under direct supervision of qualified journeyperson in accordance with trade regulations.

.4 Conform to latest MPI requirements for exterior painting work including preparation and priming.

.5 Materials: in accordance with MPI Painting Specification Manual "Approved Product" listing and from a single manufacturer for each system used.

.6 Paint materials such as linseed oil, shellac, and turpentine to be highest quality product of an approved manufacturer listed in MPI Painting Specification Manual and to be compatible with other coating materials as required.

.7 Retain purchase orders, invoices and documents to prove conformance with noted MPI requirements when requested by NRC Departmental Representative.

.8 Standard of Acceptance:

.1 Walls: No defects visible from a distance of 1000 mm at 90 degrees to surface.

.2 Soffits: No defects visible from floor at 45 degrees to surface when viewed using final lighting source.

.3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

1.3 SCHEDULING

.1 Submit work schedule for various stages of painting to NRC Departmental Representative for approval. Submit schedule minimum of 48 hours in advance of proposed operations.

.2 Obtain written authorization from NRC Departmental Representative for changes in work schedule.

.3 Schedule painting operations to prevent disruption of occupants in and about building.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit WHMIS MSDS - Material Safety Data Sheets.

.2 Upon completion, submit records of products used. List products in relation to finish system and include the following:

.1 Product name, type and use.

.2 Manufacturer's product number.

.3 Colour numbers.

.4 MPI Environmentally Friendly classification system rating.

.5 Manufacturer's Material Safety Data Sheets (MSDS).

.3 Provide samples:

.1 Submit duplicate 200 x 300 mm sample panels of each paint with specified paint or coating in colours, gloss/sheen and textures required to MPI Painting Specification Manual standards submitted on the following substrate materials:

.1 3 mm plate steel for finishes over metal surfaces.

.2 13 mm birch plywood for finishes over wood surfaces.

.3 50 mm concrete block for finishes over concrete or concrete masonry surfaces.

.4 13 mm gypsum board for finishes over gypsum board and other smooth surfaces.

.5 10 mm cedar hardboard siding plywood for finishes over wood surfaces.

.2 When approved, samples shall become acceptable standard of quality for appropriate on-site surface with one of each sample retained on-site.

.3 Submit full range of available colours where colour availability is restricted.

1.5 MAINTENANCE

.1 Submit one, four litre can of each type and colour of primer, finish coating. Identify colour and paint type in relation to established colour schedule and finish system.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials:

.1 Deliver and store materials in original containers, sealed, with labels intact.

.2 Labels: to indicate:

.1 Manufacturer's name and address.

.2 Type of paint or coating.

.3 Compliance with applicable standard.

.4 Colour number in accordance with established colour schedule.

.3 Remove damaged, opened and rejected materials from site.

.4 Provide and maintain dry, temperature controlled, secure storage.

.5 Observe manufacturer's recommendations for storage and handling.

.6 Store materials and supplies away from heat generating devices.

.7 Store materials and equipment in well ventilated area with temperature range 7 degrees C to 30 degrees C.

.8 Store temperature sensitive products above minimum temperature as recommended by manufacturer.

.9 Keep areas used for storage, cleaning and preparation, clean and orderly to approval of NRC Departmental Representative. After completion of operations, return areas to clean condition to approval of NRC Departmental Representative.

.10 Remove paint materials from storage only in quantities required for same day use.

.11 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.

.12 Fire Safety Requirements:

.1 Provide one 9 kg Type ABC dry chemical fire extinguisher adjacent to storage area.

.2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

.3 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling.

.2 Paint, finishes and related materials (thinners, solvents, etc.) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.

.3 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

.4 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

.5 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into the ground the following procedures shall be strictly adhered to:

.1 Retain cleaning water for water-based materials to allow sediments to be filtered out.

.2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

.3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.

.4 Dispose of contaminants in an approved legal manner in accordance with hazardous waste regulations.

.5 Empty paint cans are to be dry prior to disposal or recycling (where available).

.6 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.

.7 Set aside and protect surplus and uncontaminated finish materials: Deliver to or arrange collection for verifiable re-use or re-manufacturing.

.8 Close and seal tightly partly used sealant and adhesive containers and store protected in well ventilated fire-safe area at moderate temperature.

1.7 AMBIENT CONDITIONS

~~.1 Heating, Ventilation and Lighting:~~

~~.1 Ventilate enclosed spaces.~~

~~.2 Do not perform painting work unless adequate and continuous ventilation and sufficient heating facilities are in place to maintain ambient air and substrate temperatures above 10 degrees C for24 hours before, during and after paint application until paint has cured sufficiently.~~

~~.3 Where required, provide continuous ventilation for seven days after completion of application of paint.~~

~~.4 Co-ordinate use of existing ventilation system with NRC Departmental Representative and ensure its operation during and after application of paint as required.~~

~~.5 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.~~

~~.6 Perform no painting work unless a minimum lighting level of 323 Lux is provided on surfaces to be painted. Adequate lighting facilities to be provided by General Contractor.~~

~~.2~~ **.1** Temperature, Humidity and Substrate Moisture Content Levels:

.1 Unless specifically pre-approved by specifying body, Paint Inspection Agency and, applied product manufacturer, perform no painting work when:

.1 Ambient air and substrate temperatures are below 10 degrees C.

.2 Substrate temperature is over 32 degrees C unless paint is specifically formulated for application at high temperatures.

.3 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's prescribed limits.

.4 Relative humidity is above 85 % or when dew point is less than 3 degrees C variance between air/surface temperature.

.5 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.

.2 Perform no painting work when maximum moisture content of substrate exceeds:

.1 12% for concrete and masonry (clay and concrete brick/block).

.2 15% for wood.

.3 12% for plaster and gypsum board.

.3 Conduct moisture tests using a properly calibrated electronic Moisture Meter, except test concrete floors for moisture using a simple "cover patch test".

.4 Test concrete, masonry and plaster surfaces for alkalinity as required.

~~.3~~ **.2** Surface and Environmental Conditions:

.1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.

.2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits noted herein.

.3 Apply paint when previous coat of paint is dry or adequately cured.

.4 Apply paint finishes when conditions forecast for entire period of application fall within manufacturer's recommendations.

.5 Do not apply paint when:

.1 Temperature is expected to drop below 10 degrees C before paint has thoroughly cured.

.2 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's limits.

.3 Surface to be painted is wet, damp or frosted.

.6 Provide and maintain cover when paint must be applied in damp or cold weather. Heat substrates and surrounding air to comply with temperature and humidity conditions specified by manufacturer. Protect until paint is dry or until weather conditions are suitable.

.7 Schedule painting operations such that surfaces exposed to direct, intense sunlight are scheduled for completion during early morning.

.8 Remove paint from areas which have been exposed to freezing, excess humidity, rain, snow or condensation. Prepare surface again and repaint.

.9 Paint occupied facilities in accordance with approved schedule only. Schedule operations to approval of NRC Departmental Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.

Part 2 Products

2.1 MATERIALS

.1 Paint materials listed in latest edition of MPI Approved Products List (APL) are acceptable for use on this project.

.2 Paint materials for paint systems: to be products of single manufacturer.

.3 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids, to be as follows:

.1 Do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.

.4 Water-borne surface coatings must be manufactured and transported in a manner that steps of processes, including disposal of waste products arising therefrom, will meet requirements of applicable governmental acts, by-laws and regulations including, for facilities located in Canada, Fisheries Act and Canadian Environmental Protection Act (CEPA).

.5 Water-borne surface coatings must not be formulated or manufactured with aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavelant chromium or their compounds.

.6 Water-borne surface coatings and recycled water-borne surface coatings must have flash point of 61.0 degrees C or greater.

.7 Both water-borne surface coatings and recycled water-borne surface coatings must be made by a process that does not release:

.1 Matter in undiluted production plant effluent generating a 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.

.2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.

.8 Water-borne paints and stains, recycled water-borne surface coatings and water borne varnishes must meet a minimum "Environmentally Friendly" E2 rating.

.9 Recycled water-borne surface coatings must contain 50 % post-consumer material by volume.

.10 Recycled water-borne surface coatings must not contain:

.1 Lead in excess of 600.0 ppm weight/weight total solids.

.2 Mercury in excess of 50.0ppm weight/weight total product.

.3 Cadmium in excess of 1.0ppm weight/weight total product.

.4 Hexavelant chromium in excess of 3.0 ppm weight/weight total product.

.5 Organochlorines or polychlorinated biphenyls (PCBS) in excess of 1.0ppm weight/weight total product.

.11 The following must be performed on each batch of consolidated post-consumer material before surface coating is reformulated and canned. These tests must be performed at a laboratory or facility which has been accredited by the Standards Council of Canada.

.1 Lead, cadmium and chromium are to be determined using ICP-AES (Inductively Coupled Plasma - Atomic Emission Spectroscopy) technique no. 6010 as defined in EPA SW-846.

.2 Mercury is to be determined by Cold Vapour Atomic Absorption Spectroscopy using Technique no. 7471 as defined in EPA SW-846.

.3 Organochlorines and PCBs are to be determined by Gas Chromatography using Technique no. 8081 as defined in EPA SW-846.

2.2 COLOURS

.1 NRC Departmental Representative will provide Colour Schedule after Contract award.

.2 Colour schedule will be based upon selection of five base colours and three accent colours. No more than eight colours will be selected for entire project and no more than three colours will be selected in each area.

.3 Selection of colours will be from manufacturer’s full range of colours.

.4 Where specific products are available in restricted range of colours, selection will be based on limited range.

.5 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

2.3 MIXING AND TINTING

.1 Perform colour tinting operations prior to delivery of paint to site. On-site tinting of painting materials is allowed only with NRC Departmental Representative's written permission.

.2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.

.3 Add thinner to paint manufacturer's recommendations. Do not use kerosene or organic solvents to thin water-based paints.

.4 Thin paint for spraying according in accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to NRC Departmental Representative.

.5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 GLOSS/SHEEN RATINGS

.1 Paint gloss: defined as sheen rating of applied paint, in accordance with following values:

Gloss Level / Category	Units @ 60 Degrees	Units @ 85 Degrees
G1 - matte finish	0 to 5	max. 10
G2 - velvet finish	0 to 10	10 to 35
G3 - eggshell finish	10 to 25	10 to 35
G4 - satin finish	20 to 35	min. 35
G5 - semi-gloss finish	35 to 70	
G6 - gloss finish	70 to 85	
G7 - high gloss finish	> 85	

.2 Gloss level ratings of painted surfaces as specified and as noted on Finish Schedule.

2.5 EXTERIOR PAINTING SYSTEMS

.1 Asphalt Surfaces: zone/traffic marking for drive and parking areas, etc.

.1 EXT 2.1A - Latex zone/traffic marking finish.

.2 EXT 2.1B - Alkyd zone/traffic marking finish.

.2 Structural Steel and Metal Fabrications:

.1 EXT 5.1A - Quick dry enamel finish.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 EXAMINATION

.1 Exterior repainting work: inspected by MPI Accredited Paint Inspection Agency (inspector) acceptable to specifying authority and local Painting Contractor's Association. Painting contractor to notify Paint Inspection Agency minimum of one week prior to commencement of work and provide copy of project repainting specification and Finish Schedule.

.2 Exterior surfaces requiring repainting: inspected by both painting contractor and Paint Inspection Agency who will notify NRC Departmental Representative in writing of defects or problems, prior to commencing repainting work, or after surface preparation if unseen substrate damage is discovered.

.3 Where assessed degree of surface degradation of DSD-1 to DSD-3 before preparation of surfaces for repainting is revealed to be DSD-4 after preparation, repair or replacement of such unforeseen defects discovered are to be corrected, as mutually agreed, before repainting is started.

.4 Where "special" repainting or recoating system applications (i.e. elastomeric coatings) or non-MPI listed products or systems are to be used, paint or coating manufacturer to provide as part of work, certification of surfaces and conditions for specific paint or coating system application as well as on site supervision, inspection and approval of their paint or coating system application as required at no additional cost to NRC Departmental Representative.

3.3 PREPARATION

.1 Perform preparation and operations for exterior painting in accordance with MPI Maintenance Repainting Manual except where specified otherwise.

.2 Apply paint materials in accordance with paint manufacturer's written application instructions.

.3 Clean and prepare exterior surfaces to be repainted in accordance with MPI Maintenance Repainting Manual requirements. Refer to the MPI Manual in regard to specific requirements and as follows:

.1 Remove dust, dirt, and surface debris by vacuuming, wiping with dry, clean cloths or compressed air.

.2 Wash surfaces with a biodegradable detergent and bleach where applicable and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.

.3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.

.4 Allow surfaces to drain completely and allow to dry thoroughly. Allow sufficient drying time and test surfaces using electronic moisture meter before commencing work.

.5 Use water-based cleaners in place of organic solvents where surfaces will be repainted using water based paints.

.6 Many water-based paints cannot be removed with water once dried. Minimize use of kerosene or such organic solvents to clean up water-based paints.

.4 Clean metal surfaces to be repainted by removing rust, dirt, oil, grease and foreign substances in accordance with MPI requirements. Remove such contaminates from surfaces, pockets and corners to be repainted by brushing with clean brushes, blowing with clean dry compressed air, or brushing/vacuum cleaning as required.

.5 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before priming and between applications of remaining coats. Touch-up, spot prime, and apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.

.6 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.

3.4 EXISTING CONDITIONS

.1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Departmental Representative DCC Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.

3.5 PROTECTION

.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore such surfaces as directed by NRC Departmental Representative.

.2 Protect items that are permanently attached such as Fire Labels on doors and frames.

.3 Protect factory finished products and equipment.

.4 Protect passing pedestrians, building occupants and general public in and about building.

.5 Remove light fixtures, surface hardware on doors, and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Store items and re-install after painting is completed.

.6 Move and cover exterior furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.

.7 As painting operations progress, place "WET PAINT" signs in pedestrian and vehicle traffic areas to approval of NRC Departmental Representative.

3.6 APPLICATION

.1 Method of application to conform to manufacturer's application instructions unless specified otherwise.

.2 Apply coats of paint as continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.3 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.

.4 Sand and dust between coats to remove visible defects.

.5 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as projecting ledges.

.6 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

3.7 MECHANICAL/ ELECTRICAL EQUIPMENT

.1 Unless otherwise specified, paint exterior exposed conduits, piping, hangers, duct work and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as noted otherwise.

.2 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.

.3 Do not paint over nameplates.

.4 Paint fire protection piping red.

.5 Paint steel electrical light standards. Do not paint outdoor transformers and substation equipment.

3.8 CLEANING

.1 General.

.1 Remove paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.

3.9 RESTORATION

.1 Clean and re-install hardware items removed before undertaken painting operations.

.2 Remove protective coverings and warning signs as soon as practical after operations cease.

.3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.

.4 Protect freshly completed surfaces from paint droppings and dust to approval of NRC Departmental Representative. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by NRC Departmental Representative.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Department of Justice Canada (Jus)

.1 Canadian Environmental Protection Act (CEPA), 1999, c. 33

.2 Environmental Protection Agency (EPA)

.1 EPA Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 - 1995, (for Surface Coatings).

.3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 Master Painters Institute (MPI)

.1 MPI Architectural Painting Specifications Manual, 2004.

.5 National Fire Code of Canada - 1995

.6 Society for Protective Coatings (SSPC)

.1 SSPC Painting Manual, Volume Two, 8th Edition, Systems and Specifications Manual.

.7 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34

1.2 QUALITY ASSURANCE

.1 Qualifications:

.1 Contractor: minimum of five years proven satisfactory experience. Provide list of last three comparable jobs including, job name and location, specifying authority, and project manager.

.2 Journeymen: qualified journeymen who have "Tradesman Qualification Certificate of Proficiency" engaged in painting work.

.3 Apprentices: working under direct supervision of qualified trades person in accordance with trade regulations.

1.3 SCHEDULING

.1 Submit work schedule for various stages of painting to NRC Departmental Representative for review. Submit schedule minimum of 48 hours in advance of proposed operations.

.2 Obtain written authorization from NRC Departmental Representative for changes in work schedule.

.3 Schedule painting operations to prevent disruption of occupants.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit product data and instructions for each paint and coating product to be used.

.2 Submit product data for the use and application of paint thinner.

.3 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS). Indicate VOCs during application and curing.

.2 Samples:

.1 Submit full range colour sample chips to indicate where colour availability is restricted.

.2 Submit duplicate 200 x 300 mm sample panels of each paint with specified paint or coating in colours, gloss/sheen and textures required to MPI Architectural Painting Specification Manual standards submitted on following substrate materials:

.1 3 mm plate steel for finishes over metal surfaces.

.2 13 mm birch plywood for finishes over wood surfaces.

.3 50 mm concrete block for finishes over concrete or concrete masonry surfaces.

.4 13 mm gypsum board for finishes over gypsum board and other smooth surfaces.

.3 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.

.4 Test reports: submit certified test reports for paint from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

.1 Lead, cadmium and chromium: presence of and amounts.

.2 Mercury: presence of and amounts.

.3 Organochlorines and PCBs: presence of and amounts.

.5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.6 Manufacturer's Instructions:

.1 Submit manufacturer's installation and application instructions.

.7 Closeout Submittals: submit maintenance data for incorporation into manual and include the following:

.1 Product name, type and use.

.2 Manufacturer's product number.

.3 Colour numbers.

.4 MPI Environmentally Friendly classification system rating.

1.5 MAINTENANCE

.1 Extra Materials:

.1 Deliver to extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels.

.2 Quantity: provide one - one four litre can of each type and colour of primer, finish coating. Identify colour and paint type in relation to established colour schedule and finish system.

.3 Delivery, storage and protection: comply with NRC Departmental Representative requirements for delivery and storage of extra materials.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Packing, Shipping, Handling and Unloading:

.1 Pack, ship, handle and unload materials in accordance with manufacturer's written instructions.

.2 Acceptance at Site:

.1 Identify products and materials with labels indicating:

.1 Manufacturer's name and address.

.2 Type of paint or coating.

.3 Compliance with applicable standard.

.4 Colour number in accordance with established colour schedule.

.3 Remove damaged, opened and rejected materials from site.

.4 Storage and Protection:

.1 Provide and maintain dry, temperature controlled, secure storage.

.2 Store materials and supplies away from heat generating devices.

.3 Store materials and equipment in well ventilated area with temperature range 7 degrees C to 30 degrees C.

.5 Store temperature sensitive products above minimum temperature as recommended by manufacturer.

.6 Keep areas used for storage, cleaning and preparation clean and orderly. After completion of operations, return areas to clean condition.

.7 Remove paint materials from storage only in quantities required for same day use.

.8 Fire Safety Requirements:

.1 Provide one 9 kg Type ABC dry chemical fire extinguisher adjacent to storage area.

.2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

.3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.

.9 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling.

.4 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste.

.5 Place materials defined as hazardous or toxic in designated containers.

.6 Handle and dispose of hazardous materials in accordance with Regional and Municipal, regulations.

.7 Ensure emptied containers are sealed and stored safely.

.8 Unused paint, coating materials must be disposed of at official hazardous material collections site.

.9 Paint, stain and wood preservative finishes and related materials (thinners, and solvents) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.

.10 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

.11 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

.12 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground follow these procedures:

.1 Retain cleaning water for water-based materials to allow sediments to be filtered out.

.2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

.3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.

.4 Dispose of contaminants in approved legal manner in accordance with hazardous waste regulations.

.5 Empty paint cans are to be dry prior to disposal or recycling (where available).

.13 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.

.14 Set aside and protect surplus and uncontaminated finish materials. Deliver to or arrange collection for verifiable re-use or re-manufacturing.

1.7 SITE CONDITIONS

.1 Heating, Ventilation and Lighting:

.1 Ventilate enclosed spaces.

.2 Provide heating facilities to maintain ambient air and substrate temperatures above 10 degrees C for 24 hours before, during and after paint application until paint has cured sufficiently.

.3 Provide continuous ventilation for seven days after completion of application of paint.

.4 Coordinate use of existing ventilation system with NRC Departmental Representative and ensure its operation during and after application of paint as required.

.5 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.

.6 Provide minimum lighting level of 323 Lux on surfaces to be painted.

.2 Temperature, Humidity and Substrate Moisture Content Levels:

.1 Unless pre-approved written approval by product manufacturer, perform no painting when:

.1 Ambient air and substrate temperatures are below 10 degrees C.

.2 Substrate temperature is above 32 degrees C unless paint is specifically formulated for application at high temperatures.

.3 Substrate and ambient air temperatures are not expected to fall within MPI or paint manufacturer's prescribed limits.

.4 The relative humidity is under 85% or when the dew point is more than 3 degrees C variance between the air/surface temperature. Paint should not be applied if the dew point is less than 3 degrees C below the ambient or surface temperature. Use sling psychrometer to establish the relative humidity before beginning paint work.

.5 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.

.6 Ensure that conditions are within specified limits during drying or curing process, until newly applied coating can itself withstand 'normal' adverse environmental factors.

.2 Perform painting work when maximum moisture content of the substrate is below:

.1 Allow new concrete and masonry to cure minimum of 28 days.

.2 15% for wood.

.3 12% for plaster and gypsum board.

.3 Test for moisture using calibrated electronic Moisture Meter. Test concrete floors for moisture using "cover patch test".

.4 Test concrete, masonry and plaster surfaces for alkalinity as required.

.3 Surface and Environmental Conditions:

.1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.

.2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.

.3 Apply paint when previous coat of paint is dry or adequately cured.

.4 Additional interior application requirements:

.1 Apply paint finishes when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

.2 Apply paint in occupied facilities during silent hours only. Schedule operations to approval of NRC Departmental Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.

Part 2 Products

2.1 MATERIALS

.1 Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.

.2 Provide paint materials for paint systems from single manufacturer.

.3 Conform to latest MPI requirements for interior painting work including preparation and priming.

.4 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) in accordance with MPI Architectural Painting Specification Manual "Approved Product" listing.

.5 Linseed oil, shellac, and turpentine: highest quality product from approved manufacturer listed in MPI Architectural Painting Specification Manual, compatible with other coating materials as required.

.6 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids:

.1 Do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.

.7 Formulate and manufacture water-borne surface coatings with no aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.

.8 Flash point: 61.0 degrees C or greater for water-borne surface coatings and recycled water-borne surface coatings.

.9 Ensure manufacture and process of both water-borne surface coatings and recycled water-borne surface coatings does not release:

.1 Matter in undiluted production plant effluent generating 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to natural watercourse or sewage treatment facility lacking secondary treatment.

.2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to natural watercourse or a sewage treatment facility lacking secondary treatment.

.10 Water-borne paints and stains, recycled water-borne surface coatings and water borne varnishes to meet minimum "Environmentally Friendly" E2 rating.

.11 Recycled water-borne surface coatings to contain 50 % post-consumer material by volume.

.12 Recycled water-borne surface coatings must not contain:

.1 Lead in excess of 600.0 ppm weight/weight total solids.

.2 Mercury in excess of 50.0ppm weight/weight total product.

.3 Cadmium in excess of 1.0ppm weight/weight total product.

.4 Hexavelant chromium in excess of 3.0 ppm weight/weight total product.

.5 Organochlorines or polychlorinated biphenyls (PCBS) in excess of 1.0 ppm weight/weight total product.

2.2 COLOURS

.1 NRC Departmental Representative will provide Colour Schedule after Contract award.

.2 Colour schedule will be based upon selection of five base colours and three accent colours. No more than eight colours will be selected for entire project and no more than three colours will be selected in each area.

.3 Selection of colours from manufacturer’s full range of colours.

.4 Where specific products are available in restricted range of colours, selection based on limited range.

.5 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

2.3 MIXING AND TINTING

.1 Perform colour tinting operations prior to delivery of paint to site.

.2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.

.3 Use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.

.4 Thin paint for spraying in accordance with paint manufacturer's instructions.

.5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 GLOSS/SHEEN RATINGS

.1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

	Gloss @ 60 Degrees	Sheen @ 85 Degrees
Gloss Level 1- Matte Finish (flat)	Max. 5	Max. 10
Gloss Level 2 - Velvet-Like Finish	Max. 10	10 to 35
Gloss Level 3 - Eggshell Finish	10 to 25	10 to 35
Gloss Level 4 - Satin-Like Finish	20 to 35	min. 35
Gloss Level 5 - Traditional Semi-Gloss Finish	35 to 70	
Gloss Level 6 - Traditional Gloss	70 to 85	
Gloss Level 7 - High Gloss Finish	More than 85	

2.5 INTERIOR PAINTING SYSTEMS

.1 Concrete vertical surfaces: including horizontal soffits:

.1 INT 3. 1A - Latex finish (over sealer).

.2 Concrete horizontal surfaces: floors and stairs:

.1 INT 3.2C - Epoxy finish.

.3 Concrete masonry units: smooth and split face block and brick:

.1 INT 4.2A - Latex finish.

.4 Structural steel and metal fabrications: columns, beams, joists:

.1 INT 5.1A - Quick dry enamel semi-gloss finish.

.5 Steel - high heat: (boilers, furnaces, heat exchangers, breeching, pipes, flues, stacks, etc., with temperature range as noted):

.1 INT 5.2A - Heat resistant enamel finish, maximum 205 degrees C.

.2 INT 5.2B - Heat resist ant aluminum paint finish, maximum 427 degrees C.

.3 INT 5.2C - Inorganic zinc rich coating, maximum 400 degrees C.

.4 INT 5.2D - High heat resistant coating, maximum 593 degrees C.

.6 Galvanized metal: doors, frames, railings, misc. steel, pipes, overhead decking, and ducts.

.1 INT 5.3A - Latex finish.

.2 INT 5.3D - Epoxy finish (over epoxy primer).

.7 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock type material", and textured finishes:

.1 INT 9.2A - Latex finish (over latex sealer).

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 GENERAL

.1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.

.2 Apply paint materials in accordance with paint manufacturer's written application instructions.

3.3 EXAMINATION

.1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to NRC Departmental Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.

.2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

.3 Maximum moisture content as follows:

.1 Stucco, plaster and gypsum board: 12%.

.2 Concrete: 12%.

.3 Clay and Concrete Block/Brick: 12%.

.4 Wood: 15%.

3.4 PREPARATION

.1 Protection:

.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by NRC Departmental Representative.

.2 Protect items that are permanently attached such as Fire Labels on doors and frames.

.3 Protect factory finished products and equipment.

.4 Protect passing pedestrians, building occupants and general public in and about the building.

.2 Surface Preparation:

.1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.

.2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.

.3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of NRC Departmental Representative.

.3 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:

.1 Remove dust, dirt, and other surface debris by vacuuming, wiping with dry, clean cloths or compressed air.

.2 Wash surfaces with a biodegradable detergent and bleach where applicable and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.

.3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.

.4 Allow surfaces to drain completely and allow to dry thoroughly.

.5 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.

.6 Use trigger operated spray nozzles for water hoses.

.7 Many water-based paints cannot be removed with water once dried. Minimize use of mineral spirits or organic solvents to clean up water-based paints.

.4 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.

.5 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.

.1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.

.2 Apply wood filler to nail holes and cracks.

.3 Tint filler to match stains for stained woodwork.

.6 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.

.7 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes blowing with clean dry compressed air or vacuum cleaning.

.8 Touch up of shop primers with primer as specified.

3.5 APPLICATION

.1 Method of application to conform to manufacturer's application instructions unless specified otherwise.

.2 Brush and Roller Application:

.1 Apply paint in uniform layer using brush and/or roller type suitable for application.

.2 Work paint into cracks, crevices and corners.

.3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.

.4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces free of roller tracking and heavy stipple.

.5 Remove runs, sags and brush marks from finished work and repaint.

.3 Spray application:

.1 Provide and maintain equipment that is suitable for intended purpose, capable of atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.

.2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.

.3 Apply paint in uniform layer, with overlapping at edges of spray pattern. Back roll first coat application.

.4 Brush out immediately all runs and sags.

.5 Use brushes and rollers to work paint into cracks, crevices and places which are not adequately painted by spray.

.4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access.

.5 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.

.7 Sand and dust between coats to remove visible defects.

.8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.

.9 Finish inside of cupboards and cabinets as specified for outside surfaces.

.10 Finish closets and alcoves as specified for adjoining rooms.

.11 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

3.6 MECHANICAL/ ELECTRICAL EQUIPMENT

.1 Second Floor: paint exposed ductwork **only.**~~and other mechanical and electrical equipment.~~

~~.2 Boiler room, mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.~~

~~.3~~**.2** **Lowe level and** ~~O~~**o**ther unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.

~~.4~~**.3** Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.

~~.5~~**.4** Do not paint over nameplates.

~~.6~~**.5** Keep sprinkler heads free of paint.

~~.7~~**.6** Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.

~~.8~~**.7** Paint fire protection piping red.

~~.9~~**.8** Paint disconnect switches for fire alarm system and exit light systems in red enamel.

~~.10~~**.9** Paint natural gas piping yellow.

~~.11~~**.10** Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

~~.12~~**.11** Do not paint interior transformers and substation equipment.

3.7 SITE TOLERANCES

.1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.

.2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.

.3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

3.8 FIELD QUALITY CONTROL

.1 Standard of Acceptance:

.1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.

.2 Ceilings: no defects visible from floor at 45 degrees degrees to surface when viewed using final lighting source.

.3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

.2 Advise NRC Departmental Representative when surfaces and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.

.3 Cooperate with inspection firm and provide access to areas of work.

.4 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by NRC Departmental Representative.

3.9 RESTORATION

.1 Clean and re-install hardware items removed before undertaken painting operations.

.2 Remove protective coverings and warning signs as soon as practical after operations cease.

.3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.

.4 Protect freshly completed surfaces from paint droppings and dust to approval of NRC Departmental Representative. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by NRC Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 05 50 00 - Metal Fabrications.

.2 Section 06 10 00 - Rough Carpentry.

.3 Section 10 21 13.13 - Metal Toilet Compartments.

1.2 REFERENCES

.1 ASTM International

.1 ASTM A 167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

.2 ASTM B 456-03, Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.

.3 ASTM A 653/A 653M-09, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.4 ASTM A 924/A 924M-09, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.81-M90, Air Drying and Baking Alkyd Primer for Vehicles and Equipment.

