



**PURCHASING SECTION**  
13450 – 104 Avenue, Surrey BC V3T 1V8  
Tel: 604-590-7274  
E-mail: [purchasing@surrey.ca](mailto:purchasing@surrey.ca)  
**ADDENDUM #1**

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**REQUEST FOR QUOTATIONS (RFQ) NO.:** 1220-040-2016-096  
**TITLE:** MECHANICAL ROOM ADDITION AND GALLERY  
HVAC UPGRADE – SURREY ARTS CENTRE  
**ADDENDUM ISSUE DATE:** October 3, 2016  
**REVISED CLOSING DATE:** prefer to receive Quotations on or before:  
Wednesday, October 12, 2016

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### **INFORMATION FOR CONTRACTORS**

This Addendum is issued to provide additional information to the RFQ for the above named project, to the extent referenced and shall become a part thereof. No consideration will be allowed for extras due to the Contractor not being familiar with this Addendum. This Addendum No. 1 contains 181 pages in total.

### **NEW CLOSING DATE**

The City would prefer to receive Quotations on or before **Wednesday, October 12, 2016**. The City's office hours are 8:30 a.m. to 4:00 p.m., Monday to Friday, except statutory holidays.

### **MECHANICAL SPECIFICATIONS:**

Mechanical Specifications dated September 28, 2016 and Mechanical Specifications Addendum No. 1 dated September 30, 2016 by The AME Consulting Group Ltd. is hereby added to the detailed scope of work as listed in Schedule B – Appendix 2 – Supplementary Specifications (Project). Refer to Attachment #1 of this Addendum #1 for the Mechanical Specifications and Mechanical Specifications Addendum No. 1.

### **VISION AIR HANDLING UNIT SPECIFICATIONS:**

Vision Air Handling Unit Specifications dated September 14, 2016 is hereby added to the detailed scope of work as listed in Schedule B – Appendix 2 – Supplementary Specifications (Project). Refer to Attachment #2 of this Addendum #1 for the Vision Air Handling Unit Specifications.

## ARCHITECTURAL DRAWINGS:

Architectural Addendum #1 dated September 30, 2016 by Chernoff Thompson Architects is hereby added to the detailed scope of work and contract drawings as listed in Schedule A – Scope of Work and Drawings. Refer to Attachment #3 of this Addendum #1 for the Architectural Addendum #1.

## STRUCTURAL DRAWINGS:

Structural Addendum #1 dated September 30, 2016 by Wicke Herfst Maver Consulting Inc. is hereby added to the detailed scope of work and contract drawings as listed in Schedule A – Scope of Work and Drawings. Refer to Attachment #4 of this Addendum #1 for the Structural Addendum #1.

## QUESTIONS AND ANSWERS:

Q1: Can a second site viewing opportunity be scheduled?

A1: At this time, a second information meeting is not planned.

Q2: Please provide a size and gauge/thickness for the angle in detail 1 – 5 / A03.

A2: Steel angel is to be 75x75x8.

Q3: Please provide further details/specifications for the security gate i.e. HSS size, metal panel specs or if this is prefabricated please provide a manufacturer.

A3: See revised detail on A-03 included with the Architectural Addendum #1.

Q4: On behalf of our trade we would like to request an alternate to the metal decking.

A4: Based on Addendum #1, structural steel deck (Vicwest 938) is no longer required.

Q5: We request alternate product approval for Westform HF-12 flat panels in lieu of the specified Vicwest AD300 (incorrectly tag as CL300).

A5: The Westform HF-12 flat panels are NOT an approved alternative product for this project.

Q6: Regarding drawing # E102 Mechanical Schedule, Panel Schedule and Single Line Diagram, Drawing Key Notes # 3 is asking to reuse existing 600v panel on existing 208v panel. However you cannot use a 600vac on a 208vac. Please clarify.

A6: Key note # 3 states to re-use the existing 208V panel NM and re-feed it from the new 600V panel via a new step down transformer. This is detailed on the single line diagram as well.

3 RE-USE EXISTING PANEL NM AND RE-FEED FROM PANEL 6MECH1 VIA NEW STEP DOWN TRANSFORMER AS INDICATED ON SINGLE LINE DIAGRAM. EXISTING LOADS ON PANEL NM WHICH ARE NOT NOTED TO BE REMOVED SHALL REMAIN AS INDICATED ON UPDATED PANEL SCHEDULES. RELOCATE BREAKERS AS REQUIRED TO ALLOW FOR INSTALLATION OF NEW BREAKERS. EXTEND CONDUIT AND WIRING AS REQUIRED TO RE-FEED THE EXISTING LOADS FROM NEW PANEL LOCATION. RENAME PANEL NM AS PANEL 2MECH1 AND PROVIDE NEW BREAKERS FOR NEW LOADS AS REQUIRED.

Q7: Who is pulling the building permit for this job? Will it be The City of Surrey or the Contractor?

A7: The City of Surrey has applied for the building permit.

Q8: Drawing A04 Specifications Division 1, item C states that the Owner shall provide and pay for course of construction insurance. However, In the RFQ document, on page 21, item 24.1 (g) the contractor is to obtain and carry course of constriction insurance. Which is correct?

A8: Provide construction insurance as per RFQ document. See architectural addendum #1.

Q9: Is professional errors and omissions insurance necessary? This is not a design-build tender.

A9: Professional errors and omissions insurance is not required.

Q10: What size is the piping to P1,P2, P3, P4 and what size is the strainer and check valve?

A10: The chilled water piping to pumps P1 & P2 are to be 3". The heating water piping to pumps P3 & P4 are to be 2". All strainers and check valves are to be line sized.

Q11: What is the sizing of the steam lines to the unit from the humidifiers to the air handler and what type of pipe can be used?

A11: Contractor to pipe steam lines with copper (type L) pipes and size as per manufacturer's recommendations. Slope all steam piping at 15% back to humidifier. Refer to attached excerpt for details.

Q12: How are you expected to keep the old units running and up on the roof when you are installing the new units as per drawing?

A12: The City of Surrey will advise on the shutdown period, when the overall installation can be done. It is our expectation that the mechanical installations can be completed by the Contractor as much as possible and leave the minimum amount of works for the shutdown period. The existing condenser units located on the roof for cooling only. The demolition scope of work include roof condenser units as well as the refrigeration piping between condenser units and existing indoor units. The existing refrigerant has to be evacuated properly.

Q13: What are the heights of the new air handling unit to be at?

A13: Please see attached Vision Air Handling Unit Specifications for further clarifications. New air handling units are to be mounted as close to structure as practical.

Q14: We would like to obtain approval for the Sime high efficiency condensing wall-hung boilers.

A14: The Sime boilers are NOT an approved alternative boiler for this project.

Q15: Is there any asbestos that we are to be concerned with in regards to existing conditions?

A15: A pre-construction survey will be done; any asbestos removal will be managed by the City of Surrey.

Q16: What will be expected for structural upgrading of existing roof framing as the group of the suspended air handling units are in excess of 1500 lbs each?

A16: The existing units are currently suspended from the roof, which will be replaced with the new units. If any structural upgrade requires, that will be reviewed and design by the design team. Please see attached Vision Air Handling Unit Specifications for further clarifications. New air handling units are to be mounted as close to structure as practical.

Q17: As per floor plan 1/A02 it shows the side walk terminating into the block wall, will there need to be any other provision to get this sidewalk to tie into any other existing component other than the wall?

A17: No, there is no existing block wall at the current side walk. The new sidewalk is to be flush with the existing sidewalk.

Q18: Who is the base building Sprinkler Contractor?

A18: Fraser Valley Fire Protection or Viking Fire Protection Inc.

Q19: Who is the base building Controls Contractor?

A19: ESC.

Q20: Is there a base building roofing contractor? Is there still a warranty on the existing roof that will be impacted by this work?

A20: There is no warranty on the roof.

Q21: Do you have an Independent Electrical Company that currently does the service on the building?

A21: No, City of Surrey electrical staff will perform work on the facility.

Q22: Regarding the Separate Prices on page 42 of the RFQ document: The wording of this paragraph is confusing. Are the Separate prices to be INCLUDED or EXCLUDED in the base price?

A22: Per the wording in the RFQ, the Separate Prices are an addition or a deduction to the Total Quotation Price and do not include GST. DO NOT state a revised Total Quotation Price.

Q23: Are we to provide an Agreement to Bond with our tender submission?

A23: Yes, Contractors should provide an agreement to Bond with their submission.

Q24: Is there a requirement for a bid bond for this tender?

A24: Yes, Contractors should provide a Bid Bond with their submission.

Q25: Please can you confirm the route for the 600V Electrical supply to the chiller unit?

A25: The wiring for the chiller unit and convenience outlet shall run from the electrical closet, along the ceiling to the chiller location and terminate in a junction box, liquid tight conduit or teck cable shall run from the junction box and penetrate the roof slab up, with a

sealed/watertight penetration, to the appropriate connection locations. This has been noted on drawing E101 – General note 'D' for all rooftop equipment wiring.

Q26: If the exhibit is to be shut down, are there any internal spaces we can utilize as an office & have use of WC's etc.?

A26: No office space or washrooms will be available during construction.

Q27: Will any work be required out of hours?

A27: No.

Q28: Is the general contractor required to pay for the Building Permit?

A28: No.

Q29: Drawing M-501 says for the rooftop units to remain in place and in service until the new system is installed and operating correctly. We don't see how this can be done as the new water based equipment is to be installed where the demo is to take place. Is there any plan as how this is to happen?

A29: See response to question 12 above.

Q30: Photo 06 on drawing A-05 indicates that the existing roof canopy is to remain in place above the mechanical room addition, but on drawing S2 roof plan a new roof deck is indicated. Which is correct?

A30: Architectural drawing is correct, the existing roof canopy is to remain in place above the mechanical room addition. Structural drawing has been revised.

**END OF ADDENDUM #1**

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All Addenda will become part of the RFQ Documents.

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**ATTACHMENT #1**

to

**ADDENDUM #1**

**MECHANICAL SPECIFICATIONS**

**AND**

**MECHANICAL SPECIFICATIONS ADDENDUM NO. 1**

*The following addendum supersedes information contained in drawings and specifications issued for the project to the extent referenced. This Addendum forms part of the Tender Documents and is subject to all of the conditions set out in the contract conditions.*

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## **1. DRAWINGS – MECHANICAL**

### **1.1 Drawing No.: M002 – Mechanical Equipment Schedules**

.1 Clarify:

- .1 Air Cooled Chiller Schedule updated to show SI units. Refer to mechanical specification for supplementary information.

### **1.2 Drawing No.: M401 – Mechanical Room Elevation Plans**

.1 Clarify:

- .1 High elevation mechanical equipment layout is to allow for a new service platform is to be installed in the future.

## **2. SPECIFICATIONS – MECHANICAL**

### **2.1 Section: 15870 – Steam Grid Humidifier**

.1 Item No.:

.1 Add:

- .1 See attached supplemental information for humidifier piping.  
.2 Contractor to use Type L Copper only

### **2.2 Section: 15200 – Piping Insulation**

.1 Item No.: 3.3 Insulation Installation Thickness Schedule

.1 Add:

| Piping or Equipment                      | Pipe Sizes mm/in. | Insulation Thickness mm/in. | Recovery Jacket |
|--|-------------------|-----------------------------|-----------------|
| Low Pressure Steam and Condensate Piping | All sizes         | 40/1½                       | Canvas / PVC    |

**END OF MECHANICAL ADDENDUM NO. 1**



[illegible]

| MECHANICAL MOTORLIST |   |                    |       |      |      |     |           |   |     |         |         |   |     |     |         |      |       |     |     |
|----------------------|---|--------------------|-------|------|------|-----|-----------|---|-----|---------|---------|---|-----|-----|---------|------|-------|-----|-----|
| EQUIPMENT TAG        | EQUIPMENT DESCRIPTION                   | EQUIPMENT LOCATION | LOAD  |      |      |     | EQUIPMENT |   | ALL |         | CONTROL |   |     |     | REMARKS |      |       |     |     |
|                      |   |                    | HP    | MCA  | VOLT | PH  | S         | I | C   | STARTER | S       | I | C   | T   |         | TYPE | S     | I   | C   |
| AHU-1                | AIR HANDLING UNIT FOR PREP AREA (CLEAN) | PREP AREA (CLEAN)  | 3.20  | FLA  | 1.00 | 208 | 3         | M | M   | E       | M       | M | E   | VFD | M       | M    | M     | DDC | ALL |
| AHU-2                | AIR HANDLING UNIT FOR ART GALLERY       | ARTS HOLDING       | 3.20  | FLA  | 1.00 | 208 | 3         | M | M   | E       | M       | M | E   | VFD | M       | M    | M     | DDC | ALL |
| AHU-3                | AIR HANDLING UNIT FOR ART GALLERY       | ARTS HOLDING       | 3.20  | FLA  | 1.00 | 208 | 3         | M | M   | E       | M       | M | E   | VFD | M       | M    | M     | DDC | ALL |
| AHU-4                | AIR HANDLING UNIT FOR ART GALLERY       | ARTS HOLDING       | 3.20  | FLA  | 1.00 | 208 | 3         | M | M   | E       | M       | M | E   | VFD | M       | M    | M     | DDC | ALL |
| AHU-5                | AIR HANDLING UNIT FOR ART GALLERY       | ARTS HOLDING       | 1.70  | FLA  | 1.50 | 575 | 3         | M | M   | E       | M       | M | E   | VFD | M       | M    | M     | DDC | ALL |
| AHU-6                | AIR HANDLING UNIT FOR ART GALLERY       | ARTS HOLDING       | 3.20  | FLA  | 1.00 | 208 | 3         | M | M   | E       | M       | M | E   | VFD | M       | M    | M     | DDC | ALL |
| AHU-7                | AIR HANDLING UNIT 100% OUTDOOR AIR      | PREP AREA (DIRTY)  | 2.20  | FLA  | 2.00 | 575 | 3         | M | M   | E       | M       | M | E   | VFD | M       | M    | M     | DDC | ALL |
| FC-1                 | SERVER ROOM COOLING                     | GALLERY            | —     | FRAC | 120  | 1   | M         | M | E   | E       | E       | E | HOA | M   | M       | M    | DDC   | ALL |     |
| B-1                  | CONDENSING BOILER                       | MECH ROOM          | 12.00 | —    | 120  | 1   | M         | M | E   | M       | M       | E | INT | M   | M       | M    | DDC   | ALL |     |
| B-2                  | CONDENSING BOILER                       | MECH ROOM          | 12.00 | —    | 120  | 1   | M         | M | E   | M       | M       | E | INT | M   | M       | M    | DDC   | ALL |     |
| CH-1                 | ROOF TOP MOUNTED AIR-COOLED CHILLER     | MAIN ROOF          | 62.00 | —    | 575  | 3   | M         | M | E   | M       | M       | E | INT | M   | M       | M    | DDC   | ALL |     |
| EF-1                 | MECH ROOM EXHAUST FAN                   | MECH ROOM          | 0.45  | —    | 115  | 1   | M         | M | E   | E       | E       | E | HOA | M   | M       | M    | DDC   | ALL |     |
| FF-1                 | FORCE FLOW HEATER                       | MECH ROOM          | 11.10 | —    | 208  | 3   | M         | M | E   | E       | E       | E | HOA | M   | M       | M    | TSTAT | ALL |     |
| FF-2                 | FORCE FLOW HEATER                       | MECH ROOM          | 11.10 | —    | 208  | 3   | M         | M | E   | E       | E       | E | HOA | M   | M       | M    | TSTAT | ALL |     |
| H-1                  | HUMIDIFIER FOR AHU-1                    | PREP AREA (CLEAN)  | 20.00 | —    | 120  | 1   | M         | M | E   | —       | —       | — | —   | —   | M       | M    | M     | DDC | ALL |
| H-2                  | HUMIDIFIER FOR AHU-2                    | ARTS HOLDING       | 20.00 | —    | 120  | 1   | M         | M | E   | —       | —       | — | —   | —   | M       | M    | M     | DDC | ALL |
| H-3                  | HUMIDIFIER FOR AHU-3                    | ARTS HOLDING       | 15.00 | —    | 575  | 3   | M         | M | E   | —       | —       | — | —   | —   | M       | M    | M     | DDC | ALL |
| H-4                  | HUMIDIFIER FOR AHU-4                    | ARTS HOLDING       | 15.00 | —    | 575  | 3   | M         | M | E   | —       | —       | — | —   | —   | M       | M    | M     | DDC | ALL |
| H-5                  | HUMIDIFIER FOR AHU-5                    | ARTS HOLDING       | 15.00 | —    | 575  | 3   | M         | M | E   | —       | —       | — | —   | —   | M       | M    | M     | DDC | ALL |
| H-6                  | HUMIDIFIER FOR AHU-6                    | PREP AREA (DIRTY)  | 15.00 | —    | 575  | 3   | M         | M | E   | —       | —       | — | —   | —   | M       | M    | M     | DDC | ALL |
| P-1                  | CHILLED WATER SUPPLY PUMP               | MECH ROOM          | —     | 1.00 | 575  | 3   | M         | M | E   | E       | E       | E | HOA | M   | M       | M    | DDC   | ALL |     |
| P-2                  | CHILLED WATER SUPPLY PUMP               | MECH ROOM          | —     | 1.00 | 575  | 3   | M         | M | E   | E       | E       | E | HOA | M   | M       | M    | DDC   | ALL |     |
| P-3                  | HEATING WATER SUPPLY PUMP               | MECH ROOM          | —     | 0.50 | 575  | 3   | M         | M | E   | E       | E       | E | HOA | M   | M       | M    | DDC   | ALL |     |
| P-4                  | HEATING WATER SUPPLY PUMP               | MECH ROOM          | —     | 0.50 | 575  | 3   | M         | M | E   | E       | E       | E | HOA | M   | M       | M    | DDC   | ALL |     |
| P-5                  | BOILER PUMP                             | MECH ROOM          | —     | FRAC | 120  | 1   | M         | M | E   | E       | E       | E | HOA | M   | M       | M    | DDC   | ALL |     |
| P-6                  | BOILER PUMP                             | MECH ROOM          | —     | FRAC | 120  | 1   | M         | M | E   | E       | E       | E | HOA | M   | M       | M    | DDC   | ALL |     |
| GFT-1                | GLYCOL FILL TANK                        | MECH ROOM          | —     | FRAC | 120  | 1   | M         | M | E   | M       | M       | E | INT | —   | —       | —    | —     | ALL |     |

MAN = MANUAL STARTER  
HOA = MAGNETIC STARTER C/W HAND/OFF/AUTO SWITCH & AUX STATUS CONTACTS  
MAG = MAGNETIC STARTER C/W AUX STATUS CONTACTS  
INT = INTEGRAL PART OF UNIT  
VFD = VARIABLE FREQUENCY DRIVE

DEFINITIONS:  
VOLT = REQUIRED SUPPLY VOLTAGE  
PH = POWER PHASE  
S = SUPPLIED BY DIV.  
I = INSTALLED BY DIV.  
C = CONNECTED BY DIV.

NOTES: 1) ALL DISCONNECT SWITCHES BY DIV. 16  
2) SINGLE POINT CONNECTION TO UNIT

SW = WIRED TO WALL SWITCH/STARTER (SUPPLIED AND WIRED BY DIV 16)  
RSTAT = REVERSE ACTION THERMOSTAT  
TSTAT = CONTROLLED BY THERMOSTAT (120V) (SUPPLIED BY DIV.15 AND WIRED BY DIV 16)  
LIGHT = WIRED TO LIGHT SWITCH  
DDC = CONTROLLED BY DDC SYSTEM  
VS = VARIABLE SPEED CONTROL SWITCH (SUPPLIED BY DIV.15)  
SMOKE = FAN TO BE SHUT DOWN ON SIGNAL FROM FIRE ALARM (HARDWIRED BY DIV. 16)  
ANNUNC = FAN TO BE CONTROLLED BY FIRE SITUATION FROM ANNUNCIATOR PANEL. (ALL WIRING BY DIV. 16)  
INTROCK WITH FIRE ALARM = FAN TO START ON SIGNAL FROM FIRE ALARM. (ALL WIRING BY DIV. 16)

| PUMPS   |     |                           |                 |                    |              |             |                    |                          |                  |               |                |                    |                    |       |
|---|-----|---------------------------|-----------------|--------------------|--------------|-------------|--------------------|--------------------------|------------------|---------------|----------------|--------------------|--------------------|-------|
| EQUIPMENT TAG   | QTY | DESCRIPTION               | LOCATION        | TYPE               | MANUFACTURER | MODEL       | FLOW (EA)<br>(L/S) | LIQUID TEMP.<br>(DEG. C) | HEAD (EA)<br>(M) | MOTOR<br>(HP) | MOTOR<br>(RPM) | AT DESIGN<br>(RPM) | POWER<br>(V/PH/Hz) | NOTES |
| P-1   | 1   | CHILLED WATER SUPPLY PUMP | MECHANICAL ROOM | VERTICAL IN-LINE   | ARMSTRONG    | 4380        | 5.0                | 15.6                     | 8.2              | 1.0           | 1800           | 1777               | 575/3/60           | ALL   |
| P-2   | 1   | CHILLED WATER SUPPLY PUMP | MECHANICAL ROOM | VERTICAL IN-LINE   | ARMSTRONG    | 4380        | 5.0                | 15.6                     | 8.2              | 1.0           | 1800           | 1777               | 575/3/60           | ALL   |
| P-3   | 1   | HEATING WATER SUPPLY PUMP | MECHANICAL ROOM | VERTICAL IN-LINE   | ARMSTRONG    | 4360        | 1.6                | 60.0                     | 6.7              | 0.5           | 1800           | 1740               | 575/3/60           | ALL   |
| P-4   | 1   | HEATING WATER SUPPLY PUMP | MECHANICAL ROOM | VERTICAL IN-LINE   | ARMSTRONG    | 4360        | 1.6                | 60.0                     | 6.7              | 0.5           | 1800           | 1740               | 575/3/60           | ALL   |
| P-5   | 1   | BOILER PUMP               | MECHANICAL ROOM | IN-LINE CIRCULATOR | GRUNDFOS     | UPS 26-99FC | 0.9                | 48.9                     | 6.1              | FRAC          | 1800           | 1740               | 120/1/60           | ALL   |
| P-6   | 1   | BOILER PUMP               | MECHANICAL ROOM | IN-LINE CIRCULATOR | GRUNDFOS     | UPS 26-99FC | 0.9                | 48.9                     | 6.1              | FRAC          | 1800           | 1740               | 120/1/60           | ALL   |
| NOTES:<br>1. EACH AT 100% CAPACITY WITH ONE AS STANDBY<br>2. DDC CONTROLLED<br>3. PUMPS TO BE VFD COMPATIBLE<br>4. PUMPS TO BE C/W SUPPORTS |     |                           |                 |                    |              |             |                    |                          |                  |               |                |                    |                    |       |

| FAN COIL UNIT   |     |                |          |              |            |             |                |                   |          |              |            |              |                  |                    |                    |                         |                         |                         |                         |                 |                  |                  |       |
|---|-----|----------------|----------|--------------|------------|-------------|----------------|-------------------|----------|--------------|------------|--------------|------------------|--------------------|--------------------|-------------------------|-------------------------|-------------------------|-------------------------|-----------------|------------------|------------------|-------|
| EQUIPMENT TAG   | QTY | SERVICE        | LOCATION | MANUFACTURER | MODEL SIZE | WEIGHT (KG) | AIR FLOW (LPS) | OUTDOOR AIR (LPS) | ESP (PA) | NO. FANS (#) | DRIVE TYPE | MOTOR QTY/HP | NO. ROWS COOLING | TOTAL CLG CAP (KW) | SENS. CLG CAP (KW) | CLG COIL EAT DB (DEG C) | CLG COIL EAT WB (DEG C) | CLG COIL LAT DB (DEG C) | CLG COIL LAT WB (DEG C) | COIL FLOW (LPS) | COIL EWT (DEG C) | COIL LWT (DEG C) | NOTES |
| FC-1  | 1   | SERVER COOLING | GALLERY  | WHALEN       | 6*WPHBC-4  | --          | 378            | --                | 62.5     | 1            | DIRECT     | FRAC         | 4                | 6.9                | 43.2               | 27                      | 19                      | --                      | 7                       | 0.35            | 7                | --               | ALL   |
| NOTES: <div>1. PROVIDE HEATING AND/OR COOLING COIL SIZED AS INDICATED.<br/>2. PROVIDE DRIP PAN UNDER COOLING COIL AND/OR UNIT.<br/>3. REFER TO THE MOTORLIST FOR ADDITIONAL REQUIREMENTS.<br/>4. EXISTING FANCOIL TO BE RELOCATED AND REBALANCED AS INDICATED<br/>5. UNIT TO COME WITH FACTORY-WIRED STARTER<br/>6. REPLACE EXISTING 4 ROW COOLING COIL WITH 3 ROW COOLING COIL<br/>7. UNIT TO BE SUPPLIED WITH MERV13 FILTER</div> |     |                |          |              |            |             |                |                   |          |              |            |              |                  |                    |                    |                         |                         |                         |                         |                 |                  |                  |       |

| CHILLER (AIR COOLED)   |           |              |                |         |         |            |               |       |               |     |         |  |
|--|-----------|--------------|----------------|---------|---------|------------|---------------|-------|---------------|-----|---------|--|
| EQUIPMENT  | LOCATION  | MANUFACTURER | MODEL          | COOLING |         |            | CAPACITY (KW) | EER   | POWER V/P/H/2 | MCA | REMARKS |  |
|  |           |              |                | EWI (C) | LWT (C) | FLOW (L/S) |               |       |               |     |         |  |
| CH-1   | MAIN ROOF | AERMEC       | NRL055***A*B03 | 13      | 7       | 5.0        | 112           | 11.65 | 575/3/60      | 62  | ALL     |  |
| NOTES: <div><div><div>1. ONLY USE R-134A TYPE REFRIGERANT.</div><div>2. MANUFACTURER RECOMMENDED FLOW SWITCH TO CONFIRM WATER FLOW TO BE PART OF CHILLER PACKAGE</div><div>3. USE MANUFACTURER CONTROLLER</div><div>4. FACTORY SUPPLIED FILTER FITTINGS ON CONDENSER AND EVAPORATOR.</div><div>5. UNIT TO BE FULLY BACKNET COMPATIBLE WITHOUT ANY ADDITIONAL INTERFACE REQUIREMENTS</div></div><div><div>6. CHILLER TO BE PLACED ON SPRING TYPE (CP2E) VIBRATION ISOLATORS (SEE MANUFACTURERS REC. FOR DETAILS)</div><div>7. SIZE 40-MESH STRAINER ON COND. &amp; EVAP. CONNECTION.</div><div>8. SOUND PERFORMANCE TO BE 52 DB OR BETTER</div></div></div> |           |              |                |         |         |            |               |       |               |     |         |  |

| BOILER (GAS FIRED) |                 |              |            |                        |            |             |          |                 |                     |             |             |                 |                 |                 |       |
|--------------------|-----------------|--------------|------------|------------------------|------------|-------------|----------|-----------------|---------------------|-------------|-------------|-----------------|-----------------|-----------------|-------|
| EQUIPMENT TAG      | LOCATION        | MANUFACTURER | TYPE       | MODEL                  | INPUT (KW) | OUTPUT (KW) | EFF. (%) | FLOW RATE (L/S) | WATER P. DROP (kPa) | EWT (DEG C) | LWT (DEG C) | OP. WEIGHT (KG) | ELEC LOAD (MCA) | POWER (V/PH/Hz) | NOTES |
| B-1                | MECHANICAL ROOM | VISSMAN      | CONDENSING | VITODENS 200-W B2HB-45 | 46.9       | 43.7        | 95.0     | 0.9             | 45.0                | 48.9        | 60.0        | 109.8           | 12.0            | 120/1/60        | ALL   |
| B-2                | MECHANICAL ROOM | VISSMAN      | CONDENSING | VITODENS 200-W B2HB-45 | 46.9       | 43.7        | 95.0     | 0.9             | 45.0                | 48.9        | 60.0        | 109.8           | 12.0            | 120/1/61        | ALL   |

NOTES:

1. LOW WATER CUT-OFF

2. FULLY MODULATING BURNER

3. TEMPERATURE AND PRESSURE GAUGE

4. 2-BOILER MANIFOLD WITH LOW-LOSS HEADER, MODEL 200/120

5. RELIEF VALVES

6. UL APPROVED

7. GAS VALVE

8. REFER TO MOTORIS FOR SEPARATE POWER TO CONTROLLERS.

9. BOILER TO BE SUPPLIED WITH PACKAGED CONTROLS SYSTEM FOR BOILER (AND CIRCUIT PUMP VFD) MODULATION, OUTDOOR AIR SENSOR AND DDC SYSTEM MONITOR POINTS

10. PROVIDE WITH ACID NEUTRALIZER

11. PROVIDE CO-AXIAL VENT KIT

| GLYCOL FILL UNIT  |         |                                |               |          |                       |              |       |                |                 |         |
|---|---------|--------------------------------|---------------|----------|-----------------------|--------------|-------|----------------|-----------------|---------|
| EQUIPMENT TAG   | QTY (#) | DESCRIPTION                    | SERVICE       | LOCATION | TYPE                  | MANUFACTURER | MODEL | MIXING CAP (L) | ELEC (V/PH/CYC) | REMARKS |
| GFT-1   | 1       | CHILLED WATER GLYCOL FILL TANK | CHILLED WATER | MECH     | STORAGE & MIXING TANK | AXIOM        | MF300 | 65             | 120/1/60        | ALL     |
| NOTES:<br>1. PROVIDE INTEGRAL CENTRIFUGAL PUMP WITH PACKAGED CONTROLS<br>2. PROVIDE SUCTION SIDE PUMP STRAINER.<br>3. PROVIDE INTERNAL ISOLATION VALVES ON PUMP.<br>4. PROVIDE CHECK VALVE ON DISCHARGE SIDE OF PUMP.<br>5. PROVIDE 24V LOW WATER CUT-OUT FLOAT SWITCH. |         |                                |               |          |                       |              |       |                |                 |         |

|     |                    |                                     |
|-----|--------------------|-------------------------------------|
| 5.  | 30/09/16           | ISSUED FOR ADD#1                    |
| 4.  | 16/09/16           | ISSUED FOR RFQ<br>AND BP SUBMISSION |
| 3.  | 13/09/16           | ISSUED FOR COORD.                   |
| 2.  | 17/08/16           | ISSUED FOR COORD.                   |
| 1.  | 12/07/16           | ISSUED FOR REVIEW                   |
| No. | DATE<br>(dd/mm/yr) | REVISION                            |

PROJECT TITLE

SURREY  
ARTS CENTRE  
HVAC

CITY OF SURREY

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All dimensions on the project must be checked by the contractor.