.2 CAN/CGSB-1.88-92, Gloss Alkyd Enamel, Air Drying and Baking.

.3 CGSB 31-GP-107MA-90, Non-inhibited Phosphoric Acid Base Metal Conditioner and Rust Remover.

.3 CSA International

.1 CAN/CSA-B651-04, Accessible Design for the Built Environment.

.2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Provide manufacturer's printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of **Ontario,** Canada.

.2 Indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment devices, description of rough-in-frame, building-in details of anchors for grab bars .

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for toilet and bath accessories for incorporation into manual.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Tools:

.1 Provide special tools required for assembly, disassembly or removal for toilet and bath accessories.

.2 Deliver special tools to NRC Departmental Representative.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground, indoors ,in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect toilet and bathroom accessories from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

Part 2 Products

2.1 MATERIALS

.1 Sheet steel: to ASTM A 653/A 653M with ZF001 designation zinc coating.

.2 Stainless steel sheet metal: to ASTM A 167, Type 302, withclear finish.

.3 Stainless steel tubing: Type 302, commercial grade, seamless welded, 1.2 mm wall thickness.

.4 Fasteners: concealed screws and bolts hot dip galvanized, exposed fasteners to match face of unit. Expansion shields fibre, lead or rubber as recommended by accessory manufacturer for component and its intended use.

2.2 COMPONENTS

.1 Toilet tissue dispenser: Owner supplied.

.2 Paper towel dispenser: Owner supplied.

.3 Soap dispenser: Owner supplied.

.4 Grab bars: 30 mm diameter x 1.6 mm wall tubing of stainless steel, 38 mm diameter wall flanges, concealed screw attachment, flanges welded to tubular bar, provided with steel back plates and all accessories. Knurl bar at area of hand grips. Grab bar material and anchorage to withstand downward pull of 2.2 kN.

.5 Tilt mirror: wall mounted unit, fixed framed mirror 6 mm, stainless steel frame with integral shelf.

.6 Diaper changing station: surface mounted wall unit, polyethylene insert, moulded-in steel-on-steel hinge assembly, moulded-in integral support mechanism, 851 mm wide x 584 mm high, concealed gas shock, security lock, tamper resistant hardware, steel backer plate, diaper bag hook, liner dispenser, safety belt, safety instructions in both official languages, labeled with universally accepted symbol "changing station".

.1 Acceptable Material:

.1 Rubbermaid Horizontal Change Station 7818-88.

.7 Feminine napkin/tampon dispenser: stainless steel, semi-recessed unit including rough-in frame, min capacity 15 napkins and 20 tampons, free operation, key locked, continuous hinge front panel.

.8 Feminine napkin disposal bin: stainless steel, semi-recessed unit including rough-in frame, continuous hinged door, self closing, embossed with "napkin disposal", "receptacle de serviette-sanitaire", removable stainless steel receptacles fitted with spring clip for deodorizer block.

.9 Electronic dryer: power controlled by infrared admitting, receiving electronic control device positioned to dryer on when hands are placed under nozzle. Operation to continue for no more than 80 seconds of continued use.

.1 Acceptable Material:

.1 Dyson Airblade db Hand Dryer.

2.3 FABRICATION

.1 Weld and grind joints of fabricated components flush and smooth. Use mechanical fasteners only where approved.

.2 Wherever possible form exposed surfaces from one sheet of stock, free of joints.

.3 Brake form sheet metal work with 1.5 mm radius bends.

.4 Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.

.5 Back paint components where contact is made with building finishes to prevent electrolysis.

.6 Hot dip galvanize concealed ferrous metal anchors and fastening devices to CAN/CSA-G164.

.7 Shop assemble components and package complete with anchors and fittings.

.8 Deliver inserts and rough-in frames to job site at appropriate time for building-in. Provide templates, details and instructions for building in anchors and inserts.

.9 Provide steel anchor plates and components for installation on studding and building framing.

2.4 FINISHES

.1 Chrome and nickel plating: to ASTM B 456, satin finish.

.2 Baked enamel: condition metal by applying one coat of metal conditioner to CGSB 31-GP-107Ma, apply one coat Type 2 primer to CAN/CGSB-1.81 and bake, apply two coats Type 2 enamel to CAN/CGSB-1.88 and bake to hard, durable finish. Sand between final coats. Colour selected from standard range by NRC Departmental Representative.

.3 Manufacturer's or brand names on face of units not acceptable.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrates and surfaces to receive toilet and bathroom accessories previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's instructions prior to toilet and bathroom accessories installation.

.2 Inform NRC Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval from NRC Departmental Representative.

3.2 INSTALLATION

.1 Install and secure accessories rigidly in place as follows:

.1 Stud walls: install steel back-plate to stud prior to plaster or drywall finish. Provide plate with threaded studs or plugs.

.2 Hollow masonry units, existing plaster or drywall: use toggle bolts drilled into cell or wall cavity.

.3 Solid masonry, marble, stone or concrete: use bolt with lead expansion sleeve set into drilled hole.

.4 Toilet and shower compartments: use male to female through bolts.

.2 Install grab bars on built-in anchors provided by bar manufacturer.

.3 Use tamper proof screws/bolts for fasteners.

.4 Fill units with necessary supplies shortly before final acceptance of building.

3.3 ADJUSTING

.1 Adjust toilet and bathroom accessories components and systems for correct function and operation in accordance with manufacturer's written instructions.

.2 Lubricate moving parts to operate smoothly and fit accurately.

3.4 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by toilet and bathroom accessories installation.

3.6 SCHEDULE

.1 Locate accessories where indicated and as follows. Exact locations determined by NRC Departmental Representative.

.2 Combination towel dispenser/waste receptacles: one in each washroom. Maximum height of dispenser and operable part from floor 1200 mm.

.3 Soap dispenser: one at each wash basin.

.4 Hand dryer: one in each washroom. Maximum height of dispenser and operable part from floor 1200 mm.

.5 Grab bar: where indicated. Height of grab bar from floor 750 mm. Side grab bar: maximum distance from rear wall 300 mm, minimum distance passed front edge of toilet 450 mm.

.6 Tilt mirror: one at each accessible wash basin, height of bottom edge of mirror from floor 1000 mm.

.7 Diaper changing station: where indicated.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop drawings:

.1 Drawings to show:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

.2 Drawings and product data accompanied by:

.1 Detailed drawings of bases, supports, and anchor bolts.

.2 Acoustical sound power data, where applicable.

.3 Points of operation on performance curves.

.4 Manufacturer to certify current model production.

.5 Certification of compliance to applicable codes.

.3 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.2 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

.1 Operation and maintenance manual approved by, and final copies deposited with, NRC Departmental Representative before final inspection.

.2 Operation data to include:

.1 Control schematics for systems including environmental controls.

.2 Description of systems and their controls.

.3 Description of operation of systems at various loads together with reset schedules and seasonal variances.

.4 Operation instruction for systems and component.

.5 Description of actions to be taken in event of equipment failure.

.6 Valves schedule and flow diagram.

.7 Colour coding chart.

.3 Maintenance data to include:

.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency, tools required and task time.

.4 Performance data to include:

.1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.

.2 Equipment performance verification test results.

.3 Special performance data as specified.

.4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.5 Approvals:

.1 Submit [2] copies of draft Operation and Maintenance Manual to NRC Departmental Representative for approval. Submission of individual data will not be accepted unless directed by NRC Departmental Representative.

.2 Make changes as required and re-submit as directed by NRC Departmental Representative.

.6 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.7 Site records:

.1 NRC Departmental Representative will provide [1] set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.8 As-Built drawings:

.1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.

.2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).

.3 Submit to NRC Departmental Representative for approval and make corrections as directed.

.4 Perform testing, adjusting and balancing for HVAC using as-built drawings.

.5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

.9 Submit copies of as-built drawings for inclusion in final TAB report.

1.3 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Furnish spare parts as follows:

.1 One set of packing for each pump.

.2 One casing joint gasket for each size pump.

.3 One head gasket set for each heat exchanger.

.4 One glass for each gauge glass.

.5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

.3 Provide one set of special tools required to service equipment as recommended by manufacturers.

.4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

.1 HVAC R Equipment:

.1 Refrigerant:

.1 HCFC based refrigerant.

.2 HFC based refrigerant.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Departmental Representative.

3.2 PAINTING REPAIRS AND RESTORATION

.1 Do painting in accordance with Section 09 91 23 - Interior Painting.

.2 Prime and touch up marred finished paintwork to match original.

.3 Restore to new condition, finishes which have been damaged.

3.3 SYSTEM CLEANING

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units **in accordance with NADCA Standard 2013 requirements**.

3.4 TEMPORARY USE OF SYSTEMS

Building HVAC systems are not to be used for heating or cooling during construction.

3.5 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.6 DEMONSTRATION

.1 NRC Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Trial usage to apply to following equipment and systems:

.1 Chiller

.2 Cooling Tower

.3 Air handlers

.4 Pumps

.5 Automation system

.6 Vacuum System

.3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

.5 Instruction duration time requirements as specified in appropriate sections.

.6 NRC Departmental Representative will record these demonstrations on video tape for future reference.

3.7 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.8 PROTECTION

.1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

3.9 SEISMIC

.1 Seismic restraint systems for all mechanical work to conform to requirements of Section 23 05 48.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 35 21 – Construction Waste Management

.2 Section 02 41 19 – Selective Demolition

1.2 REFERENCES

.1 Comply with Federal, Provincial and local requirements, provided that in any case of conflict among those requirements or with these specifications the more stringent requirements shall apply. Work shall be performed under regulations in effect at the time work is performed.

.2 The Federal Halocarbon Regulations, 2003 - SOR/99/255, made under the Canadian Environmental Protection Act.

.1 Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems (Report EPS 1/RA/2), March 1996, Environment Canada.

.2 ARI Standard 740-98, Refrigerant Recovery/Recycling Equipment, 1998, Air Conditioning and Refrigeration Institute.

.3 Ozone-Depleting Substances Regulations (1998), SOR/99-7, made under the Canadian Environmental Protection Act.

.4 Ontario Refrigerants Regulation, Ontario Regulation 189/94 made under the Environmental Protection Act.

.5 Ozone Depleting Substances – General Regulation, Ontario Regulation 356.

.6 Halon Fire Extinguishing Equipment, O. Reg. 413/94.

.7 Department of Justice Canada (Jus)

.1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).

.8 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.9 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

.10 Occupational Health and Safety Act – Ontario Regulation 654.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 35 21 – Construction Waste Management.

.2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.3 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Consultant.

.4 Place materials defined as hazardous or toxic in designated containers.

.5 Handle and dispose of hazardous materials in accordance with Regional and Municipal regulations.

1.4 GENERAL

.1 Modifications, demolition and installation of services within this building require utmost care due to the intent to reuse systems involved. Demolition activities generally relate to disconnection of mechanical system elements from ceilings and walls that are noted to be demolished.

1.5 CO-ORDINATION BETWEEN NEW AND EXISTING INSTALLATIONS

.1 Provide interfacing components between new and existing systems as necessary for proper performance and operation.

.2 Coordinate relocations and scheduling of services with all disciplines.

1.6 EXISTING SERVICES

.1 Ensure existing services remain undisturbed and energized except where indicated to be disconnected.

.2 Disconnect and remove abandoned fixtures and fittings. Cut pipework and plug flush where embedded in structure. Make safe all connections left for future use.

Part 2 Products

2.1 USE OF EXISTING MATERIAL AND EQUIPMENT

.1 Unless noted otherwise, all existing equipment, ductwork, pipework, fixtures and fittings may not be reused.

.2 Unless noted otherwise, provide additional equipment of same type and manufacture to supplement existing equipment.

Part 3 Execution

3.1 DEMOLITION

.1 Demolish existing work, where indicated, and remove from site.

.2 Execute all demolition work so as to create minimum vibration or dust within and outside the building. Obtain Consultant’s approval of methods before proceeding.

3.2 SALVAGE MATERIALS

.1 Remove from site materials in renovated areas that are not to remain or be reused, unless noted as remaining property of Consultant.

.2 Remove in accordance with Section 01 35 21 – Construction Waste Management.

3.3 MECHANICAL EQUIPMENT REMOVAL

.1 Remove all mechanical equipment and all associated ductwork, piping, electrical and controls as per mechanical demolition drawing.

.2 All coils shall be drained of water and disposed of in a controlled and safe manner to applicable codes and regulations prior to the demolition and disposal of those systems by the hazardous material contractor.

3.4 FIRE PROTECTION SYSTEMS REMOVAL

.1 Remove all fire extinguishers as per mechanical demolition drawings.

3.5 EMCS DEMOLITION

.1 All room sensors located on walls to be demolished are to be carefully relocated from the wall prior to demolition. Existing system wiring shall remain connected to the sensor, spooled and taped and the sensor relocated to the ceiling above with temporary supports.

3.6 REMOVAL AND RECYCLING

.1 Separate and recycle waste material in accordance with Section 01 35 21 – Construction Waste Management.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Department of National Defence Canada (DND)/Infrastructure and Environment/Construction and Property Services

.1 Canadian Forces Fire Marshal (CFFM).

.2 Fire Commissioner of Canada (FC)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for fire extinguishing systems and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for dry chemical fire extinguishing systems for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect fire extinguishing systems from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 COMPONENTS

.1 UL listed dry chemical fire extinguisher. 3-A: 40-B:C

.1 Steel cylinder, plated brass valve, stainless steel handle/lever **and 10 lbs in capacity.**

.2 Complete with wall-bracket mounting.

.2 Fire extinguisher cabinets:

.1 Recessed cabinets with glass door and full piano hinge, flush stainless steel latch, finished with baked enamel paint.

.1 National Fire Equipment CE-950-3

.2 229mmx610mmx152mm

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with National Fire Code and Authority Having Jurisdiction.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet for fixtures and equipment.

.2 Submit WHMIS MSDS in accordance with Section 02 81 01 - Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing.

.3 Shop Drawings.

.1 Submit shop drawings to indicate:

.1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.

.2 Wiring and schematic diagrams.

.3 Dimensions and recommended installation.

.4 Pump performance and efficiency curves.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Manufacturers' Field Reports: manufacturers' field reports specified.

.7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals, include:

.1 Manufacturers name, type, model year, capacity and serial number.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list with names and addresses.

1.3 QUALITY ASSURANCE

.1 Pre-Installation Meeting:.

.1 Convene pre-installation meeting one week prior to beginning work of this Section.

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Separate waste materials for recycling in accordance with Section 01 47 19 - Construction/Demolition Waste Management and Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal materials from landfill to metal recycling facility as approved by NRC Departmental Representative.

.5 Unused sealant materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

.6 Fold up metal and plastic banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 DOMESTIC HOT WATER CIRCULATING PUMPS

.1 Capacity: as indicated.

.2 Construction: closed-coupled, in-line centrifugal, all bronze construction, stainless steel shaft, stainless steel or bronze shaft sleeve, two oil lubricated bronze sleeves or ball bearings. Design for 57kPa and 105 degrees C continuous service.

.3 Motor: drip-proof, with thermal overload protection.

.4 Supports: provide as recommended by manufacturer.

2.2 SUMP PUMP SUBMERSIBLE

.1 Capacity: as indicated.

.2 Construction: duplex CSA approved, housing epoxy coated cast iron, bronze fitted stainless steel stainless steel shaft, non-clog bronze impeller, mechanical shaft seal.

.3 Motor: hermetically sealed, with automatic overload protection.

.4 Control: mercury switches and duplex control box.

.5 Provide high level and trouble alarm relay for connection to BMS. Relay to suit requirements of Division 25. Refer to Section 25 35 00.

2.3 BILGE AND SEWAGE PUMP

.1 Capacity: as indicated.

.2 Construction: duplex, vertical extended shaft, single stage centrifugal, designed to handle 50 mm solids and for sump depth as indicated bronze fitted.

.3 Motor: drip-proof, with overload and under voltage protection.

.4 Control: copper ball float operated heavy duty switch. Starter switch on cover plate. Automatic electric alternator with selector relays to alternate or activate both pumps. Adjustable float stops on stainless steel rod.

.5 Alarm: audible and visual alarm located as indicated controlled by float or pressure operated switch.

.6 Provide high level and trouble alarm relay for connection to BMS. Relay to suit requirements of Division 25. Refer to Section 25 35 00.

~~.6~~**.7** Sump: fibreglass reinforced plastic one piece, to manufacturers standard, with heavy bituminous coating inside and out.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 INSTALLATION

.1 Make piping and electrical connections to pump and motor assembly and controls as indicated.

.2 Ensure pump and motor assembly do not support piping.

.3 Align vertical pit mounted pump assembly after mounting and securing cover plate.

3.3 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:

.1 Check power supply.

.2 Check starter protective devices.

.2 Start-up, check for proper and safe operation.

.3 Check settings and operation of hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature and other protective devices.

.4 Adjust flow from water-cooled bearings.

.5 Adjust impeller shaft stuffing boxes, packing glands.

3.4 START-UP

.1 General:

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.

.2 Procedures:

.1 Check power supply.

.2 Check starter O/L heater sizes.

.3 Start pumps, check impeller rotation.

.4 Check for safe and proper operation.

.5 Check settings, operation of operating, limit, safety controls, over-temperature, audible/visual alarms, other protective devices.

.6 Test operation of hands-on-auto switch.

.7 Test operation of alternator.

.8 Adjust leakage through water-cooled bearings.

.9 Adjust shaft stuffing boxes.

.10 Adjust leakage flow rate from pump shaft stuffing boxes to manufacturer's recommendations.

.11 Check base for free-floating, no obstructions under base.

.12 Run-in pumps for 12 continuous hours.

.13 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

.14 Adjust alignment of piping and conduit to ensure full flexibility.

.15 Eliminate causes of cavitation, flashing, air entrainment.

.16 Measure pressure drop across strainer when clean and with flow rates as finally set.

.17 Replace seals if pump used to degrease system or if pump used for temporary heat.

.18 Verify lubricating oil levels.

3.5 PERFORMANCE VERIFICATION (PV) PRESSURE BOOSTER PUMPS

.1 General:

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified.

.2 Obtain manufacturer's approval, before performing PV, to ensure warranties remain intact.

.3 Application tolerances:

.1 Flow: +/- 10%.

.2 Pressure: Plus 20%, minus 5%.

.4 PV procedures:

.1 Open pump balancing valve fully.

.2 Measure differential pressure (DP) across pump.

.3 Measure amperage and voltage and compare with manufacturer's data sheets and motor nameplate data.

.4 If suction is different size than discharge connection, add velocity head correction factor to DP.

.5 Mark this DP on manufacturer's pump curve.

.6 If flow rate is higher than specified, slow close balancing valve until specified DP is reached.

.7 Repeat measurements of amps and volts. Compare with manufacturer's data sheets.

.8 Calculate BHP and compare with nameplate data.

3.6 PV - SANITARY PUMPS

.1 Application tolerances:

.1 Flow: plus 10%; minus 0%.

.2 Pressure: plus 10%; Minus 5%.

.2 PV Procedures:

.1 Fill sump at rate slower than capacity of pump #1.

.2 Record levels at which pump #1 starts and stops. Determine flow rate by observing time taken to down water level.

.3 Fill sump at rate faster than capacity of pump #1 but slower than capacities of pumps #1 and #2 operating in parallel.

.4 Record levels at which pumps start and stop - water level rising and water level falling.

.5 Verify operation of alternator.

.6 Adjust water level controls as necessary.

.7 Fill sump at rate faster than capacities of pumps #1 and #2 operating in parallel.

.8 Record levels at pump starts and stops - water level rising and falling.

.9 Check operation of alternator.

.10 Adjust level controls as necessary.

.11 Check level at which high water level alarm starts and stops. Adjust as necessary.

.3 Check removability of pumps for servicing without interfering with installation or operation of other equipment.

.4 Verify non-clog capability and maximum size of solids, using procedures recommended by manufacturer.

3.7 REPORTS

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: reports, supplemented as specified.

.2 Include:

.1 PV results on approved PV Report Forms.

.2 Product Information report forms.

.3 Pump performance curves (family of curves) with final point of actual performance.

3.8 TRAINING

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O M Personnel, supplemented as specified.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 ASTM International

.1 ASTM A126- 04(2009), Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

.2 ASTM B62- 09, Standard Specification for Composition Bronze or Ounce Metal Castings.

.2 American Water Works Association (AWWA)

.1 ANSI/AWWA C700- 09, Standard for Cold Water Meters-Displacement Type, Bronze Main Case.

.2 ANSI/AWWA C701- 12, Standard for Cold Water Meters-Turbine Type for Customer Service.

.3 ANSI/AWWA C702- 10, Standard for Cold Water Meters-Compound Type.

.3 CSA International

.1 CSA-B64 Series- 11, Backflow Preventers and Vacuum Breakers.

.2 CSA B79- 08, Commercial and Residential Drains and Cleanouts.

.3 CAN/CSA-B356- 10, Water Pressure Reducing Valves for Domestic Water Supply Systems.

.4 Efficiency Valuation Organization (EVO)

.1 International Performance Measurement and Verification Protocol (IPMVP).

.1 IPMVP 2007 Version.

.5 Plumbing and Drainage Institute (PDI)

.1 PDI-G101- R2010, Testing and Rating Procedure for Grease Interceptors with Appendix of Installation and Maintenance.

.2 PDI-WH201- R2010, Water Hammer Arresters Standard.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation Meetings:

.1 Convene pre-installation meeting 1 week prior to on-site installation, with contractor's representative NRC Departmental Representative to:

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building construction subtrades.

.4 Review manufacturer's written installation instructions and warranty requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for plumbing products and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements. Indicate VOC's:

.3 Shop Drawings:

.1 Indicate on drawings to indicate materials, finishes, method of anchorage, number of anchors, dimensions construction and assembly details accessories.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Manufacturers' Field Reports: manufacturers' field reports specified.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for plumbing specialties and accessories for incorporation into manual.

.1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect plumbing materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 FLOOR DRAINS

.1 Floor Drains and Trench Drains: to ASME A112.6.3-2001.

.2 Type FD1: foot traffic areas; cast iron body round, adjustable head, nickel bronze strainer, integral seepage pan, and flashing collar, trip seal primer tapping, no hub outlet.

.1 Equivalent to Jay R. Smith 2005Y

.3 Type FD2: wheel traffic areas (mechanical rooms, basement corridor, workshops); cast iron body round, adjustable head, heavy duty nickel bronze strainer, integral seepage pan, and flashing collar, trip seal primer tapping, no hub outlet.

.1 Equivalent to Jay R. Smith 2005AHD

.4 Type FFD: funnel floor drain (mechanical rooms); cast iron body round, adjustable head, heavy duty nickel bronze strainer with integral oval funnel, integral seepage pan, and flashing collar, trip seal primer tapping, no hub outlet.

.1 Equivalent to Jay R. Smith 2005AHD-F19

2.2 ROOF DRAINS

.1 Type 1: cast iron body, under deck clamp and sump receiver to suit roof construction, flashing clamp ring with integral gravel stop, bearing pan, polyethylene dome.

.1 Equivalent to Jay R Smith 1010

2.3 CLEANOUTS

.1 Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.

.2 Access Covers:

.1 Wall Access: face or wall type, stainless steel square cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.

.2 Floor Access: round cast iron body and frame with adjustable secured nickel bronze top and:

.1 Plugs: bolted bronze with neoprene gasket.

.2 Cover for Unfinished Concrete Floors: cast iron round, gasket, vandal-proof screws.

.1 Equivalent to Jay R. Smith 4220

.3 Cover for Terrazzo Finish: polished nickel bronze with recessed cover for filling with terrazzo, vandal-proof locking screws.

.1 Equivalent to Jay R. Smith 4180-CAN

.4 Cover for Tile and Linoleum Floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.

.5 Cover for Carpeted Floors: polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.

.1 Equivalent to Jay R. Smith 4021S-Y

2.4 NON-FREEZE WALL HYDRANTS

.1 Recessed type with integral vacuum breaker-backflow preventor, NPS 3/4 hose outlet, removable operating key. Chrome plated brassfinish.

.2 To ASSE 1019

.1 Equivalent to Watts series HY42

2.5 WATER HAMMER ARRESTORS

.1 Hard drawn copper body with machined lead-free brass piston, NPT solid hex brass, air chamber precharged to 422 kPa.

.2 PDI WH201 approved

.3 ANSI A112.26.1M approved

.1 Equivalent to Watts Series LF15

2.6 BACK FLOW PREVENTERS

.1 Preventers: to CSA-B64 Series, application as indicated,

.2 reduced pressure principle type, complete with strainer, isolation ball valves, differential pressure relief valve between two positively seated check valves – Watts Series 909

.3 double check valve assembly

.4 Dual check valve with intermediate atmospheric vent, complete with union connections, stainless steel internals, rubber seated checks, ASSE approved – Watts 9D.

2.7 VACUUM BREAKERS

.1 Breakers: to CSA-B64 Series, vacuum breaker.

2.8 HOSE BIBBS AND SEDIMENT FAUCETS

.1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.

2.9 WATER MAKE-UP ASSEMBLY

.1 Complete with backflow preventer pressure gauge on inlet and outlet, pressure reducing valve to CAN/CSA-B356, pressure relief valve on low pressure side and gate valves on inlet and outlet.

2.10 WATER METERS

.1 Compound type to ANSI/AWWA C702.

.2 Accessories: remote readout device **and interface with BMS**.

2.11 TRAP SEAL PRIMERS

.1 Brass, with integral vacuum breaker, NPS 1/2 solder ends, NPS 1/2 drip line connection.

.1 Equivalent to P.P.P Inc Model P0-500

2.12 STRAINERS

.1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.

.2 NPS 2 and under, bronze body, screwed ends, with brass cap.

.3 NPS 2 1/2 and over, cast iron body, flanged ends, with bolted cap.

2.13 VACUUM PUMP TANK (SUPPLIED BY OWNER)

.1 Vacuum tank:

.1 300 gallon – 6mm (1/4") A36 Grade Carbon Steel

.2 Single Compartment, 914mm (36") diameter x 1829mm (6') long

.3 Offset construction

.4 Two flanged & Dished tank heads

.5 Exterior seams submerged arc welded (SAW)

.2 The Vacuum Tank shall be furnished will all of the following accessories:

.1 Rails – standard style, 25mm A36 Carbon Steel

.2 Discharge port – 100mm threaded nipple, male NPT

.3 Valve – Brass Lever – 75mm Female NPT x Female NPT with 75mm Male Camlock NPT & Female Camlock Dust Cap.

.4 Valve – Brass Level – 100mm Female NPT x Female NPT with 100mm Male Camlock NPT & Female Camlock Dust Cap.

.5 Manway – 914mm (36") with 305mm (12") Neck, 8 Wingnut, 6mm (1/4") A36 Carbon Steel, Rear Mounted

.6 Accessory Package – Conde – For Super & SDS Pump Models, includes Oil Catch Muffler, Primary & Secondary Shutoffs, Pre-Filters

.7 Hose Hangers – 150mm (6") Driver's Side

.8 Sight Eyes (2) – 125mm (5") Glass with Carbon Steel Weldment

.9 Vacuum/Pressure Gauge – 115mm (4.5") Standard with Guard

.10 Pressure Relief Valve – 38mm (1.5") Brass (109 L/S) with Guard.

.11 Vacuum Relief Valve – 38mm (1.5") Brass (175 L/S)

.12 SDS-12 Conde 85 L/S (Vacuum/Pressure) pump belt driven with 10 HP three phase electric motor platform.

.13 Pump Platform – Standard (LMT)

.14 Paint Preparation – Wash, Phosphatization, Primer (< 3785 L or < 1000 Gal)

.15 Paint – Standard – 1890 L – 3591 L (500 – 950 Gal) Tank, Bright White.

.16 3m long 75mm diameter reinforced flexible drain hose with threaded coupling for connecting to tank discharge and plain end for discharge into sanitary.

.17 Recessed floor box with hinged cover for access to capped sanitary wye in floor to drain tank.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for plumbing specialities and accessories installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Departmental Representative.

3.2 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.3 INSTALLATION

.1 Install in accordance with National Plumbing Code of Canada.

.2 Install in accordance with manufacturer's instructions and as specified.

3.4 CLEANOUTS

.1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as indicated.

.2 Bring cleanouts to wall or finished floor unless serviceable from below floor.

.3 Building drain cleanout and stack base cleanouts: line size to maximum NPS 4.

3.5 NON-FREEZE WALL HYDRANTS

.1 Install 600 mm above finished grade and as indicated.

3.6 WATER HAMMER ARRESTORS

.1 Install on branch supplies to fixtures or group of fixtures.

3.7 BACK FLOW PREVENTERS

.1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.

.1 Drains.

.2 Backwater Valves.

.3 Water Make-up Assembly.

.4 Grease Interceptors.

.2 Pipe discharge to terminate over nearest funnel floor drain.

3.8 HOSE BIBBS AND SEDIMENT FAUCETS

.1 Install at bottom of risers, at low points to drain systems, and as indicated.

3.9 TRAP SEAL PRIMERS

.1 Install for floor drains and elsewhere, as indicated.

.2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of NRC Departmental Representative.

.3 Install soft copper tubing to floor drain.

3.10 STRAINERS

.1 Install with sufficient room to remove basket for maintenance.

3.11 WATER METERS

~~.1 Install water meter provided by local water authority.~~

~~.2~~**.1** Install water meter as indicated.

3.12 WATER MAKE-UP ASSEMBLY

.1 Install on valved bypass.

.2 Pipe discharge from relief valve to nearest floor drain.

3.13 START-UP

.1 General:

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.

.2 Timing: start-up only after:

.1 Pressure tests have been completed.

.2 Disinfection procedures have been completed.

.3 Certificate of static completion has been issued.

.4 Water treatment systems operational.

.3 Provide continuous supervision during start-up.

3.14 TESTING AND ADJUSTING

.1 General:

.1 Test and adjust plumbing specialties and accessories in accordance with Section 01 91 13- General Commissioning (Cx) Requirements : General Requirements, supplemented as specified.

.2 Timing:

.1 After start-up deficiencies rectified.

.2 After certificate of completion has been issued by authority having jurisdiction.

.3 Application tolerances:

.1 Pressure at fixtures: +/- 70 kPa.

.2 Flow rate at fixtures: +/- 20%.

.4 Adjustments:

.1 Verify that flow rate and pressure meet design criteria.

.2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.

.5 Floor drains:

.1 Verify operation of trap seal primer.

.2 Prime, using trap primer. Adjust flow rate to suit site conditions.

.3 Check operations of flushing features.

.4 Check security, accessibility, removability of strainer.

.5 Clean out baskets.

.6 Vacuum breakers, backflow preventers, backwater valves:

.1 Test tightness, accessibility for O M of cover and of valve.

.2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.

.3 Verify visibility of discharge from open ports.

.7 Roof drains:

.1 Check location at low points in roof.

.2 Check security, removability of dome.

.3 Adjust weirs to suit actual roof slopes, meet requirements of design.

.4 Clean out sumps.

.5 Verify provisions for movement of roof systems.

.8 Access doors:

.1 Verify size and location relative to items to be accessed.

.9 Cleanouts:

.1 Verify covers are gas-tight, secure, yet readily removable.

.10 Water hammer arrestors:

.1 Verify proper installation of correct type of water hammer arrester.

.11 Wall, ground hydrants:

.1 Verify complete drainage, freeze protection.

.2 Verify operation of vacuum breakers.

.12 Pressure regulators, PRV assemblies:

.1 Adjust settings to suit locations, flow rates, pressure conditions.

.13 Strainers:

.1 Clean out repeatedly until clear.

.2 Verify accessibility of cleanout plug and basket.

.3 Verify that cleanout plug does not leak.

~~.14 Grease interceptors:~~

~~.1 Activate, using manufacturer's recommended procedures and materials.~~

~~.15~~.14 Hose bibbs, sediment faucets:

.1 Verify that flow and pressure meet design criteria.

.2 Check for leaks, replace compression washer if required.

~~.16~~.15 Hydronic system water Make-up Assembly:

.1 Verify flow, pressure, and connection.

~~.17~~.16 Water meters:

.1 Verify location and accessibility.

.2 Test meter reading accuracy.

3.15 CLOSEOUT ACTIVITIES

.1 Commissioning Reports: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: reports, supplemented as specified.

.2 Training: provide training in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O M Personnel, supplemented as specified.

3.16 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.17 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by plumbing specialties and accessories installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-B45 Series- 02(R2008) , Plumbing Fixtures.

.2 CAN/CSA-B125.3- 05 , Plumbing Fittings.

.3 CAN/CSA-B651- 04 , Accessible Design for the Built Environment.

.2 Green Seal Environmental Standards (GSES)

.1 Standard GS-36- 00 , Commercial Adhesives.

.3 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168- A2005 , Adhesive and Sealant Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for washroom fixtures, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Indicate fixtures and trim:

.1 Dimensions, construction details, roughing-in dimensions.

.2 Factory-set water consumption per flush at recommended pressure.

.3 For water closets, urinals: minimum pressure required for flushing.

1.3 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for washroom fixtures, for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.2 Include:

.1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.

.2 Details of operation, servicing, maintenance.

.3 List of recommended spare parts.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MANUFACTURED UNITS

.1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.

.2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.3.

.3 Exposed plumbing brass to be chrome plated.

.4 Number, locations: as indicated.

.5 Fixtures in any one location to be product of one manufacturer and of same type.

.6 Trim in any one location to be product of one manufacturer and of same type.

.7 Water closets:

.1 WC-1 : wall-mounted, exposed flush valve, top spud ultra-low flush, maximum 6 litres/flush.

.1 Bowl: vitreous china, syphon jet, elongated rim. Fully glazed trapway.

.2 MaP score: 1000g of miso @ 1.6 gpf

.3 Equivalent to American Standard Afwall 1.6gpm

.2 WC-2 : As above and barrier free

.8 Electronic Water Closet Flush Valves:

.1 Barrier free, stainless steel, electronic, sensor proximity type, activated by infra-red.

.2 Sensor: waterproof, with impact-resistant, anti scratch coated plastic lens, sensitivity adjustable from 100 mm to 450 mm.

.3 Water conservation: 30 second maximum run time.

.4 Controls: interchangeable receptacles for stainless steel sheathed sensor and modular plug-type solenoid connections, single 6 VDC, slow-closing commercial solenoid for 860 kPa, 85 degrees C.

.5 Transformer: 120VAC/6 VDC , Class 2, UL and CSA listed, hardwire type, sized for up to 8 solenoids.

.6 Equipped with manual override button.

.9 Water Closet Seats.

.1 Seat: white, elongated, open front, moulded solid plastic, less cover, stainless steel check hinges, stainless steel insert post.

.10 Urinals:

.1 U-1 : wall mounted, ultra-low flush, exposed flush valve, top spud.

.1 Urinal: vitreous china, washout type, integral flushing rim, extended shields, integral trap, removable stainless steel strainer, back outlet**, full height equivalent to American Standard Stallbrook**.

.11 Urinal Electronic Flush Valves:

.1 Surface mounted, controlled by infra-red occupancy detector.

.1 Complete with removable filter, 9 second time delay, flush time adjustable from 0-8 seconds, factory set at 4.5 seconds, 4.5 L flush/cycle maximum.

.2 Sensor adjustable from 50-1220 mm, factory set to 860 mm.

.3 Solenoid valve: 6 VDC slow-closing type for 60 kPa (minimum), 1000 kPa (maximum), 85 degrees C with manual over-ride, adjustable flow control.

.4 Transformer: 120/ VAC Class 2, 6 VDC UL and CSA listed, hardwire type.

.5 Manual mechanical override.

.12 Washroom Lavatories:

.1 L-1 : counter-top:

.1 Porcelain-on-steel, self-rimming, with front overflow, soap depressions, gasket, swivel clamps, semi-oval or rectangular bowl, supply openings on 200 mm centres. Sizes: 475 x 400 mm outside, 400 x 250 mm nominal inside.

.2 L-2: wall-hung, for handicapped.

.1 Vitreous china, low shelf, with integral back, contoured front, shallow front basin, front overflow, soap depressions, supply openings on 299 mm centres, concealed supports. Sizes: 686 x 508 mm.

.13 Washroom Lavatory Electronic Trim:

.1 Barrier-free electronic faucet:

.1 Infra-red motion sensor activated by hand motion in lavatory.

.2 Sensor: waterproof, incorporated in body of unit, with impact-resistant plastic lens and anti-scratch coating, inside spout, sensitivity adjustable from 100 mm to 450 mm.

.3 Water conservation: 30 second maximum run time.

.4 Controls: vandal-proof, interchangeable receptacles for stainless steel sheathed sensor and modular plug-type solenoid connections, single 12 VDC slow-closing commercial solenoid for 860 kPa, 85 degrees C.

.5 Transformer: 120/12 VDC Class 2, UL and CSA listed, hard wire type, sized for up to 8 solenoids.

.6 Spout: Chrome plated, with integral flow control aerator rated at 8.35 l/minute at 413 kPa maximum.

.7 Under-counter temperatures mixing controls.

.14 Exam Room Sinks

.1 SK-2 Shampoo Sink

.1 Willoughby 1911 SHAMPOO Sink, Right Hand Hole, 19" x 18-3/4" x 9-1/4" (483mm x 476mm x 235mm) deep, cut into a counter-top, solid surfaced bowl, with wide front neck cut out and wall hanger,

C.P. crumb cup strainer, (standard colour as selected). American Standard #4137.100.002 'CULINAIRE' Combi Pull-Out Spray Faucet, C.P., 8" (203mm), C.C., lead-free cast brass waterways body, ceramic disc valve cartridge, 7-7/8" (200mm) long swing spout with 8.3 LPM (2.2 GPM) max. flow aerator outlet, cast brass swing spout with deluxe pull-out spray, removable deck plate for single hole applicaton, single control metal lever handle and flexible copper supplies. PPP #TCP-2 'TEMPRA VALVE,' C.P. pressure balancing located under sink to serve faucet, specific for Shampoo Sink. Allow 7" (178mm) below interceptor for removal of basket. McGuire #H165N5-LR Supplies, C.P. Polished Brass Sink Supplies, rigid horizontal nipples 3/8" (10mm) x 5" (127mm) long, I.P.S. heavy all brass angle stops with wheel handle stops and escutcheons, less flexible copper risers. Jay R. Smith #8750 Hair Interceptor, C.P. cast iron, with removable basket 1-1/2" (38mm) inlet and outlet, escutcheon. Interceptor is also used as a sink 'p' trap (check local codes). All exposed piping to be chrome plated

~~.14~~**.15** Fixture piping:

.1 Hot and cold water supplies to fixtures:

.1 flexible supply pipes with screwdriver stop, reducers, escutcheon.

.2 Waste:

.1 Brass P trap with clean out on fixtures not having integral trap.

.2 Chrome plated in exposed places.

~~.15~~**.16** Chair carriers:

.1 Factory manufactured floor-mounted carrier systems for wall-mounted fixtures.

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 Mounting heights:

.1 Standard: to manufacturer's recommendations, measured from finished floor.

.2 Barrier free: to most stringent of NBCC and CAN/CSA B651.

3.3 ADJUSTING

.1 Conform to water conservation requirements specified this section.

.2 Adjustments:

.1 Adjust water flow rate to design flow rates.

.2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.

.3 Adjust flush valves to suit actual site conditions.

.4 Adjust urinal flush timing mechanisms.

.5 Set controls of automatic flush valves for WCs and urinals to prevent unnecessary flush cycles.

.3 Checks:

.1 Water closets, urinals: flushing action.

.2 Aerators: operation, cleanliness.

.3 Vacuum breakers, backflow preventers: operation under all conditions.

.4 Thermostatic controls:

.1 Verify temperature settings, operation of control, limit and safety controls.

3.4 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)

.1 ANSI/ASME B31.1- 2007 , Power Piping.

.2 ANSI/ASME B31.3- 2006 , Process Piping.

.3 ANSI/ASME Boiler and Pressure Vessel Code- 2007 :

.1 BPVC 2007 Section I: Power Boilers.

.2 BPVC 2007 Section V: Nondestructive Examination.

.3 BPVC 2007 Section IX: Welding and Brazing Qualifications.

.2 American National Standards Institute/American Water Works Association (ANSI/AWWA)

.1 ANSI/AWWA C206- 03 , Field Welding of Steel Water Pipe.

.3 American Welding Society (AWS)

.1 AWS C1.1M/C1.1- 2000(R2006) , Recommended Practices for Resistance Welding.

.2 AWS Z49.1- 2005 , Safety in Welding, Cutting and Allied Process.

.3 AWS W1- 2000 , Welding Inspection Handbook..

.4 Canadian Standards Association (CSA International)

.1 CSA W47.2- M1987(R2008) , Certification of Companies for Fusion Welding of Aluminum.

.2 CSA W48- 06 , Filler Metals and Allied Materials for Metal Arc Welding.

.3 CSA B51- 03(R2007) , Boiler, Pressure Vessel and Pressure Piping Code.

.4 CSA-W117.2- 2006 , Safety in Welding, Cutting and Allied Processes.

.5 CSA W178.1- 2008 , Certification of Welding Inspection Organizations.

.6 CSA W178.2- 2008 , Certification of Welding Inspectors.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.3 QUALITY ASSURANCE

.1 Qualifications:

.1 Welders:

.1 Welding qualifications in accordance with CSA B51.

.2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.

.3 Submit welder's qualifications to NRC Departmental Representative.

.4 Each welder to possess identification symbol issued by authority having jurisdiction.

.5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.

.2 Inspectors:

.1 Inspectors qualified to CSA W178.2.

.3 Certifications:

.1 Registration of welding procedures in accordance with CSA B51.

.2 Copy of welding procedures available for inspection.

.3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 ELECTRODES

.1 Electrodes: in accordance with CSA W48 Series.

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 QUALITY OF WORK

.1 Welding: in accordance with ANSI/ASME B31.3, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, and applicable requirements of provincial authority having jurisdiction.

3.3 INSTALLATION REQUIREMENTS

.1 Identify each weld with welder's identification symbol.

.2 Backing rings:

.1 Where used, fit to minimize gaps between ring and pipe bore.

.2 Do not install at orifice flanges.

.3 Fittings:

.1 NPS 2 and smaller: install welding type sockets.

.2 Branch connections: install welding tees or forged branch outlet fittings.

3.4 INSPECTION AND TESTS - GENERAL REQUIREMENTS

.1 Review weld quality requirements and defect limits of applicable codes and standards with NRC Departmental Representative before work is started.

.2 Formulate "Inspection and Test Plan" in co-operation with NRC Departmental Representative.

.3 Do not conceal welds until they have been inspected, tested and approved by inspector.

.4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

.5 Apply for, pay and arrange for all inspections and registrations required by Authorities having Jurisdiction.

3.5 SPECIALIST EXAMINATIONS AND TESTS

.1 General:

.1 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 and approved by NRC Departmental Representative.

.2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.

.3 Inspect and test 10 % of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination spot gamma ray radiographic (hereinafter referred to as "radiography") tests.

.2 Hydrostatically test welds to ANSI/ASME B31.1.

.3 Visual examinations: include entire circumference of weld externally and wherever possible internally.

.4 Failure of visual examinations:

.1 Upon failure of welds by visual examination, perform additional testing as directed by NRC Departmental Representative of total of up to 10.

.5 Full radiographic tests for steam piping systems.

.1 Spot radiography:

.1 Conduct spot radiographic tests of up to 10% of welds, selected at random by NRC Departmental Representative from welds which would be most difficult to repair in event of failure after system is operational.

.2 Radiographic film:

.1 Identify each radiographic film with date, location, name of welder, and submit to NRC Departmental Representative. Replace film if rejected because of poor quality.

.3 Interpretation of radiographic films:

.1 By qualified radiographer.

.4 Failure of radiographic tests:

.1 Extend tests to welds by welder responsible when those welds fails tests.

3.6 DEFECTS CAUSING REJECTION

.1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.

.2 In addition, chilled water systems:

.1 Undercutting greater than 0.8 mm adjacent to cover bead on outside of pipe.

.2 Undercutting greater than 0.8 mm adjacent to root bead on inside of pipe.

.3 Undercutting greater than 0.8 mm at combination of internal surface and external surface.

.4 Incomplete penetration and incomplete fusion greater than total length of 38 mm in 1500 mm length of weld depth of such defects being greater than 0.8 mm.

.5 Repair cracks and defects in excess of 0.8 mm in depth.

.6 Repair defects whose depth cannot be determined accurately on basis of visual examination or radiographic tests.

3.7 REPAIR OF WELDS WHICH FAILED TESTS

.1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

3.8 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.2 Waste Management:in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

1.1 REFERENCES

.1 Definitions:

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - means "not concealed" as previously defined.

.3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

.2 TIAC Codes:

.1 CRD: Code Round Ductwork,

.2 CRF: Code Rectangular Finish.

.2 Reference Standards:

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE/IESNA 90.1-04, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ASTM International Inc.

.1 ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

.2 ASTM C335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.

.3 ASTM C411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.

.6 ASTM C553-02e1, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.7 ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.8 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.9 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 Green Seal Environmental Standards (GSES)

.1 Standard GS-36-00, Commercial Adhesives.

.5 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

.6 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).

.7 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.

.1 Description of equipment giving manufacturer's name, type, model, year and capacity.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

.3 Manufacturers' Instructions:

.1 Provide manufacture's written duct insulation jointing recommendations. and special handling criteria, installation sequence, cleaning procedures.

1.3 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return of pallets crates padding packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 FIRE AND SMOKE RATING

.1 To CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

.4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).

.1 Mineral fibre: to ASTM C553.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to ASTM C553.

2.3 JACKETS

.1 Canvas:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: compatible with insulation.

.1 Maximum VOC limit 250 g/L to SCAQMD Rule 1168.

.3 Aluminum:

.1 To ASTM B209 with moisture barrier as scheduled in PART 3 of this section.

.2 Thickness: 0.50 mm sheet.

.3 Finish: Stucco embossed.

.4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.

.1 Stainless steel:

.5 Type: 316.

.6 Thickness: 0.50 mm sheet.

.7 Finish: Smooth.

.8 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.

2.4 ACCESSORIES

.1 Vapour retarder lap adhesive:

.1 Water based, fire retardant type, compatible with insulation.

.1 Maximum VOC limit 50 170 200 g/L to SCAQMD Rule 1168 GSES GS-36.

.2 Indoor Vapour Retarder Finish:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.

.4 ULC Listed Canvas Jacket:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.5 Outdoor Vapour Retarder Mastic:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m^2.

.6 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.

.7 Contact adhesive: quick-setting

.1 Maximum VOC limit 250 g/L to SCAQMD Rule 1168.

.8 Canvas adhesive: washable.

.1 Maximum VOC limit 250 g/L to SCAQMD Rule 1168.

.9 Tie wire: 1.5 mm stainless steel.

.10 Banding: 12 mm wide, 0.5 mm thick stainless steel.

.11 Facing: 25 mm stainless steel hexagonal wire mesh stitched on one face of insulation with expanded metal lath on other face of insulation.

.12 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PRE-INSTALLATION REQUIREMENTS

.1 Pressure test ductwork systems complete, witness and certify.

.2 Ensure surfaces are clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer’s instructions and as indicated.

.3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Ensure hangers, and supports are outside vapour retarder jacket.

.5 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

3.4 DUCTWORK INSULATION SCHEDULE

.1 Insulation types and thicknesses: conform to following table:

~~TIAC Code~~	~~Vapour Retarder~~**TIAC Code**	~~Thickness (mm)~~ **Vapour Retarder**	**Thickness (mm)**
Rectangular cold and dual temperature supply air ducts	C-1	yes	50
Round cold and dual temperatire supply air ducts	C-2	yes	50
Rectangular warm air ducts	C-1	no	25
Round warm air ducts	~~C-1~~**C-2**	no	25
Outside air ducts to mixing plenum	C-1	yes	25
Mixing plenums	C-1	yes	25
Exhaust duct between dampers and louvres	C-1	no	25
Rectangular ducts outside	C-1	~~special~~**Yes**	50
Round ducts outside	~~C-1~~**C-2**	~~special~~**Yes**	50
Acoustically lined ducts	none		

.2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:

.1 Use TIAC code C-1 insulation, scored to suit diameter of duct.

.1 Finishes: conform to following table:

TIAC Code		
	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed within mechanical room	Canvas	Canvas
Indoor, exposed elsewhere	Canvas	Canvas
Outdoor, exposed to precipitation	Aluminum	Aluminum
Outdoor, elsewhere	Aluminum	Aluminum

3.5 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ASHRAE Standard 90.1-[01], Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM B209M-[04], Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate [Metric].

.2 ASTM C335-[04], Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C411-[04], Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M-[00], Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C533-[2004], Calcium Silicate Block and Pipe Thermal Insulation.

.6 ASTM C547-[2003], Mineral Fiber Pipe Insulation.

.7 ASTM C795-[03], Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.8 ASTM C921-[03a], Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma-[89], Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.2 CAN/CGSB-51.53-[95], Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts

.4 Department of Justice Canada (Jus)

.1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.

.2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.6 Manufacturer's Trade Associations

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

.7 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102-[03], Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701-[01], Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 CAN/ULC-S702-[1997], Thermal Insulation, Mineral Fibre, for Buildings

.4 CAN/ULC-S702.2-[03], Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.2 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as specified.

.2 TIAC ss:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.3 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.1 NRC Departmental Representative will make available 1 copy of systems supplier's installation instructions.

1.4 QUALITY ASSURANCE

.1 Qualifications:

.2 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

.3 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

.3 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.2 Place excess or unused insulation and insulation accessory materials in designated containers.

.3 Divert unused metal materials from landfill to metal recycling facility approved by NRC Departmental Representative.

.4 Dispose of unused adhesive material at official hazardous material collections site approved by NRC Departmental Representative.

Part 2 Products

2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102.

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM E 84.

.2 TIAC Code A-1: rigid moulded inorganic glass fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S102-M88.

.2 Maximum "k" factor: to CAN/ULC-S102-M88.

.3 Equivalent to Knauf 1000°

.3 TIAC Code A-3: rigid moulded inorganic glass fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S102-M88.

.2 Maximum "k" factor: to CAN/ULC-S102-M88.

.3 Equivalent to Knauf 1000°

.4 TIAC Code C-2: rigid moulded inorganic glass fibre with factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S102-M88.

.2 Maximum "k" factor: to CAN/ULC-S102-M88.

.3 Equivalent to Knauf 1000°

.5 TIAC Code A-6: flexible closed cell fiber-free tubular elastomeric foam.

.1 Insulation: shall conform to minimum requirements in ASTM C534

.2 Maximum "k" factor: 0.04 W/mK., to ASTM C 177 or C518

.3 All locations, PVC jacketing.

.4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

.5 Equivalent to AP Armaflex or nOMACO Flex Therm

.6 Produce application to conform to: “NOMACO THERMAL INSULATION SPECIFICATION GUIDE FOR REFRIGERATION SYSTEMS”

.6 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.

.1 Insulation: to ASTM C533.

.2 Maximum "k" factor: 0.059 W/mK to ASTM C 177.

.3 Design to permit periodic removal and re-installation.

.4 Equivalent to Industrial Insulation Group Thermo 12 Gold

2.3 INSULATION SECUREMENT

.1 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: stainless steel, 19mm wide, 0.5 mm thick.

2.4 CEMENT

.1 Thermal insulating and finishing cement:

.1 Hydraulic setting on mineral wool, to ASTM C449/C449M.

2.5 VAPOUR RETARDER LAP ADHESIVE

.1 Water based, fire retardant type, compatible with insulation.

2.6 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 OUTDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: fibrous glass, untreated 305 g/m^2.

2.8 JACKETS

.1 Polyvinyl Chloride (PVC):

.1 One-piece moulded type [and sheet] to CAN/CGSB-51.53 with pre-formed shapes as required.

.2 Colours: NRC Departmental Representative.

.3 Minimum service temperatures: -20 degrees C.

.4 Maximum service temperature: 65 degrees C.

.5 Moisture vapour transmission: 0.02 perm.

.6 Fastenings:

.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.

.2 Tacks.

.3 Pressure sensitive vinyl tape of matching colour.

.7 Special requirements:

.1 Outdoor: UV rated material at least 0.5 mm thick.

.2 Aluminum:

.1 To ASTM B209.

.2 Thickness: 0.50 mm sheet.

.3 Finish: stucco embossed.

.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.

.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.

.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5mm thick at 300 mm spacing.

2.9 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS

.1 Caulking to: Section 07 92 00 - Joint Sealants.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 PRE-INSTALLATION REQUIREMENT

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

.2 Type 6 Flex Cell insulation to be operationally tested and inspected prior to installing jacketing.

.3 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturers instructions and this specification.

.3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Install hangers, supports outside vapour retarder jacket.

.5 Supports, Hangers:

.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

.1 Application: at expansion joints, valves, primary flow measuring elements flanges and unions at equipment.

.2 Design: to permit movement of expansion joint to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:

.1 Insulation, fastenings and finishes: same as system.

.2 Jacket: PVC.

3.5 INSTALLATION OF ELASTOMERIC INSULATION

.1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.

.2 Provide vapour retarder as recommended by manufacturer.

3.6 PIPING INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 TIAC Code: A-1.

.1 Securements: Tape at 300 mm on centre.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code 1501-H.

.3 TIAC Code: A-3.

.1 Securements: Tape at 300 mm on centre.

.2 Seals: VR lap seal adhesive, VR lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.4 TIAC Code: A-6.

.1 Continuous formed (not Self-Seal)

.2 Seals: lap seal adhesive, lagging adhesive.

.5 TIAC Code: C-2 with vapour retarder jacket.

.1 Seals: lap seal adhesive, lagging adhesive.

.2 Installation: TIAC Code: 1501-C.

.6 TIAC Code: A-2.

.1 Seals: lap seal adhesive, lagging adhesive.

.2 Installation: TIAC Code: 1501-H.

.7 Thickness of insulation as listed in following table.

.1 Run-outs to individual units and equipment not exceeding 4000 mm long.

.2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

~~Applica-tion~~	~~Temp degrees C~~	~~TIAC code~~	~~Pipe sizes (NPS) and insulation thickness (mm)~~										
~~Run-out~~	~~to 1~~	~~1 1/4 to 2~~	~~2 1/2 to 4~~	~~5 to 6~~	~~8~~	~~up to 175~~	~~[A-1]~~	~~38~~	~~50~~	~~65~~	~~75~~	~~90~~	~~90~~
~~Steam, Saturated and Superheated~~	~~over 175~~	~~[A-1]~~	~~38~~	~~65~~	~~65~~	~~75~~	~~90~~	~~90~~					
~~Condensate Return~~	~~60 - 94~~	~~[A-1]~~	~~25~~	~~38~~	~~38~~	~~38~~	~~38~~	~~38~~					
~~Pumped Condensate return~~	~~up to 94~~	~~[A-1]~~	~~25~~	~~38~~	~~38~~	~~38~~	~~38~~	~~38~~					
~~Boiler Feed Water~~	~~[A-1]~~	~~25~~	~~25~~	~~25~~	~~25~~	~~25~~	~~25~~						
~~Hot Water Heating~~	~~60 - 94~~	~~[A-1]~~	~~25~~	~~38~~	~~38~~	~~38~~	~~38~~	~~38~~					
~~Hot Water Heating~~	~~up to 59~~	~~[A-1]~~	~~25~~	~~25~~	~~25~~	~~25~~	~~38~~	~~38~~					
~~Glycol Heating~~	~~60 - 94~~	~~[A-1]~~	~~25~~	~~38~~	~~38~~	~~38~~	~~38~~	~~38~~					
~~Glycol Heating~~	~~up to 59~~	~~[A-1]~~	~~25~~	~~25~~	~~25~~	~~25~~	~~38~~	~~38~~					
~~Domestic HWS~~	~~[A-1]~~	~~25~~	~~25~~	~~25~~	~~38~~	~~38~~	~~38~~						
~~Chilled Water~~	~~4 - 13~~	~~[A-3]~~	~~25~~	~~25~~	~~25~~	~~25~~	~~25~~	~~25~~					
~~Chilled~~	~~below~~	~~[A-6]~~	~~38~~	~~38~~	~~38~~	~~38~~	~~38~~	~~38~~					

~~Water or Glycol~~	~~4~~	~~38~~						~~8~~					
~~Dual Temp. Heating~~	~~[A-3]~~	~~[ ]~~	~~[ ]~~	~~[ ]~~	~~[ ]~~	~~[ ]~~	~~[ ]~~						
~~Dual Temp. Cooling~~	~~[A-3]~~	~~[ ]~~	~~[ ]~~	~~[ ]~~	~~[ ]~~	~~[ ]~~	~~[ ]~~						
~~Chilled Water Pump Casing~~	~~[A-3]~~	~~25~~	~~25~~	~~25~~	~~25~~	~~25~~	~~25~~						
~~Condenser Water Outdoors~~	~~[ ]~~	~~[ ]~~	~~[ ]~~	~~[ ]~~	~~[ ]~~	~~[ ]~~							
~~Condenser Water Indoors~~	~~[ ]~~	~~[ ]~~	~~[ ]~~	~~[ ]~~	~~[ ]~~	~~[ ]~~							
~~Refrigerated Drinking Water~~	~~[A-3]~~	~~25~~	~~25~~	~~25~~	~~25~~	~~25~~	~~25~~						
~~Domestic CWS~~	~~[A-3]~~	~~25~~	~~25~~	~~25~~	~~25~~	~~25~~	~~25~~						
~~Domestic CWS with vapour retarder~~	~~[C-2]~~	~~25~~	~~25~~	~~25~~	~~25~~	~~25~~	~~25~~						
~~Refrigerant[hot gas] [liquid] [suction]~~	~~4 - 13~~	~~[A-6]~~	~~25~~	~~25~~	~~25~~	~~25~~	~~25~~	~~2 5~~					
~~Refrigerant[hot gas] [liquid] [suction]~~	~~below 4~~	~~[A-6]~~	~~25~~	~~25~~	~~38~~	~~38~~	~~38~~	~~3 8~~					
~~RWL and RWP~~	~~[C-2]~~	~~25~~	~~25~~	~~25~~	~~25~~	~~25~~	~~25~~						
~~Cooling Coil cond. drain~~	~~[C-2]~~	~~25~~	~~25~~	~~25~~	~~25~~	~~25~~	~~25~~						
~~Diesel generator exhaust system~~	~~[A-2]~~	~~38~~	~~65~~	~~65~~	~~75~~	~~90~~	~~90~~						

Application	**Temp degrees C**	**TIAC code**	**Pipe sizes (NPS) and insulation thickness (mm)**					
			Run out	**to 1**	**1 1/4 to 2**	**2 1/2 to 4**	**5 to 6**	**8 and over**
Steam, Saturated and Super heated	**Upto 175** **over 175**	**[A-1]** **[A-1]**	**38** **38**	**50** **65**	**65** **65**	**75** **75**	**90** **90**	**90** **90**

Condensate Return	60 - 94	[A-1]	25	38	38	38	38	38
Pumped Condensate return	up to 94	[A-1]	25	38	38	38	38	38
Boiler Feed Water		[A-1]	25	25	25	25	25	25
Hot Water Heating	60 - 94	[A-1]	25	38	38	38	38	38
Hot Water Heating	up to 59	[A-1]	25	25	25	25	38	38
Glycol Heating	60 - 94	[A-1]	25	38	38	38	38	38
Glycol Heating	up to 59	[A-1]	25	25	25	25	38	38
Domestic HWS		[A-1]	25	25	25	38	38	38
Chilled Water	4 - 13	[A-3]	25	25	25	25	25	25
Chilled Water or Glycol	below 4	[A-6]	38	38	38	38	38	38
Chilled Water Pump Casing		[A-3]	25	25	25	25	25	25
Condenser Water Outdoors		[A-3]	25	25	25	25	25	25
Condenser Water Indoors		[A-3]	25	25	25	25	25	25
Refrigerated Drinking Water		[A-3]	25	25	25	25	25	25
Domestic CWS		[A-3]	25	25	25	25	25	25
Domestic CWS with vapour retarder		[C-2]	25	25	25	25	25	25
Refrigerant [hot gas] [liquid] [suction]	4 - 13	[A-6]	25	25	25	25	25	25
Refrigerant [hot gas] [liquid] [suction]	below 4	[A-6]	25	25	38	38	38	38

RWL and RWP		**[C-2]**	**25**	**25**	**25**	**25**	**25**	**25**
Cooling Coil cond. drain		**[C-2]**	**25**	**25**	**25**	**25**	**25**	**25**

.8 Finishes:

.1 Exposed indoors: PVC jacket.