This drawing must not be used for construction purposes until here countersigned

cta:                      date:

**A M E Group**  
consulting mechanical engineers

|   |                          |   |                                     |   |                          |
|---|--------------------------|---|-------------------------------------|---|--------------------------|
| <b>VICTORIA</b><br>T. 250-363-0999<br>F. 250-362-0998<br>7270 JONES BLVD ST<br>VICTORIA, BC V8W 1M6 | <input type="checkbox"/> | <b>YANCOUVER</b><br>T. 604-434-5995<br>F. 604-404-5993<br>1100 W 808 W HASTINGS ST<br>YANCOUVER, BC V6C 3K4 | <input checked="" type="checkbox"/> | <b>CALGARY</b><br>T. 403-253-2333<br>F. 403-253-2324<br>710 W 1122 4TH STREET SW<br>CALGARY, AB T2R 1M1 | <input type="checkbox"/> |
|---|--------------------------|---|-------------------------------------|---|--------------------------|

SHEET TITLE

MECHANICAL  
EQUIPMENT  
SCHEDULES

|             |             |
|-------------|-------------|
| PROJECT No. | 085b-047-16 |
| DRAWN       | HG          |
| CHECKED     | AO          |
| SCALE       | N.T.S.      |
| DATE        | 16/09/2016  |
| PRINTED     | 16/09/2016  |

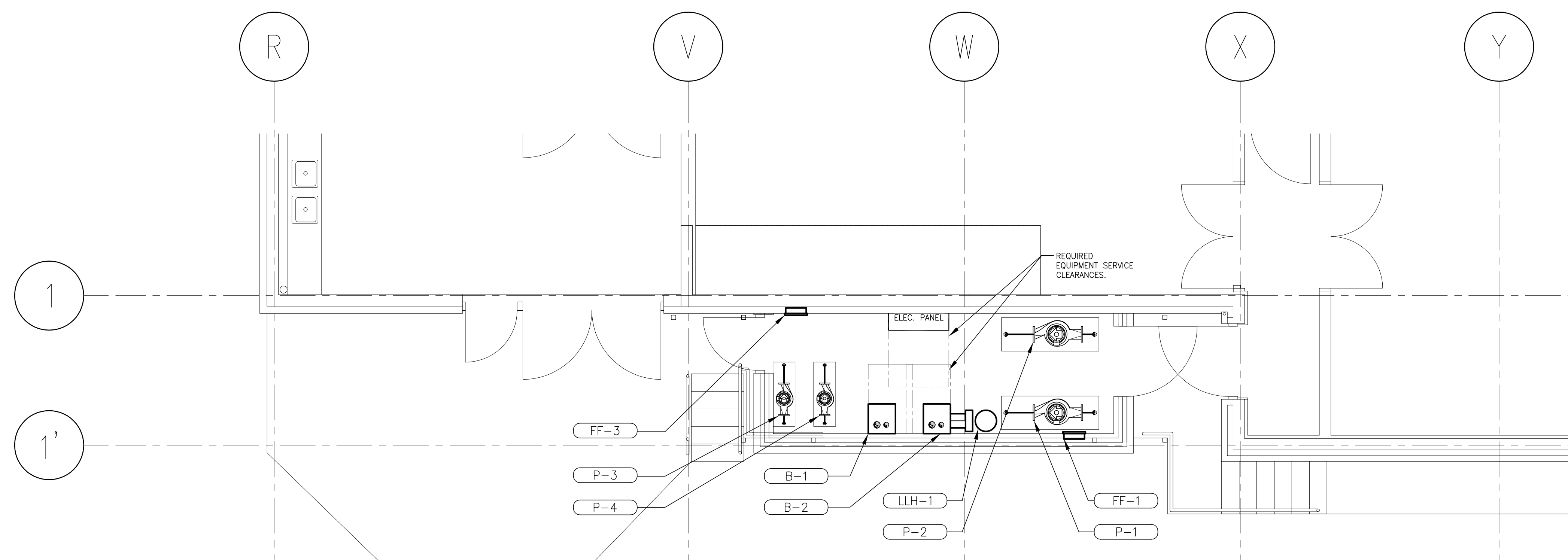
DRAWING No.

M002

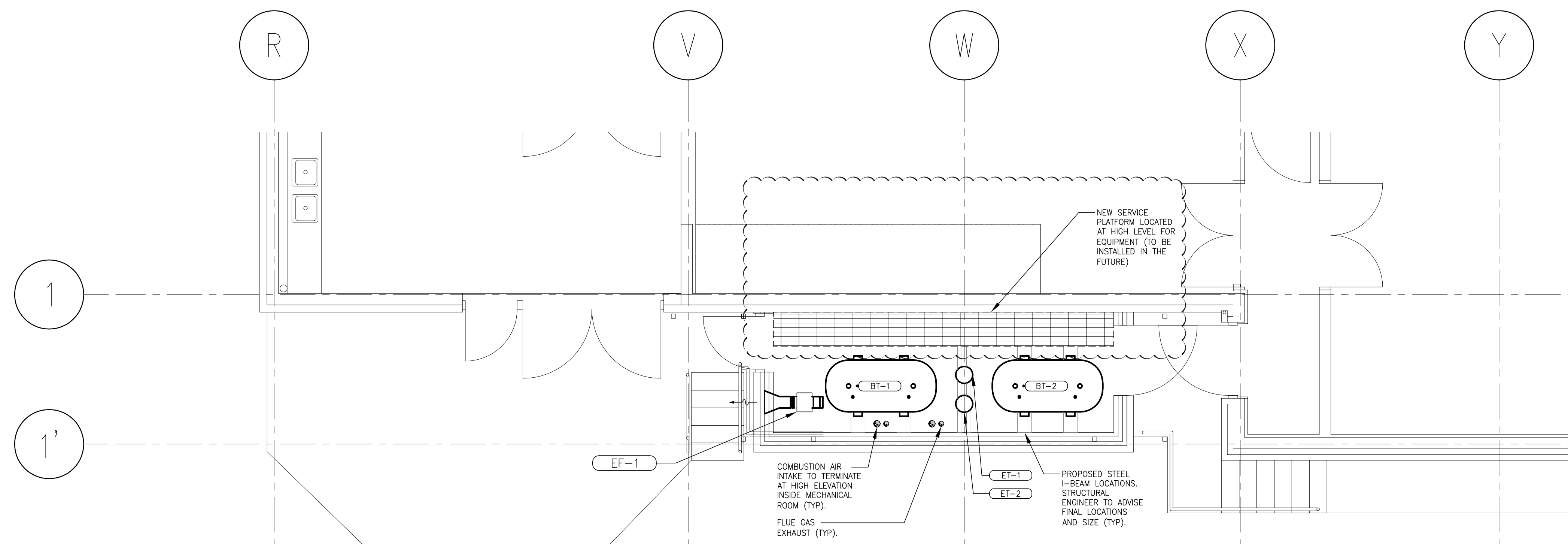
110-1281 WEST GEORGIA, VANCOUVER, B.C. V6E 3J5  
TELEPHONE (604) 669-9460 FAX. (604) 683-7684

CHERNOFF THOMPSON ARCHITECTS





MECHANICAL ROOM LOW ELEVATION PLAN



2 MECHANICAL ROOM HIGH ELEVATION PLAN  
M401 SCALE: 1:50

|     |                    |                                     |
|-----|--------------------|-------------------------------------|
| 5.  | 30/09/16           | ISSUED FOR ADD#1                    |
| 4.  | 16/09/16           | ISSUED FOR RFQ<br>AND BP SUBMISSION |
| 3.  | 13/09/16           | ISSUED FOR COORD.                   |
| 2.  | 17/08/16           | ISSUED FOR COORD.                   |
| 1.  | 12/07/16           | ISSUED FOR REVIEW                   |
| No. | DATE<br>(dd/mm/yr) | REVISION                            |

PROJECT TITLE

SURREY  
ARTS CENTRE  
HVAC

CITY OF SURREY

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cta:

date:

**AME Group**  
consulting mechanical engineers

☐ VICTORIA  
T 250-363-9999  
F 250-362-1198  
275 JACOBSON DR  
VICTORIA, BC V8M 1M6

☐ YAMCOOFT  
T 604-484-1995  
F 604-484-1893  
1100 W HASTINGS ST  
YAMCOOFT, BC V6C 2G4

☒ CALGARY  
T 403-254-2333  
F 403-253-3234  
710 - 132 4th STREET SW  
CALGARY, AB T2B 1M1

SHEET TITLE

MECHANICAL  
ROOM  
ELEVATION  
PLANS

|             |             |
|-------------|-------------|
| PROJECT No. | 085b-047-16 |
| DRAWN       | HG          |
| CHECKED     | AO          |
| SCALE       | 1:50        |
| DATE        | 16/09/2016  |
| PRINTED     | 16/09/2016  |

DRAWING No.

M401

110-1281 WEST GEORGIA, VANCOUVER, B.C. V6E 3J5  
TELEPHONE (604) 669-9460 FAX. (604) 683-7684

CHERNOFF THOMPSON ARCHITECTS

Table 17: Recommended Steam Line Material\*, Maximum Length, Losses

| NH-EL Model   | Maximum Steam Line Length |       | MED-L Copper Tube       | Stainless Steel Tube | Possible Steam Losses<br>(based on 1" insulated copper pipe) |           |
|---|---------------------------|-------|-------------------------|----------------------|--|-----------|
|   | ft                        | (m)   |                         |                      | lb/hr/ft   | (kg/hr/m) |
| 5   | 7                         | (2)   | 0.75                    | 0.875 X 0.049W       | 0.06   | (0.09)    |
| 10  | 12                        | (3.5) |                         |                      |  |           |
| 20  | 17                        | (5)   |                         |                      |  |           |
| 30  | 22                        | (6.5) |                         |                      |  |           |
| 50  | 43                        | (13)  | 1.5                     | 1.75 X 0.065W        | 0.11   | (0.16)    |
| 75/150**  | 47                        | (14)  |                         |                      |  |           |
| 100/200**   | 50                        | (15)  |                         |                      |  |           |
| Oversized Steam Line (Use for longer steam runs)*** |                           |       |                         |                      |  |           |
| 5   | 14                        | (4)   | 1                       | 1.125 X 0.049W       | 0.06   | (0.09)    |
| 10  | 24                        | (7)   |                         |                      |  |           |
| 20  | 34                        | (10)  |                         |                      |  |           |
| 30  | 44                        | (13)  |                         |                      |  |           |
| 50  | 86                        | (26)  | 2                       | 2.0 X 0.065W         | 0.11   | (0.16)    |
| 75/150**  | 94                        | (28)  |                         |                      |  |           |
| 100/200**   | 100                       | (30)  |                         |                      |  |           |
| Nortec Steam Hose                                   |                           |       |                         |                      |  |           |
| 5-30  | 5                         | (1.5) | Pt No 1328810 (7/8")    |                      | 0.1  | (0.15)    |
| 50-200**  | 5                         | (1.5) | Pt No. 1328820 (1 3/4") |                      | 0.15   | (0.22)    |

**Note:** \* The use of steam line other than copper, stainless steel tube or Nortec supplied steam line will void the warranty and may adversely affect the operation of the humidifier

\*\* Use one steam line per cylinder for NH-EL150-200 humidifiers. Do not combine lines except at distributor using a Nortec adapter designed for that purpose and only if humidifiers are operated in parallel.

\*\*\* These diameters require a reducer at humidifier and steam distributor connection

Combining Steam Lines

To combine multiple steam lines from a double unit or from multiple units, always use a Nortec supplied adapters at the steam distributor. Do not use common steam lines for double units or from multiple humidifiers. Always operate units or double tank units in parallel. See Double Unit (150-200 lb/hr) on page 14.

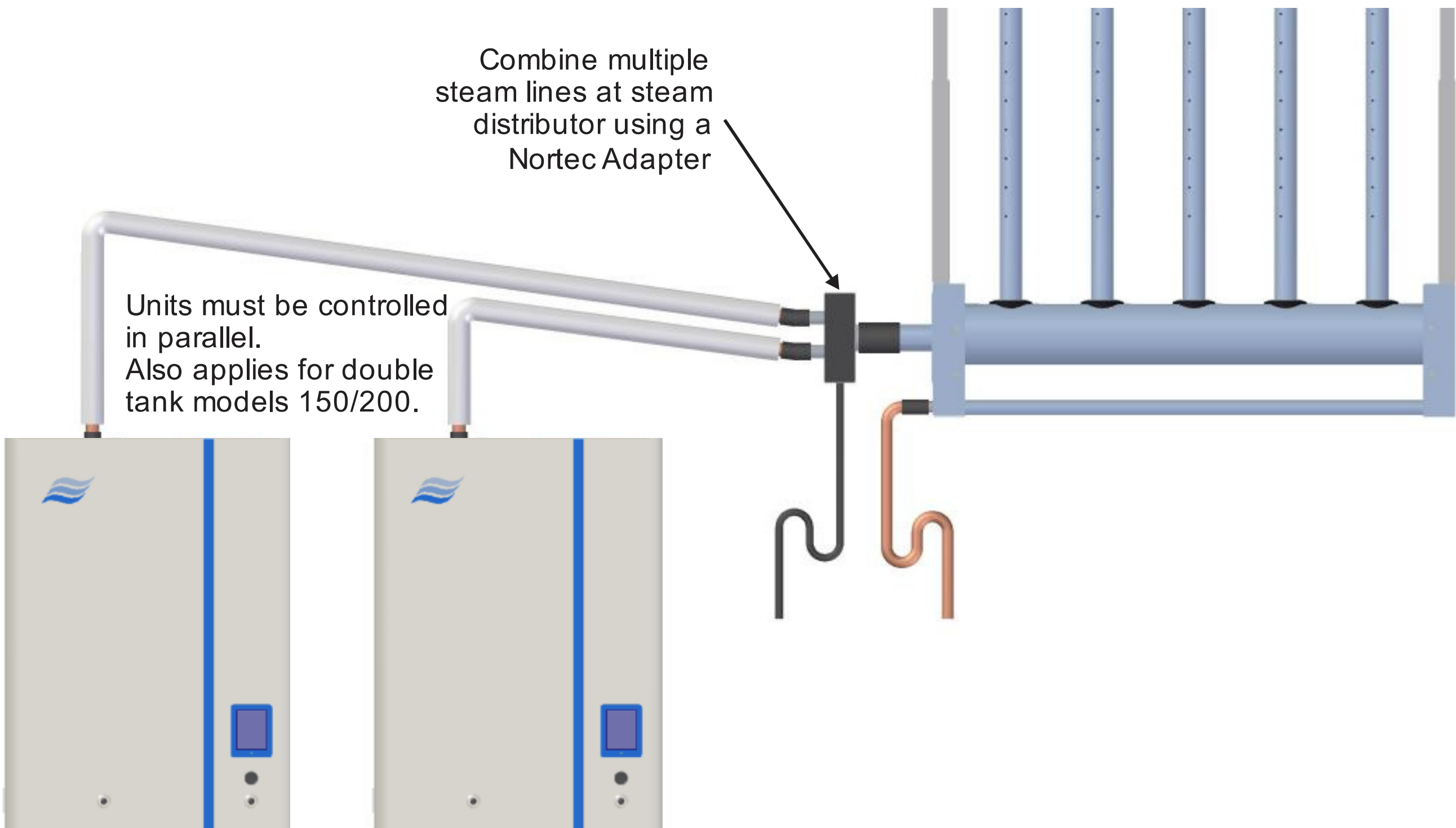


Figure 21: Combining Multiple Steam Lines

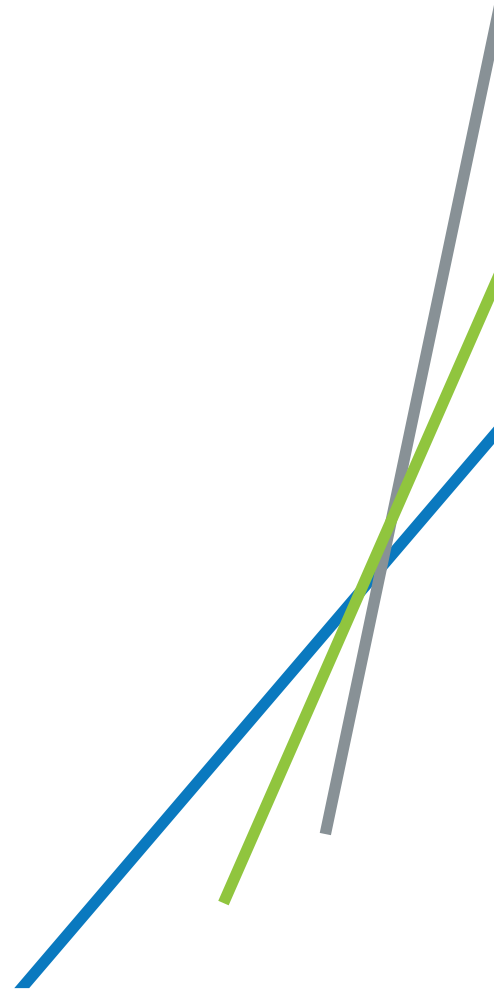
# SURREY ART GALLERY HVAC UPGRADES

MECHANICAL SPECIFICATION  
ISSUED FOR RFQ

PROJECT NO. 085B-047-16

September 28, 2016

1100-808 West Hastings Street,  
Vancouver, BC V6C 2X4  
T 604-684-5995



|   |
|---|
| 15010 General Mechanical Provisions                   |
| 15013 Selective Demolition                            |
| 15015 Documentation                                   |
| 15020 Commissioning                                   |
| 15025 Balancing                                       |
| 15030 Testing   |
| 15040 Metal Fabrication                               |
| 15040 Seismic Restraints                              |
| 15050 Vibration Isolation                             |
| 15060 Access Doors                                    |
| 15065 Meters And Gauges                               |
| 15070 Supports, Anchors & Seals                       |
| 15080 Counterflashing For Mechanical Equipment        |
| 15085 Pre-Operational Cleaning And Chemical Treatment |
| 15090 Pipe And Pipe Fittings                          |
| 15100 Valves & Strainers                              |
| 15115 Hot Water Specialties                           |
| 15116 Glycol Specialties                              |
| 15118 Gas Distribution                                |
| 15130 Tanks   |
| 15200 Piping Insulation                               |
| 15210 Duct Insulation                                 |
| 15220 Equipment Insulation                            |
| 15250 Fire Stopping                                   |
| 15300 Pumps   |
| 15410 Plumbing General                                |
| 15500 Sprinkler Equipment                             |
| 15510 Fire Extinguishers                              |
| 15710 Air Cooled Water Chiller                        |
| 15750 Coils   |
| 15820 Fans  |
| 15835 Duct Accessories                                |
| 15840 Ductwork Cleaning                               |
| 15855 Air Outlets                                     |
| 15865 Air Filters                                     |
| 15870 Steam Grid Humidifier                           |
| 15900 Controls General Provisions – DDC               |

## **1. GENERAL**

- .1 The project will achieve or exceed following temperature, humidity and acoustical requirements:
- .2 Commissioning and stabilization of HVAC function in museums: Environment standards for a Class A museum tolerate only a minimal variation of temperature and humidity over the course of 24 hours. Proof of stability is a requirement using these charts, by lenders such as the National Gallery of Canada for approval of artwork loans to the Surrey Art Gallery: Requirements for proving consistency are the paper hygrothermograph charts sourced from a number of machines placed throughout the Gallery's art handling/storage, exhibition and preparation spaces at the height of art storage and display.
- .3 Temperature: should be set at a steady temperature within this range 18-24°C and controlled with a variation no more than  $\pm 1^\circ\text{C}$  over 24 hours. The Gallery recommends 20C.
- .4 Relative Humidity: 40-55% and should be set within this range and not vary more than the control value variation of  $\pm 5\%$  over 24 hours. The Gallery recommends 50%.
- .5 New HVAC units meet CCI requirements for a Class A museum - Fluctuations must be within minimal tolerances over limited passages of time
- .6 HVAC units operate to museum standard until scheduled removal - No fluctuations can occur while artwork is on display or in gallery art holding or prep areas
- .7 HVAC units and air systems need to be very quiet as the Gallery presents audio art. - The HVAC needs to be almost silent
- .8 Mechanical Contractor shall be acting as General Contractor for the Surrey Arts Centre HVAC Upgrades Project. Therefore following specification sections shall be read with that understanding. The mechanical contractor means, general contractor and mechanical contract means, contract. From electrical work prospective, all work is to be carried by Electrical Contractor (hired by Mechanical contractor, where mechanical contractor will act as General Contractor, as it has been stated already). Since design documents were not developed for electrical scope of work, electrical work is to be conducted strictly on "design build" basis. Upon all electrical work being completed, it is expected that electrical contractor mark-up (CAD format) all new work being completed on existing City Record drawings (record drawings to be provided by City).

### **1.2 Intent**

- .1 Provide complete, fully tested and operational mechanical systems to meet the requirements described herein and in complete accord with applicable codes and ordinances.
- .2 Contract documents and drawings of this Division are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions.
- .3 Should inconsistencies exist such as the drawings disagreeing within themselves or with the specifications, the better quality and/or greater quantity of work or materials shall be estimated upon, performed and furnished unless otherwise ordered by the Consultant in writing during the bidding period.
- .4 Follow manufacturers' recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.



- .5 Install equipment generally in locations and routes shown. Run piping close to building structure, parallel to building lines to maximize head room and with minimum interference with other services and free space. Remove and replace improperly installed equipment to satisfaction of the Engineer at no extra cost.
- .6 Install equipment to provide access and ease of maintenance.
- .7 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Owner. Uncrate equipment, move in place and install complete; start-up and test.
- .8 Install control valves, thermal wells, and other devices on piping, furnished by Controls Contractor.
- .9 Provide seismic restraints for all required equipment, piping.
- .10 Furnish a written guarantee stating that all work executed in this contract will be free from defective workmanship and materials for a period of one (1) year from the date of Substantial Performance. The Contractor shall, at his own expense, repair and replace any work which fails or becomes defective during the term of the guarantee/warranty, providing such work is not due to improper usage. The period of guarantee specified shall not in any way supplant any other guarantees of a longer period but shall be binding on work not otherwise covered.
- .11 If the equipment is used during construction, the guarantee or guarantee period shall not be shortened or altered.
- .12 'Provide' shall mean ;supply and install'.

### **1.3 Coordination of Work**

- .1 Cooperate and coordinate with other trades on the project.
- .2 Make reference to mechanical, existing electrical, structural and architectural drawings when setting out work. Consult with respective Divisions in setting out locations for equipment, and piping, so that conflicts are avoided and symmetrical even spacing is maintained. Jointly work out all conflicts on site before fabricating or installing any materials or equipment.
- .3 Where dimensional details are required, work with the applicable existing architectural and structural drawings.
- .4 Full size and detailed drawings shall take precedence over scale measurements from drawings. Drawings shall take precedence over specifications.
- .5 Any areas indicated as space for future materials or equipment shall be left clear.

### **1.4 Permits**

- .1 All work shall comply with provincial, municipal, bylaws and authorities having jurisdiction.
- .2 Obtain all permits and pay all fees applicable to the work.
- .3 Contractor shall arrange for inspections of the work by the authorities having jurisdiction and shall provide certificates indicating Final Approval.
- .4 Contractor shall provide schedule B1/B2 letters of assurance for seismic engineering.

### **1.5 RFQ Price Breakdown**

- .1 Submit a RFQ price breakdown within thirty (30) days of RFQ closing and before first progress claim, in a format agreed to with the Consultant.
- .2 As a minimum, include the following in the RFQ price breakdown:

- .1 Mechanical: Equipment, materials, labour
- .2 Plumbing: Equipment, materials, labour
- .3 Controls: Equipment, materials, labour

#### 1.6 Progress Claims

- .1 Submit a Progress Summary and a Detailed Price Breakdown with each Progress Claim. The Summary and Breakdown shall include all Change Orders issued.
- .2 Progress claims shall not be processed past 95% of the overall Mechanical Contract until the final commissioning has been completed. This will allow for sufficient deficiency holdbacks for problems identified during commissioning.

#### 1.7 Examination of Site

- .1 Before submitting RFQ, visit and examine the site and note all characteristics and features affecting the work. No allowances will be made for any difficulties encountered or any expenses incurred because of any conditions of the site or item existing thereon, which is visible or known to exist at the time of RFQ.

#### 1.8 Quality of Work

- .1 All work shall be by qualified tradesmen with valid Provincial Trade Qualification Certificates. Spot checks will be made by the Consultant.
- .2 Work which does not conform to standards accepted by the Consultant and the trade may be rejected by the Consultant. The Contractor shall redo rejected work to the accepted standard at no cost to the Owner.

#### 1.9 Metric Conversion

- .1 All units in this division are expressed in SI units.
- .2 Submit all shop drawings and maintenance manuals in SI units.
- .3 On all submittals (shop drawings etc.) use the same SI units as stated in the specification.
- .4 Equivalent Nominal Diameters of Pipes - Metric and Imperial:
  - .1 Where pipes are specified with metric dimensions and Imperial sized pipes are available, provide equivalent nominal Imperial sized pipe as indicated in the table, and provide at no extra cost adapters to ensure compatible connections to all metric sized fittings, equipment and piping.
  - .2 When CSA approved SI Metric pipes are provided, the Contractor shall provide at no extra cost adapters to ensure compatible connections between the SI Metric pipes and all new and existing pipes, fittings, and equipment.