.2 Exposed in mechanical rooms: PVC jacket.

.3 Concealed, indoors: canvas on valves, fittings. No further finish.

.4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.

.5 Outdoors: water-proof aluminum jacket.

.6 Finish attachments: SS bands, at 150 mm on centre. Seals: wing.

.7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

.2 ASTM International

.1 ASTM A480/A480M-12, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

.2 ASTM A635/A635M-09b, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.

.3 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.3 Green Seal Environmental Standards (GS)

.1 GS-36-11, Standard for Adhesives for Commercial Use.

.4 National Fire Protection Association (NFPA)

.1 NFPA 90A-12, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.2 NFPA 90B-12, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

.3 NFPA 96-11, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.

.2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.

.3 IAQ Guideline for Occupied Buildings Under Construction 2007.

.6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for metal ducts and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province ~~Territory~~ of _____**Ontario**, Canada.

.4 Test and Evaluation Reports:

.1 Certification of Ratings:

.1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C
125	Unsealed
Zero Leakage Ductwork (round 304 SS)	All welded joints / airtight flanged equipment connections

.2 Seal classification:

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

.2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.

.3 Class C: transverse joints and connections made air tight with gaskets sealant or combination thereof. Longitudinal seams unsealed.

.4 Unsealed seams and joints.

2.2 SEALANT

.1 Sustainability Characteristics:

.1 Adhesives and sealants: in accordance with Section 07 92 00 - Joint Sealants.

.2 Adhesives and sealants: VOC limit 250 g/L maximum to SCAQMD Rule 1168.

.2 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

2.3 TAPE

.1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.4 DUCT LEAKAGE

.1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.5 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows:

.1 Rectangular: centreline radius: 1.5 times width of duct.

.2 Round: smooth radius, centreline radius: 1.5 times diameter.

.3 Mitred elbows, rectangular:

.1 To 400 mm: with single double thickness turning vanes.

.2 Over 400 mm: with double thickness turning vanes.

.4 Branches:

.1 Rectangular main and branch: with radius on branch 1.5 times width of duct.

.2 Round main and branch: enter main duct at 45 degrees with conical connection.

.3 Provide volume control damper in branch duct near connection to main duct.

.4 Main duct branches: with splitter damper.

.5 Transitions:

.1 Diverging: 20 degrees maximum included angle.

.2 Converging: 30 degrees maximum included angle.

.6 Offsets:

.1 Full radiused elbows.

.7 Obstruction deflectors: maintain full cross-sectional area.

.1 Maximum included angles: as for transitions.

2.6 FIRE STOPPING

.1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Fire Stopping.

.2 Fire stopping material and installation must not distort duct.

2.7 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.

.2 Thickness, fabrication and reinforcement: to SMACNA.

.3 Joints: to ASHRAE SMACNA. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

2.8 STAINLESS STEEL

.1 To ASTM A480/A480M, Type 304.

.2 Finish: number 4.

.3 Thickness, fabrication and reinforcement: to SMACNA as indicated.

.4 Joints: to SMACNA be continuous inert gas welded.

.5 Gasket and flanged equipment connections

2.9 ALUMINUM

.1 To ASHRAE SMACNA. Aluminum type: 3003-H-14.

.2 Thickness, fabrication and reinforcement: to ASHRAE SMACNA as indicated.

.3 Joints: to ASHRAE SMACNA be continuous weld.

2.10 HANGERS AND SUPPORTS

.1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.

.1 Maximum size duct supported by strap hanger: 500.

.2 Hanger configuration: to SMACNA.

.3 Hangers: galvanized steel angle with black galvanized steel rods to SMACNA following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

.4 Upper hanger attachments:

.1 For concrete: manufactured concrete inserts.

.2 For steel joist: manufactured joist clamp steel plate washer.

.3 For steel beams: manufactured beam clamps:

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for metal duct installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Departmental Representative.

3.2 GENERAL

.1 Do work in accordance with SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

.1 Insulate strap hangers 100 mm beyond insulated duct Ensure diffuser is fully seated.

.3 Support risers in accordance with SMACNA as indicated.

.4 Install breakaway joints in ductwork on sides of fire separation.

.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

3.3 HANGERS

.1 Strap hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with SMACNA as follows:

Duct Size	Spacing
(mm)	(mm)
to 1500	3000
1501 and over	2500

3.4 ZERO LEAKAGE

.1 Provide zero leakage all welded stainless steel ductwork and flanged equipment connections for supply and return ducting serving 22-AHU-05 and 22-AHU-06 between bubble tight dampers CD01, 04, 11, 12, 16,17 and air flow stations capped connections within the Flight simulator Lab and the Flexible Cabin Lab.

3.5 WATERTIGHT DUCT

.1 Provide watertight duct for:

.1 Fresh air intake.

.2 Minimum 3000 mm from duct mounted humidifier in all directions.

.3 As indicated.

.2 Form bottom of horizontal duct without longitudinal seams.

.1 Solder joints of bottom and side sheets.

.2 Seal other joints with duct sealer.

.3 Fit base of riser with 150 mm deep drain sump and 32 mm drain connected, with deep seal trap and trap primer and discharging to open funnel drain.

3.6 SEALING AND TAPING

.1 Apply sealant in accordance with SMACNA.

.2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

3.7 LEAKAGE TESTS

.1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems.

.2 In accordance with SMACNA HVAC Duct Leakage Test Manual.

.3 Do leakage tests in sections.

.4 Zero leakage ductwork testing shall be entire duct segment between bubble tight dampers with all flanged equipment in place and blind flanges at end of runs.

.5 Make trial leakage tests as instructed to demonstrate workmanship.

.6 Do not install additional ductwork until trial test has been passed.

.7 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.

.8 Complete test before performance insulation or concealment Work.

3.8 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)

.1 ANSI/AMCA Standard 210-[2007]/(ANSI/ASHRAE 51-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.2 International Organization of Standardization (ISO)

.1 ISO 3741-[2010], Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.

.3 National Fire Protection Association (NFPA)

.1 NFPA 90A-[12], Standard for the Installation of Air Conditioning and Ventilating Systems.

.4 Underwriter's Laboratories (UL)

.1 UL 181-[2005(R2008)], Factory-Made Air Ducts and Air Connectors.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for air terminal units and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate the following:

.1 Capacity.

.2 Pressure drop.

.3 Noise rating.

.4 Leakage.

.4 Samples:

.1 Submit duplicate samples of air valves for testing and client acceptance.

.5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.6 Test and Evaluation Reports:

.1 Test data: to ANSI/AMCA Standard 210.

.1 Submit published test data on DIN (Direct Internal Noise), in accordance with ISO 3741 made by independent testing agency for 0, 2.5 and 6 m/s branch velocity or inlet velocity.

.2 Sound power level with minimum inlet pressure of 0.25 kPa in accordance with ISO 3741 for 2nd through 7th octave band, also made by independent testing agency.

.3 Pressure loss through silencer shall not exceed 60% of inlet velocity pressure maximum.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for air terminal units for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect air terminal units from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

2.2 MANUFACTURED UNITS

.1 Terminal units of the same type to be product of one manufacturer.

2.3 VARIABLE VOLUME BOXES

.1 Pressure independent factory reset to air flow between zero and maximum air volume.

.2 Sizes, capacities, differential pressures and sound ratings: as indicated.

.3 Differential pressure not to exceed 25 Pa at inlet air velocity of 10 m/s.

.4 Sound ratings of assembly not to exceed 20 NC at 25 Pa.

.5 Complete with:

.1 Operator and controller

.2 Sound attenuator

.3 Multiport outlet adapter: as indicated.

.4 Reheat coil: as indicated.

.6 Operator to be factory mounted and calibrated:

.7 Casing: constructed of 18ga galvanized steel, internally lined with 25 mm, 0.7 kg density fibrous glass, to UL181. Mount control components inside protective metal shroud.

.8 Damper: 18 ga galvanized steel with peripheral gasket and self lubricating bearings. Air leakage past closed damper not to exceed 2% of nominal rating at 750 Pa inlet static pressure, in accordance with Air Diffusion Council test procedure.

.9 Air velocity sensor pitot rack as standard to manufacturer.

.10 Electronic control package factory calibrated and set at factory. Features to accommodate field calibration and readjustment of air volume settings to include:

.1 Metre taps for balancing with digital DC voltmeter.

.2 Adjustable flow settings at thermostat.

.11 Factory installed 20 VA transformer, 115 V to 24 V. Power consumption of terminal not to exceed 15 VA.

.12 Terminal unit to be CSA certified.

2.4 VENTURI AIR VALVES

.1 Pressure independent factory reset to air flow between zero and maximum air volume.

.2 Sizes, capacities, differential pressures and sound ratings: as indicated.

.3 Internal plunger assembly responds to static pressure changes in less than one second.

.4 Turndown 20:1

.5 Factory calibrated and characterized by by flow to valve position with N.I.S.T traceable equipment.

.6 Accurate to +/-5% of flow

.7 14 ga aluminum valve body, 16 ga aluminum cone, Teflon coated 316 stainless steel shaft, 316 stainless steel shaft supports, 316 stainless steel internal hardware.

.8 Low pressure application: 75Pa to 750Pa.

.9 Electronic control package factory calibrated and set at factory. Features to accommodate field calibration and readjustment of air volume settings to include:

.1 Metre taps for balancing with digital DC voltmeter.

.2 Adjustable flow settings at thermostat.

.10 Factory installed 20 VA transformer, 115 V to 24 V. Power consumption of terminal not to exceed 15 VA.

.11 Terminal unit to be CSA certified.

.12 Equivalent to EH Price Venturi Valve.

2.5 LOW PRESSURE SHUT-OFF AIR VALVES

.1 Pressure independent factory calibrated venture-type air valve with shut-off mode to provide isolation of ~~n~~ HVAC system.

.2 16 ga. Spun aluminum valve body with continuous welded seam

.3 Composite Teflon shaft bearings

.4 Spring grade stainless steel spring and polyester slide assembly

.5 Operating range: 32°C-122°C ambient. 10%-90% non-condensing RH

.6 Pressure independent over a 75 – 750PA pressure drop across valve

.7 Volume accurate to +/- 5%, 5 cfm of airflow command signal throughout normal operating range

.8 No additional straight duct runs needed before or after valve

.9 Less than 1 minute response time

.10 10VA – 70VA power consumption. 24VAC power at 60Hz

.11 VAV controller with 3 universal inputs, 1 digital output, 2 analog outputs, 1 digital output. Volts, mA, ohms or NTC 2 or 3 thermistor signals.

.1 Input accuracy: voltage, current, resistance: +/- 1% full scale

.2 Output accuracy:

.1 0 to 10VDC: +/- 1% full scale into 10 kOhms minimum

.2 4 to 20 mA: +/- 1% full scale into 500 Ohms +0/-50 Ohms

.12 CSA compliant

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air terminal units installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Departmental Representative.

3.2 INSTALLATION

.1 Install in accordance with manufacturers recommendations.

.2 Support independently of ductwork.

.3 Install with at least 1000 mm of flexible inlet ducting and minimum of four duct diameters of straight inlet duct, same size as inlet.

.4 Locate controls, dampers and access panels for easy access.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 CSA Group

.1 CSA C22.2 No.46- M1988(R2011) , Electric Air-Heaters.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures .

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for duct heaters and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit product data and include:

.1 Element support details.

.2 Heater: total kW rating, voltage, phase.

.3 Number of stages.

.4 Rating of stage: rating, voltage, phase.

.5 Heater element watt/density and maximum sheath temperature.

.6 Maximum discharge temperature.

.7 Unit support.

.8 Clearance from combustible materials.

.9 Internal components wiring diagrams.

.10 Minimum operating airflow.

.11 Pressure drop at operating airflow.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect duct heaters from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 ELECTRIC DUCT HEATERS

.1 Duct heaters: flange type.

.2 Frame: galvanized steel

.3 Elements:

.1 Heating coils of open nickel chrome alloy resistance wire.

.2 High temperature resistant ceramic coil supports

.4 Complete with magnetic contactors and primary automatic reset thermal cut-out to avoid overheating.

.5 Maximum temperature at discharge: 45 degrees Celsius.

.6 Controls:

.1 Factory mounted and wired in control box. Use terminal blocks for power and control wiring to thermostat and sail switch.

.2 With terminal strips in heater terminal box for power and control wiring.

.3 Controls mounted in a CSA enclosure and to include:

.1 Magnetic contactors.

.2 Control transformers.

.3 SCR controller.

.4 Load fuses

.5 Stage fuses

.4 Where controls are mounted in heater, exercise care in mounting contactors to minimize switching noise transmission through ductwork.

.5 High temperature cutout and air proving switch.

.7 Main isolation disconnect switch.

2.2 GLYCOL DUCT HEATER – SERVING 22SAF01

.1 Copper tube with aluminum fins mechanically bonded to copper.

.2 Pressure and leak tested at factory

.3 500fpm maximum velocity over coil,

.4 18 GA sheet metal casing

.5 Performance certified to ARI Standard 410.

.6 ~~1000~~**2000**cfm, 110mbh, ~~17~~**70 degree** F EAT, ~~85~~**121 degree** F LAT, 180 **degree** F EWT, 160 **degree** F LWT, 12 gpm 50% ethylene glycol flow.

2.3 STEAM DUCT HEATER – SERVING 22AHU04

.1 Seamless drawn copper tubes mechanically expanded to aluminum fins with die-formed self-spacing collars.

.2 Tubular copper headers silver brazed into the tube ends

.3 Coil casing is heavy gauge galvanised sheet steel

.4 Tube end plates have die-formed collared end holes to allow expansion and contraction

.5 Complete with flow regulator, air purge and vacuum breaker

.6 Performance certified to ARI Standard 410.

.7 2000cfm, 145mbh, -17F EAT, 50F LAT, 50psi steam.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for duct heaters installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Departmental Representative.

3.2 INSTALLATION

.1 Make power and control connections to CSA C22.2 No.46.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements and Section 26 05 00 - Common Work Results for Electrical.

.2 Perform tests in presence of NRC Departmental Representative.

.1 Provide test report and include copy with Operations and Maintenance Manuals.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Air-Conditioning, Heating and Refrigeration Institute (AHRI)

.1 AHRI-550/590-03, Performance Rating of Water Chilling Packages Using the Vapor Compression Cycle.

.2 CSA International

.1 CSA B52-05 SMART, Mechanical Refrigeration Code.

.3 Environment Canada, (EC)/Environmental Protection Services (EPS)

.1 EPS 1/RA/2-1996, Environmental Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for chillers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate:

.1 Equipment including connections, piping and fittings, valves, strainers, control assemblies and ancillaries, identifying factory and field assembled.

.2 Wiring as assembled and schematics.

.3 Dimensions, construction details, recommended installation and support, mounting bolt hole sizes and locations and point loads.

.4 Type of refrigerant used.

.4 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for chillers for incorporation into manual.

.3 Data to include:

.1 Description of equipment giving manufacturers name, model type and year, capacity and serial numbers.

.2 Provide part load performance curves.

.3 Details on operation, servicing and maintenance.

.4 Recommended spare parts list.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect chillers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan.

Part 2 Products

2.1 GENERAL

.1 Provide complete chiller package including: compressor; evaporator; condenser, motor and motor starter; controls; control centre; piping; wiring; refrigeration and oil change; ready for connection to chilled water circuit and condenser water circuit interlocks, and electric power source, installed in welded steel frame panels and access doors finished to manufacturers standard.

2.2 BUILDING CHILLER 22-CCH-~~03~~04

.1 Certified ratings based on AHRI 550/590:

.2 UNIT DESCRIPTION

.1 Provide and install as shown on the plans factory-assembled, factory-charged air-cooled scroll compressor packaged chiller. Each chiller shall consist of hermetic tandem scroll compressor sets (total four compressors), brazed plate evaporator, air-cooled condenser section, microprocessor-based control system and all components necessary for controlled unit operation.

.2 Each chiller shall be factory run-tested to verify operation. Operating controls and refrigerant charge shall be checked for proper operation and optimum performance.

.3 DESIGN REQUIREMENTS

.1 Flow Range: The chiller shall have the ability to support variable flow range down to 40% of nominal design (based on AHRI conditions).

.2 Operating Range: The chiller shall have the ability to control leaving chilled fluid temperature from 15F to 65F

.3 General: Provide a complete scroll compressor packaged chiller as specified herein and as shown on the drawings. The unit shall be in accordance with the standards referenced in section 1.02 and any local codes in effect.

.4 Performance: Refer to the schedule of performance on the drawings. The chiller shall be capable of stable operation to a minimum percentage of full load (without hot gas bypass) of 25%. Performance shall be in accordance with AHRI Standard 550/590.

.5 Acoustics: Sound pressure levels for the unit shall not exceed the following specified levels. All manufacturers shall provide the necessary sound treatment (parts and labor) to meet these levels if required. Sound data shall be provided with the quotation. Test shall be in accordance with AHRI Standard 370.

.1 63Hz Band: 65dB

.2 125 Hz Band: 64 dB

.3 250 Hz Band: 61 dB

.4 500 Hz Band: 60 dB

.5 1000 Hz Band: 56 dB

.6 2000 Hz Band: 51 dB

.7 4000 Hz Band: 46 dB

.8 8000 Hz Band: 41 dB

.9 Overall dBA: 61dBA

.4 CHILLER COMPONENTS

.1 Compressor

.1 The compressors shall be sealed hermetic, scroll type with crankcase oil heater and suction strainer. The compressor motor shall be refrigerant gas cooled, high torque, hermetic induction type, two-pole, with inherent thermal protection on all three phases and shall be mounted on vibration isolator pads. The compressors shall be equipped with an internal module providing compressor protection and communication capability.

.2 Evaporator

.1 The evaporator shall be a compact, high efficiency, dual circuit, brazed plate-to-plate type heat exchanger consisting of parallel stainless steel plates

.2 The evaporator shall be protected with an electric resistance heater (heat trace tape) and insulated with 3/4" (19mm) thick closed-cell polyurethane insulation. This combination shall provide freeze protection down to -20°F (-29°C) ambient air temperature.

.3 The water-side working pressure shall be a minimum of 653 psig (4502 kPa). Vent and drain connections shall be provided in the inlet and outlet chilled water piping by the installing contractor. Evaporators shall be designed and constructed according to, and listed by, Underwriters Laboratories (UL).

.3 Condenser

.1 Condenser fans shall be propeller type arranged for vertical air discharge and individually driven by direct-drive fan motors. The fans shall be equipped with a heavy-gauge vinyl-coated fan guard. Fan motors shall be TEAO type with permanently lubricated ball bearings, inherent overload protection, three-phase, direct-drive, 1140 rpm. Each fan section shall be partitioned to avoid cross circulation.

.2 Coil shall be all aluminum alloy microchannel design and shall have a series of flat tubes containing multiple, parallel flow microchannels layered between the refrigerant manifolds. Coils shall consist of a two-pass arrangement. Each condenser coil shall be factory leak tested with high-pressure air under water. Coils shall withstand 1000+ hour acidified synthetic sea water fog (SWAAT) test (ASTM G85-02) at 120°F (49°C) with 0% fin loss and develop no leaks.

.4 Refrigerant Circuit

.1 R410A. Each of the two refrigerant circuits shall include a refrigerant filter-drier, sight glass with moisture indicator, liquid line solenoid valve (no exceptions), expansion valve, and insulated suction line.

.5 Construction

.1 Unit casing and all structural members and rails shall be fabricated of pre-painted or galvanized steel to meet ASTM B117, 500-hour salt spray test.

.6 Control System

.1 A centrally located weatherproof control panel shall contain the field power connection points, control interlock terminals, and control system. Power and starting components shall include factory circuit breaker for fan motors and control circuit, individual contactors for each fan motor, solid-state compressor three-phase motor overload protection, inherent fan motor overload protection and two power blocks (one per circuit) for connection to remote, contractor supplied disconnect switches. Hinged access doors shall be lockable. Barrier panels or separate enclosures are required to protect against accidental contact with line voltage when accessing the control system.

.2 Shall include optional single-point connection to a non-fused disconnect switch with through-the-door handle and compressor circuit breakers.

.7 Unit Controller

.1 An advanced DDC microprocessor unit controller with a 5-line by 22-character liquid crystal display provides the operating and protection functions. The controller shall take preemptive limiting action in case of high discharge pressure or low evaporator pressure. The controller shall contain the following features as a minimum:

.2 The unit shall be protected in two ways: (1) by alarms that shut the unit down and require manual reset to restore unit operation and (2) by limit alarms that reduce unit operation in response to some out-of-limit condition. Shut down alarms shall activate an alarm signal.

.8 Shutdown Alarms
- .1 No evaporator water flow (auto-restart)
- .2 Sensor failures
- .3 Low evaporator pressure
- .4 Evaporator freeze protection
- .5 High condenser pressure
- .6 Outside ambient temperature (auto-restart)
- .7 Motor protection system
- .8 Phase voltage protection (Optional)

.9 Limit Alarms
- .1 Condenser pressure stage down, unloads unit at high discharge pressures.
- .2 Low ambient lockout, shuts off unit at low ambient temperatures.
- .3 Low evaporator pressure hold, holds stage #1 until pressure rises.
- .4 Low evaporator pressure unload, shuts off one compressor.

.10 Unit Enable Section
- .1 Enables unit operation from either local keypad, digital input, or BAS

.11 Unit Mode Selection
- .1 Selects standard cooling, ice, glycol, or test operation mode

.12 Analog Inputs:
- .1 Reset of leaving water temperature, 4-20 mA\
- .2 Current Limit

.13 Digital Inputs
- .1 Unit off switch
- .2 Remote start/stop
- .3 Flow switch
- .4 Ice mode switch, converts operation and setpoints for ice production
- .5 Motor protection

.14 Digital Outputs
- .1 Shutdown alarm; field wired, activates on an alarm condition, off when alarm is cleared
- .2 Evaporator pump; field wired, starts pump when unit is set to start

.15 Condenser fan control - The unit controller shall provide control of condenser fans based on compressor discharge pressure.

.16 Building Automation System (BAS) Interface
- .1 Factory mounted DDC controller(s) shall support operation on a BACnet®, Modbus® or LONMARK ® network via one of the data link / physical layers listed below as specified by the successful Building Automation System (BAS) supplier.

- .2 BACnet MS/TP master (Clause 9)

.3 BACnet IP, (Annex J)

.4 BACnet ISO 8802-3, (Ethernet)

.5 LONMARK FTT-10A. The unit controller shall be LONMARK® certified.

.6 The information communicated between the BAS and the factory mounted unit controllers shall include the reading and writing of data to allow unit monitoring, control and alarm notification as specified in the unit sequence of operation and the unit points list.

.7 For chillers communicating over a LONMARK network, the corresponding LONMARK eXternal Interface File (XIF) shall be provided with the chiller submittal data.

.8 All communication from the chiller unit controller as specified in the points list shall be via standard BACnet objects. Proprietary BACnet objects shall not be allowed. BACnet communications shall conform to the BACnet protocol (ANSI/ASHRAE135-2001). A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided along with the unit submittal.

.5 OPTIONS AND ACCESSORIES

.1 The following options are to be included:

.1 Hot Gas Bypass: allows unit operation to 10 percent of full load. Includes factory-mounted hot gas bypass valve, solenoid valve, and manual shutoff valve for each circuit. Shall be ready for field piping according to manufacturer instructions.

.2 Ground Fault Protection: Factory installed circuit breaker to protect equipment from damage from line-to-ground fault currents less than those required for conductor protection.

.3 Phase loss with under/over voltage protection and with LED indication of the fault type to guard against compressor motor burnout.

.4 BAS interface module to provide interface with the BACnet MSTP protocol.

.5 The following accessories, if selected, are to be included:

.1 Spring vibration isolators for field installation

.2 Rubber-in-shear vibration isolators for field installation

.3 Factory-mounted thermal dispersion type flow switch

.4 Field-mounted, paddle type, chilled water flow switch field wired to the control panel

.5 Evaporator inlet strainer, 40-mesh with extension pipe and Victaulic couplings (factory mounted or field installed)

.6 115V GFI convenience outlet

2.3 LABS CHILLER 22-CCH-~~04~~05

.1 Composition

.1 The machine is set-up to manage both hydraulic circuits (evaporator and condenser), allowing operation in cooling and heat pump modes, via cycle reverse on the hydraulic side.

.2 Acoustics:

.1 Sound pressure levels for the unit shall not exceed the following specified levels. All manufacturers shall provide the necessary sound treatment (parts and labor) to meet these levels if required. Sound data shall be provided with the quotation. Test shall be in accordance with AHRI Standard 370.

.1 63Hz Band: 65dB

.2 125 Hz Band: 64 dB

.3 250 Hz Band: 61 dB

.4 500 Hz Band: 60 dB

.5 1000 Hz Band: 56 dB

.6 2000 Hz Band: 51 dB

.7 4000 Hz Band: 46 dB

.8 8000 Hz Band: 41 dB

.9 Overall dBA: 61dBA

~~.2~~**.3** Refrigerant

.1 Chillers in the NXW range use R410A refrigerant.

~~.3~~**.4** Cooling Circuit

.1 Two cooling circuits, with four high-efficiency scroll type hermetic compressors. Both circuits are served by two compressors in tandem and are independent, thus guaranteeing greater operating safety. At partial loads, every operating compressor works in maximum yield conditions, thus allowing to maximize the efficiency of the entire machine. The unit is dual-circuit on the chiller side and single-circuit on the hydraulic side.

~~.4~~**.5** Description of the cooling circuit

.1 Both circuits are made using copper pipes with welded joints in silver alloy including the following components:

.1 braze welded plate type evaporator and condenser (AISI 316);

.2 thermostatic valve;

.3 dehydrator filter;

.4 liquid indicator;

.5 liquid and pressing line taps;

.6 solenoid valve.

.2 The unit also has a liquid separator placed on the compressor intake for protection against any return of liquid.

.3 Version without condenser. Machines are delivered after being pre-charged.

~~.5~~.6 Partial Capacity Steps

.1 Four partial capacity steps.

~~.6~~.7 Thermostatic Valve:

.1 Mechanical thermostatic valve with external equalizer positioned at the exit of the evaporator and bulb sensitive to the intake temperature. Depending on the heat load it modulates the flow of gas, always maintaining the correct heating level of the intake gas to the compressor. This allows working with minimum temperature of the water produced from 17.6 °F to 39 °F.

~~.7~~.8 Version

.1 Silenced. Version with acoustic protection covering made with a galvanised sheet steel panel casing covered internally using sound-absorbent material, able to isolate the noise produced by the compressors. This leads to a noise reduction of 6 db(A).

~~.8~~.9 Support frame

.1 Made in hot galvanized sheet steel with suitable thickness and painted with polyester powders able to resist atmospheric agents through time.

~~.9~~.10 Compressors

.1 The scroll-type hermetic compressors mounted on the NXW are optimized to work with R410A refrigerant and are distinguished by high efficiency and low power absorption. They are supplied with an electric resistance on the oil sump as standard. The resistance is powered automatically when the unit stops as long as the unit is live. The scroll compressors are moved by 2-pole electric motors cooled by intake gas and are supported by rubber anti-vibration mounts placed at the base. Started depending on plant load requirements, the use of several scroll compressors allows an efficient "step" adjustment of the power distributed by the unit, thus obtaining much more efficient operation at partial loads with greater efficiency with respect to traditional partial load methods. All of this means noteworthy seasonal energy efficiency ratios ESEER, calculated according to Eurovent specifications.

~~.10~~.11 Thermostatic valve

.1 Standard mechanical thermostatic valve with external equalizer placed at the exit of the evaporator and bulb sensitive to the intake temperature. Depending on the heat load, it modulates the flow of gas, always maintaining the correct heating level of the intake gas to the compressor. This allows to work at a minimum temperature of the water produced at 39 °F.

~~.11~~.12 Heat exchangers

.1 Standard: Plate type Heat exchangers of the machine are optimized for R410A, made of AISI 316 steel and covered by closed cell expanded elastomeric

insulating mattress, Victaulic hydraulic connections, with just one hydraulic circuit and two entry cooling circuits. They respect the PED standards.

~~.12~~.13 Evaporator side hydronic unit

.1 Heat exchanger has the function of evaporator in summer mode.

~~.13~~.14 Condenser side hydronic unit

.1 Heat exchanger has the function of condenser in summer mode.

~~.14~~.15 Protection and safety devices

.1 The following devices are present in the chiller:

.1 High pressure gauge with IP54 protection rate: it blocks the unit if the pressure of the refrigerant exceeds the maximum safety value of 580PSI.

.2 Chiller circuit safety valves calibrated at 653PSI: They intervene by discharging the refrigerant in case of anomalous pressures.

.3 High pressure transducer (one per circuit): allows to view the value of the compressor flow pressure on the microprocessor board display, also causing pre-alarms in case of anomalous work values; it is located in the high pressure side of the chiller circuit.

.4 Low pressure transducer.

.5 Water temperature probes on inlet and outlet to the evaporator and the condenser.

.6 Electric control board access door interlock system.

.7 Compressor magnet circuit-breaker protection.

.8 Power supply voltage check.