EQUIVALENT NOMINAL DIAMETER OF PIPES

| <i>mm</i> | <i>Inches (NPS)</i> | <i>mm</i> | <i>Inches (NPS)</i> | <i>mm</i> | <i>Inches (NPS)</i> |
|-----------|---------------------|-----------|---------------------|-----------|---------------------|
| 3         | 1/8                 | 65        | 2-1/2               | 375       | 15                  |
| 6         | 1/4                 | 75        | 3                   | 450       | 18                  |
| 10        | 3/8                 | 100       | 4                   | 500       | 20                  |
| 12        | 1/2                 | 125       | 5                   | 600       | 24                  |
| 20        | 3/4                 | 150       | 6                   | 750       | 30                  |
| 25        | 1                   | 200       | 8                   |           |                     |
| 30        | 1-1/4               | 250       | 10                  |           |                     |
| 40        | 1-1/2               | 300       | 12                  |           |                     |
| 50        | 2                   |           |                     |           |                     |

#### **1.10 Alternate Materials and Equipment**

- .1 The price submitted for this contract shall be based on the use of materials and equipment as specified or as contained within the Acceptable Manufacturers List. If no acceptable manufacturer has been listed, refer to approved equivalents below.
- .2 Requests for approval for RFQ purposes of equivalent materials or equipment shall be submitted to the Consultant no later than seven (7) working days prior to the closing date of RFQ for mechanical trade, complete with all applicable technical data, including performance curves and physical details. Approval of requests shall only be given by addendum.
- .3 The Contractor shall, in his quotation, indicate the degree of approval obtained from the Consultant. In the event that the product has been approved as "Alternate Only", this shall be stated in the quotation, and the contractor shall bear any and all costs for design/system modifications to accommodate the "alternate" equipment..
- .4 Approved equivalents and/or alternatives to specified products shall be equal to the specified product in every respect, operate as intended, meet the space, capacity, and noise requirements outlined.
- .5 The Contractor shall be fully responsible for any additional work or materials required by the trades or other Contractors to accommodate use of other than specified materials or equipment. Extras will not be approved to cover such work.

#### **1.11 Drawings and Specifications**

- .1 Drawings and specifications are complementary each to the other, and what is called for by one shall be binding as if called for by both.
- .2 Should any discrepancy appear between drawings and specifications which leaves the Contractor in doubt as to the true intent and meaning of the plans and specifications, obtain a ruling from the Consultant, before submitting a RFQ. If this is not done, it will be assumed that the most expensive alternate had been included.
- .3 Examine all contract documents, including all drawings and specifications, and work of other trades to ensure that work is satisfactorily carried out without changes to building.

#### **1.12 Shop Drawings**

- .1 Provide 4 copies, for all scheduled equipment and as specified in specific equipment sections of this specification.
- .2 Identify materials and equipment by manufacturer, trade name and model number. Include copies of applicable brochure or catalog material. Do not assume applicable catalogues are available in the Consultant's office. Maintenance and operating manuals are not suitable submittal material.
- .3 Clearly mark submittal material using arrows, underlining or circling to show differences from specified, e.g. ratings, capacities and options being proposed. Cross out non-applicable material. Specifically note on the submittal specified features such as special tank linings, pumps seals materials or painting.
- .4 Include weights, dimensional, and technical data sufficient to check if equipment meets requirements. Include wiring, piping, and service connection data and motor sizes. Provide centre of gravity diagrams for the use of the seismic consultant.
- .5 Installed materials and equipment shall meet specified requirements regardless of whether or not shop drawings are reviewed by the Consultant.
- .6 Do not order equipment or material until the Consultant has reviewed and returned shop drawings.

- .7 Prior to submission to the Consultant, the Contractor shall review all shop drawings. By this review, the Contractor certifies that he has determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data, and certifies that he has checked and coordinated each shop drawings with the requirements of the work of the contract documents. The Contractor's review of each shop drawing shall be indicated by stamp, date and signature of the contractor's designated project manager.
- .8 Retain one copy of shop drawings on site for review.

#### **1.13 Salvage**

- .1 Remove from site all equipment, or piping which is no longer required because of work under this Contract.
- .2 Turnover to and deliver to the Owner's storage area all items which have been determined to have salvage value and has been removed due to the Work.

#### **1.14 Cutting, Patching and Coring**

- .1 Provide holes and sleeves, cutting and fitting required for mechanical work. Relocate improperly located holes and sleeves.
- .2 Drill for expansion bolts, hanger rods, brackets, and supports.
- .3 Obtain written approval from the City of Surrey Structural Consultant before cutting or burning structural members.
- .4 Provide openings and holes required in precast members for mechanical work. Cast holes *100 mm* or larger in diameter. Field-cut smaller than *100 mm*.
- .5 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials as specified in the respective section.

#### **1.15 Installation of Equipment**

- .1 Pipe all equipment drains to building drains.
- .2 Unions and flanges shall be provided in piping to permit easy removal of equipment.
- .3 Maintain permanent access to equipment for maintenance.

#### **1.16 Fire-Stopping**

- .1 Fire-stop all pipe, duct, conduit and wire penetrations through floors and walls, designated as fire and/or smoke separations. The contractor is required to coordinate with the existing architectural drawings to contractual rated wall types and installation details.
- .2 Fire-stopping materials to meet ULC CAN 2S115. Acceptable Materials: by "Tremco" or "National Firestopping", "Hilti", "3-M".
- .3 Preparation of surfaces and installation of fire-stopping materials shall be carried out as per manufacturer's instructions.

#### **1.17 Connections to Existing Services**

- .1 Maintain liaison with the Owner and provide a schedule to interrupt, re-route or connect to water, sewer, heating, or gas systems, with minimum interruption of services.
- .2 Major services shall not be interrupted before all preparatory work is completed and all required materials are on site. Provide a minimum of 48 hours notice for all service shutdown.
- .3 Interruptions and shutdowns of existing services shall be by the building/plant maintenance staff.

### **1.18 Equipment and Materials**

- .1 Materials and equipment installed shall be new, full weight and of quality specified.
- .2 Each major component of equipment shall bear manufacturer's name, address, catalog and serial number in a conspicuous place.
- .3 Where two or more products of the same type are required, products shall be of the same manufacturer.
- .4 Make known in writing to the Engineer ten (10) days prior to the RFQ closing date any materials specified that are required to complete the work which are not currently available or will not be available for use as called for herein. Failing to do so, it will be assumed that the most expensive alternate has been included in the RFQ price.
- .5 All equipment supplied to the project will meet efficiencies as defined in ASHRAE Standard 90.1 2004.

### **1.19 Equipment Protection and Clean-Up**

- .1 Protect equipment and materials in storage on site during and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.
- .2 Protect equipment with polyethylene covers and crates.
- .3 Operate, drain and flush out unsealed bearings and refill with new change of oil, before final acceptance.
- .4 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other foreign substances.
- .5 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.
- .6 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

### **1.20 Electrical Motors**

- .1 Supply mechanical equipment complete with electrical motors.
- .2 Provide motors designed, manufactured, and tested in accordance with the latest edition of the following codes and standards: NEMA, EEMAC, CSA, CEC Part 1, IEEE and ANSI. All motors to be CSA labelled. All motors to be approved for use in the designated area classification by the Provincial Electrical Protection Branch. All motors intended for use with a variable speed drive (variance frequency drive) shall be inverter only rated.
- .3 Unless specified otherwise, provide motors designed for full voltage starting, EEMAC Design B. Motors driving high torque or high inertia loads may be EEMAC Design C or D.
- .4 Provide motors rated for continuous duty with 1.15 service factor unless specified otherwise in the driven equipment specifications. Provide all motors with thermal overload protection.
- .5 Motors less than 1-hp shall be 120 V, 60 Hz, 1 phase. Motors 1-hp and larger shall be 3 phase at the indicated voltage.
- .6 All motors shall be 1800 rpm where indicated.
- .7 Provide motors with complete except where indicated.
- .8 Provide motors with grease or oil lubricated anti-friction type ball or roller bearings.
- .9 Provide motors designed with Class B insulation; Class F insulation for totally enclosed motors.



- .10 Refer to electrical specifications, Division 16, for voltage, frequency, and phase data. This shall take precedence over any reference in Division 15.
- .11 Where motor power is stated in watts or kilowatts, nominal motor horsepower multiplied by 746 or 0.746 respectively, has been used as the conversion factor.
- .12 Minimum certified motor efficiency shall be as outlined in ASHRAE 90.1 2004.

|  |
|--|
| Minimum Nominal Full-Load Efficiency (%) |
|--|

|                         | Open Motors |      |      | Enclosed Motors |      |      |
|-------------------------|-------------|------|------|-----------------|------|------|
| Number of Poles         | 2           | 4    | 6    | 2               | 4    | 6    |
| Synchronous Speed (RPM) | 3600        | 1800 | 1200 | 3600            | 1800 | 1200 |

|     |      |      |      |      |      |      |
|-----|------|------|------|------|------|------|
| 1   | -    | 82.5 | 80.0 | 72.5 | 82.5 | 80.0 |
| 1.5 | 82.5 | 84.0 | 84.0 | 82.5 | 84.0 | 85.5 |
| 2   | 84.0 | 84.0 | 85.5 | 84.0 | 84.0 | 86.5 |
| 3   | 84.0 | 86.5 | 85.5 | 85.5 | 87.5 | 87.5 |
| 5   | 85.5 | 87.5 | 87.5 | 87.5 | 87.5 | 87.5 |
| 7.5 | 87.5 | 88.5 | 88.5 | 88.5 | 89.5 | 89.5 |
| 10  | 88.5 | 89.5 | 90.2 | 89.5 | 89.5 | 89.5 |
| 15  | 89.5 | 91.0 | 90.2 | 90.2 | 91.0 | 90.2 |
| 20  | 90.2 | 91.0 | 91.0 | 90.2 | 91.0 | 90.2 |
| 25  | 91.0 | 91.7 | 91.7 | 91.0 | 92.4 | 91.7 |
| 30  | 91.0 | 92.4 | 92.4 | 91.0 | 92.4 | 91.7 |
| 40  | 91.7 | 93.0 | 93.0 | 91.7 | 93.0 | 93.0 |
| 50  | 92.4 | 93.0 | 93.0 | 92.4 | 93.0 | 93.0 |
| 60  | 93.0 | 93.6 | 93.6 | 93.0 | 93.6 | 93.6 |
| 75  | 93.0 | 94.1 | 93.6 | 93.0 | 94.1 | 93.6 |
| 100 | 93.0 | 94.1 | 94.1 | 93.6 | 94.5 | 94.1 |
| 125 | 93.6 | 94.5 | 94.1 | 94.5 | 94.5 | 94.1 |
| 150 | 93.6 | 95.0 | 94.5 | 94.5 | 95.0 | 95.0 |
| 200 | 94.5 | 95.0 | 94.5 | 95.0 | 95.0 | 95.0 |

(\*) As defined in CSA C390 or IEEE 112B Nominal Standards

## 1.21 Miscellaneous Metals

- .1 Provide all necessary miscellaneous to hang or support materials, equipment and provide access for work under this contract.
- .2 All miscellaneous metals shall be prime painted.
- .3 Miscellaneous metals shall include but not limited to:
  - .1 Hangers for equipment, piping.
  - .2 Support for equipment.
  - .3 Access platforms and catwalks.

## 1.22 Pipe Sleeves

- .1 Pipe sleeves shall be provided for piping passing through walls and floors. Minimum 0.61 mm (24 ga) galvanized sheet metal. Sleeves shall extend 25 mm on either side of the wall.

- .2 Schedule 40 steel pipe shall be used as floor pipe sleeves in wet areas with a 50 mm up-stand.
- .3 Pipe sleeves are not required where pipes pass through cored concrete walls or floors.

### 1.23 Escutcheon and Plates

- .1 Provide escutcheon and plates on piping passing through finished walls, floors and ceilings.
- .2 Escutcheons shall be split type, stainless or chrome plated steel.

### 1.24 Painting and Identification

- .1 Colour code mechanical equipment, piping and exposed ductwork. Refer to colour schedule at end of this section.
- .2 Legend and direction of flow arrows shall consist of adhesive backed labels, yellow colour, with minimum 20 mm high black lettering equal to Brady System B-500, vinyl cloth labels for non-insulated surfaces; and Brady B 946 for insulated surfaces.
- .3 Identify piping with labels, colour bands, and flow arrows. Provide identification at 15 m maximum intervals, before and after pipes pass through walls, at all sides of tees, behind in equipment rooms as required.
- .4 Apply colour bands at both ends of the label with primary colour bands used to secure both ends of individual labels. Refer to colour schedule at end of this section.
- .5 Provide 20 mm diameter brass, with metal photo black numbers, or white lamacoid with black engraved numbers, secured to valve stem with key chain.
- .6 Provide neat, typewritten directories, giving valve number, services and location. Frame one copy under glass for wall mounting as directed, second copy to be forwarded to Owner. Include copies in O & M Manuals.
- .7 Tag automatic controls, instruments and relays and match/key to control shop drawing identification numbers. Tag all equipment and control panels.
- .8 Identify electric starting switches, thermostats controlling motors, remote push button stations, and controls equipment supplied under this division with lamacoid plates having 6 mm minimum letter size. Identification to state equipment controlled.

### 1.25 Colour Coding Schedule

- .1 Colour numbers are called for in Canadian Government Specification No. 5-GP-1a. Colours assigned from CGSB 1-GP-12c for colour code identification.

#### MECHANICAL PRIMARY COLOURS FOR PIPE LINES/EQUIPMENT

|     |            |   |         |
|-----|------------|---|---------|
| 1.  | Yellow     | - | 505-102 |
| 2.  | Light Blue | - | 502-106 |
| 3.  | Green      | - | 503-107 |
| 4.  | Orange     | - | 508-102 |
| 5.  | Brown      | - | 504-103 |
| 6.  | Red        | - | 509-102 |
| 7.  | White      | - | 513-101 |
| 8.  | Aluminum   | - | 515-101 |
| 9.  | Purple     | - | 501-101 |
| 10. | Grey       | - | 501-107 |

#### SECONDARY COLOURS FOR BANDS

- |    |        |   |         |
|----|--------|---|---------|
| 1. | Red    | - | 509-102 |
| 2. | Orange | - | 508-102 |
| 3. | Blue   | - | 502-106 |

**BANDING**

- |    |        |   |  |
|----|--------|---|--|
| 1. | Red    | - | to indicate extremely hazardous material |
| 2. | Orange | - | to indicate mildly hazardous material    |
| 3. | Blue   | - | to indicate non-hazardous material       |

.2 Identification Symbols and Colour for Piping

|                          | <u>Pipe Colour</u> | <u>Stripe Colour</u> | <u>Symbol</u>                                      |
|--------------------------|--------------------|----------------------|--|
| Chemical Feed Line       | Green              | Orange               | Chem.Symb.<br>(SO <sub>3</sub> )(PO <sub>4</sub> ) |
| Chilled Water Ret.       | Green              | Orange               | Ch.Wat.R.  |
| Chilled Water Supp.      | Green              | Orange               | Ch.Wat.S   |
| Compressed Air           | White              | None                 | kPa Air  |
| Condensate               | Green              | Orange               | Cond.  |
| Cooling Water Ret.       | Green              | Orange               | Cool Wat.R.  |
| Cooling Water Supp.      | Green              | Orange               | Cool Wat.S   |
| Domestic Cold Water      | Light Blue         | None                 | Dom. Cold Wat.                                     |
| Domestic Hot Water       | Green              | Orange               | Dom. Hot Wat.                                      |
| Domestic Hot Water       | Green              | Blue                 | Dom.Hot Wat.R.                                     |
| Drains                   | Aluminum           | Red/Orange           | Drain  |
| Drinking Water           | Light Blue         | None                 | None   |
| Glycol Return            | Green              | Orange               | Glycols R.   |
| Glycol Supply            | Green              | Orange               | GlycolS  |
| Heating Hot Water Return | Yellow             | Orange               | Heat Wat.R.  |
| Heating Hot Water Supp.  | Yellow             | Red                  | Heat Wat.  |
| Natural Gas              | Orange             | Red                  | Nat.Gas  |
| Sprinkler                | Red                | None                 | Sprinkler  |
| Stand Pipe (Dry)         | Red                | None                 | Dry Stand Pipe                                     |
| Stand Pipe (Wet)         | Red                | None                 | Stand Pipe   |
| Vent                     | Aluminum           | Red/Orange           | Vent   |
| Water Boiler Feed        | Green              | Orange               | Blr.Feed (Under<br>120°C)                          |
| Water Non-Potable        | Light Blue         | Red                  | NPW  |

.3 Identification Symbols and Colours for Equipment:

|                                | <u>Pipe Colour</u>     | <u>Stripe Colour</u> | <u>Symbol</u>     |
|--------------------------------|------------------------|----------------------|-------------------|
| Boilers                        | Green                  | Red                  | None 25 mm Length |
| Hangers, Brackets, Hanger Rods | Black Machinery Enamel |                      |                   |
| Heat Exchangers                | Green                  | Orange               | None              |
| Pumps - Regular                | Aluminum               | None                 | None              |
| Supports                       | Black                  | None                 | None              |
| Tanks – Hot Water (Insulated)  | Green                  | Orange               | None              |

|                               | <u>Pipe Colour</u>  | <u>Stripe Colour</u> | <u>Symbol</u> |
|-------------------------------|---|----------------------|---------------|
| Valves Uninsulated            | High Heat Aluminum  |                      |               |
| .4 Mechanical Control Systems |   |                      |               |
| .1                            | Conduit pull boxes, terminal boxes and junction boxes - GREY Covers - GREY with black 'C'.                              |                      |               |
| .2                            | Main and secondary control panels, factory finish acceptable - control Contractor to install company label to identify. |                      |               |

#### **1.26 Temporary or Trial Usage**

- .1 Temporary or trial usage by the Owner or Consultant of mechanical equipment supplied under contract shall not represent acceptance.
- .2 Repair or replace permanent equipment used temporarily.
- .3 Repair or otherwise rectify damage caused by defective materials or workmanship during temporary or trial usage.
- .4 Avoid thermal shock to heating system by co-ordination with the Owner during planning, construction and operation of temporary heating system.
- .5 Return condensate to the heating plant. Meter equipment is not required.

#### **1.27 Substantial and Total Performance**

- .1 Prior to requesting an inspection for Substantial Performance, provide a complete list of items which are deficient.
- .2 A certificate of Substantial Performance will not be granted unless the following items are completed:
  - .1 Heating, plumbing systems have been commissioned and are capable of operation with alarm controls functional and automatic controls in operation. Commissioning checklists must be submitted prior to the request by the contractor to have a substantial completion inspection.
  - .2 The necessary tests on equipment and systems including those required by authorities have been completed with certificates of approval.
  - .3 Water systems have been balanced with draft report submitted to Engineer.
  - .4 Valve tagging and equipment identification is complete.
  - .5 Warranty forms have been mailed to the manufacturer. Provide copy of original warranty for equipment which has warranty period longer than one year.
  - .6 Systems have been chemically cleaned. Flush and initiate water treatment. Provide report from manufacturer's representative to confirm status of treatment.
  - .7 Draft Operating/Maintenance Manuals have been submitted.
  - .8 Operating and Maintenance demonstrations have been provided to the Owner.
  - .9 Written inspection report by manufacturer's representative has been submitted for noise and vibration control devices and flexible connections.
  - .10 Record drawings have been submitted.
  - .11 All seismic restraint devices have been installed.
  - .12 All previously identified deficiencies have been corrected.

- .3 The following shall be an outline checklist of the minimum requirements to be met by the contractor prior to the Consultants' Substantial Performance by the contractor.  
Inspection:
  - .1 Complete Commissioning Checklists
  - .2 Final Plumbing Inspection Certificate from local plumbing inspector
  - .3 Controls Commissioning, Checklist and 15 day trend logs for all major equipment
  - .4 Seismic Engineers inspection of all Seismic restraints and schedule C letters of assurance
  - .5 Vibration isolation supplier's inspection report
  - .6 Final As-Built Drawings ready for review
  - .7 Maintenance and operation manuals, ready for review
- .4 Prior to Total Performance Inspection provide declaration in writing that deficiencies noted at time of substantial performance inspection have been corrected and the following items completed prior to the total performance inspection:
  - .1 Submit final water balance reports.
  - .2 Submit final operating and maintenance manuals.
  - .3 Complete final calibration.
- .5 The Consultant shall provide one (1) visitation for the purpose of total performance inspection. Subsequent visitations if required, shall be at the expense of the Contractor.
- .6 The Contractor shall provide qualified personnel in appropriate numbers to operate the facility until substantial performance is declared.

### 1.28 Acceptable Manufacturers

- .1 The following listed manufacturers are acceptable for their ability to meet the general design intent, quality and performance characteristics of the specified product. The list does not endorse the acceptability of all products available from the listed manufacturers/suppliers.
- .2 It remains the responsibility of the contractor to ensure the products supplied are equal to the specified products in every respect, operate as intended, and meet the performance specifications and physical dimensions of the specified product.
- .3 The contractor shall be fully responsible for any additional work or materials, to accommodate the use of equipment from the acceptable manufacturers and suppliers list.
- .4 Submit within 10 days of contract award a copy of the list underlining the name of the manufacturer whose price was carried in the RFQ. If no manufacturers names are submitted, it will be assumed that the price carried in the RFQ was that of the specified manufacturer or where the specified product is generic, the first acceptable manufacturer listed for each item and equipment.
- .5 List of acceptable Manufacturers:
  - Air Separators, Relief Valves Armstrong, Bell & Gossett, Taco, Wheatley
  - Air Vents Hoffman, Maid-O-Mist, Taco
  - Backflow Preventers Febco, Watts, Hersey, Singer, Ames
  - Balancing Agents KD Engineering
  - Boilers – Condensing De-Dietrich



|   |   |
|---|---|
| • Bypass Filter (HW)                        | Sumco, GESL, Pace Chemicals   |
| • Chimney and Breeching                     | Metalbestos P/S, Van Packer P/S, Metal Fab PIL  |
| • Commissioning Agents                      | Airmec, KD Engineering, CES Engineering Ltd.  |
| • Controls Contractors                      | Energrated (Delta),   |
| • Domestic Water Heaters – Water to Water   | P.V.I.  |
| • Expansion Compensators                    | Flexonics, Tube Turn, Hyspan, Hydroflex, Metraflex, United Flexible, Mason                            |
| • Expansion Joints                          | Flexonics, Hyspan, Hydroflex, Metraflex, United Flexible, Mason                                       |
| • Flexible Connectors - Piping              | Flexonics, Tube Turn, Atlantic, Hyspan, Hydroflex, Metraflex, United Flexible, Mason                  |
| • Flow Meter - Electromagnetic              | Onicon  |
| • Gauges - OWG Pressure                     | Terice, Marsh, Ashcroft, Weiss  |
| • Grooved Mechanical Pipe Joints            | Victaulic, Mech Line (only where permitted)   |
| • Hose Bibbs                                | Jenkins,Dahl, Crane, Toyo, Kitz, Mifab  |
| • Immersion Heaters                         | Armstrong, Taco, B&G  |
| • Insulation - Piping                       | Fibreglass Canada, Manson, Knauf Fibreglass, Plasti-Fab, Manville                                     |
| • Meters Positive Displacement              | Neptune, Rockwell   |
| • Pipe Restraints                           | Trelleborg  |
| • Piping Hangers and Saddles                | Grinnell, Myatt   |
| • Plug Cocks                                | DeZurik, Newman-Milliken  |
| • Pumps - In-Line Circulators               | Armstrong, B & G,   |
| • Pumps - Vertical In-Line and Base Mounted | Armstrong, B & G,   |
| • Strainers                                 | Armstrong, Sarco, Mueller, Toyo, Anderson, Metraflex, Yarway  |
| • Tank - Diaphragm Type Expansion           | Amtrol, Hamlet and Garneau Inc.   |
| • Tanks - Domestic Hot Water Storage        | PVI,  |
| • Thermometers                              | Terice, Marsh, Ashcroft, Winters  |
| • Valves - Butterfly                        | Jenkins, Keystone, DeZurik, Centreline, Monotight, Dresser, Lunkenheimer, Crane, Bray, Toyo, Grinnell |
| • Valves - Circuit Balancing                | Armstrong, B & G, Wheatley, Tour & Anderson   |
| • Valves - Drain,                           | Jenkins,Dahl, Crane, Toyo, Kitz   |
| • Valves - Gate, Globe, Swing, Check, Ball  | Jenkins, Toyo, Crane, Kitz, Milwaukee   |
| • Valves - Pressure Reducing                | Armstrong, Bell & Gossett, Taco   |
| • Valves - Relief                           | Armstrong, Bell & Gossett, Taco, Wheatley   |
| • Valves - Silent Check                     | Val-matic, APCO, StreamFlo  |

- Valves - Suction Diffusers Combination Check and Balance Armstrong, B&G, Taco
- Valves - Water Pressure Reducing Watts, Clayton, Singer, Zurn. Wilkins, BCA, Cash Acme, Braukman
- Vibration Isolation Mason, Vibro Acoustic

**2. PRODUCTS**

**3. EXECUTION**

- .1 Not Applicable.

**END OF SECTION**

## **1. GENERAL**

### **1.1 Intent**

- .1 Removal of all existing piping, equipment and ductwork that is redundant because of renovations.

### **1.2 Reference Standards**

- .1 Unless otherwise specified, carry out demolition work in accordance with CSA S350-M1980, Code of Practice for Safety in Demolition of Structures.

### **1.3 Existing Conditions**

- .1 Visit and examine the site and note all characteristics and irregularities affecting the work of this Section.

### **1.4 Protection**

- .1 Prevent movement or settlement of adjacent work. Provide and place bracing or shoring and be responsible for safety and support of such work. Be liable for any such movement or settlement, and any damage or injury caused.
- .2 Cease operations and notify the Prime Consultant immediately for special protective and disposal instructions when any asbestos materials are uncovered during the work of this Section.
- .3 Prevent debris from blocking surface drainage inlets and all types of drainage piping systems which remain in operation.

### **1.5 Salvageable Materials**

- .1 Except as otherwise indicated, salvageable materials from area of demolition shall become the property of the Owner at his discretion. All material not taken over by the Owner or removed from the building under this contract shall be removed from site and disposed of as required by any applicable disposal regulations.

## **2. EXECUTION**

### **2.1 Existing Services**

- .1 Disconnect and cap all mechanical services in accordance with requirements of local authority having jurisdiction. Natural gas supply lines shall be removed by the gas company or by a qualified tradesman in accordance with gas company instructions.
- .2 Building Mechanical Services: Maintain all building services during demolition/removal of existing.
- .3 Maintain all trap seals and ensure no sewer gas enters the building during renovations or demolition work. Maintain all existing sewer piping in a wet condition daily.

### **2.2 Demolition**

- .1 Completely demolish the items scheduled and remove all materials from the premises.
- .2 Carry out demolition in a manner to cause as little inconvenience to the occupied building area as possible. Co-ordinate this activity with the Owner and/or the Consultant.
- .3 Carry out demolition in an orderly and careful manner.

- .4 All coring, patching and removal of existing equipment, pipes and ductwork which may affect operation of occupied areas of the building shall be carried out outside of regular office hours or as scheduled with the Owner.

## **2.3 Asbestos Insulated Piping and Equipment**

- .1 When new work is required to be connected to existing plumbing and piping or equipment which contains asbestos insulation or products the following shall apply:
  - .1 Keep disruption to existing piping and equipment to a minimum
  - .2 Protect the site and all Contractors from the work.
  - .3 Remove the asbestos at piping and equipment for new connections and carry out work in accordance with WCB requirements for asbestos removal.

## **2.4 Core Drilling/Sleeving Through Existing Structure**

- .1 Clearly identified all proposed piping penetrations through existing slabs, walls, etc and advise the Contractor. Obtain x-rays of the locations to ensure penetration will avoid existing post tension cables or reinforced steel. Advise the structural engineer of any conflicts as a result of the x-rays.

**END OF SECTION**

## **1. GENERAL**

### **1.1 Scope**

- .1 Operating and Maintenance Manuals.
- .2 Record Drawings.

### **1.2 Quality Assurance**

- .1 Work specified in this section shall be performed by an Independent Agency specializing in this type of work and paid by the Contractor.

## **2. PRODUCTS**

### **2.1 Operating and Maintenance Manuals**

- .1 Secure and assemble all necessary literature describing the operation and maintenance of all equipment provided. Complete and transmit documentation for review to Consultant two (2) months prior to final inspection.
- .2 Provide four (4) 216 mm x 280 mm **8.5 in. x 11 in.** capacity, expanding spine catalogue binders, bound with heavy fabric, hot stamped lettering front and spine.
- .3 Index binder according to the following system:

#### Tab-1.0 Mechanical Systems:

Title page with clear plastic protection cover.

#### Tab-1.1 List of Mechanical Drawings:

#### Tab-1.2 System Descriptions:

Provide complete description of the operating sequence for all systems. Include detailed system description, with individual components described, explanation of how components interface with others and to the complete system, location of thermostats, controllers or operating variances, and controller operating setpoints.

#### Tab-1.3 Operating Division:

Provide complete and detailed operation of major components and systems. Provide information on location of components, how to energize switches and controls, how components interface with other components, operation of controls including operational sequence, operational changes for summer of winter operation, how to accomplish the changeover, complete trouble shooting sequence, emergency operating sequences in event of major component failure, and safeguards to indicate if equipment goes off-line.

#### Tab-1.4 Maintenance and Lubrication Division:

Provide general maintenance and lubrication schedule for major components to include daily, weekly, monthly, semi-annual and yearly checks and tasks. Explain how to execute maintenance tasks required for typical equipment such as bearings, drives, motors, and filters. Compile this information for equipment and separate from shop drawings.

#### Tab-1.5 List of Equipment Suppliers and Contractors:

Provide list of equipment suppliers and contractors, including address and telephone number. Outline procedures for purchasing parts and equipment.

#### Tab-Certification (2.0, 2.1, ...):



Include copy of test data on degreasing and flushing of heating system, analysis of system water taken at time system was put into operation, hydrostatic or air tests performed on piping systems, equipment alignment certificates, copy of balancing data for air and water systems, copy of valve tag identification and pipe colour code, inspection approval certificates for plumbing system, heating and ventilation systems and operational tests on oil-fired equipment.

Tab-Shop Drawings and Maintenance Bulletins (3.0, 3.1, ...):

Provide materials received in compliance with clause "Shop Drawings".

- .4 The divider tabs shall be laminated mylar plastic and coloured according to Section. The colouring is as follows: Mechanical Systems - 1.0 - 1.5 Orange; Certification - 2.0 - 2.4 Green; Shop Drawings & Maintenance - 3.0 - 3.17 Yellow. Plastic tabs with typewritten card insertions will not be accepted.

## **2.2 Record Drawings**

- .1 Refer to Division 1.
- .2 The Contractor shall keep on site, available to the Consultant at all times and particularly for each regularly scheduled site meeting, a complete set of prints, edge bound, that are to be updated daily showing any and all deviations and changes from the Contract Drawings. This set of drawings is to be used only for this purpose, and must not be used as the daily general reference set.
- .3 Provide record drawings which identify location of dampers, access doors, tagged valves, and actual room names or numbers. As well, deviations that are to be recorded shall include in general, items that are significant or are hidden from view and items of major importance to future operations and maintenance, and to future alterations and additions including cleanouts and isolation valves.

## **3. EXECUTION**

### **3.1 General**

- .1 Submit documents to the Consultant for approval prior to transmitting to the Owner.

### **3.2 Record Drawings**

- .1 Indicate real configuration of all services part of this project.
- .2 The cost per drawing sheet for transferring information to the record drawings by the Consultant shall be \$200.00 per drawing. Should the Contractor undertake major re-routing of services where the original layout is appropriate or should major changes in the scope of work occur, additional charges may apply. Costs for printing are not included.

**END OF SECTION**

## **1. GENERAL**

- .1 The project will achieve or exceed following temperature, humidity and acoustical requirements:
- .2 Commissioning and stabilization of HVAC function in museums: Environment standards for a Class A museum tolerate only a minimal variation of temperature and humidity over the course of 24 hours. Proof of stability is a requirement using these charts, by lenders such as the National Gallery of Canada for approval of artwork loans to the Surrey Art Gallery: Requirements for proving consistency are the paper hygrothermograph charts sourced from a number of machines placed throughout the Gallery's art handling/storage, exhibition and preparation spaces at the height of art storage and display.
- .3 Temperature: should be set at a steady temperature within this range 18-24°C and controlled with a variation no more than  $\pm 1^\circ\text{C}$  over 24 hours. The Gallery recommends 20C.
- .4 Relative Humidity: 40-55% and should be set within this range and not vary more than the control value variation of  $\pm 5\%$  over 24 hours. The Gallery recommends 50%.
- .5 New HVAC units meet CCI requirements for a Class A museum - Fluctuations must be within minimal tolerances over limited passages of time.
- .6 HVAC units operate to museum standard until scheduled removal - No fluctuations can occur while artwork is on display or in gallery art holding or prep areas.
- .7 HVAC units and air systems need to be very quiet as the Gallery presents audio art. - The HVAC needs to be almost silent.

### **1.2 General**

- .1 This section describes the commissioning of the mechanical system and outlines the duties and responsibilities of the team.
- .2 The commissioning of the mechanical system shall be in accordance with the Code of Practice for Commissioning Mechanical Systems in Buildings and as described in this section.
- .3 The commissioning process shall be applied to all products, equipment and systems provided under this Division.
- .4 Work specified in this section shall be performed by \*an independent Agency specializing in this type of work and paid by the Contractor.
- .5 The Commissioning Agency shall appoint a Commissioning Coordinator upon award of contract.
- .6 Acceptable Agencies: K.D. Engineering, Western Mechanical, Airmec Systems Ltd.
- .7 Where the owner engages his own commissioning agent, the following specifications are to be used as a guide by the contractor to allow and include for the necessary coordination with the commissioning agent.

### **1.3 Scope**

- .1 Demonstration of equipment and systems operations.
- .2 Instruction seminars for Owner's personnel.
- .3 System start-up, testing and operational checking.

#### **1.4 Quality Assurance**

- .1 Work specified shall be performed by \*an Independent Agency specializing in this type of work, \*the Contractor.
- .2 The commissioning process shall be consistent with the "Code of Practice for Commissioning Mechanical Systems in Buildings".
- .3 Within (20) twenty days of the award of the General Contract, supply the name, qualifications, and experience of the commissioning co-ordinator for the review and approval of the Consultant.

#### **1.5 Approved Manufacturers**

- .1 K.D. Engineering, Western Mechanical, Airmec Systems Ltd.

### **2. THE COMMISSIONING PROCESS**

#### **2.1 The Commissioning Team**

- .1 The Commissioning Team shall be formed and consist of:
  - .1 The Commissioning Agent.
  - .2 The Consultant's representative.
  - .3 The Owner's staff representative.

#### **2.2 Duties of the Team**

- .1 The duties of the team are summarized below:
  - .1 The Commissioning Coordinator shall plan, organize and implement the commissioning process and shall within one month of the award of the contract submit the name and address of the commissioning co-ordinator.
  - .2 The Commissioning Coordinator shall provide a complete description of the systems operation, performance and flow data to the Consultant for review.
  - .3 The Commissioning Coordinator shall prepare the commissioning plan and provide demonstration and instructions to the Owner's staff over a period of time to enable the staff to become familiar with the systems.
  - .4 Where the owner appoints a commissioning agent, the contractor shall include and provide for complete cooperation and all work necessary to assist the commissioning agent in the completion of the work, as outlined in this section.

#### **2.3 Commissioning Schedule**

- .1 Within [three (3)] months of commencing with the project work the commissioning coordinator shall review design intent and intended commissioning procedures with the Engineer. [Six months] prior to the date of scheduled substantial performance submit a detailed plan identifying the orderly progression of the prestart commissioning check and subsequent commissioning performance check of each sub-system, leading up to the ultimate commissioning of entire systems.
- .2 Submit a schedule for the commissioning phase of the work. This schedule shall show:
  - .1 Completion dates for each trade in each major section of the building.
  - .2 Timing of the various phases of the commissioning, testing, balancing and demonstration process.

- .3 Submission dates for the various documents required prior to verification of commissioning by the Consultant.
- .4 Prepare a commissioning statement in which each of the four (4) phases that the process is perceived to be worked through. In sequence, the phases are expected to be:
  - .1 Phase 1 - System Readiness.
  - .2 Phase 2 - System Start-Up, Testing, Balancing, Etc.
  - .3 Phase 3 - Verification of System Commissioning.
  - .4 Phase 4 - Demonstration and Instruction.
- .3 With the commissioning schedule noted above, submit a copy of all commissioning worksheets to be used during the commissioning process.
- .4 Each phase is applicable to each major and separate system making up the work in Division 15 including controls and Division 16 interface as applicable.
- .5 Where an owner appointed commissioning agent is part of the construction team, the contractor shall allow for the scheduling based on the above outline.

## 2.4 Commissioning Phases

- .1 Phase 1 - Before starting any of the separate systems, provide written verification stating that the specific system is ready for start-up and the following conditions have been met:
  - .1 Copies of all test and certificates have been submitted to the Consultant.
  - .2 All safety controls installed and fully operational (dry run test).
  - .3 Flushing, chemical cleaning (as required), charging, fluid operating (as required), are complete.
  - .4 Equipment lubrication and pre-start checks are complete.
  - .5 Control functional checks, including all alarms performed.
  - .6 Start-up verification checks by manufacturers representatives completed.
  - .7 All deficiencies to be recorded, reviewed by the commissioning team and, subsequently corrected before proceeding to the next phase, Phase 2.
- .2 Phase 2 - System Commissioning shall include but not necessarily be limited to:
  - .1 Activation of all systems.
  - .2 Testing and adjustment of all systems.
  - .3 As in the case of the System Readiness Phase, all deficiencies are to be recorded, reviewed by the Commissioning team and, subsequently, corrected. The process at the point of the deficiency shall be repeated before proceeding forward.
  - .4 Phase 2 is concluded when the installation is in full working order and acceptable for use. The work will include the following:
    - .1 Position all balance valves in piping systems (where appropriate).
    - .2 Set up all automatic temperature control devices.
    - .3 Adjust vibration isolators and earthquake restraints as necessary.
    - .4 Water balance complete.
  - .5 Fine Tuning:
    - .1 Setting up automatic controls for accurate response and precise sequencing.

- .2 Correction of problems revealed by Balancing Agency and change of fan speed and pitch as necessary.
- .6 Testing:
  - .1 The commissioning coordinator shall perform a detailed check of the following:
    - .1 All items and functions to be later demonstrated to the Owners representatives.
    - .2 Systems operation in the fire mode (pressurization and smoke removal) in the presence of the authorities having jurisdiction. Obtain a written statement/ certificate of approval from the authorized manual jurisdiction.
- .3 Phase 3 - Verification of Commissioning.
  - .1 Verification of commissioning by the Consultant shall not commence until the commissioning process, Phase 2, has been totally completed. Submit test procedure completion test certificates at the time of requesting the commencement of the verification procedure. The verification process will include the demonstration of the following:
    - .1 Location of and opening and closing of all access panels.
    - .2 Operation of all automatic control valves and automatic temperature/volume adjustment controls.
    - .3 Operation of all pumps and boilers.
    - .4 Operation of all equipment and systems, under each mode of operation, including:
      - .1 D.D.C. control features.
      - .2 Automatic controls.
      - .3 Boilers
      - .4 Chiller
      - .5 Pumps.
      - .6 Control Valves
      - .7 Tanks-expansion.
  - .2 At the completion of Phase 3, the Contractor shall submit the following to the Consultant:
    - .1 A letter certifying that all work specified under this contract is complete, clean and operational in accordance with the specification and drawings.
    - .2 A copy of Phase 2 Verification Certificates provided by the specialist trades for submission to the Consultant.
    - .3 Record drawings as specified.
    - .4 A letter from the testing and balancing agency certifying that all necessary data for inclusion in operating and maintenance manuals has been received.
    - .5 A statement confirming completion of EMCS acceptance test, Section 15900.
  - .3 Upon receipt of all documents and a satisfactory outcome of the verification procedure, the Consultant will provide a Certificate of Verification for Phase 3.
  - .4 Substantial Performance may, thereupon, be declared.

- .4 Phase 4 - Demonstration and Acceptance shall not commence until the commissioning process Phase 3 has been successfully completed - verification certificate issued and Substantial Performance declared. The demonstration process is a statement of satisfaction from the Consultant and Owner upon completion. Total Performance will not be accomplished without this achievement.

### **3. EXECUTION**

- .1 The following systems are to be commissioned:

#### **3.2 HVAC Systems**

- .1 Boilers - check out by manufacturer's representative, gas and water piping connections, burner and controls, flue connections, boil out, chemical treatment, capacity tests, expansion tank pressures and capacity, acid neutralizer.
- .2 Chiller
- .3 Pumps - alignment, rotation, motor current draw, piping connections, flow and pressure test.
- .4 Piping System - pressure tests, insulation, identification, water balance, hangers, expansion, and earthquake restraints.
- .5 Control Valves - Installation, controls, capacity modulation, connection to EMCS, identification.
- .6 Controls

#### **3.3 Earthquake Restraints**

- .1 Ducts, piping, equipment.

#### **3.4 General**

- .1 Independent Agency shall chair the demonstration and instruction sessions.
- .2 Contractor shall arrange for presentation and demonstration of mechanical equipment and systems by appropriate specialists and shall ensure that required manufacturer's representatives are in attendance.

#### **3.5 Demonstrations**

- .1 Demonstrate specific starting and general maintenance requirements for each major piece of equipment. Ensure all labeling and identification is completed.
- .2 Demonstrate the following systems, in the form of instruction seminars and contractor-guided tour of the facility.
  - .1 Hydronic Heating / Cooling Systems;
  - .2 Control Systems;
  - .3 Chemical Treatment Systems;
- .3 Demonstrate the following pieces of equipment:
  - .1 Boilers;
  - .2 Pumps;
  - .3 Chillers;

- .4 Prepare a schedule identifying the proposed sequence of demonstration. Sequence of demonstration shall correspond to full system starting. Submit for review by Engineer one month prior to demonstration.
- .5 Answer all questions raised by Owner at demonstrations; if unable to satisfactorily answer questions immediately, provide written response within three (3) days.
- .6 Provide a professionally produced video of all instructions and demonstrations. Engage the services of a professional video production company to provide four (4) copies of the edited video tape(s).

**END OF SECTION**

## **1. GENERAL**

### **1.1 Scope**

- .1 Balance, adjust, and test air and water systems and equipment and submit reports in identical units to those shown on contract documents.
- .2 Obtain sound level reading and submit reports.
- .3 Co-operate with the commissioning process.
- .4 Contractor shall prepare the facility for balancing.

### **1.2 Quality Assurance**

- .1 Work specified in this section shall be performed by an Independent Agency specializing in this type of work, and paid by the contractor.
- .2 Testing and balancing shall be performed by an agency that specializes in this type of work. Provide proof that the agency has successfully completed 5 projects of similar size and scope.
- .3 Provide extended warranty of 90 days after completion of test and balance work. During this period the Consultant may request re-check, or resetting of outlets or fans as listed in test reports. Provide technicians and instruments required.
- .4 Begin testing and balancing after systems have been completed and are in full working order. Place systems and equipment into full operation and continue operation during each working day of testing and balancing.
- .5 This agency shall remove and re-install ceiling tile to provide access to ductwork and piping. The balancing Contractor will make good any damage or soiling caused by his forces.
- .6 Carry out testing, adjusting and demonstrating of work prior to takeover by the owners.
- .7 Have all work performed solely by persons with proven ability and thoroughly versed in the type of testing and balancing. Submit names, complete with experience, record and references for review of the Consultant prior to work being carried out.
- .8 Witnessing of all tests by the Consultant and/or owner shall be at their option. Advise the consultant and/or owner of the time and location of tests.
- .9 Test records of all manufactured equipment shall be complete with a manufacturer's affidavit.
- .10 Have all records signed for accuracy by all witnesses and forward to consultant for review.
- .11 Bind a complete set of test records in each Owner's manual issued, and note those records for which tests have been witnessed by Authorities having jurisdiction.
- .12 Perform spot checks as requested by the Consultant.
- .13 Balancing procedures shall be in accordance with the latest, current requirements NEBB, SMACNA and ASHRAE Standards.

### **1.3 Approved Agencies**

- .1 K.D. Engineering; Western Mechanical Services.



#### **1.4 Site Visits**

- .1 Minimum of 3 site visits shall be made during construction to correspond with the general monthly site meetings held by the Contractor. After each site visit, a written report shall be submitted to the Contractor and Consultant. Site visits shall commence after the start of air and water distribution work and be spread over the construction period to the start of the balancing work.
- .2 A review of the installation shall be made at the specified site visit and any additional dampers or valves required for proper balance shall be reviewed with the Consultant and the Contractors.
- .3 Allow 2 visits to site to adjust systems for seasonal changes and to check and reset fans and outlets during warranty. Coordinate time of visit with the Owner. Submit reports to Consultant.
- .4 Begin balancing after balancing preparation and after systems have been completed and are in full working order. Place systems and equipment into full operation and continue operation during each working day of balancing.

#### **1.5 Balancing Agenda**

- .1 General: Submit balancing agenda to the Consultant and commissioning contractor for review at least 7 days prior to the start of balancing work. Start balancing work after agenda has been approved. Include descriptive data, procedure data, and sample forms in agenda.
- .2 Descriptive Data: General description of each system including associated equipment and different operation cycles, listing of flow and terminal measurements to be performed and selection points for proposed sound measurements.
- .3 Procedure Data: Procedures for converting test measurements to establish compliance with requirements, specify type of instrument to be used, method of instrument application (by sketch) and correction factors.
- .4 Sample Forms: Form showing application of procedures to typical systems.

#### **1.6 Balance Report**

- .1 Submit two (2) copies of balancing reports to Consultant prior to final acceptance of project.
- .2 Provide four (4) copies of final reports to Contractor for inserting in owner's Operating and Maintenance Manuals as described in Section 15015 Documentation.
- .3 Include types, serial number and dates of calibration of instruments in the reports.

#### **1.7 System Data**

- .1 The following information shall be provided:

**.1 Air Handling Equipment**

Design Data:

Total air flow rate;  
Fan total static pressure;  
System static pressure;  
Motor kW (Hp), r/min, amps, volts, phase;  
Outside air flow rate L/s (cfm);  
Fan r/min;  
Fan kW (Hp);  
Inlet and outlet, dry and wet bulb temperatures.

Installation Data:

Manufacturer and model;  
Size;  
Arrangement discharge and class;  
Motor type, kW (Hp), r/min, voltage, phase, cycles, and load amperage;  
Location and local identification data.

Recorded Data:

Air flow rate;  
Fan total static pressure;  
System static pressure;  
Fan r/min;  
Motor operating amperage;  
Inlet and outlet, dry and wet bulb temperatures.

**.2 Duct Air Quantities:** All mains supplying more than 10% of Volume, outside air and exhaust (maximum and minimum) major return air openings back to duct shafts.

Duct sizes;  
Number of pressure readings;  
Sum of velocity measurements;  
Average velocity;  
Duct recorded air flow rate;  
Duct design air flow rate.

**.3 Air Inlet and Outlets**

Outlet identification location and designation;  
Manufacturers catalogue identification and type;  
Application factors;  
Design and recorded velocities;  
Design and recorded air flow rates;  
Deflector vane or diffuser cone settings.

**.4 Pumps**

Design Data:

Fluid flow rate;  
Total head;  
kW (Hp), r/min, amps, volts, phase.

Installation Data:

Manufacturer and model;  
Size;  
Type drive;  
Motor type, kW (Hp), r/min, voltage, phase, and full load amperage.

Recorded Data:

Discharge and suction pressures (full flow and no flow);  
Operating head;  
Operating water flow rate (from pump curves if metering not provided);  
Motor operating amps (full flow and no flow);  
R/min.

**.5 Expansion Tank**

Design Data:

Size;  
Capacity;  
Pressure rating.  
Installation Data:

Manufacturer, size, capacity;  
Pressure reducing valve setting;  
Pressure relief valve setting

**.6 Air Cooled Chiller**

Design Data:

Cooling capacity;  
Evaporator flow rate and pressure drop;  
Motor kW (Hp), voltage, phase, full load amps.

Installation Data:

Manufacturer and model;  
Motor type, kW (Hp), r/min, voltage, phase, and full load amperage;  
Water flow rates;  
Water pressure drops;  
Entering and leaving water temperatures.

Recorded Data:

Water flow rates;  
Water pressure drops;  
Entering and leaving water temperatures.

**.7 Boilers**

Design Data:

Heat transfer rate;  
Fluid flow rate;  
Entering and leaving fluid temperatures;  
Fluid pressure drop.

Installation Data:

Manufacturer, model, type;  
Entering and leaving fluid temperatures;  
Capacity;  
Pressure drops;  
Flow rates.

Recorded Data:

Element type and identification (location and designation);  
Entering and leaving fluid temp (for varying outdoor temperatures);  
Fluid pressure drop;  
Fluid flow rate;  
Pressure relief valve setting.

**.8 Chiller Sound Level Data**

Diagram or description of relationship of sound source and measuring instrument;  
"A" scale reading;  
Reading at each octave band frequency.

**1.8 Acceptable Manufacturers**

**.1 Balancing Agents**

.1 KD Engineering, Western Mechanical Systems

**1.9 Instruments**

.1 Provide calibration histories for each instrument. Recalibration or use of other instruments may be requested when accuracy of readings is questionable.

**2. EXECUTION**

**2.1 General Procedure**

- .1 Permanently mark, by stick-on labels, settings on valves, splitters, dampers, and other adjustment devices.
- .2 Subsequent to correctional work, take measurements to verify balance has not been disrupted or that any such disruption has been rectified.
- .3 Balancing shall be performed to the following accuracies:
- |            |                   |      |
|------------|-------------------|------|
| • Air      | terminal outlets  | ±10% |
| • Air      | central equipment | ±5%  |
| • Hydronic | terminal outlets  | ±10% |

- Hydronic pumps and central  $\pm 5\%$

## 2.2 Air System Procedure

- .1 Perform balancing, adjusting and testing with building doors and windows in their normal operation position.
- .2 The following procedure shall be adopted for central systems:
  - Ensure dampers or volume control devices are in fully open position.
  - Balance central apparatus to  $\pm 10\%$  air flow.
  - Balance branches, mains to  $\pm 10\%$  air flow.
  - Recheck central apparatus.
  - Balance all terminal air outlets to  $\pm 10\%$ .
  - Rebalance central apparatus to  $\pm 5\%$ .
  - Recheck all air outlets.
  - Perform acoustical measurements.
- .3 When balancing air outlets:
  - .1 Rough balance furthest outlets and then balance sequentially back to source.
  - .2 Fine balance furthest outlet back to source.
- .4 Take static pressure readings and air supply temperature readings at 20 points on each air system.
- .5 Make air quantity measurements in ducts by "Pitot Tube" traverse of entire cross sectional area. If readings are inconsistent across duct, relocate to two duct \*diameters \*widths and re-do traverse.
- .6 Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control only by duct internal devices such as dampers and splitters.
- .7 Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.
- .8 Where modulating dampers are provided, take measurements and balance at extreme conditions. (Balance variable volume systems at maximum air flow rate - full cooling, and at minimum air flow rate - full heating).
- .9 The final balanced condition of each area shall include testing and adjusting of pressure conditions. Test and record building pressurization levels in variable volume systems throughout full range of fan delivery rates, under both heating and cooling conditions. Full multi-storey building test pressure conditions at ground, intermediate and upper levels. Front doors, exits, elevator shafts, should be checked for air flow so that exterior conditions do not cause excessive or abnormal pressure conditions. Document abnormal building leakage conditions noted.
- .10 Complete balancing to achieve positive building pressure unless otherwise instructed. A positive pressure relative to outside of  $10 \text{ Pa}$  (**0.04 in.w.g.**) minimum and  $20 \text{ Pa}$  (**0.08 in.w.g.**) maximum shall be achieved, measured with negligible outside wind velocity.

## 2.3 Balancing of Hydronic Systems

- .1 Open all (excepting pressure bypass must be closed) valves to fully open position including balancing valves, isolation valves, and control valves.

- .2 Set pumps to deliver 10% excess flow if possible.
- .3 Adjust flows through each boiler to ensure equal flow.
- .4 Check and adjust flows and temperatures at inlet side of coils.
- .5 Position and mark all automatic valves, hand valves and balancing cocks for design flow through all coils, connectors and all items in system requiring circulation of chilled water, hot water or glycol.
- .6 Upon completion of flow readings and coil adjustments, mark setting and record data.
- .7 Coordinate shaving of impellor to operating condition on pumps larger than 1.5 kW. (2 Hp).
- .8 Ensure all bypass valves are tightly closed.
- .9 After making all terminal unit adjustments, re-check settings at pumps. Re-adjust as required.
- .10 Calibrate all pressure and temperature gauges.
- .11 Install pressure gauges on each coil then read pressure drop through coil and set flow rate on call for full flow through coil. Set pressure drop across bypass valve to match coil full flow pressure drop.
- .12 For each pump, plot maximum and minimum flows on curve.
- .13 Verify pressure drops and flows through pressure control bypass valves at full operating range.
- .14

## 2.4 Balancing Report

- .1 Submit draft copies of reports prior to final acceptance of project.
- .2 Include types, serial number and dates of calibration of instruments.
- .3 Record test data on a sepiia made from the latest available revised set of mechanical drawings and submit four (4) copies upon completion of the balancing contract for inclusion in equipment and maintenance manuals.
- .4 Install at each piece of mechanical equipment a "Data Register" showing significant operating temperatures, pressures, amperes, voltage, brake horsepower. "Data Register" to be enclosed in a plastic holder securely attached to the equipment or to a wall in the adjacent area.
- .5 Submit with report, fan and pump curves with operating conditions plotted. Submit grille and diffuser shop drawings and diffusion factors.
- .6 Report shall be indexed as follows:
  - Instrumentation
  - Water
  - Summary
  - Procedure
  - Instrumentation
  - Drawings
  - Pump Data
  - Pump Curves
  - Boilers
  
  - Chiller
  - Coils
  - Equipment Data

Element Data Summary and Schematics (per system)  
Diagnostic

**2.5 Bring the work to an operating state and ready for balancing, including:**

- .1 Verify lubrication of equipment.
- .2 Install permanent instrumentation.
- .3 Clean piping systems and strainers, clean systems as per Section 15090, drain and fill with clean heat exchange fluid.
- .4 Complete the "start-up" of equipment.
- .5 Check rotation and alignment of rotating equipment and tension of belted drives.
- .6 Verify ratings of overload heaters in motor starters.
- .7 Set control points of automatic apparatus, check-out sequence of operation.
- .8 Make available control diagrams and sequence of operation.
- .9 Clean work, remove temporary tags, stickers, and coverings.
- .10 Make available one (1) copy of Maintenance Manuals especially for use in balancing.
- .11 Provide Balancing Agency a complete set of mechanical drawings and specifications.