.2 Electric Control Board

.1 Contains the power section and the management of controls and safety devices. It is in compliance with the IEC 60204-1 Standard and the Directives regarding electromagnetic compatibility EMC 2004/108/EC and to the LVD (Low Voltage Directive) 2006/95/EC. It is always equipped with a door-lock isolating switch: the electric control board can be accessed by removing the voltage. Act on the opening lever of the control board itself. This lever can be locked using one or more padlocks during maintenance interventions to prevent the machine being powered up accidentally. The control keyboard is located on the door of the control board, which allows the complete control of the appliance.

.3 Power Supply

.1 Three-phase power supply, 575V, 60Hz with magnet circuit breakers.

.4 Electronic adjustment

.1 The electronic adjustment is consists of a control board and a control panel with display. Transducers, loads and alarms are connected to each board. The set program and parameters are memorized permanently on FLASH memory, allowing their storage even in case of lack of power supply. The microprocessor has the following functions:

.1 remote ON/OFF with external contact without voltage;

.2 phases sequence control;

.3 amperometric transformer;

.4 separate control of the individual compressors;

.5 the distributed power adjustment depends on the outlet water temperature (proportional+integral control), complete with "Switching Hysteresis" self-adapting work differential to always ensure the correct work schedule, even with low water flow rate (stand-by between peaks, stand-by between switch off and switch on, minimum operation time etc.);

.6 rotation of the compressors depending on working hours;

.7 PDC "Pull Down Control" system to prevent the activation of power steps when the temperature of the water quickly approaches the set-point; it optimizes machine operation when working normally and in the presence of load variations, ensuring the best efficiency in all conditions;

.8 "Always Working" function to prevent machine stopping in certain critical conditions, by means of a self-adjustment system;

.9 management of any anomalies by:

.1 alarms display;

.2 historical alarms;

.3 cumulative faults block signal;

.10 differential pressure switch and/or flow meter management;

.11 display of all main sizes regarding the operation of the machine;

.12 the main operation parameters can be changed;

.13 remote control by:

.1 remote panel with the main functions (PGD1 accessory);

.2 RS485 range and compatible Modbus protocol (AER 485P1 accessory);

.14 double set-point, both summer and winter, for the temperature of the water produced, pre-set at the menu;

.15 automatic compensation of the set points on the basis of an analogue input 4 ÷ 20 mA;

.16 pump management and rotation;

.17 programmable timer function;

.18 daily/weekly programming;

.19 inlet/outlet temperature display;

.20 multi-language display of the parameters.

.5 Acoustics: Sound pressure levels for the unit shall not exceed the following specified levels. All manufacturers shall provide the necessary sound treatment (parts and labor) to meet these levels if required. Sound data shall be provided with the quotation. Test shall be in accordance with AHRI Standard 370.

.1 63Hz Band: 65dB

.2 125 Hz Band: 64 dB

.3 250 Hz Band: 61 dB

.4 500 Hz Band: 60 dB

.5 1000 Hz Band: 56 dB

.6 2000 Hz Band: 51 dB

.7 4000 Hz Band: 46 dB

.8 8000 Hz Band: 41 dB

.9 Overall dBA: 61dBA

2.4 FUSELAGE CHILLER 22-CCH-~~05~~06

.1 GENERAL

.1 Semi-Hermetic compressor chiller shall be manufactured by Refplus. Unit(s) shall be CSA approved and UL listed.

.2 Unit shall meet the performance detailed in the schedule. Construction shall be in accordance with latest, ANSI/ASHRAE 15, CSA-B52 and ASME Code.

.3 The unit shall be completely factory assembled on a rugged steel base and shall be shipped with a full operating charge of R404A refrigerant.

.4 water-cooled chiller unit bases and electrical boxes are heavy-gauge galvanized steel (G90) with plated or stainless steel hardware for corrosion-free assembly.

.5 As standard, chiller components shall be housed in an acoustically treated enclosure designed specifically to reduce radiated noise transmission by a minimum of 6 db(A). Enclosure panels shall be G90 galvanized steel.

.6 Compressors shall have Spring vibration isolators shall be factory installed

.2 COMPRESSORS

.1 Compressors are air or suction cooled, refrigeration duty, accessible semi-hermetic. They are supplied with suction and discharge valves, suction strainer, oil filter, oil pump on model 3HP and larger, solid state or line break thermal protection, crankcase heater, Polyol Ester oil with HFC refrigerant..

.3 EVAPORATOR AND CONDENSER

.1 Evaporator and condensers shall be direct expansion type with stainless steel plates brazed together. Evaporator shall be insulated with closed cell polyurethane insulation.

.2 Flow switches shall be supplied loose for field installation by others. Provide a flow switch for both the evaporator and condenser water lines. Installing contractor shall wire flow switch back to main unit control panel.

.4 REFRIGERANT CIRCUIT

.1 All units shall feature a minimum of two independent refrigerant circuits coupled to a common hydraulic circuit for increased reliability. Unit shall be capable of operating at reduced load with one refrigerant circuit shut down.

.2 Each refrigerant circuit shall include a liquid line shutoff valve, replaceable core or sealed filter-drier, sight glass with moisture indicator, liquid line solenoid valve, thermal expansion valve, and insulated suction line.

.3 Receivers (6” dia. and smaller) are UL/CSA certified and are supplied with a fusible plug. Receivers (6 5/8” dia. and larger) are CRN or ASME “U” stamped

and are supplied with relief valves. All receivers have inlet and outlet back-seated Rotalock valves**.**

.5 CONTROLS

.1 Control Panels are complete with terminal blocks, control transformer, control circuit fuses, compressor contactors, fan interlock, fix high and adjustable low pressure control, oil failure switch (for compressors with positive pressure oil pump), and a pump-down switch. The wires are numbered and color-coded, conveniently routed in wiring ducts. All terminal blocks are identified to match the wiring diagram.The control system shall stage the compressors based on the leaving water temperature.

.2 Equipment protection devices include motor protection, high pressure, loss of refrigerant, loss of water flow, and low refrigerant pressure. Controls shall include auto/stop switch, chilled water set point adjustment, anti-recycle timer, and with water temperature and set point, operating temperatures and pressures, and diagnostic messages.

.3 Control system shall monitor all system temperatures, pressures and safeties, and shall automatically shut down a refrigerant circuit or entire unit should a fault occur.

.6 ELECTRICAL

.1 Field power connection, control interlock terminals and unit control system shall be centrally located. Panel access door shall key lock to prevent unauthorized access. Dead front panel shall protect service personnel against accidental contact with line voltage components.

.2 Chiller shall be supplied with factory installed non fused disconnect.

.7 STARTUP SERVICE AND WARRANTY

.1 Manufacturer shall furnish a factory trained service technician to perform the unit startup. Manufacturer shall provide instruction of the owner's personnel on the operation and maintenance of the unit. The warranty period shall commence at the date of initial startup and shall continue for a period of one (1) year not to exceed eighteen (18) months from shipment. Manufacturer's warranty shall include all parts and labour to install parts.

.8 ACOUSTICS

.1 Sound pressure levels for the unit shall not exceed the following specified levels. All manufacturers shall provide the necessary sound treatment (parts and labor) to meet these levels if required. Sound data shall be provided with the quotation. Test shall be in accordance with AHRI Standard 370.

.1 63Hz Band: 65dB

.2 125 Hz Band: 64 dB

.3 250 Hz Band: 61 dB

.4 500 Hz Band: 60 dB

.5 1000 Hz Band: 56 dB

.6 2000 Hz Band: 51 dB

.7 4000 Hz Band: 46 dB

.8 8000 Hz Band: 41 dB

.9 Overall dBA: 61dBA

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for rotary-screw water chiller installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform NRC Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Representative.

3.2 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.3 GENERAL

.1 Provide appropriate protection apparatus.

.2 Install a field-supplied or optional manufacturer-supplied strainer in the chilled water return line at the evaporator inlet; 40 mesh on units with brazed plate evaporators.

.3 Install unit as indicated, to manufacturers recommendations, and in accordance with EPS 1/RA/2.

.4 Ensure adequate clearances for servicing and maintenance.

.5 Manufacturer to approve installation, to supervise startup and to instruct operators. Include 3 days per unit.

.6 Install units on a flat surface level within 1/8 inch and of sufficient strength to support concentrated loading.

.7 Provide components furnished as per manufacturer's literature.

.8 Provide all water piping so unit and water circuits are serviceable, without having to dismantle excessive lengths of pipe.multiple supply and return chilled water and condenser water connection required connecting to on the chiller

.9 Provide valves in water piping upstream and downstream of the evaporator and condenser water connections for isolating the shells for maintenance and to balance and trim the system.

.10 Provide pressure relief piping from relief valve to outside in accordance with manufacturer's instructions and CSA-B52.

.11 Provide certified wiring schematics to the electrical division for the chiller, associated equipment and controls.

.12 Provide all necessary control wiring as recommended by the manufacturer.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.2 Waste Management: separate waste materials for reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by chiller installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Definitions:

.1 Catalogued or published ratings: ratings obtained from tests carried out by manufacturer or manufacturer's designated independent testing agency which signify adherence to codes and standards in force.

.2 Reference Standards:

.1 American National Standards Institute/American Society of Heating, Refrigeration and Air Condition Engineers/Illuminating Engineering Society (ANSI/ASHRAE/IES)

.1 ANSI/ASHRAE 52.2-2012, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

.2 ANSI/ASHRAE/IES 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 Green Seal (GS)

.1 GS-11-11, Standard for Paints and Coatings.

.3 Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual - current edition.

.1 MPI #18.

.4 National Fire Protection Association (NFPA)

.1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.

.5 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)

.6 South Coast Air Quality Management District (SCAQMD)

.1 SCAQMD Rule 1113-11, Architectural Coatings.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for refrigerant, insulation, filters, and paints and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Actual cooling and heating fluid entering and leaving conditions for stated air side requirements.

.2 Dimensions, including **service clearance requirements**.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for air handling equipment for incorporation into manual.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect air handling equipment from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan.

Part 2 Products

2.1 GENERAL

.1 Factory assembled components to form units supplying air at design conditions as indicated.

2.2 FANS

.1 In accordance with Section 23 34 00 - HVAC Fans.

2.3 BUILDING 22-AHU-3 BUILDING CONDITIONING UNIT

.1 Air Handling Units

.1 General Description

.1 Indoor air handling units shall include filters, supply fans, chilled water coil, hot water coil, humidifier section, energy wheel, mixing box, and unit controls.

.1 Variable volume control with inverter-duty motor and variable speed drive.

.2 Unit shall discharge air vertically.

.3 Unit shall be factory assembled and tested including leak testing of the cooling coil, leak testing of the hot water coil, and run testing of the supply fans and factory wired electrical system. Run test report shall be supplied with the unit.

.4 Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.

.5 Unit components shall be labeled, including pipe stub outs, electrical and controls components.

.6 Installation, Operation and Maintenance manual shall be supplied within the unit.

.7 Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.

.8 Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

.2 Construction

.1 All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid G90 galvanized steel panels with R-13 insulating foam injected between panels.

.2 Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.

.3 Unit shall be designed to reduce air leakage and infiltration through the cabinet. Sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

.4 Access to filters, cooling coil, heating coil, supply fans, and electrical and controls components shall be through hinged access doors.

.5 Access doors shall be flush mounted to cabinetry. Coil access door and supply fan access door shall include quarter-turn lockable handles. Supply fan access door shall include removable pin hinges.

.6 Units with a cooling coil shall include sloped 304 stainless steel drain pan. Drain pan connection shall be on the right hand side of unit.

.7 Cooling coil shall be mechanically supported above the drain pan by multiple supports that allow drain pan cleaning and coil removal.

.3 Electrical

.1 Unit shall be provided with an external control panel with separate low voltage control wiring with conduit and high voltage power wiring with

conduit between the control panel and the unit. Control panel shall be field mounted.

.2 Unit shall include a factory installed 24V control circuit transformer.

.3 Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.

.4 Supply Fans

.1 Unit shall include direct drive, unhoused, airfoil fans.

.2 Blower and motor assembly shall be dynamically balanced.

.3 Blower and motor assembly shall be mounted on vibration isolators.

.5 Cooling Coil

.1 Chilled Water Cooling Coil

.1 Coil shall be certified in accordance with AHRI Standard 410 and be hydrogen or helium leak tested.

.2 Coil shall be constructed of copper tubes with aluminum fins mechanically bonded to the tubes.

.3 Coil shall have half serpentine circuitry, 6 rows and 10 fins per inch.

.4 Coil shall have right hand external piping connections.. Coil connections shall be labeled, extend beyond the unit casing, and be factory sealed on both the interior and exterior of the unit casing, to minimize air leakage.

.6 Heating Coil

.1 Hot Water Heating Coil

.1 Coil shall be certified in accordance with AHRI Standard 410 and be hydrogen or helium leak tested.

.2 Coil shall be constructed of copper tubes with aluminum fins mechanically bonded to the tubes.

.3 Coil shall be 1 row and 12 fins per inch.

.4 Coil connections shall be labeled, extend beyond the unit casing and be factory sealed on both the interior and exterior of the unit casing, to minimize air leakage.

.5 Control valves shall be field supplied and field installed.

.7 Filters

.1 Unit shall include 2 inch thick, pleated panel filters with an ASHRAE efficiency of 30% and MERV rating of 8, in a prefilter box upstream of the cooling coil.

.2 A MERV 13 cartridge type final filter shall be provided.

.3 Unit shall include a clogged filter switch.

.4 Filter section to be complete with magnahelic gauge.

.8 Mixing Box

.1 Unit shall contain a mixing box with top return air opening and front outside air opening.

.2 Return air opening shall contain an adjustable, motor operated outside air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven. Dampers shall be fixed position controlled by a fully modulating actuator.

.3 Outside air opening shall contain an adjustable, motor operated outside air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven. Dampers shall be fixed position controlled by a fully modulating actuator.

.9 Controls

.1 Unit shall be provided with terminal wiring strip for external wiring of controls for damper actuators, fan start/stop, clogged filter switch, proof of air flow.

.10 Energy Recovery Wheel

.1 VFD controlled energy recovery wheel for sensible and latent heat recovery.

.2 Media: Synthetic fibre, 4 angstrom

.3 Complete with access door, prewired VFD, bypass dampers

.11 Humidifier Section

.1 Dispersion tube system shall be welded seam stainless steel tube and header system spanning the full width of the duct, insulated with plenum-rated insulation and provide absorption to preclude water accumulation within 500mm of dispersion tube.

.2 Two rows of steam discharge tubelets discharging steam in diametrically opposite directions perpendicular to airflow.

.3 Header pitched toward drain to prevent condensate accumulation in header.

.12 VFD

.1 Factory-installed variable frequency drive for exhaust fan, supply fan and energy wheel speed control.

.2 Complete with keypad, bypass, line reactors and non-fused disconnect in NEMA-1 enclosure.

2.4 22-AHU-4 DESICCANT OUTDOOR AIR UNIT

.1 AIR HANDLING UNIT CASING:

.1 Components forming an Air Handling Unit shall be completely factory assembled and shipped as one (1) piece.

.2 Casing shall be double wall construction supported by an internal channel “C” framing. This includes the side panels, the roof and the floor.

.3 Base shall be installed on the full perimeter of the unit. The base, the intermediate ribs and the structural supports shall form a channel made of heavy gauge steel. Structural girders and lifting lugs supporting the unit from below shall be dimensioned according to proven structural design methods.

.4 Floor, 4 in. (100mm) thick, shall have adequate structural supports to allow for access to maintenance personnel. The floor shall be made of a minimum of 12 gauge galvanized steel. All joints shall be continuously welded and protected with Galvicon. The floor shall act as an airtight drain pan. Fiberglass insulation, 2 in. (50 mm) thick, shall be installed underneath the floor and protected with a 22 gauge galvanized steel sheet. Walls and ceiling shall be double wall and shall be constructed with acoustical panels including 2" (50 mm) thick fiberglass insulation. All interior wall panels shall be screwed together. Exterior wall panels shall be sealed with a strip of polyurethane base caulking to allow for visual detection of impermeability. All units shall withstand pressure differences of up to 10" H_2O (3750 Pa). Maximum air leakage rate guaranteed by the manufacturer shall be 1%, in specified operating conditions.

.5 Exterior wall panels shall be made of 16 gauge galvanized steel. Insulating medium, consisting of long fibers bound together with a thermosetting resin, shall have a density 3 lbs./ft^3, and shall be compressed at least 10% during assembly.

.2 FAN SECTION:

.1 The fans and motors shall be installed on an integral or inertia base supported by anti-vibration springs ensuring a 1" (25mm) deflection. All fans shall be statically and dynamically balanced and shall be of a construction type complying to the requirements of AMCA (Air Moving and Conditioning Association) 99 Standard.

.2 Variable volume control with inverter – duty motor and variable speed drive.

~~.2~~**.3** Fan bearings shall be designed for an average life of at least 200 000 hours, according to AFBMA (Anti-friction Bearing Manufacturers Association) L-50 Standard.

~~.3~~**.4** Fan discharge shall be connected to the fan cabinet using a flexible connection to ensure a vibration-free operation.

.3 BELT DRIVE:

.1 Motors shall be mounted on a sliding base for adequate alignment and adjustment for belt tension. Both fan belt and belt drives shall be protected by a metal belt guard permitting a reading of the revolutions on the shaft of the fan. Electrical motors shall be the high efficiency type, according to the requirements of the specifications.

.4 COILS

.1 Surface area of heat transfer coils shall consist of aluminum corrugated fins. Fins shall cover the entire surface of each tube in order to optimize heat transfer.

.2 Coil casings to be constructed of 16 gauge galvanized steel, with both ends containing a 1-1/2" flange.

.3 All unit coils shall be removable from the unit by the removal of a single screwed-on wall panel without disturbing the roof or adjoining panels of the unit. Panel construction shall be double wall with 2" (50 mm) thick insulation. An industrial quality neoprene gasket is provided on the full perimeter of the panel to obtain maximum airtightness and durability. Coils shall be placed on a slide base in order to remove the coils easily from the unit. Once the coil is in place, its distributor shall fit entirely inside the casing with only the connections extending to the exterior.

.4 Where coils are to be stacked, or under every cooling coil, intermediate drain pans, (double sloped), made of stainless steel and a drain of 1.5" dia. (40 mm) shall be provided.

.5 Coil impermeability shall be controlled by means of water immersion testing under 350 psi air pressure. Coils shall be designed to operate continuously at 250 psi. Supply and return connections to be NTP type steel.

.6 All coils shall have performance certified in accordance with ARI Standard 410.

.7 Pipefitting connections to the coils shall agree with industry standards. Pipes shall be supported separately from the coils and have sufficient flexibility to allow for thermal expansion. No load should be applied to the coil connections.

.5 FILTER SECTION:

.1 Flat or angled filters shall slide on rails. They shall be accessed through lateral panels mounted on hinges and fitted with latches.

.2 Access to high efficiency filters (cartridge or bag) shall be front or side loaded, through the adjoining section. Front loading filters shall be installed on restraint frames, permanently mounted on the inside of the section.

.3 Filter frames shall be provided with neoprene gaskets on the discharge side of the filter for increased airtightness.

.6 DAMPERS:

.1 All dampers are made of aluminum and high efficiency type. Dampers are insulated or uninsulated, opposite or parallel blades, all complying to the requirements of AMCA.

.7 ACCESS DOOR:

.1 Double wall access doors shall be provided to allow access and maintenance of air handling parts and components including fans, filters, air mixers, coils or other as indicated on drawings. Doors shall be of the same thickness and construction as the wall panels, i.e. made of 16 gauge galvanized steel on both sides including 2" (50 mm) thick insulation. Frame shall be made of 12 gauge galvanized steel. Door frame perimeter shall include 3" (75 mm) spokes in corners, as well as a neoprene sponge gasket (industrial quality), for maximum airtightness and durability.

.2 Each door shall be fitted with a heavy duty hinge made of stainless steel and two inside/outside operational handles. Doors shall be completely removable by removing the spindles from the hinges when desired. Doors shall always open against air pressure side.

.8 ACCESSORIES:

.1 Accessories such as low leak/ultra-low leak dampers, installation of controls, air blenders, economizers, diffusers, heat exchangers, silencers, and other special equipment, to be factory installed.

.9 All electrical installations inside the unit shall be CSA and UL certified.

.10 DEHUMIDIFIER – Desiccant wheel section

.1 Dehumidifier unit casing (for units with desiccant wheels below 61" diameter)

The unit casing shall be fabricated of strain-hardened aluminum with a minimum thickness of 0.125" for torsional rigidity and corrosion resistance. The casing shall be formed, welded and sealed as a single unified structure. Steel construction is not acceptable. Aluminum structures depending on screws for casing construction are not acceptable. In addition, the unit casing shall include:

.2 Insulation

.1 To avoid either condensation, heat loss or loss of cooling capacity, the unit casing shall be insulated such that the heat transfer rate through casing walls is less than 0.27 Btu/sq. ft./°F if the wall separates air streams which differ in temperature by more than 25°F.

.3 Wiring

.1 All wiring between dehumidifier components shall comply with the current National Electrical Code (NEC). Wiring unprotected by flexible conduit shall not be acceptable.

.4 Process and reactivation air flow gauges

.1 To set and verify the specified air flow rates through the unit, the casing shall be equipped with differential pressure gauges which measure and display the pressure drop across the desiccant wheel. The dial of the gauges shall include a warning zone to indicate when the air flow is above the recommended operating range of the equipment.

.5 Coating

.1 The exterior of the unit casing and all surfaces of access panels shall be degreased and cleaned, then primed with one coat of industrial wash primer and finished with one coat of catalyzed polyurethane enamel. All pieces shall be painted individually prior to assembly to assure complete protection.

.6 Weather tight construction

.1 The dehumidifier shall be capable of continuous outdoor operation when the air inlets are protected from flowing water by optional weather hoods or connected duct work. Consequently, all access panels shall be weather tight, as shall all joints between casing and electrical conduits and between the unit casing and any components mounted in separate enclosures.

.1 Weather Air Inlets

.1 Because the unit will pull in air directly from the weather, the inlets shall be protected from precipitation by weather hoods, and air flow control dampers.

.2 Weather hoods

.1 The weather hoods shall be welded aluminum and shall be finished to match the unit casing. The inlet air velocity shall not exceed 600 fpm.

.3 Air flow dampers

.1 Inlets shall be equipped with manual flow control dampers with locking hardware. For air inlets smaller than 15" in height or width, single-blade dampers shall be acceptable. When any inlet dimension exceeds 15", the manufacturer shall provide opposed-blade dampers with stainless steel end seals, elastomeric edge seals and oil-impregnated blade shaft bushings.

.7 Maintenance access and inspection panels

.1 The unit casing shall include access panels for inspection and for any maintenance required by the operating and maintenance manual. These panels shall be fastened by captive hardware permanently fixed to either the panel or the unit casing. The panels shall be airtight to the extent of not leaking more than 1% of the rated airflow when the interior of the casing is under 5" WC positive air pressure, nor more than 0.5% of the rated flow when the casing is under 5" WC of negative pressure. Panels without gaskets shall not be acceptable. Panels held in place by drill-screws shall not be acceptable. Equipment which requires disassembly of components rather than access through removable panels for any maintenance required by the operating and maintenance manual shall not be acceptable.

.11 Electrical control cabinet

.1 The electrical control cabinet shall be weather tight to NEMA 4 standards and shall include:

.1 Wiring to comply with the current National Electrical Code with further fuse and wiring sizing to meet or exceed UL 508A *Industrial Control Panel.*

.2 Wires shall be color-coded or numbered at both ends and all terminal block connection points shall be numbered. These markings shall correspond with the electrical diagram provided in the operating and maintenance manual.

.3 Components shall be UL or CSA approved.

.4 Programmable logic controller

.1 The unit sequence of operations shall be controlled by a programmable logic controller which includes separate indication for:

.1 Power on

.2 Unit running

.3 Desiccant wheel rotation fault

.4 Reactivation air overheat after heaters

.5 Reactivation air leaving below set point

.6 Motor overload

.5 Operating and maintenance manual

.1 The control cabinet shall include a copy of the O & M manual, mounted in a separate compartment or pocket to allow access to critical information by maintenance personnel after installation.

.6 Run-hour meter

.1 To allow for recording maintenance practices and to assist fault diagnosis, the cabinet shall have a run-hour meter mounted and visible from the exterior of the unit.

.12 Reactivation circuit

.1 The reactivation circuit shall conform in all respects to the current National Electrical Code.

~~.2 Indirect-fired natural gas reactivation~~

~~.1 Automatic energy modulation shall be provided by means of a modulating gas valve which varies gas flow in response to a temperature sensor mounted in the reactivation air as it leaves the dehumidifier.~~

~~.2 Gas fittings and any piping between multiple burners shall meet Canadian Gas Association standards and shall be provided as an integral part of the burner assembly by the manufacturer.~~

~~.3 Reactivation energy shall be automatically matched to dehumidification requirements by means of a modulating gas valve with proportional electric valve actuator. The valve/actuator assembly shall be connected to a temperature sensor/controller mounted in the discharge of the reactivation air stream.~~

.2 Steam Gas Reactivation

.13 Desiccant Wheel

.1 The desiccant wheel media shall be a monolithic, extended-surface contact medium, fabricated entirely of inert, inorganic binders and glass fibers formed into narrow passages in the direction of airflow. The wheel shall be bacteriostatic and non-toxic. It shall also meet the following requirements:

.1 Materials

.1 The glass fibers which form the support matrix shall be made from uniform continuous strands larger than five microns in diameter which are nonrespirable and are not considered a possible health risk by the International Agency for Research on Cancer (IARC).

.2 Flame spread and smoke generation

.1 The wheel shall be tested according to ASTM E84-90 (Standard Test Method for Surface Burning of Building Materials) and shall achieve the following results:

.1 Flame spread index = 0

.2 Smoke developed index = 10

.3 Desiccant impregnation

.1 The desiccant shall be evenly impregnated throughout the structure for predictable, consistent performance and for

maximum wheel life. Coatings applied on top of the contact medium shall not be acceptable unless the manufacturer can provide independent life tests demonstrating less than a 5% decline in desiccant capacity over a five year period of normal operation.

.4 Desiccant type

.1 Titanium-reinforced silica gel

.2 The Honeycombe® desiccant wheel shall be a fabricated extended surface contact media with a multitude of small passages parallel to the airflow. The rotary structure shall be a monolithic composite consisting of inert silicates with microscopic pores designed to remove water in a vapor phase. The desiccant shall be hydrothermally-stabilized silica gel reinforced with titanium for maximum strength and stability over time. The fabricated structure shall be smooth and continuous having a depth of 400 millimeters in the direction of airflow without interruptions or sandwich layers which restrict air flow or create a leakage path at joining surfaces. Nominal face velocity shall not exceed 600 fpm. The Honeycombe® wheel shall be manufactured in the United States. The manufacturer shall provide documentation to establish that:

.1 The desiccant retains more than 90% of its original capacity after ten years of continuous operation in clean air, with inlet air conditions up to an including 100% relative humidity.

.2 The wheel as impregnated with silica gel is capable of withstanding five complete water immersion cleaning cycles while retaining more than 95% of its original adsorption capacity.

.14 Desiccant Wheel Support and Drive Assembly

.1 For wheels of 60" diameter and smaller, the wheel shall be a single piece for fast removal and simple handling. In the smaller case, the desiccant wheel shall be supported by four rollers at the base of the unit so the wheel can be easily removed for maintenance by lifting it over the rollers using the drive belt. Center-axle support or any arrangement which requires disassembly of the support structure for wheel removal shall not be acceptable. In addition, the wheel drive assembly shall provide:

.1 Rotation speed

.1 To avoid excessive heat carryover from reactivation to the process air, the wheel rotation speed shall not exceed 10 rph while achieving the required moisture removal rate at the specified conditions.

.2 Drive belt

.1 The drive belt shall be the flat, toothed type, with aramid fiber reinforcement.

.3 Drive motor

.1 The drive motor shall be fractional horsepower and rated for continuous duty for a period of 20,000 hours under the load conditions imposed by the drive assembly.

.4 Rotation detection

.1 The drive assembly shall be equipped with a rotation detection circuit which shuts down the dehumidifier and signals the operator through an indicating light on the control cabinet if the wheel is not rotating.

.15 Air seals and internal air leakage

.1 The process and reactivation air streams shall be separated by air seals and internal partitions so that the humid reactivation air does not mix with the dry process air. The proposed equipment shall meet the following minimum requirements:

.1 Wheel face seals

.1 For units with desiccant wheels under 61" in diameter, the dehumidifier shall have full-face seals on both the process air entering and the process air leaving sides of the wheel. These shall seal the entire perimeter of both air streams as they enter and leave the wheel. Partial seals shall not be acceptable. The seals shall be the silicone rubber bulb-type, with a protective strip of low-friction, abrasive-resistant tape to extend seal life and reduce the force needed to turn the desiccant wheel. Neither wiper-type seals nor brush-type nor any non-contact-type seal shall be acceptable. The seals shall be documented to have a minimum working life of 25,000 hours of normal operation.

.2 Total casing air leakage

.1 The unit shall not allow leakage to exceed the greater of the following values:

.1 One percent of the process air flow

.2 SMACNA (Sheet Metal & Air Conditioning Contractors National Association) Leakage class 6, which is defined by:

$$F = C \times P^{0.65}$$
$$L = F \times A$$

Where:

F = Leakage flow (cfm/sq.ft. housing area)
C = Leakage class (equal to 6)
P = Design static pressure (in. WC)
L = Total leakage (cfm)
A = Housing area (sq.ft.)

.3 Determine leakage using the testing methods described by SMACNA Publication 15d, *HVAC Air Duct Leakage Test Manual (Air Distribution Equipment and Ducts)*.

.4 Terms are defined as follow:

.1 Design static pressure: Maximum positive or negative pressure referenced to the unit exterior (inches W.C.).

.2 Design airflow: Maximum unit air flow at the discharge connection (ft^3/min).

.3 Housing area: Total area of the unit air containment, including fan wall area (ft^2).

.16 Reactivation air fans

.1 Reactivation air fans shall be the single-inlet, single-width, centrifugal-type.

.1 Fan wheel type

.1 Fans driven by motors of 2 hp and below shall be the direct-drive, forward-curve centrifugal type. Fans driven by motors of 3 hp through 7.5 hp shall be backward-inclined, direct-drive centrifugal type. Fans driven by motors of 7.5 hp and larger shall be the backward-inclined, belt-driven centrifugal type.

.2 Balancing

.1 Fans shall be balanced after assembly and after coating at the speed the unit is scheduled to operate. Fans shall be balanced such that the maximum displacement in any plane is less than 1.0 mils, peak to peak.

.3 Fan motors

.1 Fan motors shall be the totally-enclosed, fan-cooled, high-efficiency type and shall be selected for a service factor of 1.15.

.17 Moisture removal capacity control

.1 The dehumidifier shall operate automatically, in response to the control system supplied by the manufacturer as follows:

.1 Process air face & bypass modulation

.1 The volume of process air passing through the dehumidifier shall be modulated by means of electric or pneumatic motor-driven dampers which cover the process air inlet and the bypass air inlet to the dehumidifier casing. The bypass air duct shall be included inside the dehumidifier casing such that no additional external ductwork need be added to the unit to achieve control. The bypass duct shall be equipped with an orifice plate to balance the pressure drop of the bypass to equal that of the desiccant wheel at full flow.

.1 Dampers

.1 Dampers shall be opposed-blade type, with galvanized steel frames, stainless steel end-seals, elastomeric blade edge seals and oil-impregnated blade shaft bushings.

.2 Damper frames and casing

.1 The damper frames shall be fastened and sealed to eliminate air bypass around the damper assembly. The operator(s) and connecting linkages shall be mounted in a separate compartments sealed from the supply air stream and from the ambient environment. The compartment shall be equipped with an access panel for ease of adjustment and servicing without the need to disturb the supply air flow.

.3 Damper actuators

.1 Damper actuators shall be the proportional type with spring return on power loss. They shall operate in response to a continuous signal input signal. Pneumatic actuators shall be equipped with positive positioning relays.

.4 Responsibility for the control system shall be divided as follows:

.1 Dehumidifier manufacturer

.1 Provide the dehumidifier complete with dampers and motors mounted, wired and tested in the factory prior to shipment. The manufacturer shall provide the sensor/controller suitable for operation and control at the specified location and humidity control range.

.2 Installing contractor

.1 Install the humidity sensor in the location specified, and wire the sensor and controller to the dehumidifier. Reset the fixed-position bypass flow control damper such that pressure drop through the bypass equals the pressure drop through the desiccant wheel at the specified process air flow rate.

2.5 22-AHU-5,6,7 LAB UNITS

.1 General

.1 Equipment to include:

.1 ECM driven direct drive backward curved plenum supply fans

.2 Double wall cabinet construction

.3 Insulation with a minimum R-value of 6.25

.4 Double sloped stainless steel drain pans

.5 Hinged access doors with lockable handles

.2 Air Handling Units

.1 General Description

.1 Indoor air handling units shall include filters, supply fans, chilled water coil, mixing box, and unit controls.

.2 Unit shall have a draw-through supply fan configuration and discharge air horizontally.

.3 Unit shall be factory assembled and tested including leak testing of the chilled water coil, and run testing of the supply fans and factory wired electrical system. Run test report shall be supplied with the unit.

.4 Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.

.5 Unit components shall be labeled, including pipe stub outs, electrical and controls components.

.6 Installation, Operation and Maintenance manual shall be supplied within the unit.

.7 Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.

.8 Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

.3 Construction

.1 All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.

.2 Unit insulation shall have a minimum thermal resistance R-value of 6.25. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610°F.

.3 Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.

.4 Unit shall be designed to reduce air leakage and infiltration through the cabinet. Sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

.5 Access to filters, cooling coil, supply fans, and electrical and controls components shall be through hinged access doors.

.6 Access doors shall be flush mounted to cabinetry. Coil access door and supply fan access door shall include quarter-turn lockable handles. Supply fan access door shall include removable pin hinges.

.7 Units with a cooling coil shall include sloped 304 stainless steel drain pan. Drain pan connection shall be on the right hand side of unit.

.8 Cooling coil shall be mechanically supported above the drain pan by multiple supports that allow drain pan cleaning and coil removal.

.4 Electrical

.1 Unit shall be provided with an external control panel with separate low voltage control wiring with conduit and high voltage power wiring with conduit between the control panel and the unit. Control panel shall be field mounted.

.2 Unit shall be provided with standard power block for connecting power to the unit.

.3 Unit shall include a factory installed 24V control circuit transformer.

.4 Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.

.5 Supply Fans

.1 Unit shall include direct drive, unhoused, backward curved, plenum supply fans.

.2 Blower and motor assembly shall be dynamically balanced.

.3 Blower and motor assembly shall be isolated with neoprene gasket.

.4 Motor shall be a high efficiency electronically commutated motor (ECM).

.6 Cooling Coil

.1 Chilled Water Cooling Coil shall be certified in accordance with AHRI Standard 410 and be hydrogen or helium leak tested.

.2 Coil shall be constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled.

.3 Coil shall have right hand external piping connections. Supply and return connections shall be sweat connection. Coil connections shall be labeled, extend beyond the unit casing, and be factory sealed on both the interior and exterior of the unit casing, to minimize air leakage.

.7 Filters

.1 Unit shall include 2 inch thick, pleated panel filters with an ASHRAE efficiency of 30% and MERV rating of 8, upstream of the cooling coil.

.2 Unit shall include a clogged filter switch.

.8 Mixing Box

.1 Unit shall contain a mixing box with top return air opening and front outside air opening.

.2 Return air opening shall contain an adjustable, motor operated outside air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven. Dampers shall be fixed position controlled by a fully modulating actuator.

.3 Outside air opening shall contain an adjustable, motor operated outside air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven. Dampers shall be fixed position controlled by a fully modulating actuator.

.9 Controls

.1 Unit shall be provided with terminal wiring strip for external wiring of controls for damper actuators, fan start/stop, clogged filter switch, proof of air flow.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air handling equipment installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Representative.

.2 Inform NRC Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Installation, Operation and Maintenance manual shall be supplied with the unit.

.2 Installing contractor shall install unit, including field installed components, in accordance with Installation, Operation and Maintenance manual instructions.

.3 Start up and maintenance requirements shall be complied with to ensure safe and correct operation of the unit.

3.3 DRIP PAN

.1 Install deep seal P trap and trap seal primer on drain lines.

.1 Depth of water seal to be 1.5 minimum times static pressure at this point.

3.4 ADDITIONAL WORK FOR AHU-4

.1 Start-up BY MANUFACTURER

.1 The service technician shall start up and adjust the unit in accordance with instructions contained in the operating and maintenance manual provided by the manufacturer. The start up technician must pay particular attention to the following items:

.1 Air flow

.1 The air flow volume of the process and reactivation air streams shall be set so that the reading on the manometers on the unit matches the values outlined on the technical data sheet provided by the manufacturer.

.2 Utilities

.1 The power and reactivation energy connections shall be made carefully and checked against the unit specifications outlined on the technical data sheet provided by the manufacturer.

.3 Documentation

.1 The start-up technician shall provide written documentation of compliance with procedures outlined by the manufacturer in the operating and maintenance manual. As a minimum, the technician shall measure and record the values for the electrical power, the air flow manometers and the run-hour meter. The technicians full name and telephone number and the start-up date shall be printed legibly on the start up documentation and on the copy of the technical data sheet in the operating and maintenance manual which is mounted inside the unit control cabinet.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 WORK INCLUDED

.1 Snow Melting: Furnish and install a Snow & Ice Melting (SIM) system complete with piping, distribution manifold(s), slab sensors and controls, pipe to manifold compression nut fittings, manufacturer-approved cold-expansion compression-sleeve pipe repair couplings, non-metallic pipe fasteners, installation specialties, supervision and field engineering required for complete and proper function of the system. Also, provide snow melt controls, snow detector sensors, and auxiliaries. Any other equipment proposed shall be submitted as alternates with cost savings.

.2 Acceptable Manufacturers

.1 REHAU

.2 Uppanor (ex-Wirsbo)

.3 Stadler

.4 Watts

.5 Heat Link

.3 Refer to drawings, Mechanical floor plans and flow diagrams, and to mechanical equipment schedule for systems performance, capacities and quantities.

1.3 REGULATORY REQUIREMENTS

.1 Cross-linked polyethylene (PEXa) pipe: Conform to ASTM F 876, F 877 and CSA B 137.5.

.2 Fittings: Conform to ASTM F 877, F 2080 and CSA B 137.5.

.3 Pipe oxygen diffusion barrier: Conform to DIN 4726.

1.4 REFERENCES

.1 ASTM F 876: Standard Specification for Cross-linked Polyethylene (PEX) Pipe

.2 ASTM F 877: Cross-linked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems

.3 ASTM F 2080: Standard Specification for Cold-Expansion Fittings with Metal Compression-Sleeves for use with Cross-linked Polyethylene (PEX) Pipe

.4 CSA B 137.5: Cross-linked Polyethylene (PEX) Tubing Systems for Pressure Applications

.5 Comply with all applicable codes, in particular with the following: OBC, OFC, Ontario Electrical Safety Code, ASHRAE 90.1 Standard, MOE requirement (relevant TSSA requirement, as per GO Transit Design Manual GO DM EN-0206-01.)

1.5 SUBMITTALS

.1 Provide submittals and shop drawings in accordance with the Division 01 and as specified herein. Submit shop drawings indicating schematic layout of system, including equipment, critical dimensions and piping/slab penetration details as well as details for protecting exposed PEX piping.

.2 Submit manufacturer's technical installation instructions.

.3 Submit independent certification results for the piping systems from a recognized testing laboratory.

.4 Submit computer-generated system design indicating pipe sizing and panel performance at pipe spacing and water temperatures selected. Design calculations to be performed on pipe manufacturer’s software.

.5 Submit catalogue data on all equipment, fittings, fasteners and associated items necessary for the installation of the piping and manifolds.

.6 System shall be installed by a contractor experienced in radiant floor heating and snow melting system pipe installation. Submit installer’s installation certification and project installation resume of experience.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver and store piping and equipment in shipping containers with labeling in place. Pipe to be kept in original shipping boxes until required for installation. Do not expose pipe to ultraviolet (sunlight) light for more than 90 days.

.2 Protect piping and manifolds from entry of contaminating materials by installing suitable plugs in all open pipe ends until installation. Where possible, connect pipes to assembled manifolds to eliminate possibility of contaminants.

.3 Piping shall not be dragged across the ground or concrete surfaces, and shall be stored on a flat surface with no sharp edges.

.4 Pipe shall be protected from oil, grease, paint, direct sunlight and other elements as recommended by manufacturer.

1.7 WARRANTY

.1 The snow ice melting pipe manufacturer shall warrant the cross-linked polyethylene piping to be free from defects in material and workmanship for a period of twenty-five (25) years. The design shall be approved either by submittal or stamped by a registered engineer licensed in the Province of Ontario as being complete and accurate.

.2 All manifolds and controls shall be warranted for 18 months and/or two heating seasons.

.3 Coupling if required shall be warranted for 25 years.

Part 2 Products

2.1 PIPING

.1 Material: All SIM = snow & ice melting and heating piping: High density cross-linked polyethylene with an approved cell classification in accordance with ASTM D 3350. Conform with ASTM F 876 and CSA B 137.5, and be certified by CSA or equivalent testing organization.

.2 Temperature and Pressure Ratings: Rated for 100 PSIG gauge pressure at 180°F temperature (690 kPa @ 82°C) continuous, and 80 PSIG gauge pressure at 200°oF temperature (550 kPa @ 93°C) continuous.

.3 Oxygen Diffusion Barrier: Co-extruded oxygen diffusion barrier capable of limiting oxygen diffusion through the pipe to less than 0.10 mg/l/day at 104°F (40°C) water temperature, in accordance with DIN 4726.

.4 Bend Radius: Not less than five (5) times the outside diameter. Bends with a radius less than this require the use of a bending template as supplied by the pipe manufacturer, and/or hot air.

.5 Install slab heating pipe as shown on approved piping design shop drawings, prepared by the SIM system manufacturer/supplier.

.6 Fasten pipe using nylon cable binders to a middle rebar mesh (provided by general contractor) maintaining 75 mm pipe clearance from the top of the concrete slab.

2.2 FITTINGS

.1 Manufactured of dezincification-resistant brass and supplied by the piping manufacturer as part of a proven catalogued system. Manifold fittings to be compression nut style with split compression ring.

.2 Certified to ASTM F 877, F 2080 and CSA B 137.5 as part of the manufacturer's PEX piping system. Pipe couplings embedded within the thermal mass shall be cold-expansion compression-sleeve fittings.

2.3 MANIFOLDS

.1 Manifolds: Equipped with visual flow gauges, balancing and isolation valves for each circuit, header isolation valves and air vent/fill ports. Mount manifolds on metal brackets and ready to install.

.2 Provide automatic air vents with each manifold.

.3 Industrial size and grade for snow melting, piped for reverse return.

.4 Manifold Enclosure: Insulated, stainless steel enclosure to house and protect Supply and Return headers. Removable, to allow maintenance and access to valves.

.5 Radiant floor heating shall be complete with manifold and pump package. All associated equipment shall be located as depicted on mechanical drawings.

2.4 RADIANT FLOOR HEATING CONTROLS

.1 Room temperature sensors, slab temperature sensors provided by BMS Contractor. Slab sensors installation by Radiant Floor Heating Contractor. Controls BMS Contractor to

supply controller, installed inside manifold/controls panel and factory pre-wired and programmed. Coordinate this work with the BMS Contractor. BMS to wire this controller to building BMS system for controls adjustment of set-points, monitoring, resetting, alarms.

.2 Space Sensors / Slab Sensors: Low voltage devices with electronic temperature sensing supplied by the controls division. Sense and control outputs based on outdoor temperature, space temperature and slab temperature, interlock floor heating with: perimeter VAV-boxes, hot water radiators heaters, and fan coil units-FCU-as applicable. Floor Heating is first stage of heat and VAV box and shall be first set to its minimum where applicable; radiator heaters and FCU's are second heating stage.

.3 Valves and Actuators: Installed to allow temperature reset controlled fluid circulation through the slab heating system.

.4 Manufacturer's representative to assist in the commissioning of the control systems.

2.5 ACCESSORIES

.1 Utilize manufacturer's system installation accessories including: nylon cable binders, pipe sleeves, control joint sleeving, pipe cutters, pipe uncoilers and other installation tools and aids and pipe ties.

2.6 PERFORMANCE

.1 Refer to Mechanical Equipment Schedule for performance details and capacities.

Part 3 Execution

3.1 PREPARATION

.1 An approved insulation should be installed under the SIM system to prevent downward heat loss and to increase SIM system response time.

.2 Concrete Slab: Reinforcing wire mesh or must be flat and level, with all sharp ends pointing down. Finished grade of the thermal mass must be a minimum of 3/4" (19 mm) above the top of PEX heating pipes and not more than 65mm above the top of PEX heating pipes.

.3 On Structural Concrete: Concrete surface must be clean and free from all construction debris that could potentially damage the pipe. Insulation, if used, to be installed above existing surface. Finished grade of the thermal mass overpour must be a minimum of 3/4" (19 mm) above the top of PEX heating pipes.

.4 Preparation of Space for Manifold Installation: Review drawings and/or design to determine proper locations for manifolds. Manifolds should be installed in a secure location within a steel manifold cabinet or behind a steel access panel. If mounted outdoors or in an unheated indoor environment, insulate manifold and pipe tails against heat loss. Check cabinet specifications to determine the width of the wall cabinet (if required) and required wall opening dimensions. Mount the manifold cabinet allowing space for the screed to fill up the front of the pipe opening. If a cabinet is not used, prepare a suitable cavity for the manifold, with a secure mounting plate that will place the

manifold at least 30 inches (75 cm) above floor level. Install in an area that will allow easy access for supply/return piping as well as future access for maintenance.

3.2 INSTALLATION

.1 Install in accordance with manufacturer's published installation manual and/or published guidelines.

.2 Mount manifolds in the locations previously prepared or in previously installed cabinets, if used. Mount level.

.3 Route piping in orderly manner, according to layout and spacing shown in approved submittal drawings. Adhere to all notes on drawings.

.4 At connections and fittings, use a plastic pipe cutter to ensure square and clean cuts, and join pipes immediately or cap ends of pipe to seal from contaminants. Where fittings are installed within the thermal mass, wrap in chloride-free tape or seal within a heat-shrink material approved by the manufacturer.

.5 Dispense piping using a suitable uncoiling device. Remove all twists prior to securing pipe. Pipe must lie flat on an even plane. Fasten piping at no more than 3 feet (90 cm) intervals, being careful not to twist the pipe. In thin concrete slabs secure piping every 2 feet (60-cm). Use only fasteners supplied or approved by the manufacturer of the PEX pipe.

.6 Cover piping that must pass through expansion joints in protective polyethylene convoluted sleeving (flexible conduit) extending 15 inches (38 cm) on each side of the joint. Secure sleeve on pipe to prevent movement during installation of thermal mass.

.7 Place protective conduit around the pipe where piping exits the thermal mass, with the conduit extending a minimum of 6 inches (15 cm) into the floor and exiting by a minimum of 6 inches. For penetrations at manifolds, use rigid PVC bend guides secured in place to prevent movement.

.8 At the time of installation of each circuit of pipe, connect the pipe to the correct manifold outlet and record pipe length for balancing. If manifold is not installed, cap the end of the pipe and label the pipe's circuit numbers along with S for supply and R for return. Connect pipes to manifold as soon as possible and record circuit lengths. All circuits shall be labeled to indicate circuit length and serviced area.

.9 The SIM system should not be put into operation until poured concrete thermal mass has cured a minimum of 28 days, unless otherwise specified and approved by thermal mass supplier. If it is necessary to operate the SIM system to prevent freezing, a maximum flow temperature of 72° F (22°C) must not be exceeded while the thermal mass is curing. After curing, gradually increase the flow temperature by no more than 10°F (6°C) each day until system reaches the required operating temperature.

.10 Contractor shall be responsible for provision of

.1 Wire mesh or rebar to secure tubing and any insulation to be provided by the general contractor

.2 Styrofoam insulation beneath slab or setting bed.

.3 Labour to install Radiant Floor Heating system

.4 Water, glycol and any chemical solutions.

.5 Field coordination of the pressure test equipment. (

.6 Supervision of concrete pours to instruct concrete installers on maintenance of pipe integrity and position of pipe in slab during concrete installation.

.7 Installation of control valves, pumps, supply and return piping, all valves and fittings.

3.3 FIELD QUALITY CONTROL

.1 Filling, Testing & Balancing: Tests of hydronic heating systems shall comply with local codes, and, where required, shall be witnessed by the building official.

.1 Pressure gauges used must show pressure increments of 1 PSIG and should be located at or near the lowest points in the distribution system.

.2 Air Test: Charge the completed, yet unconcealed pipes with air. Do not exceed 150 PSIG. Use liquid gas detector or soap solution to check for leakage at manifold connections.

.1 Perform a preliminary pressure test pressurizing the system to the greater of 1.5 times the maximum operating pressure or 100 psi for 30 minutes. As the piping expands, restore pressure, first at 10 minutes into the test and again at 20 minutes. At the end of the 30 minute preliminary test, pressure must not fall by more than 5 PSIG from the maximum, and there shall be no leakage.

.2 After performing the preliminary test, perform the main pressure test immediately. The main pressure test shall last 2 hours. The test pressure should be restored and must not fall more than 3 PSIG after 2 hours. No leakage should be detected.

.3 Pressure shall be maintained and monitored during installation of the thermal mass. If any leak is detected during installation of thermal mass, the leak must be found immediately and the area cleared for repair using manufacturer approved repair coupling. Retest before covering repair.

3.4 BMS SYSTEM AND BUILDING CONTROLS (ALSO REFER TO SECTION 25 05 00)

.1 Provide monitoring and controls of the following Mechanical Equipment, utilize dedicated stand alone DDC controllers, communicating to BMS bus.

.1 Control P- Glycol Feed Pumps and associated HX heat exchangers and solenoid valves. Monitor pumps/HX heat exchangers DDC Controllers – Monitor: ON, OFF status and ALARM.

.1 Control: ON, OFF through local controller, with override capability from BMS,

.2 Monitor: ON, OFF status and alarm

.2 Control P- Heating Water supply Pumps and associated solenoid valves and HX heat exchangers:

.1 Control: ON, OFF through local controller, with override capability from BMS,

.2 Monitor: ON, OFF status and alarm

.3 Control P- Solar/Domestic Hot Water Loop Pumps and associated HX heat exchangers and solenoid controls valves. Monitor pumps/HX heat exchangers DDC Controllers – Monitor: ON, OFF status and ALARM.

.1 Control: ON, OFF through local controller, with override capability from BMS.

.2 Monitor: ON, OFF status and alarm

.2 Cooperate with the air and water balance technicians during the balancing of the system.

.3 Install equipment so as to allow for easy maintenance access and such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.2 Provide labour, installation materials and control equipment to provide a complete and satisfactory building automation system in accordance with the intent and meaning of the Drawings and Specifications. Include:

.1 Wire or pipe remote instrumentation required to operate packaged systems supplied by others. Modulating thermostats for these systems must match the system component characteristics.

.2 Supply, install and connect all control wiring for the systems described.

.3 Control wiring of components for systems listed herein requiring 120V or less. Included are such items as remotely mounted interlocks, sensors, 120V supply to refrigerated air dryers, seven day timers, etc.

.3 Refer to and comply with requirements specified in Basic Mechanical Requirements, Section 23 05 01 and also Division 26, Electrical Work.

.4 Co-ordinate the work of this Division with other Trades to obtain their electrical input for the electrical control schematics.

.5 Advise and co-ordinate this work with all associated trades and balancing technicians.

1.2 CODES, REGULATIONS AND STANDARDS

.1 Comply with Municipal or Provincial Codes, Rules and Regulations and/or Authorities having jurisdiction.

.2 Comply with the National Building Code in areas where Municipal or Provincial Regulations and/or Codes are not mandatory.

.3 Revisions issue: latest version as amended to date.

1.3 MATERIAL APPROVALS

.1 Obtain special inspection and approvals by CSA and/or local authorities, for materials where specified.

.2 Obtain such approval for the particular installation with the co-operation of the material supplier.

1.4 PERMITS AND INSPECTIONS

.1 Obtain permits required for the installation of mechanical trades work including:

.1 Electrical inspection

.2 Arrange for inspections and tests and pay all fees and costs for the permits, inspections and tests. Obtain permits immediately after notification of award of Contract.

.1 Obtain copies of Drawings from the Consultant for submission with application for permits.

1.5 **RELATED WORK**

.1 The following equipment will be supplied and installed under other Sections or Divisions.

.1 Manual balancing dampers, fire dampers and gravity dampers: Division 23.

.2 Automatic control dampers supplied as an integral part of equipment. e.g. mixing box dampers and face and bypass dampers unless otherwise noted: Division 23.

.3 Control and power wiring between components of "packaged" systems: Division 21, 22, 23 and 26.

.4 Direct expansion cooling valves: Division 23.

.5 Refrigerant solenoid valves: Division 23.

.6 Multizone dampers unless otherwise noted: Division 23.

.7 Humidifier control valves complete with operators: Division 23.

.8 Return air fan variable vane linkage: Division 23.

.9 Supply air fan intake variable vanes and linkage: Division 23.

1.6 **ITEMS TO BE SUPPLIED UNDER THIS SECTION AND INSTALLED UNDER OTHER SECTIONS**

.1 Supply the following equipment to the appropriate Mechanical Trades for installation in accordance with instructions from, and under the supervision of, the Automatic Controls Subcontractor:

.1 Motorized dampers.

.2 Automatic control valves.

.3 Temperature control wells for pipe or tank mounted sensors.

.4 Roof mounted relief dampers, with operators and linkage.

.5 Variable volume terminal unit operators. (These operators will be installed on the terminal units by the terminal unit supplier).

1.7 **WORK UNDER OTHER CONTRACTS OR DIVISIONS**

.1 The following equipment will be supplied and installed by other trades or Contractors:

.1 Door limit switches for automatic temperature controls.

.2 Electrical items of work as defined hereinafter.

.3 All line side power wiring.

.4 Combination starters or contactors complete with integral pushbuttons, Hand-Off-Auto switches, etc. unless otherwise specified.

.5 Alternators for pump sequencing.

.6 All controls and wiring for:

.1 Fire alarm control system.

.2 Electric baseboard heaters.

.3 Electric forced flow heaters with integral thermostats.

1.8 REFERENCE STANDARDS

.1 Input/Output devices:

.1 To ASCII (American Standard for Communication and Information Exchange) code and standard EIA (Electronic Industry Association) interfaces.

.2 RFI interference: To F.C.C. regulation Part 15 Section 15 governing radio frequency electromagnetic interference and devices so labeled.

.2 Codes and Standards: comply with the following as a minimum:

.1 UL-916-PAZX listed

.2 Electrical Safety Code

.3 ASHRAE/ANSI 135-1995 (BACnet)

1.9 PRODUCT AVAILABILITY

.1 Product Development

.1 All products to be new, currently under manufacture, and have been applied in similar installations for a minimum of two (2) years.

.2 This installation shall not be used as a test site for new products unless explicitly approved by the Owner's representative in writing prior to bid date.

.2 Spare Parts

.1 Spare parts to be available for at least five (5) years after completion of this contract.

1.10 WORKING DRAWINGS AND DOCUMENTS

.1 Design Drawing Intent

.1 The design Drawings are schematic in arrangement, and describe the general design intent but do not show the exact details for the installation. They are not fabrication or installation drawings.

.2 The Work is suitably outlined on the Drawings with regard to sizes, locations, general arrangements and installation details, and has been generally coordinated for routing of services. The routing of ductwork, piping and equipment arrangement are shown more or less in diagram

except where in certain cases the Drawings may include details giving the exact locations and arrangements required.

.3 The location of equipment, and the associated arrangement of piping, ductwork, and other material describes the general requirements of the Work. Final location is dependant on the actual equipment supplied. The Consultant reserves the right to make reasonable adjustment of up to 1 m to the location of equipment, floor drains, routing of major piping and ductwork, at no cost to the Owner.

.4 In order to provide clarity to the arrangement of the work, not all details including valves, thermometers, pressure gauges, etc. are shown on the plan drawings. Refer to schematic drawings, standard details and the specification for these requirements.

.5 Where specific installation dimensions for location of equipment and access space requirements are indicated on the drawings, install to these requirements.

.6 Where Standard Details are provided, these show the general installation requirements, and are applicable to each occurrence in the Work, unless otherwise specified or shown.

.2 Contractor Coordination Responsibilities

.1 Provide the services of a mechanical/electrical coordination supervisor, to coordinate this Division of the Work, as well as providing coordination with other Divisions and/or contracts. This supervisor may be full time or part time on site, as appropriate to the work stage and complexity of the work, at the discretion of the Owner.

.2 Where multiple trades are required, the mechanical coordinating supervisor shall be the lead coordinator.

.3 The Owner reserves the right to require the coordinating supervisor to increase their attendance at site, at no cost to the Owner, if in the Owner's opinion the current level of coordination is not sufficient for the progress of the Work.

.4 Make changes and modifications as necessary to ensure coordination and to avoid interference and conflicts with other trades.

.5 Prepare construction / installation / fabrication drawings, coordinated with other trades and contracts, as required. Provide these drawings to other trades for coordination with their Work.

.6 Update these drawings as part of the As-built drawings, showing actual locations of major equipment, services, access doors, shut-off valves, etc.

.7 The design drawings show the major requirements for the installation of equipment based on one manufacturer's requirements, but may not show all installation requirements. The Contractor will include as part of the Work the specific manufacturer's installation requirements for the equipment actually provided by the Contractor.

.8 The construction / installation / fabrication drawings are not to be submitted as shop drawings. Make them available for viewing at site when requested by the Consultant.

.3 Review before proceeding (HOLD)

.1 Where the word "HOLD" appears on Drawings and other Contract Documents, the Work is included in the Contract.

.2 Execute such Work only after verification of dimensions, verification of materials and obtaining Consultant's written permission to proceed.

1.11 **COORDINATION AND EXAMINATION**

.1 Examination

.1 Carefully examine Work and Drawings of all related trades and thoroughly plan the Work so as to avoid interferences.

.2 Report defects which would adversely affect the Work. Do not commence installation until such defects have been corrected.

.2 Coordination

.1 Coordinate Work of this Division such that items will properly interface with Work of other Divisions. Prepare installation drawings of critical locations and submit to Consultant for review.

.2 Architectural Drawings, or in their absence, Mechanical Drawings govern all locations.

1.12 **PROVISION FOR FUTURE**

.1 Future equipment:

.1 Where indicated as reserved for future equipment or services, leave identified space clear and install services and equipment so that connections can be made in the future.

1.13 **EQUIPMENT NOT IN CONTRACT**

.1 Supplied By Owner (S.B.O.) equipment:

.1 Owner will receive, check and temporarily store this equipment in Building M19 located on the NRC Montreal Rd. Campus.

.2 Contractor under Division 1 will check for damage, will load and transport from M19 storage building to M22 construction site and be responsible for this equipment.

.3 Contractor under Division 1 will unpack, and assemble this equipment, and locate them in building.

.4 Connect mechanical services to accommodate this equipment.

.5 Owner shall hold equipment warrantee and Contractor shall be responsible for installation warrantee.

1.14 **PRE-PURCHASED EQUIPMENT**

.1 The following equipment has been pre-purchased by the Owner:

.1 Quantity two (2) Sewage Vacuum Tanks; refer to specification 22 42 01 section 2.13.

.2 The purchase value of the equipment is not included as part of the Work.

.3 Include as part of this Work the following:

.1 Scheduling and coordination for removal from storage and delivery of point of installation.

.2 Check, store, rigging, installation and otherwise be responsible for this equipment.

.3 All other provisions of this work including but not limited to Start-up and Performance Testing, manufacturers start-up services, training , Operating and Maintenance materials, coordination of installation, and warranty of installation provisions.

1.15 **SUBMITTALS**

.1 Shop Drawings

.1 Submit shop drawings in accordance with Section 01 33 00. Partial or incomplete submittals of data and/or drawings will be returned without review.