**2.6 Cooperate with the Balancing Agency as follows:**

- .1 Make corrections as required by Balancing Agency.
- .2 Allow Balancing Agency free access to site during construction phase. Inform Balancing Agency of any major changes made to systems during construction and provide a complete set of record drawings for their use.
- .3 Operate automatic control system and verify set points during balancing.

**2.7 Balancing Valves**

- .1 Provide and install balancing valves, and other materials requested by the Balancing Agency and/or necessary to properly adjust or correct the systems to design flows, without additional cost to Owner.

**2.8 Shaving of Pump Impellers**

- .1 Allow in the contract price shaving of impellers as required to balance the pumps to design flow at operating condition.

**END OF SECTION**

**1. GENERAL**

**1.1 Scope**

- .1 Test natural gas piping.
- .2 Test heating water piping.
- .3 Test chilled water piping.
- .4 Test hot water piping.
- .5 Manufacturer's startup of equipment.

**1.2 Quality Assurance**

- .1 Test equipment and material where required by specification or authority having jurisdiction to demonstrate its proper and safe operation.
- .2 Test procedures in accordance with the current applicable portions of ASME, ASHRAE, and other recognized test codes as far as field conditions permit.
- .3 Perform tests on site to the satisfaction of the Consultant.
- .4 Piping, fixtures or equipment shall not be concealed or covered until inspected and approved by the Engineer. Provide ample written notice (two working days) to the Consultant before tests.
- .5 Coordinate with Consultant at start of project, those tests that will require witnessing by the Consultant.
- .6 Use factory trained representatives and submit manufacturer's check sheets for starting the following specialty equipment.
  - .1 Pumps
  - .2 Humidifiers
  - .3 Boilers
  - .4 Chillers
  - .5 Variable speed drive units
  - .6 Control components
  - .7 Chemical cleaning and treatment
- .7 Prior to starting, testing, balancing, adjusting and cleaning processes, verify with Engineer any tests required to be witnessed. Provide sufficient notice to Engineer prior to commencement of procedures.
- .8 Engineer shall be allowed to witness any testing, adjusting, starting, balancing and cleaning procedures.
- .9 Assume all costs associated with starting and testing, including the supply of testing or cleaning medium.
- .10 Prior to starting equipment or systems, secure and review manufacturer's installation, operation and starting instructions. Read in conjunction with procedures defined herein.
- .11 Use manufacturer's or supplier's starting personnel where required to ensure integrity of manufacturer's warranty.



- .12 Compare installations to published manufacturer's data and record discrepancies. Items proving detrimental to equipment performance shall be corrected prior to equipment starting.
- .13 Some processes involved in starting procedures defined in this section may be duplications of authorities verification. To facilitate expedient completion of project, arrange for authorities to assist or witness these procedures. (Gas inspectors, boiler and pressure vessels inspections etc.)
- .14 All starting, testing procedures shall be in accordance with applicable portions of the latest, current ASME, ASHRAE, AABC, CSA, NFPA, SMACNA, ASTM and ASPE codes and standards.
- .15 Personnel involved in starting, testing, balancing and adjusting procedures shall be experienced in the design and operation of mechanical equipment and systems being checked and shall be able to interpret results of the reading and tests.
- .16 Assume all liabilities associated with starting, testing and balancing procedures.

### **1.3 Submittals**

- .1 Obtain certificates of approval, acceptance, and comply with current rules and regulations from authorities having jurisdiction and include in Operating and Maintenance Manuals.
- .2 Perform tests as specified and upon completion of mechanical installation. Provide certification of tests with detailed data as required. Itemize each test as to time performed and personnel responsible. Include in Operating and Maintenance Manuals.

### **1.4 Liability**

- .1 Take charge of plant during tests, assume responsibility for damages in event of injury to personnel, building or equipment and bear costs for liability, repairs, and restoration in this connection.

## **2. PRODUCTS**

Not Applicable.

## **3. EXECUTION**

### **3.1 Pressure Tests**

- .1 Provide equipment, materials and labour for tests and pay expenses. Use test instruments from approved laboratory or manufacturer and furnish certificate showing degree of accuracy. Install permanent gauges and thermometers used for tests just prior to tests to avoid possible changes in calibration.
- .2 Carry out tests for eight-hour period and maintain pressure with no appreciable pressure drop. Where leakage occurs, repair and re-test and pay necessary costs for re-witnessing.
- .3 Water Piping: Test to 1-1/2 times maximum working pressure or 1033 kPa (**150 psi**), whichever is greater, water pressure measured at system low point.
- .4 Natural Gas: Test as required by current edition of CAN/CGA 149.1, and authority having jurisdiction.
- .5 Check systems during application of test pressure including visual check for leakage of water test medium, soap bubble test for air.
- .6 During heating and cooling piping system tests, check linear expansion at elbows, U bends, expansion joints and offsets for proper clearance.

- .7 When using water as test medium for system not using water, evacuate and dehydrate the piping and certify the lines are dry. Use agency specializing in this type of work.
- .8 Should tests indicate defective work or variance with specified requirements, make changes immediately to correct the defects. Correct leaks by re-making joints in screwed fittings, cutting out and re-welding welded joints, re-making joints in copper lines. Do not caulk.

### 3.2 Radiographic Examination of Welded Joints

- .1 A minimum of 10% of the welded joints unless otherwise specified elsewhere, selected by the Consultant shall be examined by radiography, at Contractor's expense, as specified below.
- .2 Pipe joints selected for examination shall be 100% radiographed.
- .3 Examination method shall be as per current edition of ASME Code Section V, Article 2.
- .4 Acceptance Criteria shall be as per current edition of ASME Code Section VIII Par UW-51. The standard of weld quality shall meet the applicable current Standard ANSI/ASME B31.1.
- .5 Where a radiograph discloses defects, two additional joints shall be examined. The cost of additional radiography and the cost of repairs shall be borne by the Contractor.

### 3.3 Testing of Soldered Copper Joints

- .1 Submit two (2) sample soldered copper pipe joints prepared by each tradesmen to be used on the project, to the Consultant within two (2) months of contract award. These samples may be subjected to radiographic testing to verify quality of workmanship.
- .2 Remove ten (10) samples of soldered copper pipe joints on heating system during construction as selected by the Consultant and remake joints removed. Arrange and pay for radiographic testing of removed joints to verify quality of workmanship.
- .3 Rejection of a sample will require re-test of adjacent joints at the Contractor's expense.
- .4 Failure of more than 75% of the above removed samples will necessitate removal and replacement of all joints completed up to the time of test, at Contractor's expense.

### 3.4 General

- .1 Conduct performance tests to demonstrate equipment and systems meet specified requirements after mechanical installations are completed and pressure tested. Conduct tests as soon as conditions permit. Make changes, repairs, and adjustments required prior to operating tests.
- .2 Where required by the Authority having jurisdiction, gas fired appliances rated in excess of 117 kW (**400 MBH**) shall be subjected to an operational test established by the Authority and shall pass this test before being approved for operation.
- .3 Meet with Division 16 manufacturers, suppliers, and other specialists as required to ensure all phases of work are properly coordinated prior to the commencement of each particular testing procedure. Establish all necessary manpower requirements.
- .4 Operate and test motors and speed switches for correct wiring and sequences and direction of rotation. Check and record overload heaters in motor starters.
- .5 Confirm voltages and operating amperages at full load.

- .6 Failure to follow instruction pertaining to correct starting procedures may result in re-evaluation of equipment by an Independent Testing Agency selected by Owner at Contractor's expense. Should results reveal equipment has not been properly started, equipment may be rejected, removed from site, and replaced. Replacement equipment shall also be subject to full starting procedures, using same procedures specified on the originally installed equipment.

### **3.5 Procedures**

- .1 Procedures shall be identified in the following five (5) distinct phases:
  - .1 Pre-Starting: Visual inspection.
  - .2 Starting: Actual starting procedure.
  - .3 Post-Starting: Operational testing adjusting or balancing, and equipment run-in phase.
  - .4 Pre-Interim Acceptance of the Work: Final cleaning, re-testing, balancing and adjusting, and necessary maintenance.
  - .5 Post-Interim Acceptance of the Work: Repeat tests and fine-tuning resulting from corrective action of deficiency clean-up.
- .2 Check specified and shop drawing data against installed data.
- .3 Check the installation is as defined by contract documents and as per manufacturer's recommendations including manufacturer's installation check sheets.

**END OF SECTION**

## **1. GENERAL**

### **1.1 Scope**

- .1 Work shall include the furnished of all labor, materials, equipment and services necessary for and incidental to the completion of all the miscellaneous metal work indicated on the drawings and specified herein.

### **1.2 Related Work**

- .1 Catwalks, stairs and ladders.
- .2 Steel supports for piping, ductwork and equipment.
- .3 Gratings.
- .4 Anchors and guides.
- .5 Seismic supports.
- .6 Checker plate covers and supports for mechanical shafts.

### **1.3 Quality Assurance**

- .1 Qualifications
  - .1 Welding to conform to design and procedure requirements of CSA Standard W59-1989 unless otherwise stated.
  - .2 All members or items subject to loading or stress shall be fabricated by an operator qualified under CSA Standard W47.1-1992.
  - .3 Structural or semi-structural members shall conform to CSA Standard S16.1-1994.
  - .4 Light gauge cold formed structural steel members shall conform to CSA Standard S136-1994.

### **1.4 Submittals**

- .1 Shops Drawings
  - .1 Submit shop drawings, to the Consultant, for each item listed, indicating the type of construction, finishes and method of installation related to adjoining construction.
  - .2 Manufacturer's printed literature may be considered sufficient to meet the above requirements, should they specifically indicate applicable details of the products and installation methods that apply to this project and are satisfactory to the Consultant.

### **1.5 Delivery, Storage & Handling**

- .1 Storage
  - .1 Materials and equipment to be properly stored so no deterioration by rusting of metals shall occur.
- .2 Handling
  - .1 Damaged or deteriorated materials shall be removed from site.

### **1.6 Project Conditions**

- .1 Existing Conditions

- .1 Consult with other sections in advance and make provision for work to avoid cutting, patching and making good.

## **2. PRODUCTS**

### **2.1 Materials**

- .1 Steel (Sections & Plates): Conforming to CSA Standard G40.21-1992, Type 33W, unless otherwise noted.
- .2 Welding Materials: to CSA Standard W59-1989.
- .3 Galvanizing: Double hot dipped galvanizing with a minimum coating of 57 g of zinc per 300 mm<sup>2</sup> to CSA Standard G164-M92.
  - .1 Shop Coat Primer: to CGSB 1-GP-40M
  - .2 Galvanized Primer: Zinc rich, ready mix to CGSB 1-GP-181M.

### **2.2 Fabrication**

- .1 Members shall be fabricated to shape and size indicated with well defined sharp lines, angles and risers.
- .2 Where possible, work to be fitted and shop assembled, ready for erection.
- .3 Exposed surfaces shall be smoother with all fastenings and connection hidden where possible.
- .4 Exposed welds to be continuous for length of joint except where specified otherwise.
- .5 Shearing and punching shall leave clean, true lines and surfaces. Provide holes and connections for all other sections.
- .6 Curved or brake formed work shall be evenly sprung.
- .7 Joints exposed to the exterior shall be weather proof, with all joints in any members closely fitted and machined.
- .8 Provide necessary rebates, lugs, brackets and supports so that all work can be assembled in a neat and substantial manner with ample strength and stiffness.
- .9 Galvanizing shall be a hot-dip process.
- .10 All exterior railings, handrails, guardrails, brackets and associated items of work shall be fabricated of galvanized materials.
- .11 All components not galvanized shall be prime coated.

## **3. EXECUTION**

### **3.1 Inspection**

- .1 Inspection of Structure
  - .1 Examine the drawings and the existing building(s) to ascertain fabrication procedures so that the work is carried out with a minimum of job site cutting and fitting.

### **3.2 Preparation**

- .1 Field Measurement

- .1 Where members are required to be installed neat between finished openings or walls, co-ordinate fabrication from drawing information supplemented with actual job site dimensions.
- .2 Priming and Sealing
  - .1 Apply one shop coat of rust inhibitive primer to metal items, with exception of stainless steel, aluminum, and those to be galvanized or encased in concrete.
  - .2 Use primer unadulterated, as prepared by recognized manufacturer. Apply paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 45°F.
  - .3 Clean surfaces to be field welded; do not paint prior to welding. Paint over welded areas. (Use galvicon on welds on galvanized materials.)

### **3.3 Method of Work**

- .1 Erection
  - .1 Units which are required to be built in under other sections of work shall be supplied well in advance of the time required and accompanied by all necessary setting templates or placing drawings and diagrams.
  - .2 Wood plugs are strictly forbidden and shot set anchorage will not be permitted. Obtain prior approval on anchorage devices proposed to be used.
  - .3 Erect metal work square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
  - .4 Provide suitable and acceptable means of anchorage, such as dowels, anchor clips, bar anchors, expansion bolts, or weld.

**END OF SECTION**

## **1. GENERAL**

### **1.1 Scope**

- .1 Provide seismic restraints on all piping, and equipment. Restraints shall be in accordance with the latest edition of the Seismic Restraint Manual for Mechanical Systems produced by SMACNA and the latest edition of the ASHRAE Applications Handbook Chapter 49 Seismic Restraint Design as well as current local building codes.
- .2 Where rotating equipment is factory installed in a cabinet or enclosure and the vibration isolation mounts are also factory installed they shall have factory installed seismic restraints and provisions for anchoring complete unit to structure. The manufacturer shall supply certificates (signed by a Professional Engineer registered within the jurisdiction) verifying the design of the seismic restraints in accordance with the provisions of this section.
- .3 Submit shop drawings of all seismic restraint details, prepared and sealed by a Professional Engineer registered in British Columbia.
- .4 Provide signed and sealed letters of assurance, as required by the authority having jurisdiction, taking responsibility for the seismic restraints.
- .5 Provide these letters of assurance sealed by a registered professional engineer for the seismic restraints, "Assurance of Professional design and commitment for field review" as well as "Assurance of Professional field review and compliance".

## **2. PRODUCTS**

- .1 Provide slack cable restraint systems, or other acceptable systems (pipe snubbers, struts, etc.).
- .2 Other approved systems are conventional pipe guides, rigid restraint where the piping is non-isolated or passes through a block or concrete wall, or a cable strap and space piece attached to the structure, used where the piping is adjacent to a wall and conventional slack cable/rigid restraints cannot be used.

### **2.2 Approved Manufacturers**

- .1 Pipe Restraints
  - .1 Trelleborg.

## **3. EXECUTION**

- .1 Select the restraints for the specified seismic requirements. (These requirements are generally 0.8 g for normal fans and piping and 1.4 g for piping and equipment containing toxic materials).
- .2 Select the anchor in the concrete slab for a load equal to one quarter of the weight of the fan at a 45° pull (0.35 x the specified seismic requirements).
- .3 Install vibrating equipment on seismically rated isolators whenever possible.
- .4 Where seismically rated isolators can not be used on vibrating equipment, use non-seismic isolators and provide slack cable restraints.
- .5 For non-vibrating equipment, secure the equipment to the structure by:
  - .1 Bolting directly to the structure.
  - .2 Use rigid seismic restraints.
  - .3 Use taught cable restraints - not slack.

- .4 Rigid restraints are preferable to cable restraints as cables have no compression load capabilities.
- .6 Installation of bolts and fasteners:
  - .1 Torque bolts to 75% of proof load.
  - .2 For threaded connections use either self locking nuts, double nuts or a chemical thread lock (Loctite Series 242).
- .7 Install cables using appropriate grommet, shackles, and other hardware to ensure alignment of the restraints and to avoid bending the cables at connection points. Cables can be directly wrapped around the pipe as opposed to using collars.
- .8 On piping systems, provide transverse slack cable restraints at a maximum spacing of 12.5 m (**40 ft.**) and longitudinal restraints at 25 m (**80 ft.**) maximum spacing, or as limited by anchor/slack cable performance.
- .9 Vary adjacent spacing of restraints on a piping by 10% to 30% to avoid coincident resonances.
- .10 Transverse bracing for one pipe section may also act as longitudinal bracing for the pipe connected perpendicular to it, provided the bracing is installed within 600 mm (**24 in.**) of the elbow or tee, and if the connected pipe is the same or smaller in size. Do not use branch lines to restrain main lines.
- .11 Provide flexibility in piping joints or sleeves where pipes pass through building seismic or expansion joints.
- .12 At vertical pipe risers, wherever possible, support the weight of the riser at a point or points above the centre of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 10 m (**32 ft.**) on centre with guide clearance not exceeding 3 mm. Vary adjacent spacing of restraints on a piping run by 10% to 30% to avoid coincident resonances.
- .13 Restraints shall be installed at least 25 mm (**1 in.**) clear of all other equipment and services.
- .14 Adjust restraint cables such that they are not visibly slack, or that the flexibility is approximately 35 mm (**1.5 in.**) under thumb pressure for a 1,500 mm (**5 ft.**) cable length (equivalent ratio for other cable lengths). Adjust the clearance at cable/spacer piece restraints to not exceed 6 mm (**1/4 in.**).
- .15 Bolt all non-isolated equipment (eg. floor mounted tanks, heat exchangers, etc.) to the structure.
- .16 300 mm Rule: As indicated in SMACNA, seismic restraint for piping and ductwork is not required if suspended less than 300 mm from supporting structure. This rule does not apply to equipment. Where beams occur, the pipe/duct must be supported from the beams for the rule to apply.

### 3.2 Piping

- .1 Provide restraint details on piping and equipment as follows.
- .2 Vertical Piping
  - .1 Attachment - Secure vertical piping at sufficiently close intervals to keep the pipe in alignment and carry the weight of the pipe and contents. Stacks shall be supported at their bases and, if over 2 stores in height, at each floor by approved metal floor clamps.
  - .2 Screwed pipe - Screwed pipe (I.P.S.) shall be supported at not less than every other storey height.



- .3 Copper tubing - Copper tubing shall be supported at each storey for piping 40 mm and larger diameter, and at not more than 1.8 m intervals for piping 40 mm and smaller in diameter.
- .4 Support pipes of other materials in accordance with the capability of the pipe to resist seismic loads.
- .3 Horizontal Piping
  - .1 Supports - Horizontal piping shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.
  - .2 Screwed pipe - Screwed pipe (I.P.S.) or flanged pipe shall be supported at approximately 3 m intervals.
  - .3 Copper tubing - Copper tubing shall be supported at approximately 1.8 m intervals for tubing 40 mm and smaller in diameter and 3 m intervals for tubing
  - .4 50 mm and larger id diameter.
  - .5 Support pipes of other materials in accordance with the capability of the pipe to resist seismic loads.
- .4 Provide transverse bracings at 12.2 m o.c. maximum unless otherwise noted.
- .5 Provide longitudinal bracings at 24.4 m o.c. maximum unless otherwise noted. When thermal expansion or contraction is involved, provide longitudinal bracings at anchor points. The longitudinal braces and the connections must be capable of resisting the force induced by expansion and contraction.
- .6 Transverse bracing for one pipe section may also act as longitudinal bracing for the pipe section connected perpendicular to it, if the bracing is installed within 600 mm of the elbow or tee of similar size.
- .7 For threaded piping the flexibility may be provided by the installation of swing joints. In welded or solder joint piping the flexibility shall be provided by expansion loops or manufactured flexible connectors. For piping with manufactured ball joints select length of piping offset using "Seismic Drift" in place of "Expansion Per Joint Manufacturers" selection table. Seismic Drift = 0.015 ft. per foot of height 12 mm/m of height.
- .8 Do not use branch lines to brace main lines.
- .9 Trapeze hangers may be used. Provide flexibility in joints where pipes pass through building seismic or expansion joints, or where rigidly supported pipes connected to equipment with vibration isolators.
- .10 A rigid piping system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.
- .11 Provide large enough pipe sleeves through walls or floors to allow for anticipated differential movements.
- .12 At vertical pipe risers, wherever possible, support the weight of the riser at a point of points above the centre of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 9.2 m o.c.
- .13 Cast iron pipe of all types, glass pipe and any other pipe joined with a shield and clamp assembly where the top of the pipe is 300 mm or more from supporting structure shall be braced on each side of a change in direction of 90° or more. Riser joints shall be braced or stabilized between floors.

- .14 For gas piping, the bracing details, schedules and notes may be used except that transverse bracing shall be at 6.1 m o.c. maximum and longitudinal bracing at 12.2 m o.c. maximum. 25, 30, 40 & 50 mm diameter pipes shall be braced the same as 65 mm diameter pipe in the schedule. (No bracing is required for pipes 18 mm diameter and smaller.)
- .15 The seismic bracing and support of fire sprinkler piping is not part of this specification.
- .16 It is the responsibility of the contractor to ascertain that an appropriate size restraint device be selected for each individual piece of equipment. Submit details on shop drawings.

### **3.3 Non-Isolated Floor Mounted Equipment**

- .1 Bolt all non-isolated equipment, e.g. floor mounted tanks, heat exchangers, boilers, etc. to the structure. Design anchors and bolts for seismic force applied horizontally through the centre of gravity. For equipment which may be subject to resonances, use a nominal 2g seismic force.

### **3.4 Isolated Piping And Equipment**

- .1 Install cables using appropriate grommets, shackles and other hardware to ensure alignment of the restraints and to avoid bending the cables at connecting points.
- .2 Vary adjacent spacing of restraints on a piping run by 10% to 30% to avoid coincident resonances.
- .3 Install restraints at least 50 mm clear of all other equipment and services.
- .4 Adjust restraint cables such that they are not visibly slack, or such that the flexibility is approximately 40 mm under thumb pressure for a 1.5 m cable length (equivalent ratio for other cable lengths). Adjust the clearance at cable strap/spacer piece restraints to not exceed 6 mm.
- .5 Provide transverse and axial restraints as close as practical to a vertical bend.
- .6 At steel trusses, connect to top chords and follow truss manufacturer's instructions.
- .7 Connect slack cable restraints to ceiling hung equipment in such a way that the axial projection of the wires passes through the centre of gravity of the equipment.
- .8 Orient restraint wires on ceiling hung equipment at approximately 90° to each other (in plan), and tie back to the ceiling slab at an angle not exceeding 45° to the slab.
- .9 Select the anchors in the concrete slab for a load equal to twice the weight of the equipment.

**END OF SECTION**

## **1. GENERAL**

### **1.1 Scope**

- .1 Supply all labour, materials and equipment required and necessary to isolate and restrain the equipment as indicated on the drawings and specified herein and guarantee the function of the materials and equipment supplied.

### **1.2 Qualifications**

- .1 All vibration isolators and bases shall be supplied by an acceptable supplier with the exception of isolators which are factory installed and are standard equipment with the machinery.
- .2 Provide shop and placement drawings for all vibration isolation elements for review, before materials are ordered. The drawings shall bear the stamp and signature of the responsible supplier's technical representative.
- .3 The work shall be carried out in accordance with the specification and, where applicable, in accordance with the manufacturer's instructions and only by workmen experienced in this type of work.
- .4 Seismic rated isolators shall be made part of the seismic restraint systems scope of work and become the responsibility of the contractor's seismic engineer/supplier.

### **1.3 Samples**

- .1 Samples of materials required to complete the work of this section shall be submitted to the Consultant for inspection and review, prior to submission of the shop drawings.

### **1.4 Submittals**

- .1 Provide vibration isolation shop drawings showing isolator locations, load on each isolator, inertia slab dimensions.
- .2 Provide details and calculations for attachment of isolator to equipment and structure. Drawings to show calculated tension and shear forces at anchor/structure interface and device/equipment interface. Drawings must confirm that the isolator restraint component or independent restraint device meets or exceeds the project seismic requirements.

### **1.5 General Requirements**

- .1 Supply vibration isolation equipment and materials by one supplier. Consider side loading of equipment and inertia bases when calculating maximum loads on isolators.
- .2 Provide vibration isolation on all motor driven equipment with motors of 0.37 kW and greater power output (as indicated on the motor nameplate) and on piping and ductwork, as specified herein. For equipment less than 0.37 kW, provide neoprene grommets at the support points.
- .3 Provide seismic restraint for all isolated equipment. Isolators for all base mounted equipment shall incorporate seismic restraints or be used in conjunction with an independently rated seismic restraint system..
- .4 Electrical cable connected to isolated equipment shall allow for a minimum +/-25 mm of equipment movement in any direction.
- .5 Ensure isolation systems have a vertical natural frequency no higher than one third of the lowest forcing frequency, unless otherwise specified. Use dynamic stiffness in selection of elastomers and do not exceed 60 durometer.

- .6 Provide spring thrust restraints on all fans (except vertical discharge) in excess of 1 kPa static pressure, and on hanger supported, horizontally mounted axial fans with more than 333 N thrust due to static pressure.
- .7 Isolators and restraining devices which are factory supplied with equipment shall meet the requirements of this section.
- .8 Provide concrete inertia bases where specified or required by equipment manufacturers located between all vibrating equipment and the vibration isolation elements. Provide inertia bases on centrifugal fans with static pressure in excess of 875 Pa and/or motor in excess of 30 kW and on base mounted pumps over 7.5 kW, except slab on grade installations. Refer to structural specifications for concrete work. Concrete work by General Contractor.
- .9 Co-ordinate with Division 3 for the provision of housekeeping pads at least 100 mm high under all isolated equipment. Provide at least 175 mm clearance between drilled inserts and edge of housekeeping pads and follow structural consultant's instructions for drilled inserts.
- .10 Bolt all equipment to the structure. Do not bridge isolation elements.
- .11 For isolated equipment, design anchors, bolts, isolators and bases to withstand without failure or yielding the seismic forces as defined by the BC and/or National Building Code. Should individual pieces of seismic hardware be incapable of withstanding the calculated forces, provide additional restraint to ensure that the system, as a whole, meets these requirements.

## **1.6 Regulatory Requirements**

- .1 Tested values must show that the seismic restraint hardware used in conjunction with the vibration isolation product is capable of withstanding the increased forces, as calculated for the specific project, using the formulae provided in the BC and/or National building codes.
- .2 Reference BC building code sections 4.1.9.1(15) and 6.2.1.9(2) regarding seismic requirements of integral isolation/restraint devices.
- .3 Post Disaster projects not only require that the seismic restraint of the resiliently mounted systems be design to withstand a seismic event but also that the equipment be functional following a design earthquake, provided that the building structure has not been compromised. Isolation/restraint supplier shall submit a dynamic analysis on each piece of equipment which has been specified as requiring post disaster restraint, indicating expected movements at all flexible connections to the structure. Contractor will coordinate with other divisions to ensure that these expected movements can be accommodated. Equipment manufacturers must confirm that the amplified forces to their equipment do not exceed the equipment or its component's fragility levels.

## **1.7 Inspection**

- .1 A qualified representative of the isolator manufacturer shall inspect the isolated equipment after installation and submit a concise report stating any deficiencies in the installation.

## **2. PRODUCTS**

### **2.1 Approved Manufacturers**

- .1 Vibration Isolation: Mason, Vibro Acoustic.
- .2 Flexible Connectors – Ducting: Thermaflex, G.I. Industries Type IHP.
- .3 Flexible Connectors – Piping: Flexonics, Tube Turn, Atlantic, Hyspan, Hydroflex, Metraflex, United Flexible.

## 2.2 Isolators

- .1 Spring isolators located out of doors or in humid areas shall have Rustoleum painted housing and neoprene coated springs, unless otherwise indicated on drawings.
- .2 Isolation mounts for equipment with operating weights substantially different from the installed weights, such as chillers or boilers, shall have adjustable limit stops.

## 2.3 Open Spring Isolators

- .1 Springs shall be "Iso-Stiff" having equal stiffness in the horizontal and vertical planes with a working deflection between 0.3 and 0.6 of solid deflection.
- .2 Spring mounts shall be complete with levelling devices, minimum *6 mm (1/4 in.)* thick neoprene sound pads and zinc chromate plated hardware.
- .3 Sound pads shall be sized for a minimum deflection of *1.2 mm (1/16 in.)* and shall meet the requirements for neoprene isolators.

## 2.4 Closed Spring Isolators

- .1 Compression springs shall be used both for hangers and floor mount isolators.
- .2 Springs shall be stable under operating conditions.
- .3 Housings shall incorporate a minimum *6 mm (1/4 in.)* thick sound pad sized for a minimum static deflection of *1.2 mm (1/16 in.)* meeting the requirements for neoprene isolators.
- .4 Floor mount units shall incorporate neoprene side stabilizers with a minimum 6 mm clearance.

## 2.5 Neoprene Isolators

- .1 All neoprene isolators shall be tested to latest ASTM specifications.
- .2 Where a ribbed pad is used, the height of the ribs shall not exceed 0.7 times the width of the rib. A steel layer shall be used to distribute the load in a multi-layered unit.
- .3 Neoprene pads or elements shall be selected at the manufacturer's optimum recommended loading and shall not be loaded beyond the limit specified in the neoprene manufacturer's literature.

## 2.6 Inertia Bases

- .1 Concrete inertia bases shall be a minimum of 1.5 times the weight of the isolation equipment and shall be constructed using a channel iron perimeter and adequate reinforcing. The concrete shall be rated at *20 MPa (3000 psi)*. Design shall be by the isolation suppliers.
- .2 Concrete inertia bases shall meet the requirements of the isolation supplier's shop drawings.
- .3 Structural steel bases shall be sufficiently rigid to prevent misalignment or undue stress on the machine, and to transmit design loads to the isolators.

## 2.7 Spring Hangers

- .1 Hangers capable of a 10° misalignment shall be provided unless otherwise specified.

### 3. EXECUTION

#### 3.1 Application

- .1 Provide vibration isolator for mechanical motor driven equipment throughout, unless specifically noted otherwise.
- .2 Set steel bases for 25 mm (**1 in.**) clearance between housekeeping pad and base. Set concrete inertia bases for 50 mm (**2 in.**) clearance. Adjust equipment level.
- .3 Deflections 12 mm (**1/2 in.**) and over shall use steel spring isolators.
- .4 Deflections 5 mm (**0.2 in.**) and under shall use neoprene isolators.
- .5 All equipment mounted on vibration isolators shall have a minimum clearance of 50 mm (**2 in.**) to other structures, piping equipment, etc. All isolators shall be adjusted to make equipment level.
- .6 Prior to making piping connections to equipment with operating weights substantially different from installed weights, the equipment shall be blocked up with temporary shims to the final heights. When full load is applied, the isolators shall be adjusted to take up the load just enough to allow shim removal.
- .7 Adjustable, horizontal stabilizers on close spring isolators shall be adjusted so that the side stabilizers are clear under normal operating conditions.
- .8 All piping connections to isolated equipment shall be supported resiliently for the following distances or to the nearest flexible pipe connector.

| Pipe Size ( <i>in</i> )                   | Distance, <i>m</i> ( <i>ft</i> ) |
|---|----------------------------------|
| 15 - 40 mm ( <b>1/2 in. - 1-1/2 in.</b> ) | 3.0 ( <b>10</b> )                |
| 50 - 65 mm ( <b>2 in. - 2 1/2 in.</b> )   | 4.5 ( <b>15</b> )                |
| 75 - 100 mm ( <b>3 in. - 4 in.</b> )      | 7.0 ( <b>25</b> )                |
| 125 - 200 mm ( <b>5 in. - 8 in.</b> )     | 9.0 ( <b>30</b> )                |
| 225 - 275 mm ( <b>9 in. - 11 in.</b> )    | 13.5 ( <b>45</b> )               |
| 300 - 350 mm ( <b>12 in. - 14 in.</b> )   | 15.0 ( <b>50</b> )               |

The three closest hangers to the vibration source shall be selected for the lesser of a 25 mm (**1 in.**) static deflection or the static deflection of the isolated equipment. The remaining isolators shall be selected for the lesser of the 25 mm (**1 in.**) static deflection or 1/2 the static deflection of the isolated equipment.

- .9 Spring hangers shall be installed without binding.
- .10 Adjust isolators as required and ensure springs are not compressed.
- .11 Provide neoprene side snubbers or retaining springs where side torque or thrust is developed.
- .12 Where movement limiting restraints are provided, they shall be set in a position with minimum 6 mm (**1/4 in.**) air gap. Restraints, isolator equipment and attachment points shall be designed to withstand the impact of the isolated equipment subjected to an acceleration not exceeding 3 g without permanent distortion or damage.
- .13 Wiring connections to isolated equipment shall be flexible.

#### 3.2 Performance

- .1 Install inertia bases of type and thickness as indicated on Isolation Schedule.

- .2 Install isolators of type and deflection as indicated on the Isolation Schedule or according to the following table, whichever provides the greater deflection.  
The required static deflection of isolators for equipment exceeding *0.35 kW (1/2 Hp)* is indicated below. Spring isolators shall be "open spring". Closed spring isolators shall only be used where specified.

| Machine<br>Speed r/min | Basement               |                       | Upper Floor          |                      |
|------------------------|------------------------|-----------------------|----------------------|----------------------|
|                        | Under 15 kW<br>(20 Hp) | Over 15 kW<br>(20 Hp) | Normal               | Critical             |
| Under 400              | Special*               | Special*              | Special*             | Special*             |
| 400 - 600              | 25 mm (1 in.)          | 50 mm (2 in.)         | 90 mm<br>(3 1/2 in.) | Special*             |
| 600 - 800              | 12 mm (1/2 in.)        | 25 mm (1 in.)         | 50 mm (2 in. )       | 90 mm<br>(3 1/2 in.) |
| 800 - 1100             | 5 mm (3/16 in.)        | 12 mm (1/2 in.)       | 25 mm (1 in.)        | 50 mm (2 in.)        |
| 1100 - 1500            | 3 mm (1/8 in.)         | 4 mm (5/32 in.)       | 5 mm<br>(3/16 in.)   | 12 mm<br>(1/2 in.)   |

- "Special" indicates as directed by the acoustical consultant.

**END OF SECTION**

## **1. GENERAL**

### **1.1 General Requirements**

- .1 Access for maintenance or adjustment of all parts of the mechanical system shall be provided. This shall apply but not be limited to valves, volume dampers including splitter dampers, fire dampers, cleanouts and controls.
- .2 Where equipment is concealed by a removable tile ceiling, the location of equipment shall be indicated by coloured markings on the T bar system.
- .3 Where equipment is concealed by a continuous structural or architectural surface, supply access doors of design to suit and match the surface in which they will be installed.
- .4 Provide stainless steel doors in walls of washrooms, kitchen, janitor rooms and laundry rooms.
- .5 All fasteners on access panels shall be tamper proof, contractor shall provide three (3) sets of keys.

### **1.2 Submittals**

- .1 Submit as part of shop drawings for all types of access doors, specifications and installation instructions.

## **2. PRODUCTS**

### **2.1 Approved Manufacturers**

- .1 Maxam, Acudor, Milcor, Can.Aqua, Mifab

### **2.2 Drywall Surface:**

- .1 Valve and Damper Access:
  - .1 Acudor DW-5040 with flange of textured galvanized steel drywall taping bead with prepunched holes. Installed after drywall.
- .2 Concealed Equipment Access:
  - .1 Baucoplus series fabricated with extruded aluminum frame with gypsum board inlay and structural corner elements. Hinge to be concealed 2-point hinge, non corroding with screw driver cam latch.

### **2.3 Masonry Wall**

- .1 Acudor UF-5000 universal flush door.

### **2.4 Tile Surface**

- .1 Acudor UF-5000 stainless steel universal flush door.

### **2.5 Fire Rated Walls**

- .1 Acudor FB-5060 uninsulated doors where temperature rise is not a problem and Acudor FW-5050 insulated door for maximum 250°C rise after 30 minutes. Door and frame shall be 16 gauge with masonry anchor straps and carry a ULC - 2 hour 'B' label.



## **2.6 Fire Rated Ceilings**

- .1 Acudor FB-5050, 50 mm thick insulated door with one hour combustible and three hour non-combustible rating.

## **2.7 Ductwork**

- .1 Nailor Industries 800 series insulated duct access doors with gaskets and camlocks, stainless steel in stainless steel ducts.

# **3. EXECUTION**

## **3.1 Installation**

- .1 Access doors are to be provided by the Mechanical Division. Installation in building construction to be by the ceiling contractor. Access doors in mechanical equipment to be provided and installed by the mechanical division.
- .2 Door Sizes:
  - .1 300 mm x 300 mm minimum for inspection and hand access.
  - .2 450 mm x 450 mm minimum, larger if indicated on drawings, where entry is required and access is difficult.
- .3 Flush to frame type steel door with rounded safety corners: 16 GA door, 18 GA frame for inspection and hand access types. Concealed bar hinge and one piece trim flange.
- .4 Concealed equipment access door frames shall have edges similar to drywall bead against which ceiling surfaces can be finished.
- .5 For ductwork provide access doors with lever locks, insulated for insulated ductwork.
- .6 Cam type, screwdriver operated locking device on the side opposite the hinges.
- .7 Prime coat grey baked enamel after 5 stage iron phosphate preparation, or stainless steel #4 satin finish where required.
- .8 Size to suit masonry modules when located in a masonry wall.
- .9 When located in a finished floor with tile, stonework, terrazzo, etc., a recessed bearing type access door is required. The door surface shall have a recess to take the particular surface material and pattern if this is available at the time the units are ordered.

**END OF SECTION**

## **1. GENERAL**

### **1.1 Scope**

- .1 Provide meters, gauges, and taps where shown on drawings and/or specified herein.
- .2 Submit shop drawings of proposed products to the Consultant for review.
- .3 Submit data sheets on thermometers and pressure gauges indicating service, and temperature or pressure ranges to the Engineer for review.

## **2. PRODUCTS**

### **2.1 Approved Manufacturers**

- .1 Gauges – Air: Dwyer, Magnehelic.
- .2 Gauges – OWG Pressure: Trerice, Marsh, Ashcroft, Weiss.
- .3 Thermometers: Trerice, Marsh, Ashcroft, Winteres.

### **2.2 Thermometers**

- .1 Dial Thermometers: 75 mm (3 in.) diameter dial in drawn steel case, bimetallic helix actuated, brass separable socket of flange and bushing, glass cover, adjustable pointer.
- .2 Mercury Thermometer: Red reading mercury filled, 2° graduations, aluminum case, 230 mm (9 in.) scale, straight shank, separable socket, and adjustable angle.

### **2.3 Thermometer Well**

- .1 Stainless steel suitable for stem type thermometer with gasket and cap except in potable water and open systems, in which case brass type shall be used.

### **2.4 Pressure Gauges**

- .1 100 mm (4 in.) diameter, drawn steel case, phosphor bronze bourdon tube, brass movement, extruded brass socket, 1% midscale accuracy, front calibration adjustment, black figures on white background. Provide gauge cock and syphon for steam service, pulsating damper and pet cock for water service.

### **2.5 Pressure Gauge Taps**

- .1 Brass needle valve.

## **3. EXECUTION**

### **3.1 Installation**

- .1 Provide one pressure gauge per pump installing taps before strainers and on suction and discharge of pump. Pipe to gauge.
- .2 Select gauges so that normal operating point is approximately mid-point of instrument range.
- .3 On pipes 65 mm (1½ in.) and smaller, place well in tee used in lieu of an elbow to accommodate well.

### **3.2 Meters and Gauges Installation Schedule**

- .1 Pressure Gauges:
  - .1 Pumps
  - .2 Expansion tanks
  - .3 Pressure tanks
  - .4 Leaving side of automatic make-up valves
  - .5 Where shown on drawings
- .2 Pressure Gauge Taps:
  - .1 Both sides of two-way control valves
  - .2 All lines to three-way control valves
  - .3 Major coils, inlet and outlet
  - .4 Heat exchangers, inlet and outlet, tube and shell side
  - .5 Chillers, inlet and outlet
  - .6 Where shown on drawings
- .3 Thermometers:
  - .1 Boiler, inlet and outlet
  - .2 Supply and return headers of central equipment
  - .3 Heating water zone supply and return mains
  - .4 Heating and cooling coils, inlet and outlet
  - .5 Where shown on drawings
- .4 Thermometer Wells Only:
  - .1 All lines to three-way control valves
  - .2 Where shown on drawings

**END OF SECTION**

## **1. GENERAL**

### **1.1 Scope**

- .1 Pipe hangers and supports.
- .2 Duct hangers and supports.
- .3 Flashing for mechanical equipment.
- .4 Sleeving for mechanical equipment.
- .5 Pipe anchors.

### **1.2 Reference Standards**

- .1 Pipe supports shall meet the requirements of current edition of ANSI B31.1, Power piping.
- .2 Automatic sprinkler pipe supports shall meet the requirements of current edition of NFPA No. 13, Standard for the Installation of Sprinkler Systems.
- .3 Standpipe and hose system pipe supports shall meet the requirements of current edition of NFPA No. 14, Standard for the Installation of Standpipe and Hose Systems.
- .4 Duct hangers shall follow the recommendations of the current edition of the SMACNA Duct Manuals.

### **1.3 Submittals**

- .1 Submit shop drawings of each factory manufactured component.

### **1.4 General Requirements**

- .1 Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade, and provide for expansion and contraction and to accommodate insulation; provide insulation protection saddles.
- .2 Install supports of strength and rigidity to suit loading without unduly stressing building. Locate adjacent to equipment to prevent undue stresses in piping and equipment.
- .3 Select hangers and supports for the service and in accordance with the manufacturer's recommended maximum loading. Hangers shall have a safety factor of 5 to 1.
- .4 Fasten hangers and supports to building steel or inserts in concrete construction.
- .5 Provide and set sleeves required for equipment, including openings required for placing equipment. Provide sleeves for all pipe and duct penetrations through walls, ceilings, floors and footings.
- .6 Dielectrically isolate dissimilar metals.
- .7 Obtain approval from the Consultant prior to drilling for inserts and supports for piping systems.
- .8 Obtain approval from the Consultant prior to using percussion type fastenings.
- .9 Use of piping or equipment for hanger supports is not permitted.
- .10 Use of perforated band iron, wire or chain as hangers is not permitted.
- .11 Do not weld piping, ductwork or equipment supports to building metal decking or building structural steel supports unless prior written approval has been obtained from the Consultant and Structural Consultant.

- .12 Where deemed necessary by the Consultant the contractor shall, at his own cost, employ a structural consultant to design equipment supports and/or pipe anchors.

## **2. PRODUCTS**

### **2.1 Inserts**

- .1 Inserts shall be malleable iron case or galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, and lugs for attaching to forms.
- .2 Size inserts to suit threaded hanger rods.

### **2.2 Pipe Hangers and Supports**

- .1 Hangers: Pipe sizes *15 mm (½ in.)* to *40 mm (1½ in.)*: Adjustable wrought steel ring.
- .2 Hangers: Pipe sizes *50 mm (2 in.)* to *100 mm (4 in.)* and Cold Pipe Sizes *150 mm (6 in.)* Over: Adjustable wrought steel clevis.
- .3 Hangers: Hot Pipe Sizes *150 mm (6 in.)* and over: Adjustable steel yoke and cast iron roll.
- .4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods, cast iron roll and stand for hot pipe sizes *150 mm (6 in.)* and over.
- .5 Wall Support: Pipe Sizes to *80 mm (3 in.)*: Cast iron hook.
- .6 Wall Support: Pipe Sizes *100 mm (4 in.)* and Over: Welded steel bracket and wrought steel clamp, adjustable steel yoke and cast iron roll for hot pipe sizes *150 mm (6 in.)* and over.
- .7 Vertical Support: Steel riser clamp.
- .8 Floor Support: Pipe Sizes to *100 mm (4 in.)* and All Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange and concrete pier to steel support.
- .9 Floor Support: Hot Pipe Sizes *125 mm (5 in.)* and over: Adjustable cast iron roll and stand, steel screws and concrete pier or steel support.
- .10 Install hangers so they cannot become disengaged by movements of supported pipe.
- .11 Provide copper plated hangers and supports for copper piping or provide sheet lead packing between hanger or support and piping. Provide galvanized hangers and supports for galvanized piping.
- .12 Support all piping below grade and under floor slabs in *3.2 mm (1/8 in.)* continuous cadmium plated channel. Support channel with cadmium plated clevis hangers and rods. Install supports on centres as specified in 3.2. Extend cadmium plated hanger rods *450 mm (18 in.)* above slab rebar and bend back over rebar so as to provide a minimum of *450 mm (18 in.)* of support in slab. Do not stress rod when bending.

### **2.3 Hanger Rods**

- .1 Provide steel hanger rods, threaded both ends, threaded one end, or continuous threaded.

### **2.4 Flashing**

- .1 Steel Flashing: *0.55 mm (26 ga.)* galvanized steel.
- .2 Lead Flashing: *25 kg/m² (5 lb/ft²)* sheet lead for waterproofing, *5 kg/m² (1 lb/ft²)* sheet lead for soundproofing.
- .3 Safes: *25 kg/m² (5 lb/ft²)* sheet lead or *0.5 mm (0.02 in.)* neoprene.

- .4 Caps: Steel, *0.7 mm (24 ga.)* thickness minimum, *1.6 mm (16 ga.)* thickness at fire resistance structures.

## 2.5 Sleeves

- .1 Pipes through Floors: Form with *1.2 mm (18 ga.)* galvanized steel.  
.2 Pipes through Beams, Walls, Fire Proofing, Footings, Potentially Wet Floor: Form with steel pipe or *1.2 mm (18 ga.)* thickness galvanized steel.  
.3 Ducts: Form sleeves with galvanized steel.  
.4 Size large enough to allow for expansion with continuous insulation.

## 2.6 Pipe Seals

- .1 Provide "Link-seal pipe sealing system where passing through room foundation walls.

## 2.7 Finishes on Hanger Rods, Hangers and Supports

- .1 All steel hanger rods, hangers and supports shall be galvanized or factory primed with alkyd red oxide primer to CGSB 1-GP-40m.

# 3. EXECUTION

## 3.1 Inserts

- .1 Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.  
.2 Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying piping over *100 mm (4 in.)* or ducts over *1500 mm (60 in.)* wide.  
.3 Where concrete slabs form finished ceiling, finish inserts flush with slab surface.  
.4 Where inserts are omitted, drill through concrete slab from below and provide rod with recessed square steel plate and nut above slab.

## 3.2 Pipe Hangers and Supports

- .1 Support horizontal steel and copper piping as follows:

| Nominal Pipe Size                           | Distance Between Supports |                         | Hanger Rod Diameter      |
|---|---------------------------|-------------------------|--------------------------|
|   | Steel                     | Copper                  |                          |
| 15 mm ( <i>½ in.</i> )                      | 1.8 m ( <i>6 ft.</i> )    | 1.5 m ( <i>5 ft.</i> )  | 10 mm ( <i>0.4 in.</i> ) |
| 20 mm to 40 mm ( <i>¾ in. - 1½ in.</i> )    | 2.1 m ( <i>7 ft.</i> )    | 1.8 m ( <i>6 ft.</i> )  | 10 mm ( <i>0.4 in.</i> ) |
| 50 mm & 65 mm ( <i>2 in. - 2½ in.</i> )     | 3.0 m ( <i>10 ft.</i> )   | 2.4 m ( <i>8 ft.</i> )  | 10 mm ( <i>0.4 in.</i> ) |
| 80 mm & 100 mm ( <i>3 in. - 4 in.</i> )     | 3.6 m ( <i>12 ft.</i> )   | 3.0 m ( <i>10 ft.</i> ) | 16 mm ( <i>0.6 in.</i> ) |
| 150 mm to 300 mm ( <i>6 in. - 12 in.</i> )  | 4.2 m ( <i>14 ft.</i> )   | 4.0 m ( <i>13 ft.</i> ) | 22 mm ( <i>¾ in.</i> )   |
| 350 mm to 450 mm ( <i>14 in. - 18 in.</i> ) | 6.0 m ( <i>20 ft.</i> )   | --                      | 25 mm ( <i>1 in.</i> )   |

- .2 Install hangers to provide minimum *12 mm (½ in.)* clear space between finished covering and adjacent work.

- .3 Place a hanger within *300 mm (12 in.)* of each horizontal elbow.
- .4 Use hangers which are vertically adjustable *40 mm (1½ in.)* minimum after piping is erected.
- .5 Support horizontal soil pipe near each hub with *1.5 m (5 ft.)* maximum spacing between hangers.
- .6 Support vertical piping at every other floor. Support vertical soil pipe at each floor at hub.
- .7 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- .8 Where practical, support riser piping independently of connected horizontal piping.
- .9 Use oversized hangers to accommodate pipe insulation thickness. For pipes up to *50 mm (2 in.)* use high density rigid pipe insulation at hanger location, with an insulation protection shield. For pipes *65 mm (2½ in.)* and over, use insulation protection saddle.

### **3.3 Equipment Bases and Supports**

- .1 Provide for floor mounted equipment, reinforced concrete housekeeping bases poured directly on structural floor slab *100 mm (4 in.)* thick minimum, extended *100 mm (4 in.)* minimum beyond machinery bedplates. Provide templates, anchor bolts and accessories required for mounting and anchoring equipment.
- .2 Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.
- .3 Rigidly anchor ducts and pipes immediately after vibration connections to equipment.

### **3.4 Flashing**

- .1 Flash and counterflash where mechanical equipment passes through weather or waterproofed walls, floors, and roofs.
- .2 Flash vent and soil pipes projecting *75 mm (3 in.)* minimum above roof membrane with lead worked *25 mm (1 in.)* minimum into hub, *200 mm (8 in.)* minimum clear on sides with minimum *600 x 600 mm (24 x 24 in.)* sheet size. For pipes through outside walls turn flange back into wall and caulk.
- .3 Flash floor drains over finished areas with lead *250 mm (10 in.)* clear on sides with minimum *920 x 920 mm (36 x 36 in.)* sheet size. Fasten flashing to drain clamp device.
- .4 Provide curbs for mechanical roof installations minimum *200 mm (8 in.)* high. Flash and counterflash with steel; solder and make waterproof.
- .5 Provide continuous lead or neoprene safes below air supply casings, built-up mop sinks, shower stalls, shower room floors located above finished rooms. Solder at joints, flash into floor drains and turn up *150 mm (6 in.)* into walls or to top of curbs and caulk into joints.
- .6 Provide lead flashing around ducts and pipes passing from equipment rooms, installed according to manufacturer's data for sound control.

### **3.5 Sleeves**

- .1 Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeve.
- .2 Extend sleeves through potentially wet floors *25 mm (1 in.)* above finished floor level. Caulk sleeves full depth and provide floor plate.

- .3 Piping and duct work passing through floor, ceiling or wall, close off space between duct and sleeve and non-combustible insulation. Provide tight fitting metal caps on both sides and caulk.
- .4 Piping passing through mechanical room floor, roof or wall, close off space between pipe and sleeve with synthetic rubber compound mechanical type seals.
- .5 Sleeves provided through walls or floors where liquids could potentially pass from one side to the other, provide sleeves with a *25 mm (1 in.)* "flange" welded to the external face of the sleeve at the mid point of the thickness of the structure to provide a water stop.
- .6 Install chrome plated escutcheons where piping passes through finished surfaces.

**END OF SECTION**



**1. GENERAL**

**1.1 Related Work in Other Sections**

- |    |                                     |               |
|----|-------------------------------------|---------------|
| .1 | Metal flashing for built-up roofing | Section 07640 |
| .2 | Sealants                            | Section 07910 |

**1.2 Qualifications**

- .1 Installation work by competent qualified tradesmen only.

**2. PRODUCTS**

**2.1 Materials**

- .1 Counterflashings - galvanized sheet steel of 0.8 mm minimum thickness.

**3. EXECUTION**

**3.1 Installation**

- .1 Counterflashings are attached to mechanical equipment and lap the base flashings on the roof curbs.
- .2 All joints in counterflashings shall be flattened and solder double seam. Storm collars shall be adjustable to draw tight to pipe with bolts. Caulk around the top edge. Storm collars shall be used above all roof jacks.
- .3 Vertical flange section of roof jacks shall be screwed to face of curb.

**END OF SECTION**

## **1. GENERAL**

### **1.1 Scope**

- .1 Provide for cleaning and degreasing of hot water heating, glycol, and any other system affected by this project scope of work.
- .2 Provide all necessary equipment and chemicals to treat hot water heating, glycol, and any other system affected by this project scope of work.
- .3 Provide for flushing and disinfection of domestic water systems.

### **1.2 Acceptable Agency**

- .1 Chemical treatment agency shall provide equipment, chemicals and site supervision so as to fully comply with all requirements and their intent contained within this specification section.
- .2 Acceptable Agency: Dearborn, Pace, IPAC Chemicals Ltd.

### **1.3 Quality Assurance**

- .1 Perform the cleaning and degreasing operation on site in conjunction with the mechanical contractor and submit written reports on all situations found, actions taken and final results. Reports shall be signed by the (contractor), (commissioning coordinator), and chemical treatment agency. Inform the Consultant and commissioning agency fifteen (15) working days prior to commencing of work.
- .2 Provide chemical treatment as specified herein and provide written reports. Reports shall be signed by the chemical treatment agency, mechanical contractor and commissioning agency.
- .3 Chemical treatment agency shall provide directive and assistance to the mechanical contractor in the degreasing, cleaning and chemical treatment of all piping systems. Use of the permanent mechanical systems for pumping or heating of cleaning and dilution solutions is not permitted. Permanent systems shall be isolated and portable pumps and boilers utilized for the duration of the cleaning process. Permanent equipment shall be flushed, degreased and chemically treated independent of the piping systems.

### **1.4 Submittals**

- .1 Submit shop drawings with complete description of proposed chemicals, quantities, calculations, procedures, test kits and equipment to be supplied. Along with product shop drawings, provide copies of data sheets, procedure instructions and analysis reports to be used on this project. Shop drawings shall be submitted within 10 working days of the award of contract.
- .2 Include with the shop drawings Material Safety Data Sheets (MSDS) for all chemicals to be used.
- .3 Provide written reports containing procedure of system cleaning and degreasing, giving times, dates, conditions of water and problems and actions encountered.
- .4 Submit written reports to the mechanical contractor and Consultant containing results of tests taken every seven days after completion of chemical treatment. Reports shall be done every seven days for a minimum time period of 35 days.
- .5 Provide monthly site visits (12 minimum) within the warranty year to check the treatment, take samples, analyze and recommend proper addition of treatment. Provide written reports to the owner after each visit with a copy to the Consultant.

## **2. PRODUCTS**

### **2.1 Materials**

- .1 Provide sufficient chemicals to treat and test the systems from the time of activation and acceptance of the building for the first year of operation by the owner.
- .2 Materials which may contact finished areas shall be colorless and non-staining. Chemicals used must comply with environmental and health standards applicable to the usage on this project.
- .3 System Cleaner: Alkaline compound which in solution removes grease and petroleum products.
- .4 Close System Treatment: Sequestering agent to reduce deposits and adjust pH, and a corrosion inhibitor.

### **2.2 Equipment**

- .1 Solution Pumps: Provide positive displacement diaphragm type metering pumps for adding chemicals. Pumps shall have an adjustable flow rate and be suitable for chemicals to be pumped. Pumps shall be self flushing. Provide pumps with plastic solution tanks complete with agitator, pump mounting, cover, provision for fill line and pump strainer. Size the pumps and tanks to permit operation for three days at 50% pump capacity without refill of tanks. Provide agitator motor with terminals and junction box for electric wiring.
- .2 Provide chemical pot feeder with a minimum of 10 L2.6 USgal capacity, semi-sphere top and bottom, one pot feeder per system, located as shown on system schematics and floor plans. If location is in question obtain clarification from the Consultant prior to installation.
- .3 Sidestream Filter: All closed hot water and chilled water systems shall have a sidestream filter housing of steel construction using a 250 mm x 30 micron filter cartridge, with a minimum flow rate of 35 litres per minute. A Flow Indicator with stainless steel impeller shall be installed in conjunction with the sidestream filter. Connections shall be 18 mm NPT and all isolating valves shall be installed as per manufacturer's instructions. Include 10 filter cartridges.
- .4 Chemical Feed Piping:
  - .1 Schedule 40 black steel
- .5 Corrosion Coupon and Holder Assembly:
  - .1 Mild steel corrosion coupon
  - .2 Holder, 18 mm or 25 mm NPT male connection.
  - .3 Provide malleable or cast iron cross, 18 mm or 25 mm NPT male connection.