.2 Commence installation of the controls only after the shop drawings have been reviewed by the Consultant.

.3 Include the following in the shop drawings:

.1 Pneumatic piping and/or electric schematic drawings for the various control systems including component make and model numbers in accordance with the operating sequences on the instrument data sheets.

.2 Description and sequence of operation for each system in accordance with the Drawings. The preferred location for the operating sequence is on the Schematic Drawing.

.3 Drawings for control panels showing control equipment arrangement.

.4 Point address

.5 Manufacturer’s data/specification sheets. Indicate supplied model and options.

.6 Location of local support office

.7 Location of local parts supply

.8 Names of subcontractors, if any

.9 BMS Architecture schematic(s)

.10 System capacity and identified points reserve

.11 Software programs included

.12 Sample of commissioning plan and documentation

.4 Include electric control schematics for all systems in this Section. Schematic format and wire numbering:

.1 In accordance with the typical schematics attached to this Specification and on drawings.

.2 Include electrical components, e.g. control transformers, relays, overloads selector switches, running lights, thermostats, etc. which are necessary to provide a complete schematic.

.5 Use contact identification identical to the contacts shown on the suppliers shop drawings. List the reference shop drawing numbers on each schematic drawing.

.6 Revise the suppliers shop drawings for the systems listed herein to show the appropriate power demand, master clock and fire alarm contacts and the reference drawing numbers.

1.16 "AS-BUILT" RECORD DRAWINGS

.1 Reference

.1 Conform to Section 01 77 00 Contract Closeout.

.2 Maintain an accurate dimensional record of all underground piping and all deviations and changes in aboveground piping and equipment.

1.17 INSTALLATION AND START-UP INSTRUCTIONS

.1 Reference

.1 Conform to Section 01 77 00 Contract Closeout.

.2 Submit copies of installation instructions and copies of start-up instructions for any item of equipment when requested by the Consultant.

1.18 OPERATING AND MAINTENANCE INSTRUCTION MANUALS

.1 Reference

.1 Conform to Section 01 77 00 Contract Closeout.

.2 In addition, include the following in the manuals:

.1 Non-dimensional layout showing location of all electrical devices on mechanical equipment.

.2 Operating instructions, including start-up and shut-down procedure.

.3 Lubricating instructions and recommended cycle of lubrication for each item of equipment, including various types of lubricants.

.4 List of spare parts.

.3 All the above applies to component parts of equipment whether they are manufactured by the supplier of the equipment or are supplied as a component part of an item of equipment.

1.19 **TRADE QUALIFICATIONS**

.1 Applicable to the following trades

.1 Electricians

.2 Requirements

.1 Trade workers to have a Certificate of Qualification as Journeyman or Apprentice Registration for the province where the work is performed or an Interprovincial Certificate.

.2 Ratio of journeyman to apprentice: not to exceed the defined ratio in the Apprenticeship Act of Ontario.

.3 Certificates and Registration must be provided to the Consultant on request.

.4 Maintain on-site an up-to-date record listing journeyman and apprentices working on site.

1.20 **PRODUCT DELIVERY, STORAGE AND HANDLING**

.1 Seal instruments after manufacture and inspection and remain sealed until ready for installation.

.2 Handle instruments and equipment carefully handled and protect from weather, dust and construction materials.

PART - 2 PRODUCTS

2.1 **MATERIALS AND EQUIPMENT**

.1 Use new materials and equipment, free from defects impairing strength and durability, as specified or specified equivalent.

.2 Of Canadian manufacture wherever possible.

.3 Labelled or listed as required Code and/or inspection authorities.

2.2 **B.M.S. GENERAL SYSTEM PERFORMANCE REQUIREMENTS**

.1 General

.1 Distributed, microprocessor based, direct digital control system, capable of performing binary and PID control loop operations independent of communications with external controllers.

.2 Design Intent: the design documentation is schematic in nature. Provide hardware, software, and system architecture design to implement the functions, performance and control sequences shown.

.3 Any items required to complete the work and not specifically mentioned herein shall be supplied to the same quality standards as the specified items.

.2 Performance Standards: BMS system to conform to the following:

.1 Graphic Display: display a graphic with a minimum of 20 dynamic points. All current data displayed within 20 seconds of the request.

.2 Graphic Refresh: update all dynamic points with current data within 30 seconds.

.3 Object Command: maximum time between the command of a binary object by the operator and the reaction by the device not to exceed 10 seconds. Analog object to begin adjusting within 10 seconds of command input.

.4 Object Scan: all changes of state and change of analog values to be transmitted over the high-speed network and displayed at a controller or Workstation with 60 seconds of change.

.5 Alarm Response Time: maximum 45 seconds between alarm condition and annunciation at the work station.

.6 Program Execution Frequency: custom and standard application executions run a minimum of once every 5 seconds. Contractor to select execution times consistent with the mechanical process under control.

.7 Control Loop Performance: execute PID control loops at a selectable frequency, at least once every 5 seconds. Scan and update the process value and output generated by this calculation at the same frequency.

.8 Multiple Alarm Annunciation: all work stations on the network to receive alarms within 5 seconds of each other.

.3 Network Communications General Requirements:

.1 Communications designed such that each control system is capable of operating under stand-alone control during network communication failure.

.2 Network communication: high-speed peer based network.

.3 Building Management System LAN : BACnet TCP/IP protocol (10baseT Ethernet).

.4 Fault Tolerance:

.1 All system components are to be designed, built, and installed to be fault tolerant as follows:

.1 Satisfactory operation without damage at 110% above and 85% below rated voltage and at +3 hertz variation in line frequency.

.2 Static, transient, and short circuit protection on all inputs and outputs.

.3 Communications lines protected against incorrect wiring, static transients and induced magnetic interference.

.4 All real time clocks and data file RAM shall be battery backed for a minimum of 72 hours.

.5 Bus connected devices to be a.c. coupled or equivalent so that any single device failure will not disrupt or halt bus communication.

.5 Building Services NRC Network Systems Reporting Accuracy:

Space Temperature	±0.5°C	±1°F
Ducted Air	±0.5°C	±1°F
Outside Air	±1.0°C	±2°F
Water Temperature	±0.5°C	±1°F
Delta-T	±0.15°C	±0.25°F
Relative Humidity	±1% RH	
Water Flow	±5% full scale reading	
Air flow (terminal unit)	±10% full scale reading	
Air flow (measuring station)	±5% full scale reading	
Air pressure (ducts)	±25 Pa	±0.1 in.wc.
Air pressure (space)	±3 Pa	±0.01 in.wc.
Water pressure	±2% full scale reading	
Non-utility electrical metering	5% of reading	
Carbon Monoxide (CO)	±50 ppm	
Carbon Dioxide (CO2)	±5 ppm	

.6 Process BAS Systems Reporting Accuracy:

Space Temperature	±0.5°C	±1°F
Ducted Air	±0.5°C	±1°F
Outside Air	±1.0°C	±2°F
Water Temperature	±0.5°C	±1°F
Delta-T	±0.15°C	±0.25°F
Relative Humidity	±1% RH	
Water Flow	±5% full scale reading	
Air flow (terminal unit)	±10% full scale reading	
Air flow (measuring station)	±5% full scale reading	
Air pressure (ducts)	±25 Pa	±0.1 in.wc.
Air pressure (space)	±3 Pa	±0.01 in.wc.
Water pressure	±2% full scale reading	

Non-utility electrical metering	5% of reading
Carbon Monoxide (CO)	±50 ppm
Carbon Dioxide (CO2)	±5 ppm

.7 Suppliers/Installers:

.1 Supplied and installed by a Control Subcontractor specializing in such work. As far as practical, all control equipment to be the products of a single manufacturer.

.2 Bids by Wholesalers, Contractors, Franchised Dealers or any firm whose principal business is not that of manufacturing and installing automatic temperature control systems shall not be acceptable.

.3 Single source responsibility of supplier shall be the complete installation and proper operation of the BMS and control system, including commissioning and proper calibration of each component in the entire system.

.4 An in-place support facility within 50 kilometers of the site with technical staff, spare parts inventory and all necessary test and diagnostic equipment.

.5 Standard of Acceptance:

.1 Airtron

2.3 LOCAL CONTROL PANELS

.1 Type: wall or floor mounted

.1 EEMAC 12: sheet metal cubicles for indoor use.

.2 EEMAC 4: sheet metal cubicles with hinged and locking front panels, for outdoor use.

.2 Construction:

.1 Suitable knockouts and hinged, lockable doors all keyed alike.

.2 Factory piped, wired, assembled and ready for field installation.

.3 Door mounted temperature gauges, filter gauges, pneumatic selector switches, etc.

.4 Interior compartment mounted DDC Controllers, controllers, air solenoid valves, relays, air gauges, etc.

.5 Nameplates for components mounted in and on local control panels in accordance with the Nameplate Article of this Section.

.6 Where one panel serves more than one system in a Mechanical Room, clearly separate the system components on the front of the panel.

.3 Panel Wiring:

.1 Wire electrical components mounted in local control panels.

.2 Terminate wire at terminal blocks located near the top or bottom of the panel to suit incoming conduit.

.1 Terminal blocks: Electrovert WK Series.

.3 Number and identify each terminal block point to tie in with the control drawings.

.4 Wire panel neatly and conform to all applicable codes.

.5 Identify control wires terminating at terminal strips.

.1 Markers: Electrovert Type Z

2.4 WIRING

.1 Wiring Standards

.1 To Section 25 05 00 requirements and the Electrical Safety Code as amended to date.

.2 Conduit:

.1 Wiring in ceilings, furred spaces, in hollow walls and partitions and where not exposed to mechanical injury: thin wall up to 32 mm.

.2 Wiring in poured concrete, where exposed and for conduit 40 mm: rigid galvanized.

.3 Wiring used as part of a smoke control/venting system, all locations: 40 mm: rigid galvanized.

.3 Power Wiring:

.1 Colour coded No. 14 gauge for control

2.5 IDENTIFICATION

.1 Lamacoid Nameplates:

.1 75 x 50 mm, 10 mm high black lettering on white background. Include the following information:

.1 Component name/ID

.2 Data Cards:

.1 100 x 150 mm (nominal) pre-printed data card, mounted in a hard plastic case, secured to device with nylon tie-wraps. Include the following information:

.1 Device Tag Identification

.2 Device Name

.3 BCU or ECU address

.4 Power Requirements

.3 Brass Valve Tags:

.1 25 mm dia. circular brass tag, fastened to valve body with keychain. Include the following information:

.1 Valve Tag ID (to correspond with manual valve tags under Section 23 05 53)

2.6 **EQUIPMENT SUPPORTS**

.1 Support Frames: galvanized modular framing system: Unistrut.

.2 Backboards: 20 mm fire rated plywood.

PART - 3 EXECUTION

3.1 **EXAMINATION**

.1 Thoroughly examine the design documentation for control devices and equipment, Notify the consultant of any discrepancies, conflicts or omissions prior to commencement of rough-in work.

3.2 **INSTALLATION**

.1 The BAS system is to be divided into two separate architectures, one with and one without a local front end.

.1 Those systems designated for general Building Services HVAC system applications and that support laboratory / research functional programs will NOT require a local work station but rather be interconnected with the NRC campus wide network. These shall include Zones “Terminal Units”, Mics Equipment, 20, 27 and 28.

.2 Those systems that are dedicated to process and laboratory / research functional programs will require a local front end that will be housed in the Flight Simulator Observation Room 26. These shall include all remaining Zones.

.3 Refer to the Points list tabulated in Section 25 95 00_01 for details.

.2 Execute work in accordance with requirements specified in the various Sections of Division 25, and where referenced to other Divisions.

.3 Lay out the work so that it does not interfere with work under other Divisions of Specifications.

.4 Make good any damage to Owner’s property or other trade’s work caused by improperly locating or carrying out of work.

.5 Location of pipes, ductwork, raceways and equipment may be altered without extra cost provided alteration is made before installation.

3.3 **PROTECTION**

.1 Protect work and materials before, during and after erection from weather and other hazards and keep in a clean and orderly manner.

.2 Protect pipe ends, valves and parts of equipment left unconnected to prevent damage or intrusion of foreign matter. Provide pipe caps for threaded male connections and plugs for threaded female connections.

3.4 **PAINTING**

.1 With the exception of prime painting of miscellaneous steel or any other specific requirements as specified under the respective Sections of this Work, or equipment otherwise factory painted, all painting will be provided under Division 09 (under a Separate Contract).

.2 Field prime painting:

.1 Mechanical rooms, boiler rooms, fan rooms, crawl spaces, pipe tunnels and penthouses: paint exposed galvanized metal surfaces with one coat of zinc dust galvanized primer and one coat of 100% alkyd base enamel.

.2 Clean rust and oil from exposed iron and steel work provided under this Division, whether or not it has been factory prime painted. Paint this equipment with one coat of chrome oxide phenolic base primer and one coat of 100% alkyd base enamel in an approved colour.

3.5 **CONSTRUCTION REVIEW**

.1 The construction review will include milestone and periodic reviews.

.2 Milestone Reviews

.1 Specific milestone reviews will be performed by the Consultant for compliance with the Ontario Building Code, including any or all of the following:

.1 Equipment Demonstration and Training

.2 Substantial Performance and Deficiency Review

.3 Total Performance

.2 Some or all of these reviews are of portions of the work which may be concealed. If work is enclosed before the Consultant can review the installation, the Consultant may direct the Contractor to expose the Work for it to be examined, at no additional cost to the project including rework affecting other Trades.

.3 If deficiencies are noted during any review where work will be enclosed, correct noted deficiencies and have them reviewed by the Consultant prior to the Work being enclosed.

.4 Provide a minimum of seven (7) calendar days written notice to the Consultant when requesting each review date.

.5 The Consultant will provide a check-list to the Contractor of required milestone reviews which must be completed. Maintain this list on site along with identified test reports, and make available for Consultants review when requested. When completed, include this checklist form with the Test Reports forms specified in this Division.

.3 Periodic Reviews

.1 The Consultant will conduct periodic reviews, as required for the project. These reviews are for the benefit of the Owner to describe the progress and workmanship of the Work, and are not intended as any form of quality assurance for the Contractor.

.2 Deficiencies will generally not be reported as part of this review, as the work has not been reported by the Contractor as being complete. However, deficiencies may be reported where it may not be possible to correct the work at a later date, or at great expense.

.3 The Contractor shall not relay on these Periodic Reviews to identify deficiencies during the progress of the Work.

.4 Deficiency Review

.1 The Consultant will conduct a deficiency review only after the Contractor submits an application for Substantial Performance. As part of this application, the Contractor shall submit their own comprehensive deficiency list of incomplete or incorrect work. Failure by the contractor to list any deficiency does not relieve the Contractor from correcting or completing the Work.

.2 The Consultant shall review the work and any deficiencies noted will be classified as Major or Minor.

.1 Major deficiencies are required to be corrected as part of obtaining Substantial Performance.

.2 Minor deficiencies may be corrected before or after Substantial Performance.

.5 Final Review

.1 The Consultant will conduct a final review only after the Contractor submits a declaration that all of the following has been completed:

.1 Noted deficiencies have been corrected

.2 Final As-built drawings have been submitted to the Owner

.3 Final Operating and Maintenance manuals have been submitted to the Owner

.4 Final Test reports, including Alternate season tests have been submitted to the Owner.

.6 The Consultant will only review the deficiency list to confirm these deficiencies have been corrected.

.7 Tubing and Conduit

.1 Tubing and conduit: follow horizontal and perpendicular building lines to fit into the layout of the area. Properly support and install in a neat and workmanlike manner throughout.

.2 Install panels in readily accessible locations. Unless other wise shown, mount control panels at a height of 1800 mm from the floor to the top of the cabinet for units without operator input devices (LCD screens, keypads, etc). For units with operator input devices, mount unit so that the horizontal centerline of the LCD display is located 1650 mm above the floor.

.3 Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.

3.6 LOCAL CONTROL PANELS

.1 Install BCU and ECU controllers in separate EEMAC 4 or 12 panels, to suit location. Install operator LCD screen, where specified, on the front panel door to allow operator access without opening door.

.2 Install BCU and ECU controllers, complete with OEM factory installed EEMAC 1 enclosures, directly to walls or support stands as described below. On systems requiring pneumatic control elements including pressure gauges, selector switches, etc., mount controller and pneumatic devices in an EEMAC 1 sheet metal enclosure. Install operator LCD screen, where specified, on the front panel door to allow operator access without opening door.

.3 Support local control panels from fixed masonry or concrete walls. Do not support from drywall partition walls. Provide free standing support frames in other locations.

3.7 VIBRATION ISOLATION

.1 Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

.2 Sensing elements in ductwork: substantially supported and protected from vibration.

.3 Vibration sensitive controllers: isolate either by location or by mounting device.

.4 Tubing and conduit: install to preserve vibration isolation of equipment and ducting.

3.8 WIRING COORDINATION

.1 Provide wiring and conduit under this Section of the work as follows:

.1 Between ceiling mounted junction boxes and terminal unit controllers.

.2 Between MCC mounted receptacle panels in mechanical rooms and controllers and control devices within the same area.

.3 Provide circuit breakers in "RP" and "ERP" panels; provide breaker locks to prevent unauthorized use of the breaker.

.2 Power wiring provided under Division 26 as follows:

.1 120 VAC power and conduit to a junction box located in the ceiling adjacent to each terminal unit.

.2 120 VAC normal power panels labeled "RP" with spaces available for use.

.3 120 VAC emergency power panels labeled "ERP" with spaces available for use.

.3 Termination at Packaged Equipment and Systems:

.1 Terminate wiring at packaged equipment and system controllers provided under Mechanical Division.

.2 For equipment or systems panels provided under other Divisions of the Work, pull wire into control panel as per OEM manufacturers instructions. Final termination at equipment or panel will be by the trade Contractor providing/installing the equipment.

3.9 WIRING

.1 Maximum control voltage : 120 V.

.2 Supply, install and connect power transformers as required for each system.

.3 Sizing of conduit and selection of size and type of wire is by the Contractor under this Section of the Work.

.4 Flexible metal and liquid tight conduit:

.1 Maximum 1000 mm length

.2 Minimum size: 20 mm

.3 Supported at each end

.5 Control and Status Relays:

.1 Provide relays in designated enclosures only. Relays may be installed within packaged equipment control panels.

.2 Do not install relays within motor starter enclosures. Install relays in spare MCC sections, or provide a NEMA 1 enclosure mounted adjacent to the MCC or starter.

.6 Control and interlock wiring: comply with Ontario Electrical Safety Code and Division 26, and as specified herein.

.7 Wire:

.1 All cables ULC listed for application.

.2 Exposed cable in ceiling plenums: FT6 plenum rated.

.8 Conduit:

.1 Wiring in ceiling plenum spaces to be in conduit or be FT6 plenum rated cable.

.2 Wiring in all other areas to be in conduit.

.3 Wiring for rated smoke venting/control system to be FT6 plenum rated cable and be installed conduit.

.9 Sleeves:

.1 Provide wall sleeves for plenum rated cable passing through walls.

.2 Maintain fire rating at all penetrations.

3.10 **FIBRE OPTIC CABLE SYSTEM**

.1 Install cable to maintain the minimum cable and unjacketed fiber bend radii as specified by the manufacturer.

.2 Do not exceed maximum pulling tensions as specified by the manufacturer. Do not exceed manufacturer's ratings for post installation residual cable tension.

.3 Install fiber optic cabinets, hardware, and cable entering the cabinet as per manufacturer's instructions.

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3.11 **ARCHITECTURE**

.1 Refer to drawings for system architecture schematic. The system architecture shown provides a general summary of the design intent, and does not show all control devices.

.1 Obtain a CAD design file form the consultant and complete the development of the system architecture drawing. In the absence of a design architecture, provide an architecture drawing as required.

.2 Include on the architecture drawing the following:

.1 Operator work stations

.2 Building LAN network

.3 Field LAN network

.4 BCU units, with identification label, and room location

.5 ECU units, with identification label, and room location

.6 LAN system repeaters

.2 Controllers:

.1 Provide a separate ECU for each piece of major equipment.

.2 Provide a separate ECU for each major system, including hydronic system water pumps.

.3 A universal programmable style ECU may be used to terminate miscellaneous I/O including system instrumentation, freestanding fans and pumps, etc. which may not form part of a more complex system.

.4 Select ECU's to provide a minimum of 15% spare capacity for each point type at each controller, but in no case less than 1 spare point.

3.12 **PROGRAMMING**

.1 General

.1 Point Naming: modular description without written point index.

.1 Use naming convention as indicated in contract documents.

.2 Provide programming for the system as specified and control sequence requirements. Include for additional programming necessary for the operation of the system but not specifically identified herein.

.3 Imbed sufficient comments in programming logic to clearly describe each section of the program. Comment statements to reflect language used in the sequences of operation.

.4 Enter all computer programs and data files into the related computers including English descriptors, control programs, approved parameters, and settings.

.2 Graphics

.1 Provide graphics for each major piece of equipment/system and for each floor plan in the building. Design CAD files will be provided to the controls Contractor for this purpose. Equipment to include:

.1 Chillers

.2 Cooling Towers

.3 Air Compressors

.4 Boilers

.5 Air Handling units

.6 Terminal box units

.7 Fan coils, unit heaters, etc

.8 Any integrated system including fire alarm, lighting control, security, etc.

.3 Reporting Information

.1 Implement samples of the following features:

.1 Bar chart (four different bars on one chart)

.2 Curve plot (five curves on one plot)

.3 Trend log

.4 Alarm message (action taking message)

.5 Run time maintenance message

.6 Trouble action message

3.13 NAMEPLATES

.1 Provide Nameplates:

.1 Lamacoid type:

.1 On each BMS control device, indicating device number.

.2 On the panel front to identify each system being controlled and to identify each front mounted component.

.2 Laminated Data Card:

.1 Field devices

.2 Damper actuators

.3 DDC terminal unit box controllers

.4 Automatic control valve actuators

.3 Brass Valve Tags:

.1 Pipe mounted valves, etc., supplied under this section.

.2 Control valves supplied under other Sections of the Specifications but controlled under this Section. Radiator valves do not require valve tags.

.2 Warning Labels:

.1 Provide plastic adhesive-backed labels, black lettering on yellow background, on each starter and equipment automatically controlled through the BMS system, as follows:

CAUTION
This equipment is operating under automatic control and may start at any time without warning.

ATTENTION
Cet équipement fonctionne sous contrôle automatique et peut commencer à tout moment et sans avertissement .

.3 Securely fasten Lamacoid nameplates to the equipment or adjacent to the equipment, with round-head cadmium plated steel self-tapping screws.

3.14 OPERATING INSTRUCTIONS

.1 Provide the services of a competent technician qualified to instruct the operating personnel in maintenance and operating procedures, after commissioning, for a period of not less than 1 day. Training to include:

.1 Overall operational program

.2 Equipment functions

.3 Commands

.4 Graphics generation

.5 Appropriate operator intervention following system's operation.

.2 Provide Operating instructions for the control system in accordance with Section 23 05 01, and include a description of the sequence of operation, and reproducible drawings of the "as-built" system schematics.

.3 Maintain CD-R copies of all data file and application software for reload use in the event of a system crash or memory failure. Deliver one copy to the owner during training sessions, and archive one copy in the control manufacturer's local software vault.

.4 "As-built" system schematics:

.1 Changes made during construction.

.2 Component final set points.

.3 Controller sensitivity and authority settings.

.5 Include maintenance instructions for control components supplied under this Section.

3.15 ADJUSTMENT AND DEMONSTRATION OF SYSTEMS

.1 After completion of the installation, regulate and adjust all sensors, motors and other equipment provided under this contract and place them in complete operating condition. Coordinate this work with the Mechanical Contractor and system balancing technicians.

.2 During the balancing and adjustment of the heating and ventilating systems, assist the Mechanical Contractor and system balancing technicians in the complete balancing of the systems.

.3 After this work is completed, advise the Consultant in writing that the installation is complete and ready for inspection.

3.16 TESTING AND REPORTING

.1 Conduct complete performance tests to demonstrate to the Consultant the correct operation of each individual control system and each item of control equipment. Repeat performance tests as necessary until all systems are proven satisfactory.

.2 Report Format

.1 Prepare test forms in MS Excel, Word, Access or other Database format.

.2 Include the following header information for each test report:

.1 Owner Name

.2 Project Name

.3 Contractor Name

.4 Consultant Name

.5 Name of Test Report

.3 Include the following on the front sheet of the consolidated report:

.1 Contractor Company Name

.2 Name and signature of the person submitting the report

.3 Date of report

.4 The following statement: “The undersigned certifies that the test results recorded in this report are correct, and that results have been witnessed by the trade responsible for the test”.

.4 Submit the above tests in a hardcopy form, separately bound from the Operations and Maintenance manuals, and in Adobe Acrobat PDF format, in accordance with Section 01 33 00.

.3 Controls Report:

.1 Provide a test report in spreadsheet format which summarizes the following data for each piece of controls operation.

.1 Equipment ID and name

.2 Device Location

.3 ECU reference

.4 BCU reference

.5 I/O reference

.2 Record the following tests for each device as applicable:

.1 Communications Loop Integrity Test

.2 Sensor Range Test

.3 Actuator Stroke Test

.4 Controls logic function test – single loop.

.5 Controls logic function test – equipment or system test.

.3 Communications Loop integrity test

.1 Check communications between DDC controller and remote I/O device

.4 Sensor Range Calibration Test

.1 Provide data for minimum and maximum sensor values, setpoint value, and current value at time of test.

.5 Actuator Stroke Test

.1 Provide data on actuator stroke from 0-100% full stroke.

.2 Indicate output value vs. actuator position (i.e. 20 mA = 100% open)

.6 Controls Logic Function Test – Single Loop

.1 Two position actuators: use manual control function from operators workstation to change current state of controller output.

.2 Modulating valves: vary Setpoint of control variable to modulate valve from 0-100% opening, at nominal 25% increments.

.7 Controls Logic Function Test – Equipment or System Test

.1 Create a point form checklist of the Sequence of Operation for each system.

.2 Operate system through each control sequence element specified.

.3 Operate each system through an actual power outage, and restart on power resumption.

.4 Operate each applicable system for automatic restart on emergency power.

.5 Operate each system through scheduled operation.

.8 Trend Logs

.1 Provide a copy of each trend log specified or requested.

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3.17 **COMMISSIONING ASSISTANCE**

.1 Provide (fifteen) (15) days of 8 hours each (net of travel time) after Substantial Performance for on-site programming in conjunction with the Owner's commissioning agent.

.2 (Perform commissioning of the controls system in accordance with Section 23 08 23).

3.18 **SERVICE AND GUARANTEE**

.1 The controls systems herein specified shall be free from defects in workmanship and material under normal use and service after commissioning and acceptance of the complete control system.

.2 After acceptance of the systems by the Consultant, provide any service required for the proper performance of the control systems for a period of one (1) year or one complete heating and cooling cycle.

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.3 This service shall include readjustment of the controls for proper balance of the systems under the direction of the Testing and Balancing firm six months after the initial adjustment. The controls shall be adjusted and set for optimum performance under the changed operating conditions during this system rebalancing.

.4 Include replacement parts for defective components and any labour to remove and replace such parts at no cost to the Owner.

END OF SECTION

PART - 1 GENERAL

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

PART - 2 PRODUCTS

2.1 CONTROL AIR DAMPERS

.1 Type

.1 Modulating control dampers

.1 Opposed blades

.2 Two position control dampers

.1 Parallel blades

.2 Construction

.1 Bearings

.1 Thermal plastic resin copolymer, nylon or oil impregnated bronze,

.2 At blade axles, linkage devices, etc.

.2 Damper blades and frames

.1 Extruded aluminum

.2 Maximum blade length: 1.2 m without internal frame support

.3 Maximum blade length: 1.2 m without internal frame support

.4 Blade edge seals: EPDM gaskets

.5 Frame side seals: extruded TPE

.6 Frame style: flanged to duct.

.7 Jack shaft: extendable, combination of aluminum, and zinc/nickel coated steel

.8 Damper leakage: [50 l/s per m^2][10 CFM per ft^2] damper face area at 1 kPa differential static pressure.

.3 Damper blades for outside air applications

.1 As above

.2 Operating temperature: -40°C to 100°C

.3 Thermally broken and insulated blades; expanded polyurethane foam insulation

.4 Damper leakage: 21 l/s per m^2 damper face area at 1 kPa differential static pressure.

.4 Acceptable Manufacturer:

.1 Tamco - Series 1000

.2 Tamco - Series 9000 (outside air applications)

2.2 AUTOMATIC CONTROL VALVES

.1 Body Construction and Selection

.1 Proportional Valves:

.1 Ball valves in accordance with Section 23 05 23

.2 Pressure independent balancing and control valves in accordance with Section 23 05 23 and as follows:

.1 Danfoss AM-QM Self Balancing And Control Valves (13mm To 32mm)

.2 Danfoss AM-QM Self Balancing And Control Valves (38mm To 50mm)

.3 Danfoss AM-QM Self Balancing And Control Valves (65mm To 100mm)

.3 Globe valves in accordance with Section 23 05 23 and as follows:

.1 Bronze body with screwed ends in sizes NPS 2 and smaller.

.2 Cast iron with flanged ends in sizes NPS 2½ and larger.

.3 Forged steel with flanged ends in sizes NPS 2½ and larger for steam systems.

.4 Two butterfly valves, operated in tandem, are not acceptable for 3-way valves.

.2 Two Position Valves:

.1 Ball valves in accordance with Section 23 05 23

.2 Butterfly valves in accordance with Section 23 05 23 and as follows:

.1 Full lug-wafer style, drilled and tapped

.2 Extended neck for flange and insulation clearance

.3 Valve discs

.4 Composition type with bronze trim

.5 Steam service with supply pressures greater than 103 kPa: stainless steel trim

.3 Valve seat rings

.1 Screw in type.

.4 Proportional (2 way and 3 way)

.1 Ball, and Globe type in accordance with Section 23 05 23.

.5 Two Position

.1 Ball and Butterfly type in accordance with Section 23 05 23.