### **2.3 Test Kits**

- .1 Provide test kits as required to determine proper system treatment consisting of, but not limited to the following:
  - .1 Heating water test kit to determine proper treatment.
  - .2 Glycol systems treatment test kits to determine proper concentration and glycol inhibitor, this shall include a hydrometer type tester.
- .2 Provide test kits for hardness and chlorides in addition to those listed above.
- .3 Provide an electronic pH meter complete with three different calibration standard solutions.
- .4 All test kits shall be provided with adequate chemicals and reagents for one year of testing.

### **3. EXECUTION**

#### **3.1 System Cleaning**

- .1 Ensure reasonable care is exercised to prevent debris, dirt and other foreign material from entering the pipe during construction. This is to include proper protection of piping on site prior to installation, temporary caps on partial systems, and complete evacuation of moisture within systems being hydrostatically pressure tested.
- .2 Chemical treatment agency shall, in conjunction with the mechanical contractor, review connections for complete draining and venting of the systems. The mechanical contractor shall provide adequate drain connections to completely drain the systems within one hour. Utilize water meter to record capacity within each system, and record for maintenance manuals.
- .3 Protect and/or remove control devices from systems during cleaning. All terminal control valves shall be in open position during cleaning. Particular attention is to be made to control valves which have a normally closed position.
- .4 Make systems completely operational, totally filled, thoroughly vented, and completely started.
- .5 Add system cleaner and degreasant to flow systems at concentration of 1 kg per 1000 L8.3 lb per 1000 USgal of water contained in systems for hot systems.
- .6 For hot water heating systems apply heat while circulating, raise temperature to 71°C160°F slowly and maintain at 71°C160°F for a minimum of 12 hours. Remove heat and circulate systems to 38°C100°F or less. Drain system, entirely at one time, including all low points and coils. Intermittent start/stop of drainage is not approved. The mechanical contractor to provide additional temporary pipe, pumps as necessary and drainage location for complete drainage. Refill the entire system with clean water, circulate for six hours at design temperature, provide complete venting and deaeration, repeat the draining procedure. Refill complete system with clean water and retest.
- .7 For glycol systems utilize the same procedure for hot water heating systems specified above.
- .8 Inspect, clean of sludge and flush all low points with clean water after cleaning and degreasing process is completed. Include disassembly of components as required. All cleaning and flushing of low points, coils, boilers, etc. shall be done prior to final fill and chemical treatment.
- .9 All domestic hot, cold and domestic recirculation water systems will be required to be flushed and disinfected. Add chlorine to water in system to 50 milligrams per litre190 mg per USgal and let stand for 24 hours. Check chlorine content after 24 hours and insure the content is not less than 20 mg per L75 mg per USgal. If less than 20 mg per L75 mg per USgal repeat process. Flush system until the chlorine content of water being drained is equal to the chlorine content of the make-up water. Utilize plumbing fixtures (i.e. lav., sinks, flushometers, etc.) for drainage.

#### **3.2 Heating Water and Glycol Systems**

- .1 Provide one pot feeder for each individual system. Install complete with isolating and drain valves and necessary piping. Install as indicated on schematics.
- .2 Treat closed systems with closed systems treatment introduced through pot feeder when required or indicated by test.
- .3 Provide one side stream 5 micron filter per main circulation pump system, c/w isolation valves, unions, and bypass with N.C. valve.
- .4 .Provide "Dowfrost" brand propylene glycol to % for [heating] [chilled water system to act as an antifreeze solution.

**END OF SECTION**

## 1. GENERAL

### 1.1 Quality Assurance

- .1 Welding materials, fabrication standards and labour qualifications must conform to ANSI/ASME B31.1, ANSI B16.25, ASME Section IX, and the Provincial Board of Labour Regulations latest current editions.
- .2 Use welders fully qualified and licensed by Provincial Authorities.
- .3 Gas Piping: National Standard of Canada CAN1-B149.1 (latest edition), installation Code for Natural Gas Burning Appliances and Equipment.

## 2. PRODUCTS

### 2.1 Approved Manufacturers

- .1 Grooved Mechanical Pipe Joints: Victaulic, Mech Line (only where permitted).

### 2.2 Pipe

|    | Service   | Material  |
|----|---|---|
| .1 | Hot water and glycol heating to $120^{\circ}\text{C}$ <b><math>250^{\circ}\text{F}</math></b> | Steel, Sch.40, ASTM A53, Grade B heating to $120^{\circ}\text{C}$ <b><math>250^{\circ}\text{F}</math></b> |
| .2 | Natural gas, propane Grade B  | Steel, Sch.40, ASTM A53   |
| .3 | Equipment drains and overflows  | Sch.40, galvanized steel, ASTM A120   |

Domestic water piping to be all copper. (Do proper flushing and disinfection of all new domestic water piping).

### 2.3 Fittings and Joints

|    | Service  | Material   | Joint  |
|----|--|--|--|
| .1 | Hot water and glycol heating $120^{\circ}\text{C}$ <b><math>250^{\circ}\text{F}</math></b> | Banded malleable iron, $1033\text{ kPa}$ <b><math>150\text{ psi}</math></b> , up to $50\text{ mm}$ <b><math>2\text{ in.}</math></b>                          | Screwed,   |
|    |  | Steel, same schedule as pipe, for sizes $50\text{ mm}$ <b><math>2\text{ in.}</math></b> and larger   | Welded   |
|    |  | Wrought copper,  | 95-5 solder, brazed bronze, for pipes over $50\text{ mm}$ <b><math>2\text{ in.}</math></b> |
|    |  | Cast brass   | Screwed  |
|    |  | Cast bronze  | Flare tube   |
| .2 | Natural gas, propane   | Banded malleable iron, $1033\text{ kPa}$ <b><math>150\text{ psi}</math></b> , for sizes $40\text{ mm}$ <b><math>1\frac{1}{2}\text{ in.}</math></b> and under | Screwed  |

|    | Service                        | Material   | Joint        |
|----|--------------------------------|--|--------------|
|    |                                | Steel, same schedule as pipe, for sizes <b>50 mm2 in.</b> and larger: and for high pressure(over <b>860 kPa125 psi</b> )- all sizes; and for piping installed outdoors - all sizes | Welded       |
| .3 | Equipment drains and overflows | Galvanized banded malleable iron   | Screwed      |
|    |                                | Wrought copper, bronze   | 50-50 solder |
|    |                                | Cast brass   | Screwed      |

## 2.4 Unions, Flanges and Couplings

- .1 Size **50 mm2 in.** and under: **1033 kPa150 psi** malleable iron, bronze to iron ground joint unions for threaded ferrous piping, air tested for gas service, all bronze for copper piping.
- .2 Sizes **65 mm2½ in.** and over: **1033 kPa150 psi** forged steel welding neck flanges for ferrous piping, **1033 kPa150 psi** bronze slip-on flanges for copper piping. Gaskets shall be **1.5 mm1/16 in.** thick performed synthetic rubber bonded asbestos. Gaskets for gas service shall be synthetic rubber.
- .3 Flange bolting: For systems up to **120°C250°F**, use carbon steel stud bolts, semi-flushed and heavy hex nuts, ASTM A307-GrB. For systems up to **215°C420°F**, use alloy steel bolts ASTM A193-GrB7, and semi-finished heavy hex nuts ASTM A194-Gr2H.
- .4 Where permitted by the Consultant, use grooved mechanical couplings to engage and lock grooved or shouldered pipe ends and to allow for some angular deflection, contraction and expansion. Couplings consist of malleable iron housing-clamps, C-shaped composition sealing gasket EPDM Grade 'E' and steel bolts. Use galvanized couplings for galvanized pipe. Victaulic brand or Grinnel Gruv-Lok only

## 2.5 Grooved Mechanical Piping

- .1 Grooved Mechanical is acceptable on chilled water, condenser water, potable water, compressed air lines, fire protection, equipment drains and overflows.
- .2 Couplings: Contractor shall use "Zero Flex" Rigid Couplings in all applications except where flexible style couplings are approved by the Engineer for use at equipment connections: i.e.: Pumps, chillers, cooling towers. An installation diagram will need to be approved by Engineer prior to installation.
- .3 For copper connections 2" to 4", Contractor shall use Victaulic Style 606 Couplings complete with EPDM Flush Seal Gasket. Coupling has angle bolt pad to provide a rigid joint.
- .4 When transitioning between grooved ductile iron and grooved copper in a potable water system, Contractor shall use the Groove X Groove Style 47 Dielectric Water Way.
- .5 Butterfly Valves: Where Victaulic piping system is used, Contractor shall incorporate Victaulic Style 300 Butterfly, complete with EPDM Grade "E" encapsulated disc, rated to 300 PSI dead en service. In compressed air lines, Contractor shall incorporate Style 300 complete with Nitrile Grade "T" encapsulated disc.
- .6 Valves and specialties for use in chilled, condenser, glycol and heat pump systems:

- |                          |   |
|--------------------------|---|
| Check Valves             | Victaulic Style 716 & Style 779 complete with Venturi Ports |
| Circuit Balancing Valves | Tour and Anderson   |
| Suction Diffusers        | Victaulic Style 731   |
| Triple Duty Valves       | Combination Victaulic 300 BFV/716 Check Valve               |
| Strainers                | Victaulic Style 730 (Tee) and Style 732 (Wye)               |
- .7 For Victaulic grooved joints, pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket seating. The gasket style and elastomer material (grade) shall be verified as suitable for the intended service as specified.
- .8 Contractor shall verify the pipe and grooves meet Victaulic's current specifications. Acceptable products - Victaulic brand or Grinnel Gruv-Lok.

### 3. EXECUTION

#### 3.1 Preparation

- .1 Ream pipes and tubes. Clean off scale and dirt, inside and outside, before assembly. Remove welding slag or other foreign material from piping.
- .2 Protect all steel pipes when stored on site from external conditions and ensure protective coating remains intact. If in the opinion of the Consultant, deterioration of the protective coating has instigated corrosion, all rust must be removed down to bare metal and prime coated with red oxide paint.

#### 3.2 Connection

- .1 Screw joint steel piping up to and including **40 mm1½ in.** Weld piping **65 mm2½ in.** and larger, including branch connections. Screw or weld **50 mm2 in.** piping for liquid systems, weld **50 mm2 in.** piping for air and gas systems.
- .2 Make screwed joints with full cut standard taper pipe threads with approved non-toxic joint compound applied to male threads only.
- .3 Make joints for plain end pipe with gasket and clamp type mechanical fastener.
- .4 Clamp cast iron water pipe at fittings with **20 mm¾ in.** rods and properly anchor and support.
- .5 Use grooved mechanical couplings and mechanical fasteners, only where permitted by the Consultant.
- .6 Use galvanized couplings with galvanized pipe.
- .7 Make connections to equipment, specialty components, and branch mains with unions or flanges.
- .8 Provide dielectric type connections wherever joining dissimilar metals in open systems. Brass adapters and valves are acceptable.
- .9 Use insulating plastic spacers for copper pipe installation in metal studs.

#### 3.3 Route and Grades

- .1 Route piping in orderly manner and maintain proper grades. Install to conserve headroom and interfere as little as possible with use of space. Run exposed piping parallel to walls. Group piping wherever practical at common elevations. Install concealed pipes close to the building structure to keep furring to a minimum.



- .2 Slope water piping 0.2% and provide hose bibb drains at low points.
- .3 Equip low points with *20 mm $\frac{3}{4}$  in.* drain valves and hose nipples.
- .4 Provide air collection chambers with manual air vent at all high points of system. Collection chambers to be *25 mm1 in.* dia. or line size whichever is greater and *150 mm6 in.* high minimum. Square tees may only be used to assist with complete venting and draining.
- .5 Pipe the discharge from all relief valves, safety valves, vents, drains, equipment blowdowns, water columns and overflows to the nearest building drain. Pipe to glycol recovery tanks for a glycol based system.

### 3.4 Installation

- .1 Install piping to allow for expansion and contraction without unduly stressing pipe or equipment connected.
- .2 Provide clearance for proper installation of insulation and for access to valves, air vents, drains and unions.
- .3 Install piping material specified as inside the building to *2500 mm8 ft.* outside of building.
- .4 Yellow jacket buried steel lines, joints and fittings, prime coat and paint lines exposed to outdoors.

### 3.5 Welded Pipe Branch Connections

- .1 Make branch connections according to the following schedule.

Legend:

T: Forges tee or reducing tee

S: Socolet

W: Weldolet

|        |           |    |    |     |     |    |     |    |    |     |     |     |     |     |
|--------|-----------|----|----|-----|-----|----|-----|----|----|-----|-----|-----|-----|-----|
| HEADER | 15½ in.   | T  |    |     |     |    |     |    |    |     |     |     |     |     |
|        | 20¾ in.   | T  | T  |     |     |    |     |    |    |     |     |     |     |     |
|        | 251 in.   | T  | T  | T   |     |    |     |    |    |     |     |     |     |     |
|        | 301¼ in.  | T  | T  | T   | T   |    |     |    |    |     |     |     |     |     |
|        | 401½ in.  | T  | T  | T   | T   | T  |     |    |    |     |     |     |     |     |
|        | 502 in.   | S  | S  | S   | T   | T  | T   |    |    |     |     |     |     |     |
|        | 652½ in.  | S  | S  | S   | S   | T  | T   | T  |    |     |     |     |     |     |
|        | 753 in.   | S  | S  | S   | S   | S  | T   | T  | T  |     |     |     |     |     |
|        | 1004 in.  | S  | S  | S   | S   | S  | T   | T  | T  | T   |     |     |     |     |
|        | 1506 in.  | S  | S  | S   | S   | S  | W   | T  | T  | T   | T   |     |     |     |
|        | 2008 in.  | S  | S  | S   | S   | S  | W   | W  | W  | T   | T   | T   |     |     |
|        | 25010 in. | S  | S  | S   | S   | S  | W   | W  | W  | W   | T   | T   | T   |     |
|        | 30012 in. | S  | S  | S   | S   | S  | W   | W  | W  | W   | W   | T   | T   | T   |
|        |           | 15 | 20 | 25  | 30  | 40 | 50  | 65 | 75 | 100 | 150 | 200 | 250 | 300 |
|        | ½"        | ¾" | 1" | 1¼" | 1½" | 2" | 2½" | 3" | 4" | 6"  | 8"  | 10" | 12" |     |
|        | BRANCH    |    |    |     |     |    |     |    |    |     |     |     |     |     |

END OF SECTION

## **1. GENERAL**

### **1.1 Scope**

- .1 Gate valves.
- .2 Globe or angle valves.
- .3 Ball valves.
- .4 Check valves.
- .5 Plug cocks.
- .6 Eccentric plug valves.
- .7 Butterfly valves.
- .8 Drain valves.
- .9 Hose bibbs.
- .10 Strainers.

### **1.2 Manufacturer**

- .1 Provide valves of the same type by the same manufacturer throughout.
- .2 Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.

### **1.3 Shop Drawings**

- .1 Submit copies of valves "ordering schedule" for review before ordering valves.
- .2 Submit detailed shop drawings clearly indicating make, model, size, pressure rating, materials of construction and intended service.

## **2. PRODUCTS**

### **2.1 Approved Manufacturers**

- .1 Valves – Butterfly: Jenkins, Keystone, DeZurik, Centreline, Monotight, Dresser, Lunkenheimer, Crane, Bray, Toyo, Grinnell.
- .2 Valves – Circuit Balancing: Armstrong, B & G, Wheatly, Tour & Anderson.
- .3 Valves – Drain, Radiator: Jenkins, Dahl, Crane, Toyo, Kitz.
- .4 Valves – Eccentric Plug: DeZurik, Homestead.
- .5 Valves – Gate, Globe, Swing, Check, Ball: Jenkins, Toyo, Crane, Kitz, Milwaukee.
- .6 Valves – Plumbing Flush: Crane, Sloan, Teck.
- .7 Valves – Pressure Balanced Mixing: Symmons.
- .8 Valves – Pressure Reducing: Armstrong, Bell & Gossett, Taco.
- .9 Valves – Relief: Armstrong, Bell & Gossett, Taco, Wheatley.
- .10 Valves – Shower: Symmons, Powers.
- .11 Valves – Silent Check: Val-matic, APCO, StreamFlo.
- .12 Valves – Suction Diffusers Combination Check and Balance: Armstrong, B&G, Taco.

- .13 Valves – Thermostatic Mixing: Symmons, Poweres.
- .14 Valves – Water Pressure Reducing: Watts, Clayton, Singer, Zurn, Wilkins, BCA, Cash Acme, Braukman.
- .15 Plug Cocks: DeZurik, Newman-Milliken.

## 2.2 Domestic Cold Water System

- .1 Ball Valves up to 50 mm 2 in.: Brass body, chrome plated brass ball, threaded or solder ends, TFE seat and packing. 4134 kPa 600 psi non-shock WOG rating. Threaded, Red-White Fig. 5044A. Solder joint, Red-White Fig. 5049A.
- .2 Globe Valves up to 50 mm 2 in.: Bronze body, screw over bonnet, threaded ends rating 1035 kPa 150 psi steam, solder ends rating 2070 kPa 300 psi water. Threaded, Red-White Fig. 221. Solder ends, Red-white Fig. 222.
- .3 Globe Valves 65 mm 2½ in. and over: Cast iron body, flanged ends, O.S. and Y, renewable bronze seat ring, renewable composition disc. Rating 860 kPa 125 psi steam. 1380 kPa 200 psi. Red-White Fig. 400.
- .4 Butterfly Valves: Cast iron wafer full-lug body, 300 Series stainless steel shaft, bronze disc, replaceable EPDM seat, lever lock handle operator with multiple position lock plate for valve sizes to 100 mm 4 in., heavy duty gear handwheel operator with position indicator for valve sizes 150 mm 6 in. and over. Minimum rating 1200 kPa 175 psi, 121°C 250°F. Keystone F1000, F1020.
- .5 Gate Valves up to 50 mm 2 in.: Bronze body, inside screw, travelling stem, solid wedge, screw-in bonnet, threaded ends rating 860 kPa 125 psi steam, solder ends rating 1380 kPa 200 psi water. Threaded, Red-White Fig. 293. Solder ends, Red-White Fig. 299.
- .6 Gate Valves 65 mm 2½ in. and over: Cast iron body, bronze trim, O.S. and Y, rising stem, solid wedge, flanged ends, rating 860 kPa 125 psi steam. Red-White Fig. 421.
- .7 Swing Check Valves up to 50 mm 2 in.: Bronze body, screw-in cap, replaceable disc, 860 kPa 125 psi steam rating. Threaded, Red-White Fig. 236. Solder ends, Red-White Fig. 237.
- .8 Swing Check Valves 65 mm 2½ in. and over: Cast iron body, regrind-renew swing check, bolted cover, flanged ends, bronze disc and seat ring, rating 860 kPa 125 psi steam. Red-White Fig. 435.
- .9 Silent Check Valves for Pump Discharge:
- .10 Up to 50 mm 2 in.: Bronze body, SS stem, 316 SS spring, teflon disc and seat ring, 430 SS seat screw, threaded ends. 1380 kPa 200 psi water. Val Matic VM-S1400.
- .11 65 mm 2½ in. and over: Wafer style, cast iron body, 316 SS seat, plug, spring and bushing. ANSI Class 125. Val Matic, Series 1400.

## 2.3 Domestic Hot Water System

- .1 Valves to be used in the hot water section of the system shall be exactly as specified in the cold water section with one exception, that all composition disc valves shall be fitted with discs suitable for hot water

## 2.4 Hot Water Heating Systems

- .1 Ball Valves up to 50 mm 2 in.: Brass body, chrome plated brass ball, threaded or solder ends, TFE seat and packing. 4134 kPa **600 psi** non-shock WOG rating. Threaded, Red-White Fig. 5044A. Solder joint, Red-White Fig. 5049A.

- .2 Globe Valves up to 50 mm **2 in.**: Bronze body, screw over bonnet, threaded ends rating 1035 kPa **150 psi** steam, solder ends rating 2070 kPa **300 psi** water. Threaded, Red-White Fig. 221. Solder ends, Red-white Fig. 222.
- .3 Globe Valves 65 mm **2½ in.** and over: Cast iron body, flanged ends, O.S. and Y, renewable bronze seat ring, renewable composition disc. Rating 860 kPa **125 psi** steam. 1380 kPa **200 psi** water. Red-White Fig. 400.
- .4 Butterfly Valves: Cast iron wafer full-lug body, 300 Series stainless steel shaft, bronze disc, replaceable EPDM seat, lever lock handle operator with multiple position lock plate for valve sizes to 100 mm **4 in.**, heavy duty gear handwheel operator with position indicator for valve sizes 150 mm **6 in.** and over. Minimum rating 1200 kPa **175 psi**, 121°C **250°F**. Keystone F1000, F1020.
- .5 Gate Valves up to 50 mm **2 in.**: Bronze body, inside screw, travelling stem, solid wedge, screw-in bonnet, threaded ends rating 860 kPa **125 psi** steam, solder ends rating 1380 kPa **200 psi** water. Threaded, Red-White Fig. 293. Solder ends, Red-White Fig. 299.
- .6 Gate Valves 65 mm **2½ in.** and over: Cast iron body, bronze trim, O.S. and Y, rising stem, solid wedge, flanged ends, rating 860 kPa **125 psi** steam. Red-White Fig. 421.
- .7 Swing Check Valves up to 50 mm **2 in.**: Bronze body, screw-in cap, replaceable disc, 860 kPa **125 psi** steam rating. Threaded, Red-White Fig. 236. Solder ends, Red-White Fig. 237.
- .8 Swing Check Valves 65 mm **2½ in.** and over: Cast iron body, regrind-renew swing check, bolted cover, flanged ends, bronze disc and seat ring, rating 860 kPa **125 psi** steam. Red-White Fig. 435.
- .9 Silent Check Valves for Pump Discharge:
  - .1 Up to 50 mm **2 in.**: Bronze body, SS stem, 316 SS spring, teflon disc and seat ring, 430 SS seat screw, threaded ends. 1380 kPa **200 psi** water. Val Matic VM-S1400.
  - .2 65 mm **2½ in.** and over: Wafer style, cast iron body, 316 SS seat, plug, spring and bushing. ANSI Class 125. Val Matic, Series 1400.
- .10 Eccentric Plug Valves: Cast iron body with resilient faced cast iron plug, bolted bonnet, stainless steel bearings, nickel seat. Multiple packing ring, stem seal and resilient plug facing materials suitable for hot water/glycol service to 121°C **250°F**. Valve ends threaded up to 50 mm **2 in.**, flanged 65 mm **2½ in.** and over. Lever operator with adjustable open position memory stop up to 100 mm **4 in.** valves, heavy duty gear reducer handwheel operator with adjustable open position memory stop for valves 150 mm **6 in.** and over. Rating 1210 kPa **175 psi** water at 121°C **250°F**. DeZurik Series 100.
- .11 Terminal Heat Transfer Unit Valves up to 30 mm **1 ¼ in.**: Heavy pattern brass body radiator valve, wheel handle, rising stem, inside screw, renewable composition swivel disc, straight or angle globe, threaded or union ends, positive back seating. Dahl Series 11040.
- .12 Terminal Heat Transfer Unit Valves 40 mm **1½ in.** and over: Bronze gate valves, threaded ends up to 50 mm **2 in.**, cast iron gate valves, flanged ends, valve sizes 65 mm **2½ in.** and over. Red-White Fig. 421.
- .13 Terminal Heat Transfer Unit Balancing Valves up to 30 mm **1 ¼ in.**: Removable cap key, screw set memory bonnet for balancing, brass body, rising stem, inside screw, renewable composition swivel disc, straight or angle globe, threaded or union ends, positive back seating. Dahl Series 13000-M.
- .14 Terminal Heat Transfer Unit Balancing Valves 40 mm **1½ in.** and over: Eccentric plug valve, as described above.

- .15 Drain Valves up to **50 mm 2 in.**: Brass 2 piece body ball valve, blowout proof stem, teflon seats, forged brass chrome plated ball, hose end connection with cap and chain by male IP, **4200 kPa 600 psi** water, oil, gas rating, Red-White Fig. 5046.
- .16 Terminal unit brass T-body drain valve, wheel handle, ground body-bonnet joint, renewable disc, brass chain, forged brass gasketed cap. Working pressure **1725 kPa 250 psi** at **121°C 250°F**. Dahl 21.616.
- .17 Circuit Balancing Valves: Suitable for throttling. All metal parts non-ferrous, die cast non-porous copper alloy. Flow measuring accuracy  $\pm 2\%$ . Positive shut-off, drain connection with cap. Memory balancing feature. Fittings for connection of portable differential pressure meter. Bell & Gosset circuit setter.

## 2.5 Natural Gas Systems

- .1 Plug Cocks: Class 125 non-lubricated parallel-plug valve, cast iron body and plug, short pattern, regular port, full bore, threaded or flanged ends, CGA approved.
- .2 Ball valves up to **50 mm 2 in.**: Class 125 non-lubricated ball valves suitable for outdoor use, brass body, CGA approved Section 3.16 threaded ends, Kitz Fig. #68 (AKTAF).
- .3 Ball valves **65 mm 2½ in.** and larger: Flanged, carbon steel body, stainless steel trim, lever operated, teflon seats and seals. Kitz Fig. 150SCTB-N.
- .4 Seismic Gas Shut Off Valve:
  - .1 Up to 50 mm
    - .1 Koso series 310 high pressure screwed body.
  - .2 65 mm and larger
    - .1 Koso series 314 high pressure flanged body.
    - .2 138 kPa maximum gas pressure.

## 2.6 Valve Operators

- .1 Provide suitable hand wheels for gate, globe or angle, radiation and drain valves and inside hose bibbs.
- .2 Provide one plug cock wrench for every ten plug cocks sized **50 mm 2 in.** and smaller, minimum of one. Provide each plug cock sized **65 mm 2½ in.** and larger with a wrench, with set screw.
- .3 Provide valves larger than **100 mm 4 in.** located more than **2.1 m 7 ft.** from floor in equipment rooms with chain operated sheaves. Extend chains to **1.5 m 5 ft.** above floor and hook to clips to arrange to clear walking aisles.

## 2.7 Strainers

- .1 Size **50 mm 2 in.** and under: Screwed brass or iron body, Y pattern with **0.75 mm 24 ga.** stainless steel perforated screen.
- .2 Size **65 mm to 100 mm 2½ in. to 4 in.**: Flanged iron body, Y pattern with **1 mm 20 ga.** stainless steel perforated screen.
- .3 Size **125 mm 5 in.** and larger: Flanged iron body, Y pattern with **3 mm 11 ga.** stainless steel perforated screen.
- .4 Screen free area shall be minimum three times area of inlet pipe.

## 2.8 Triple Duty Valve

- .1 For base mounted or vertical inline pump discharge application, performs the functions of a non-slam check valve, throttling valve, shut-off valve and calibrated balancing valve. Equip with brass readout valves (with integral check valves) to read differential pressure across valve.
- .2 Cast iron, bronze seat, replaceable bronze disc with EPDM insert.
  - .1 Up to **50 mm 2 in.**: NPT connections, **1200 kPa 175 psi** working pressure, brass stem, chatter preventing SS spring.
  - .2 Over **50 mm 2 in.**: Flanged connections, **860 kPa 125 psi** rated, stainless steel stem and chatter preventing spring.