.6 Pressure ratings for steam and water valves

.1 Minimum one and a half times the maximum system pressure.

.2 Close against a minimum differential pressure rating of 275 kPa.

.7 Selection:

.1 Select control valves as follows unless otherwise shown:

Application	Proportional	Two Position
Central Air Handling Units	SB & FC Globe	---
Refrigeration Chillers, Boilers, Cooling Towers, etc	---	Butterfly
Steam Piping system pressure, temperature and flow control	Globe	---
3 Way Hydronic Piping system pressure, temperature and flow control	Globe	---
Hydronic Piping system pressure, temperature and flow control	SB & FC Globe	---
Piping system automatic drain-down, NPS 50mm and under	---	Ball
Piping System Isolation valves, NPS 50mm and under	---	Ball
Piping System Isolation valves, NPS 100mm and over	---	Butterfly
Terminal unit reheat coils and unit heaters, NPS 32mm and under	SB & FC Globe	Ball
Terminal unit reheat coils, NPS 39mm and over	SB & FC Globe	---
Radiant ceiling panels and wall fin convectors	SB & FC Globe	---

.2 Performance

.1 General

.1 C_v values to be corrected with piping geometry factor (Fp).

.2 Straight through water valves: single seated with equal percentage flow characteristics and minimum resolution of 40:1 or greater.

.3 Three-way mixing water valves: linear for each port giving constant total flow.

.4 Modulating steam valves: modified linear flow characteristics.

.2 Steam Valves, Pressure Drop, unless otherwise shown.

.1 Modulating, 100 kPa or less steam supply pressure: maximum 80% of inlet gauge pressure.

.2 Two position, 100 kPa or less steam supply pressure: maximum 15 kPa.

.3 Modulating, greater than 100 kPa steam supply pressure: 42% of the inlet absolute pressure.

.3 Water Valves, Pressure Drop, unless otherwise shown.

.1 Two position: maximum 10% of system pump head.

.2 Modulating, two-way: maximum of 36 kPa pressure drop.

.3 Modulating, three-way: maximum of 60 kPa pressure drop.

.4 Valve Flow Rates

.1 Valves at air handling units: refer to Coil schedules

.2 Valves at Terminal Units and Unit Heaters : refer to Terminal Unit schedule and Unit Heater schedule.

.3 Valves at distributed heating units including wall fin convectors and radiant panels: refer to plan drawings for flow rate or related heat rate.

.4 All other valves : refer to Control Valve schedule.

.5 Modulating steam loads greater than 900 kg/hr: provide two valves in parallel, controlled in sequence, with first valve in opening sequence sized for 1/3 and the second valve for 2/3 of steam load.

.6 Acceptable Manufacturers

.1 Danfoss

.2 Baumann

.3 Fisher

.4 Honeywell Industrial Series

2.3 VALVE AND DAMPER OPERATORS

.1 General:

.1 Provide valves and dampers with metal body operators sized to assure smooth, positive operation over the entire operating range, without chatter or slamming, and to give tight shutoff at end positions against the system pressures to be encountered.

.2 Failure position:

.1 Spring return, normally open or normally closed sequence as required so that systems will "Fail-safe" in case of control air pressure or power failure.

.2 On 2-way butterfly valves, provide double acting or reversible actuators.

.3 Sequencing by spring range will not be approved for valves or dampers.

.4 Furnish valves and dampers with operators and spring ranges designed to match as linearly as possible the full scale operating range of the control valve.

.5 Valves NPS6 and over: manual override to open and close valve and disable control signal.

.6 Adequately size operators and in sufficient quantity to ensure smooth damper operation

~~.2 Selection:~~

~~.1 Indoor~~

~~.1 Pneumatic - Steam Pressure Regulating Valves~~

~~.3 Pneumatic Actuators~~

~~.1 Valves~~

~~.1 Fabricated steel or cast aluminum~~

~~.2 Corrosion resistant spray finish~~

~~.3 Rolling diaphragm~~

~~.4 Maximum air operating pressure: 170 kPa~~

~~.5 Start point pressure: 10 to 90 kPa adjustable~~

~~.2 Ancillary devices~~

~~.1 End switches as detailed~~

~~.2 Pilot positioner relays~~

~~.3 Interconnection piping~~

~~.4~~**.2** Electronic Actuators

.1 General

.1 Low torque, fully modulating or two position as indicated.

.2 Time for full open to full close: two minutes nominal.

.3 Current limiting, digital motor rotation sensing circuits, or adjustable end of travel switches to provide motor protection.

.4 Tandem mounting of actuators for higher torque requirements are acceptable.

.5 Spring return with manual override unless otherwise indicated or specified.

.6 On loss of control signal, valve will fail to the designated normally open or closed position.

.2 Terminal equipment

.1 Non-spring return type.

.3 Power and Communications

.1 Positive positioning at 2-10 VDC or 4-20 mA signal

.2 Visual valve position indicator

.3 Built-in rotation reversing switch

.4 Actuator generated 2-10 VDC electronic feedback signal

.5 Capacity to add auxiliary switches when required

.6 Power: 24 VAC or VDC for proportional control, 24 or 120 VAC for 2 position, maximum 15 VA.

.4 Valves NPS 6 and larger

.1 Modulating motor resolution: 1%

.2 Two 1 metre pigtails or terminal strips

.3 Field changeable, printed circuit boards to provide either 2-position or modulating operation

.4 Actuator resolution: 80:1

.5 Run time, end-to-end: 15 to 45 seconds

.6 Power: 24 or 120 VAC, 60 Hz

.7 Auxiliary switches, 1 NO, 1 NC

.8 Housing. NEMA 4

2.4 SWITCHES

.1 Electric Space Thermostats

.1 "On-Off" thermostats for 120 volt service: minimum contact rating of seven amperes.

.2 Thermostats for unit heaters: complete with a manual switching sub-base.

.1 Switching action: "Heat-Off-Fan"

.2 Minimum contact rating: seven amperes at 120 volts A.C.

.3 Modulating electric thermostats: compatible with the equipment they are to control.

.2 Electric Temperature Switches

.1 General application

.1 Minimum contact rating of seven amperes at 120 volts A.C.

.2 Switch setting: adjustable differential.

.3 Switch to switch setting: adjustable differential.

.2 Outside air application

.1 As above

.2 Installed so as not to be affected by sunlight, exhaust air, or reverse warm air flow through air supply units should the supply be off.

.3 Thermowell

.1 Complete with compression fitting for 20 mm well

.2 Mounting length: 100 mm

.3 Immersion wells: type 316 stainless steel

.4 Strap-on pipe

.1 Complete with helical screw stainless steel clamps

.3 High Limit Controls

.1 For ducts under 1.5 sq m of cross sectional area or where the longest dimension is not over 760 mm:

.1 Bi-metal operated control complete with manual reset

.2 Switch contact: normally closed.

.2 Ducts of cross sectional area greater than 1.5 sq m:

.1 Temperature sensitive heads connected to a pressure switch so that, should a high temperature occur, one of the heads will operate to open the pressure switch and stop the respective equipment.

.2 Switch contact: normally closed.

.4 Low Limit Controls

.1 6 m of capillary, wired to stop the equipment should the temperature over any 300 mm one foot] length drop below its set point.

.2 Switch contact: normally closed with a manual reset.

.5 Fan Proof-of-Flow

.1 U.L. listed adjustable set point and differential pressure type:

.1 Fan static greater than 250 Pa: piped to fan discharge

.2 Fan static less than 250 Pa: piped across the fan

.3 For fractional horsepower and non-ducted fans, use relays or auxiliary contacts.

.2 Pressure ratings

.1 Adjustable set point: 0-2500 Pa

.2 Adjustable differential: 10-250 Pa

.3 U.L. listed adjustable differential pressure or flow type as specified in the sequence of operation:

.1 Chilled water flow switches: totally sealed vapour tight switch enclosure on 2060 kPa body

.2 Differential pressure switches: valve manifold for servicing

.4 Pressure ratings

.1 Chilled and condenser water systems: 860 k

.2 Hot water systems:860 kPa

.3 Steam system and control air systems: 1200 kPa

.4 High temp water systems above 110°C: 2700 kPa, with a full operating range of 0 to 270 kPa with an accuracy of 25 kPa

.5 Pigtail siphon between sensor and fluid line: steam lines and high temperature water lines.

.6 Isolation valve and snubber installed between sensor and pressure source.

.6 Flow Switches

.1 McDonnell and Miller FS-7 Series for liquids and AF Series for air flow.

.7 Fire Stats

.1 57°C manual reset, line voltage type with bimetal actuated switches.

.2 Size switch with adequate rating for the applied load.

2.5 ELECTRICAL RELAYS

.1 Current sensing (switch)

.1 Metering transformer ranged to match load being metered

.1 Plug-in base and shorting shunt to protect current transformer when relay is removed from socket

.2 Current transformer for single or three phase metering into single relay

.3 Adjustable latch level, adjustable delay on latch and minimum differential of 10% of latch setting between latch level and release level

.4 Discrimination between phases in three phase applications to allow worst case selection

.5 Mounted in motor starter cabinet and fed from starter control transformer

.6 Rating: 10 amps at 240 VAC

.2 General relays

.1 Relays for control and status indication

.1 Double voltage DPDT

.2 Relays for implementation of control strategy

.1 Single voltage with appropriate number of contacts

2.6 ELECTRONIC SENSORS

.1 General Requirements

.1 Input/output sensors and devices: closely matched to the requirements of the DCP for accurate, responsive, noise free signal input/output.

.2 Control input response: high sensitivity and matched to the loop gain requirements for precise and responsive control.

.3 In no case shall computer inputs be derived from pneumatic sensors. In no case shall thermocouples or thermistors be used.

.2 Temperature Sensors

.1 Resistance Temperature Detector (RTD) type:

.1 500 ohm balco

.2 or, 100 or 3000 ohm platinum

.3 Factory calibrated

.4 Stem and tip construction: copper or type 304 stainless steel.

.5 End-to-end accuracy: ±0.25°C (±0.5°C) over full range of variable

.6 Transducing output circuit to suit DCP

.2 Thermistor for Terminal Box Control

.1 As above, or 100,000 ohm thermistor

.2 Accuracy: ± 0.5°C

.3 Air Temperature Sensors, Space Type 1

.1 RTD type

.2 Concealed single linear set-point adjustment

.3 Tamper-resistant access door

.4 Field Bus communications jack for portable POT connection

.5 On/Off button to allow occupant override feature

.6 (Plastic mono-chromatic) (brushed aluminum) cover and casing

.4 Air Temperature Sensors, Space Type 2 sensor:

.1 Thermistor type

.2 Stainless steel flat plate surface sensor; sensor epoxy-bonded to back of cover plate.

.3 Field Bus communications jack for portable POT connection

.5 Outside air wall mounted sensors:

.1 RTD type

.2 Provided with a sun shield.

.3 Inert section for passing through wall to unit.

.6 Duct temperature sensors:

.1 Rigid stem or averaging type as specified in the sequence of operation.

.2 Averaging element style for ducts greater than 0.4 m^2 cross-sectional area.

.7 Water temperature sensor:

.1 RTD type

.2 Immersion well: NPS 3/4 stainless steel spring loaded construction, with heat transfer compound compatible with sensor, minimum height of 50mm or to clear insulation thickness

.3 Minimum insertion length: 100 mm

.3 Dewpoint sensor

.1 Type:

.1 Non-reactive organic bobbin material to give precise dewpoint readings with accuracy of not more than +1°C

.2 Integral draft shield as part of the instrument for air velocities in excess of 0.25 m/s

.3 Operate over a minimum dewpoint temperature range suitable to the application.

.4 Provide one additional bobbin assembly with each dewpoint sensor

.4 Humidity Sensors Relative Humidity Sensors

.1 Capacitance type with 5% to 90% range

.2 Operating temperature range: 0-60°C

.3 Absolute accuracy:

.1 Duct sensors: ±5%

.2 Room sensors: ±2%

.4 Duct mounted humidity sensors: provided with a stainless steel sampling chamber for operation up to 10 m/s.

.5 Wall mounted sensors: provided with covers identical to temperature sensors.

.6 Combination temperature and humidity sensor:

.1 Combination temperature compensated humidity and temperature sensors, with remote transmitter and interconnecting cabling

.2 Stainless steel sensor probe, length as identified on drawings

.3 Cable length:[5000 mm

.5 Differential and Static Pressure Sensors

.1 Air flow and static pressure analog sensors

.1 High accuracy suitable for the low velocity pressures to be encountered:

.2 Selected for approximately 50% over-range

.3 4 to 20 ma output

.4 Adjustments for zero and span

.5 Connect differential pressure sensors to the air flow measuring station with valved lines for testing and calibration.

.2 Space pressure

.1 Flush mounted 10 gauge stainless steel welded casing with No. 4 finish

.2 Shielded space probe unaffected by airflows up to 5 m/s from a 360° radial source

.3 Accuracy: ±1% of actual space pressure

.3 Outdoor air pressure

.1 Exposed 10 gauge anodized aluminum with NPT 2 connection

.2 Shielded space probe unaffected by airflows up to 5 m/s from a 360° radial source

.3 Accuracy: ±2% of actual outdoor air static pressure when subjected to a radial wind velocities up to 35 m/s with approach angles up to 30° from the horizontal

2.7 FLOW METERS

.1 Water

.1 Provided under Section 23 05 19.

.2 Steam Flow Measurement

.1 Measure steam flow by means of an inline vortex flow meter and separately installed pressure sensor and transmitter. Flow meter shall be suitable for wet steam mass flow integrated temperature detection and measurement for steam quality falling within the range of 80% and 100%.

.2 Approvals:

.1 Approval: CSA C/US NI Cl.I Div.2 Gr. ABCD

.3 Output Signal:

.1 Output; Input: 4-20mA HART, pulse/freq./switch;

.4 Input:

.1 4-20mA input

.5 Display:

.1 Display; Operation: SD03 4-line, illum.; touch control + data backup function

.6 Construction:

.1 Housing: GT20 dual compartment, aluminium coated

.7 Sensor Version:

.1 Mass flow (integrated temperature measurement)

.8 AAS Process Connection:

.1 Cl.150 RF Sch.40, flange ASME B16.5

.9 Calibration Flow:

.1 0.75% volume 3-point

.10 Operation Language Display:

.1 English

.11 Application Package:

.1 Wet steam detection

.12 Performance

.1 Accuracy, measured mass flow to within ±2% of the full scale.

.1 Velocity range: 20 to 50 m/s

.2 Re > 20,000

.3 Operating temperatures: 150 °C

.13 Acceptable Products:

.1 Endress and Hauser (or equivalent)

.14 (Steam Flow Meter Companion) Pressure Sensor and Transmitter

.1 Measure steam pressure with condensate temperature buffer installation arrangement as indicated on the drawings.

.2 Approval:

.1 CSA C/US IS Cl.I,II,III Div.1 Gr.A-G, Cl.I Div.2 Gr.A-D, Ex ia, C: zone 0,1,2/ US: zone 0,1,2,20,21,22

.3 Output; Operating:

.1 4-20mA HART; inside + LCD

.4 Housing;

.1 Cover Sealing; Cable Entry: T14 Aluminium IP66/67 NEMA6P; EPDM; NPT1/2 thread, T14 = side cover

.5 Sensor Range;

.1 Sensor Overload Limit: 10bar/1MPa/150psi gauge; 40bar/4MPa/600psi

.6 Calibration;

.1 Unit: Sensor range; psi

.7 RA Process Connection:

.1 Thread ANSI MNPT1/2 FNPT1/4, 316L

.8 A Seal:

.1 FKM Viton

.9 Additional Option 1: Not selected

.10 Additional Option 2: Mounting bracket, wall/pipe, 316L

.11 Performance

.1 Accuracy, measured pressure up to plus / minus 0.05 % of the set span.

.12 Acceptable Products:

.1 Endress and Hauser (or equivalent)

.3 Airflow Measuring Stations

.1 Measure airflow by means of a network of static and total pressure sensors factory positioned and connected in parallel to produce an averaged velocity pressure.

.2 Performance:

.1 Accuracy, measured velocity pressure converted to airflow l/s: ±2% of the full scale

.2 Velocity range: 3.5 to 20 m/s

.3 Maximum airflow resistance: 0.6 times the velocity head

.4 Maximum operating temperatures: 121°C

.3 Construction:

.1 Casing: heavy gauge (galvanized steel) construction

.2 Duct to duct mounting flanges

.3 Aluminum pitot traverse tubes

.4 Inlet honeycomb air straightening section minimum free area: 97%.

2.8 TRANSMITTERS

.1 Temperature Transmitters

.1 Standalone transmitter

.1 Microprocessor based transmitter

.2 Input circuit: 3 lead, 100 ohm at 0°C, platinum RTD type sensor.

.3 Integral multi-line digital display

.4 Combined non-linearity, repeatability, hyseterisis effects: ±0.5% of full scale range.

.5 Integral zero and span adjustments

.6 Outputs: 4-20 mA linear into maximum 500 Ohm load

.7 Power: 24 VAC, or 24 VDC, or 120 VAC

.8 Provide transformer and ac/dc converter for 24 V devices

.2 Humidity Transmitters

.1 Standalone transmitter

.1 Microprocessor based transmitter

.2 Input circuit: from RH sensor

.3 Integral multi-line digital display

.4 Combined non-linearity, repeatability, hyseterisis effects: ±1% of full scale range.

.5 Integral zero and span adjustments

.6 Outputs: 4-20 mA linear into maximum 500 Ohm load

.7 Power: 24 VAC, or 24 VDC, or 120 VAC

.8 Provide transformer and ac/dc converter for 24 V devices

.3 Pressure (Static and Airflow) Transmitters

.1 Standalone transmitters

.1 Microprocessor based transmitter

.2 Receive flow signals (total and static pressure) from an airflow station or pressure probe and produce dual output linear and scaled signals for air volume, velocity and differential pressure

.3 Integral multi-line digital display

.4 Natural full span: 0-125 Pa

.5 Accuracy: ±0.25% of natural spans

.6 Outputs

.1 0-5 VDC

.2 0-10VDC

.3 or 4-20 mA linear into maximum 500 Ohm load

.7 Power: 24 VAC, or 24 VDC, or 120 VAC

.8 Provide transformer and ac/dc converter for 24 V devices

.9 Outdoor static pressure reference

2.9 TRANSDUCERS

.1 Kilowatt Transducers

.1 Integrated electronic type with accuracy of .2% of scale.

.1 For balanced (such as motors) three phase loads, provide two current transformers (CT's).

.2 Provide two or three potential transformers (PT's) as recommended by the manufacturer for the application.

.3 Output: 4 to 20 ma.

.4 Provide suitable CT's and PT's unless specifically specified with other equipment.

.2 Current Transducers

.1 Integrated electronic type with accuracy of .2% of scale.

.1 For balanced (such as motors) three phase loads, provide two current transformers (CT's).

.2 Measure line current, with output proportional signal:

.1 4-20 mA

.2 0-1 VDC

.3 0-10 VDC

.4 0-20 VDC

2.10 ANCILLIARY DEVICES

.1 Smoke Detectors

.1 Ionization plug-in type device

.1 Two ionization chambers

.2 A comparator-switching circuit

.3 An integral alarm light indicator

.4 Solid state detector circuits

.5 Alarm status indicating lights shall be visible on the front of the detector.

.2 Self compensating for the effects of:

.1 Velocity 0-5 m/s

.2 Changes in temperature 0-50°C

.3 Humidity (5-95% RH)

.4 Atmospheric pressure

.3 Wiring connections: colour coded leadwires located on the mounting base.

.4 Mounting base: standard four inch square electrical box.

.5 Single chamber detectors and photoelectric smoke detectors will not be acceptable.

.2 Duct Smoke Detectors

.1 As above

.2 Listed by Underwriters Laboratories, Inc. for use in air handling systems.

.3 Designed to provide detection of combustion gases and fire and smoke in air conditioning and ventilating duct systems in compliance with the National Fire Protection Association and Underwriters Laboratories, Inc. Standard UL l67.

.4 Air sampling chamber with sampling tubes extending through the width of the air duct.

.5 Key controller test and reset switches plus an easily accessible test jack.

.6 Alarm relay contacts (DPDT) capable of handling loads of up to five (5) amperes at 120 VAC or 28 VDC resistive.

.7 Power: self-contained power supply requiring 120/220/240V power.

.3 Carbon Monoxide Sensors

.1 Solid state, plug-in type with a minimum 3 year sensor life, calibration to be set at 50 to 100 ppm.

.1 CSA approved

.2 Local sensors:

.1 Complete with local LED indication for High and Low alarm as well as a

green LED power “ON” light.

.2 Power: low voltage control transformer mounted adjacent to sensor for sensing device

.3 Central control panel:

.1 NEMA 12 lockable steel enclosure containing LED indicators for High, Low and power “ON” for each detection system

.2 BAS interface: one auxiliary alarm contact

.3 Power: 120 VAC, 60 Hz, single phase

.4 Calibration kit:

.1 One canister each of 50 and 100 ppm CO, one adapter and one carrying case.

.5 System supplier to provide site inspection, operating and maintenance instructions and a trained technician to perform system start-up and calibration checks.

.4 Surface Water Detection

.1 Provide alarm on presence of water on floor.

.1 Expendable cartridge sensor

.2 Internal waterproof switch

.3 One set of dry contacts: 2 A at 24 VAC or VDC

.4 Unaffected by moisture in air

.5 Self-powered.

PART - 3 EXECUTION

3.1 INSTALLATION

.1 General

.1 Provide instrumentation, control devices, (pneumatic system) and electrical wiring for control and monitoring strategies as detailed in sequences of operation.

.2 Install equipment in accordance with manufacturers instructions.

.3 Make sensors and elements accessible for replacement and servicing

.4 Install transmitters, transducers, receiver-controllers, solenoid air valves and relays in NEMA 12 enclosures with wiring and tubing within panels in trays or individually clipped to back of panel and clearly identified. Install in NEMA 4 enclosures for outdoor installation.

.5 Install outdoor sensors in NEMA 12 enclosure.

.6 Support field mounted transmitters on pipe stands or channel brackets. Pipe pneumatic sensing lines to transmitters, complete with dirt pockets at transmitter.

.7 Support wall mounted devices on plywood back board, supported from wall or floor. Paint plywood one coat of primer and two top coats, light grey colour.

.2 Thermowells

.1 Install for all piping installations.

.2 Where pipe diameter is less than well insertion length, locate well in elbow, or expand pipe size to be equal to insertion length plus 25 mm.

.3 Thermowell to restrict flow area by less than 30%.

.3 Identification

.1 Identify field devices in accordance with Section 23 05 01.

.4 Testing

.1 Calibrate and test all field devices for accuracy and performance.

.2 Submit report detailing tests performed, results obtained to Consultant for approval. Consultant will verify results at random. Provide all testing equipment and manpower necessary for this verification.

3.2 SENSORS AND SWITCHES

.1 General

.1 Install room type 1 sensors in all general areas.

.2 Install room type 2 sensors where indicated.

.3 Use combination temperature and humidity sensors only when shown on drawings, otherwise provide separate sensors.

.2 Duct Installation

.1 Do not mount in dead air space.

.2 Thermally isolate elements from brackets and supports so as to respond to air temperature only.

.3 Support sensor element independently from coils and filter racks.

.3 Averaging duct type sensor or switch

.1 Sensor length: not less than 1000 mm for each square meter of duct cross-sectional area.

.2 Wire multiple sensors in parallel for freeze protection applications.

.3 Wire multiple sensors separately for temperature measurement.

.4 High Limit Controls:

.1 Coverage

.1 Provide a temperature sensitive head for approximately every 1.5 sq m of duct cross sectional area.

.2 Install heads in a staggered arrangement to give complete coverage of the duct.

.5 Low Limit Controls

.1 Coverage:

.1 String horizontally across the full width of duct or coil with runs at a maximum of 300 mm centres.

.2 Where one control is insufficient to provide the specified coverage, provide two or more controls to be wired in series.

.3 Coordinate with other trades so that the capillary does not obstruct access from access openings or doors to other duct mounted equipment.

.4 Coordinate with other trades so that the capillary does not obstruct access from access openings or doors to other duct mounted equipment.

.6 Flow Switches

.1 Install flow switches upright in horizontal pipe lines with at least five pipe diameters of straight pipe (without fittings, restrictions etc.) on each side of the flow switch.

.7 Airflow Stations

.1 Locate airflow stations in accordance with manufacturer's guidelines so as to approach ideal laboratory conditions.

.2 Cap off manifold until cleaning of ducts is complete.

.8 Pressure and Differential Switches

.1 Install isolation valve and snubber between sensor and pressure source.

.2 Protect sensing elements on steam and high temperature greater than 98°C with pigtail syphon between valve and sensor.

.9 Pressure Gauges

.1 Provide air pressure gauges as follows:

.1 All pneumatic devices

.2 I/P transducers

.3 Pilot positioners

.4 Motor operators

.5 Switches

.6 Relays

.7 Valves

.8 Damper operators

.9 Valve actuators

.10 Controller outputs

END OF SECTION

CS 501 HOT WATER (GLYCOL) HEATING SYSTEM

Control Diagram	37788-M07	Detail Drawing	3788-M07

~~System Start~~

~~Operator initiates start-up of system. Operator selects initial lead boiler designation. Designated lead circulating pump starts ESS1.~~

~~*Boiler Warm-Up*~~

~~Open return water control valve VC1(VC2). Set starting boiler firing demand limit AO-EC to maximum 20% for 15 minutes (time to be adjusted in accordance with manufacturer's requirements) for boiler warm-up. At completion of boiler warm-up, set boiler demand limit to 100%. This control operates every time a boiler starts.~~

~~Normal Operation~~

~~*Boiler Control*~~

~~Boiler supply water temperature sensor hard wired to boiler OEM control to maintain supply water temperature.~~

~~Boiler supply water aquastat hardwired to boiler OEM control.~~

~~Boiler supply water temperature AI-LT1(2) monitored on BMS.~~

~~Provide Serial Communication (SC) to boiler OEM control to monitor boiler status~~

~~*Increasing Load*~~

~~On increasing heating load, when lead boiler is operating at 90% of maximum firing rate (AI-ER), start lag circulating pump ESS2, then open boiler control valve VO1 (VO2), and then enable lag boiler.~~

~~When lag boiler warm-up cycle is complete, reduce lead boiler demand firing rate AO-EC at 10% / 5 minutes until lead boiler and lag boiler firing rates (AI-ER) are within 10% of each other, then reset both boiler demand limits to 100%.~~

~~*Decreasing Load*~~

~~On decreasing load, when the combined firing rate of both boilers AI-ER is 85% of one boiler capacity (sum(AI-ER1% + AI-ER2% < 85%), stop the lead boiler, wait 1 minute, then close boiler control valve VO1 (VO2) and then shut-off pump. Cycle boiler and pump "lead" and "lag" designations.~~

Supply Water Pressure Control

Differential pressure sensor located across heating mains at ground floor level modulates the Constant Pressure Differential Control Valve CV-AO-VC to maintain constant pressure AI-LPD at the end of the heating mains. Control valve is sized to handle the full flow of one circulating pump and a pressure drop of 35 kPag.

CS 501 HOT WATER (GLYCOL) HEATING SYSTEM

Steam to Hot water Heat Exchangers (HX-1, & 2)

Operator OR BAS master schedule enables the heating system to operate.

When the heating system is enabled, the Heat Exchangers to operate in a staged lead lag configuration. If the lag Heat Exchanger fails to generate heat, operate the lag Heat Exchanger.

Reassign the lead and lag heat exchanger once per week.

Stage the Heat Exchangers such that the lead heat exchanger steam control valve will modulate to maintain the system supply water temperature set-point. Should the steam control valve be fully open and the system supply water temperature be less than set-point for a period of 15 minutes, the BAS shall apply an equal control signal to the steam control valves serving both the lead and lag Heat Exchangers that shall modulate to maintain the system supply water set-point. Should both control valves modulate to less than 25% open, the BAS shall revert back to single heat exchanger control.

Whenever a steam control valve is closed, the heating water control valve shall also be closed.

BAS shall monitor outdoor air temperature.

BAS shall monitor system supply and return water temperatures.

The heating supply water temperature set-point shall be linearly scheduled to the outdoor air temperature as per the following table:

Outdoor Air Temperature	System Supply Water Temperature
Deg. F / Deg. C.	Deg. C / Deg. F.
-13 / -25	180 / 82.2
65 / 18.3	140 / 60

Primary Heating Pump Control

System Start — Primary heating pumps 22-HWP-1 & 2 shall operate in a lead lag configuration. Operator OR BAS master schedule initiates start-up of the lead pump. Whenever the heating system is enabled, the lead pump shall be enabled.

CS 501 HOT WATER (GLYCOL) HEATING SYSTEM

Normal Operation	BAS monitors the differential pressure sensor located across the supply and return heating water mains where indicated on the drawings. The BAS shall use a PID control loop to modulate the speed of the active primary circuit heating water pump 22HWP-01 or 22HWP-02 to maintain differential pressure set-point. The set-point is to be determined in cooperation with the TAB contractor through field testing when all control valves are commanded open. The pumps are intended for lead lag operation. Whenever pumps are to operate they shall be duty cycled on a monthly basis. The pump speed set point shall have a minimum speed of 25%. The BAS shall sequentially cycle both the duty and standby pump on for a minimum run time of 5 minutes once per month, twelve months per year to prevent pump from seizing.	
System Stop	Primary heating pumps 22-HWP-1 & 2 shall operate in a lead lag configuration. Operator OR BAS master schedule initiates start-up of the lead pump. Whenever the heating system is disabled, the heating pumps shall be disabled.	
Schedule	Continuous during heating season.	
Fire Alarm	Circulating pumps continue to operate.	
Alarms	HTA	High heating water supply temperature > 98°C
	LTA	Low system supply water temperature < 22°C
	VFDA	Variable Frequency Drive Alarm Contacts (x2)
Trend Logs	Supply, Return, and Outdoor Air Temperature	
Emergency Power	No	

Remarks:

1.

End of Section