## 2.9 Suction Diffuser

- .1 For base mounted or floor mounted vertical inline pumps where scheduled.
- .2 Cast iron construction; NPT connections up to **50 mm 2 in.**: flanged connections.
- .3 Over **65 mm 2½ in.**: cast iron straightening fitting, stainless steel combination diffuser - strainer - orifice cylinder with **4.8 mm 3/16 in.** perforations, and permanent magnet. Provide complete with a 16 mesh bronze strainer.

## 3. EXECUTION

### 3.1 Installation and Application

- .1 Install valves with stem upright or horizontal, not inverted.
- .2 Provide threaded lug type butterfly valves for equipment isolation service. Provide wafer or threaded lug type valves for zone shut-off service.
- .3 Where permitted by codes, butterfly valves may be used in fire protection systems.
- .4 Use eccentric plug valves in water systems for throttling/balancing service.
- .5 Use memory radiator balancing valves in water and glycol systems terminal heat transfer unit balancing service. For radiant panels provide "circuit setter" valves on return line for each central zone; and a ball valve for shut off service.
- .6 Provide drain valves at main shut-off valves, low points of piping and apparatus and terminal units.
- .7 Size drain lines and drain valves equal to size of apparatus drain connection.
- .8 For pipe sizes **20 mm 3/4 in.** and over, minimum drain size to be **20 mm 3/4 in.**
- .9 Provide hose thread connection with cap and chain for **20 mm 3/4 in.** drain valves located in ceiling and public areas.
- .10 Provide male NPT nipples with threaded pipe cap for drain sizes over **20 mm 3/4 in.** where not piped directly to floor drains.
- .11 Provide valved drain and hose connections off the bottom of all strainers.
- .12 Install gate or ball valves for shut off and isolating service, to isolate equipment, part of system, and vertical risers. Ball valves shall be used up to and including 50 mm.
- .13 Install globe valves for throttling in steam system in sizes 150 mm and larger.
- .14 Install globe or angle valves for throttling service and control device or meter bypass.
- .15 \*Provide spring loaded check valves on discharge of condensate pumps, condenser water and water booster pumps

- .16 Use plug cocks for gas service.
- .17 Use plug cocks in water system for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.
- .18 \*Use butterfly valves in (heating water systems), (in chilled and condenser water systems), (in heating, chilled and condenser water systems) interchangeably in place of gate valves on all piping 65 mm and larger.
- .19 \*Use butterfly valves in fire protection systems where approved. Use OS&Y gate valves on inlet side of fire and jockey pumps and for window deluge systems.
- .20 Provide gate or ball valve in hot and cold water lines serving a male or female washroom group of fixtures at each hose bibb and at all equipment requiring isolation.
- .21 Use bronze body ball valves for domestic water service.
- .22 Provide valves upstream of all meters, gauges, automatic air vents, etc. for isolation purposes.
- .23 Run line size pipe to floor drains from all drain cocks, drain valves, etc.
- .24 Provide main piping system drain valves as a low point and pipe to drain. Drain valves shall be 2 pipe sizes smaller than largest mains and minimum 25 mm.
- .25 Provide 50 mm globe by-pass valves around steam isolation valves 150 mm and larger.
- .26 Provide isolation valves in all systems such that floor by floor for horizontal systems, all risers in a vertical system and zone areas on a large horizontal system can be isolated.
- .27 Spring loaded water check valves shall be located 8 pipe diameters downstream of pumps or elbows.

### **3.2 Valve Connections**

- .1 Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves.
- .2 Thread pipe sizes 50 mm and smaller.
- .3 Flange pipe sizes 65 mm and larger.
- .4 Solder or screw to solder adapters for copper tubing.
- .5 Use grooved body valves with mechanical grooved jointed piping.
- .6 Provide butterfly valves with tapped lug body when used for isolating service.

**END OF SECTION**



## **1. GENERAL**

### **1.1 Scope**

- .1 Manual and automatic air vents.
- .2 Air separators.
- .3 Relief valves and fittings.
- .4 Radiation valves.
- .5 Chemical pot feeder.
- .6 Bypass filter.
- .7 Pressure reducing valves.
- .8 Quantity meters.

### **1.2 Shop Drawings**

- .1 Provide shop drawings for all equipment and accessories in this section.

## **2. PRODUCTS**

### **2.1 Approved Manufacturers**

- .1 Air Separators & Relief Valves: Armstrong, Bell & Gossett, Taco, Wheatley
- .2 Air Vents: Hoffman, Maid-O-Mist, Taco
- .3 Strainers: Amrstrong, Sarco, Mueller, Toyo, Anderson, Metraflex, Yarway.

### **2.2 Manual Air Vents**

- .1 Provide manual air vents with 25 mm (1 in.) or line diameter pipe whichever is the greater, to form air collection chamber. Collection chambers to be a minimum of 150 mm (6 in.) high.

### **2.3 Air Separators**

- .1 Provide centrifugal type with 861 kPa (125 psi) WSP steel tank, galvanized steel 5 mm (0.2 in) perforated strainer, perforated stainless steel air collector tube and drain connection.

### **2.4 Relief Valves**

- .1 Provide ASME rated direct spring loaded type, lever operated non-adjustable factory set. Relief pressure as indicated.

### **2.5 Pressure Reducing Valves**

- .1 20 mm (3/4 in.) pressure reducing valve complete with low inlet pressure check valve, removable strainer, brass body and adjustable pressure of \*55 kPa to 173 kPa (8 psi to 25 psi) \*175 kPa to 415 kPa (25 psi to 60 psi.) Bell & Gossett Model \*B-7 and \*7.

### **3. EXECUTION**

#### **3.1 Relief Valves**

- .1 Provide relief valves on pressure tanks, low pressure side of reducing valves, heating convertors, expansion tanks and where indicated.
- .2 Drain relief valve to nearest floor drain.
- .3 System relief valve capacity shall equal make-up pressure reducing valve capacity. Equipment relief valve capacity shall exceed input rating of connected equipment.
- .4 Where one line vents several relief vents, cross sectional area shall exceed sum of individual vent areas.

#### **3.2 Handwheel Radiator Valves**

- .1 Provide on water inlet to terminal heating units such as radiation, unit heaters and fan coil units.

#### **3.3 Expansion Tanks**

- .1 Provide air lines, checks, charging valves and pressure gauges for expansion tanks and glycol fill tanks. Charging valves to be piped to 1200 mm (4 ft.) above finished floor.

**END OF SECTION**

## **1. GENERAL**

### **1.1 Scope**

- .1 Pressure reducing stations.
- .2 Glycol mixing/charging tank, fill pump.
- .3 Propylene glycol solution.
- .4 Manual and automatic air vents.
- .5 Air separators.
- .6 Relief valves and fittings.
- .7 By-pass filter.
- .8 Quantity meters.

### **1.2 Quality Assurance**

- .1 Thoroughly check system and make necessary corrections if system continually loses solution.
- .2 Perform tests determining strength of glycol solution before system is turned over to the Owner. Provide test prior to end of guarantee and replenish as required. Provide written test results for review.

### **1.3 Submittals**

- .1 Provide shop drawings for all equipment in this section.

## **2. PRODUCTS**

### **2.1 Air Pressure Reducing Schedule**

- .1 Provide air pressure reducing station complete with two shut-off valves, strainer, check valve and needle bypass.

### **2.2 Manual Air Vents**

- .1 Provide manual air vents with 25 mm 1 in. or line diameter pipe which ever is greater to form air collection chamber. Collection chamber to be 150 mm 6 in. high.

### **2.3 Air Separators**

- .1 Provide centrifugal type with 861 kPa 125 psi WSP steel tank, galvanized steel 5 mm 0.2 in. perforated strainer, perforated stainless steel air collector tube and drain connection.

### **2.4 Relief Valves**

- .1 Provide ASME rated direct spring loaded type, lever operated non-adjustable factory set discharge pressure as indicated.

### **2.5 Quantity Meters**

- .1 Refer to Section 15070.

## **2.6 Glycol Solution**

- .1 Provide propylene glycol/water solution suitable for a temperature range of -40°C -40°F to 104°C. 220°F. Solution to be suitable for heating complete with appropriate corrosion inhibitors. Solutions must be factory premixed.

## **2.7 Bypass Filter**

- .1 Unit to consist of cartridge filter, flow indicator, flow control valves and filter cartridges. Cartridge filter; stainless steel shell of single centre bolt construction with cast nick-plated brass head, drain plug and air vent. Flow indicator - cast bronze body with two sight glasses of high temper, thermo shock-resistant glass and nylon rotor on stainless steel pin.
- .2 Flow Control Valves: Cast Bronze Globe Valves, 25 mm **1 in.** Female NPT Thread.
- .3 Filter cartridges: 10 each of 10 micron retention, and 20 micron retention.
- .4 Manufacturer: Guthrie Hydroniclean System.

## **2.8 Glycol Mixing, Charging Tank, and Manual Fill Pump**

- .1 Provide as required.

## **2.9 Chemical Pot Feeder**

- .1 150 mm 6 in. diameter x 550 mm 22 in. long feeder, suitable for 861 kPa 125 psi operating pressure complete with isolation valves on 20 mm 3/4 in. inlet and outlet lines. 20 mm 3/4 in. drain valve 40 mm 1 1/2 in. fill complete with filling funnel.

## **2.10 Expansion Tank**

- .1 Provide glycol expansion tank.

# **3. EXECUTION**

## **3.1 Air Vents**

- .1 Provide manual type at system high points and convection type heating units.
- .2 Where large air quantities can accumulate, provide enlarged air collection standpipe.

## **3.2 Air Separator**

- .1 Provide on suction side of system circulation pump and connect to expansion tank.

## **3.3 Relief Valve**

- .1 Provide relief valves on pressure tanks, low pressure side of reducing valves, heating convertors, expansion tanks and where indicated.
- .2 Drain relief valve to glycol collection tanks. Do not waste glycol to floor drains.
- .3 System relief valve capacity shall equal make-up pressure reducing valve capacity. Equipment relief valve capacity shall exceed input rating of connected equipment.
- .4 Where one line vents several relief valves, cross sectional areas shall exceed sum of individual vent areas.

## **3.4 Quantity Meters**

- .1 Install where indicated on drawings complete with isolation valves and line size bypass.

**3.5 Bypass Filter**

- .1 Install between pump's suction and discharge. Provide isolation valves and sight glass as indicated.

**3.6 Chemical Pot Feeder**

- .1 Install one chemical pot feeder for each glycol system.

**3.7 Glycol Mixing Tank and Fill Pump**

- .1 Provide one tank and one pump for each glycol system.

**3.8 Glycol Charging Tank**

- .1 Provide one glycol charging tank for each glycol system.

**3.9 Expansion Tanks**

- .1 Provide air lines, checks, charging valves and pressure gauges for expansion tanks and glycol fill tanks. Charging valves to be piped to 1200 mm 4 ft. above finished floor.

**3.10 Installation**

- .1 Do necessary piping to complete installation as shown on the drawings specified.
- .2 Thoroughly clean and flush system before antifreeze solution is added.
- .3 Manually feed glycol to system through make-up line with pressure regulator.
- .4 Provide one extra 50 L drum of glycol for each system, at turnover of the building to owner.
- .5 Provide antifreeze solution lost from the systems from any cause other than neglect by the Owner during the first year of operation.

**END OF SECTION**

## 1. GENERAL

### 1.1 Scope

- .1 Gas Piping.
- .2 Valves and Fittings.
- .3 Pressure Regulators.
- .4 Testing.
- .5 Service Connections.

## 2. PRODUCTS

- .1 Polyethylene coated steel piping manufactured to CSA Z245.1M. High density polyethylene coating shall be to following schedule:

| Pipe Size (mm)(in.) | Thickness (Microns) |
|---------------------|---------------------|
| Up to 25 (1)        | 686                 |
| 30 (1-1/4)          | 762                 |
| 40 (1-1/2)          | 787                 |
| 50 (2) and Over     | 863                 |

- .2 Jointing Methods:
  - .1 Threaded Fittings to ANSI Standard B16.3:
    - .1 For above ground use, Schedule 80 pipe.
    - .2 Threaded joints not allowed underground.
  - .2 Forged Steel Socket Weld ANSI Standard B16.11.
  - .3 Wrought Steel Butt Welding fitting CSA Z245.10.

### 2.2 Valves

- .1 Conform to CGA Standard 3.16.
- .2 Steel plug type gas valve, (complete with cast iron curb box, cover and key).
- .3 Steel pressure lubricated plug type gas valve, (complete with cast iron curb box, cover and key).
- .4 Bronze plug-type gas valve, 900 kPa (130 psi) working pressure, complete with cast iron curb box, cover and key.

### 2.3 Pressure Regulator

- .1 Self operated gas pressure regulator. Cast iron body. Size for full gas load to reduce tank pressure down to 35 kPa (5 psi.) Body rating 1030 kPa (150 psi.) Manufacturer: Fisher.

### 2.4 Building Pressure Regulator

- .1 Self operated gas pressure regulator; malleable iron body. Size for full gas load to reduce gas pressure from 35 kPa to 2.7 kPa (5 psi to 0.4 psi.) Manufacturer: Fisher.

### **3. EXECUTION**

#### **3.1 Utilities**

- .1 Maintain, re-route or extend existing lines which remain.
- .2 Cap, plug or seal abandoned lines that remain.

#### **3.2 Excavation**

- .1 Excavate trenches in accordance with Division 2.
- .2 In roads, streets, driveways and parking areas, excavate depth of trench to provide 1200 mm (4 ft.) of cover over pipe.
- .3 On private property, in open non-travelled areas, excavate depth of trench to provide 900 mm (3 ft.) of cover over pipe.

#### **3.3 Pipe Installation**

- .1 Install gas piping in accordance with CSA B.149

#### **3.4 Valves and Valve Box**

- .1 Locate valves as specified.
- .2 Set valves on solid bearing. Set plumb and level.
- .3 Centre and plumb valve box over valve. Set box cover flush with finished ground surface. Prevent shock or stress from being transmitted through valve box to valve.
- .4 For steel valves and cast iron valve boxes, wrap valve and valve box with polyethylene tape and heat shrink; or paint valves and valve boxes with red anti-rust primer and one coat of epoxy paint.

#### **3.5 Pressure and Leakage Tests**

- .1 Test Medium: air, gas or inert gas such as carbon dioxide or nitrogen.
- .2 Fill piping with test medium for 24 hours prior to actual test.
- .3 For steel piping, subject pipe to pressure of 700 kPa (100 psi) for 24 hours or double the intended working pressure, whichever is greater.
- .4 For polyethylene piping, subject pipe to pressure of 350 kPa (50 psi) or 1.5 maximum operating pressure whichever is greater for 24 hours.
- .5 Supply pumps, connections, gauges and other necessary apparatus required for test.
- .6 Test will consist of visual inspection of the line for leaks and of measuring the pressure after 24 hours. No pipe installation will be accepted if leaks are detected or if pressure at end of test is less than 95% of original test pressure.
- .7 Replace all material found to be defective.

#### **3.6 Purging**

- .1 If air or inert gas was used for testing, purge lines with natural gas before using.

#### **3.7 Building Regulator Installation**

- .1 Install service regulator adjacent to building wall in specified location.
- .2 Install service regulator and riser pipe in such manner as to prevent undue stress upon service pipe. For plastic service pipe, use steel pipe riser from below ground to regulator.

- .3 Ensure regulator vent has rain and insect proof opening and terminates away from building openings.

**END OF SECTION**



**1. GENERAL**

**1.1 Scope**

- .1 Expansion tanks.
- .2 Accessories and connection to piping system.
- .3 Saddles and structural supports.
- .4 Provide shop drawings for all scheduled tanks.

**2. PRODUCTS**

**2.1 Approved Manufactures**

- .1 Tanks – Diaphragm or bladder Type Expansion: Amtrol, Hamlet and Garneau Inc.

**2.2 Heating System Expansion Tanks, Bladder Type**

- .1 CSA/ASME rated, welded steel, rated for working pressure, supplied with steel support structure.
- .2 Replaceable Bladder type expansion tank.
- .3 Use diaphragm type of tanks for horizontal installations.

**3. EXECUTION**

**3.1 Installation**

- .1 Support tanks inside building from building structure as indicated on drawings. Provide 100 mm (4 in.) high housekeeping bases on floor mounted tanks.
- .2 Provide all structural supports required for installing tanks that are suspended.

**3.2 Performance**

- .1 Provide tanks of dimensions and capacities as indicated on the drawings and/or tank schedule.

**END OF SECTION**

## **1. GENERAL**

### **1.1 Scope**

- .1 Piping insulation for heating and domestic water system.
- .2 Adhesives, tie wires, tapes.
- .3 Recovering.

### **1.2 Quality Assurance**

- .1 Insulation shall be installed by skilled workmen regularly engaged in this type of work.
- .2 The British Columbia Insulation Contractors Association (BCICA) Quality Standards Manual for Mechanical Insulation, 1993 Edition together with authorized additions and amendments, shall be used as a reference standard and form part of this project specification.
- .3 Materials shall meet or exceed fire and smoke hazard ratings as stated in this section and defined in applicable building codes.
- .4 Insulation will meet ASHRAE Standard 90.1 2004.

### **1.3 Submittals**

- .1 Submit shop drawings which indicate complete material data, "K" value temperature rating, density, finish, recovery jacket of materials proposed for this project and indicate thickness of material for individual services.
- .2 Submit samples of proposed insulating and recovering materials.

### **1.4 Job Conditions**

- .1 Deliver material to job site in original non-broken factory packaging, labelled with manufacturer's density and thickness.
- .2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

### **1.5 Alternatives**

- .1 Alternative insulations are subject to review and acceptance by the Consultant. Alternatives shall provide the same or better thermal resistance at normal conditions as material specified.

## **2. PRODUCTS**

### **2.1 Approved Manufacturers**

- .1 Fibreglass Canada, Manson, Knauf Fibreglass, Plasti-Fab, Manville, Robson.

### **2.2 General**

- .1 Insulation Materials, Recovery Jackets, Vapour Barrier Facings, Tapes and Adhesives: Composite fire and smoke hazard ratings shall not exceed 25 for flame spread and 50 for smoke developed.
- .2 All insulation materials shall meet current Building Code Standards, and packages or containers of such materials shall be appropriately labelled.

- .3 Insulate fittings and valve bodies with preformed removable insulated fittings.

## **2.3 Materials**

- .1 Cold Piping: Formed fine fibrous glass or formed mineral fibre pipe insulation, with factory applied vapour barrier jacket, factory moulded to conform with piping, "K" value at 24°C (75°F) maximum 0.035 W/m.°C (0.25 Btu-in/hr-ft2-°F). Service temperature -14°C (7°F) to 18°C (65°F).
- .2 Hot Piping: Formed fine fibrous glass or mineral fibre pipe insulation, with factory applied general purpose jacket, factory moulded to conform to piping, "K" value maximum 0.035 W/m.°C (0.25 Btu-in/hr-ft2-°F) at 24°C (75°F). Service temperature up to 93°C (200°F).

## **3. EXECUTION**

### **3.1 Preparation**

- .1 Do not install covering before piping and equipment has been tested and approved.
- .2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

### **3.2 Installation**

- .1 Ensure insulation is continuous through inside walls. Pack around pipes with fire proof self-supporting insulation material, properly sealed.
- .2 Insulate complete system including fittings, valves, unions, flanges, strainers. Do not insulate flexible connections and expansion joints. Terminate insulation neatly with plastic material travelled on a bevel. Alternative from insulating these devices, coat hot systems with Robson "Thermalite" and cold systems with Robson "No Sweat – Fx".
- .3 Insulate piping, fittings and valves. Do not insulate unions, flanges (except on flanged valves), "victaulic" couplings, strainers, (except on chilled water lines), flexible connections and expansion joints. Terminate insulation neatly with plastic material trowelled on a bevel.
- .4 Finish insulation neatly on hangers, supports and other protrusions.
- .5 Locate insulation or cover seams in least visible locations. Locate seams on piping in ceiling spaces on the underside of the pipe.
- .6 Provide recovering jackets on exposed insulation throughout, including equipment rooms. Insulation located in crawl spaces, pipe shafts and suspended ceiling spaces is not considered exposed. Make smooth uneven insulated surfaces before recovering.
- .7 Cover insulation exposed to outdoors with aluminum jacket secured with aluminum bands on 200 mm (8 in.) centres or screws on 150 mm (6 in.) centres. Lap joints 75 mm (3 in.) minimum and seal with compatible waterproof lap cement.
- .8 Cold Piping: Seal lap joints with 100% coverage of vapour barrier adhesive. Seal butt joints with 50 mm (2 in.) wide strips of vapour barrier sealed with vapour barrier adhesive. For fittings and valves, apply hydraulic insulating cement; or apply factory fabricated insulation half shells, seal all laps and joints.
- .9 Flare out staples may be used to secure jacket laps on hot systems. Staples are to be applied on 100 mm (4 in.) centres.
- .10 Hot Piping: For fittings and valves, apply hydraulic insulating cement; or apply factory fabricated insulation half shells.

### 3.3 Insulation Installation Thickness Schedule

| Piping or Equipment |                       | Pipe Sizes<br><i>mm/in.</i> | Insulation<br>Thickness<br><i>mm/in.</i> | Recovery<br>Jacket |
|---------------------|-----------------------|-----------------------------|--|--------------------|
| .1                  | Heating system Piping | All sizes                   | 40/1½                                    | Canvas / PVC       |
| .2                  | Domestic water piping | All sizes                   | 40/1½                                    | Canvas / PVC       |

Note: Pipe insulation for piping installed in 38 mm x 92 mm 2 in. x 4 in. (2x4) wall cavity can be reduced 15 mm ½ in., for pipe sizes 40 mm 1 ½ in. to 65 mm 2 ½ in.. Install insulation to thickness specified piping outside the wall cavity.

**END OF SECTION**

## **1. GENERAL**

### **1.1 Scope**

- .1 Duct thermal insulation.
- .2 Duct acoustic insulation.
- .3 Breeching insulation.
- .4 Adhesives, tie wires, tapes.
- .5 Recovery.
- .6 All outdoor mounted ductwork.

### **1.2 Quality Assurance**

- .1 Insulation shall be installed by skilled workmen regularly engaged in this type of work.
- .2 The British Columbia Insulation Contractors Association (BCICA) Quality Standards Manual for Mechanical Insulation, 1993 Edition together with authorized additions and amendments, shall be used as a reference standard and form part of this project specification.
- .3 Materials shall meet fire and smoke hazard ratings as stated in this section and defined in applicable current building codes.

### **1.3 Submittals**

- .1 Submit shop drawings which indicate complete material data, "K" value temperature rating, density, finish, recovery jacket of materials proposed for this project and indicate thickness of material for individual services.
- .2 Submit samples of proposed insulating materials and recovering.

### **1.4 Job Conditions**

- .1 Deliver material to job site in original non-broken factory packaging, labelled with manufacturer's density and thickness.
- .2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement, poor workmanship or material defects.

### **1.5 Alternatives**

- .1 Alternative insulations are subject to approval. Alternatives shall provide the same or better thermal resistance at normal conditions as material specified.

## **2. PRODUCTS**

### **2.1 Approved Manufactures**

- .1 Fibreglass Canada, Manson, Knauf Fibreglass, Plastic0Fab, Manville.

### **2.2 General**

- .1 Insulation Material, Recovery Jackets, Vapour Barrier Facings, Tapes and Adhesives: Composite fire and smoke hazard ratings shall not exceed 25 from flame spread and 50 for smoke developed.

- .2 Insulating materials and accessories shall withstand service temperatures without smouldering, glowing, smoking or flaming.
- .3 Recovery Jackets:
  - : \*ULC labelled thermo-canvas.
  - : \*0.5 mm (26 ga.) \*smooth \*embossed aluminum sheet.
  - : \*0.9 mm (20 ga.) \*smooth \*embossed aluminum sheet for Exterior duct work where subject to damage]
- .4 All insulation materials shall meet current Building Code Standards, and packages or containers of such materials shall be appropriately labelled.

### 2.3 Materials

- .1 Exposed Rectangular Ducts: Rigid fibrous glass or mineral fibreboard insulation, "K" value maximum  $0.035 \text{ W/m} \cdot ^\circ\text{C}$  ( $0.25 \text{ Btu-in./hr.ft}^2 \cdot ^\circ\text{F}$ ) at  $24^\circ\text{C}$  ( $75^\circ\text{F}$ ). Factory applied reinforced aluminum foil vapour barrier for cold ducts. Hot duct service temperature  $20^\circ\text{C}$  ( $68^\circ\text{F}$ ) to  $65^\circ\text{C}$  ( $150^\circ\text{F}$ ). Cold ducts service temperature  $-40^\circ\text{C}$  ( $-40^\circ\text{F}$ ) to  $65^\circ\text{C}$  ( $150^\circ\text{F}$ ).
- .2 Round Ducts and Concealed Rectangular Ducts: Flexible fibrous glass or mineral fibre insulation, "K" value maximum  $0.035 \text{ W/m} \cdot ^\circ\text{C}$  ( $0.25 \text{ Btu-in./hr.ft}^2 \cdot ^\circ\text{F}$ ) at  $24^\circ\text{C}$  ( $75^\circ\text{F}$ ). Factory applied reinforced aluminum foil vapour barrier for cold ducts. Hot duct service temperature  $20^\circ\text{C}$  ( $68^\circ\text{F}$ ) to  $65^\circ\text{C}$  ( $150^\circ\text{F}$ ). Cold duct service temperature  $-40^\circ\text{C}$  ( $-40^\circ\text{F}$ ) to  $65^\circ\text{C}$  ( $150^\circ\text{F}$ ).
- .3 Acoustic Lining: Fibrous glass or mineral fibreboard insulation with "K" value maximum  $0.035 \text{ W/m} \cdot ^\circ\text{C}$  ( $0.25 \text{ Btu-in./hr.ft}^2 \cdot ^\circ\text{F}$ ) at  $24^\circ\text{C}$  ( $75^\circ\text{F}$ ). Absolute roughness of exposed surface not to exceed  $0.58 \text{ mm}$  ( $0.02 \text{ in.}$ ), coated to prevent fibre erosion at air velocities up to  $25.4 \text{ m/s}$  ( $5,000 \text{ fpm}$ ),  $24 \text{ kg/m}^3$  ( $1.5 \text{ lb/ft}^3$ ) minimum density for ductwork and  $75 \text{ kg/m}^3$  ( $4.7 \text{ lb/ft}^3$ ) for plenums. Substrate must not be dark in colour. Service temperature  $-40^\circ\text{C}$  ( $-40^\circ\text{F}$ ) to  $65^\circ\text{C}$  ( $150^\circ\text{F}$ ).
- .4 Breeching Insulation: Semi-rigid mineral fibre insulation with glass mat "K" value  $0.035 \text{ W/m} \cdot ^\circ\text{C}$  ( $0.25 \text{ Btu-in./hr.ft}^2 \cdot ^\circ\text{F}$ ) maximum at  $24^\circ\text{C}$  ( $75^\circ\text{F}$ ). Service temperature  $65^\circ\text{C}$  ( $150^\circ\text{F}$ ) to  $450^\circ\text{C}$  ( $842^\circ\text{F}$ ).

## 3. EXECUTION

### 3.1 Preparation

- .1 Do not install covering before ductwork and equipment has been tested and approved.
- .2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions where possible.

### 3.2 Installation

- .1 Ensure insulation is continuous through inside walls. Pack around ducts with fireproof self-supporting insulation materials, properly sealed.
- .2 Finish insulation neatly at hangers, supports and other protrusions.
- .3 Do not insulate ductwork with external thermal insulation where acoustic duct insulation is specified.
- .4 Locate insulation or cover seams in least visible locations. Locate seams on ductwork in ceiling spaces on the underside of the duct.

- .5 Provide recovering jackets on exposed insulation throughout, including equipment rooms. Insulation located in crawl spaces, shafts and suspended ceiling spaces is not considered exposed. Make smooth any uneven insulated surface before recovering.
- .6 Cover insulation exposed to outdoors with aluminum jacket secured with aluminum bands on 200 mm (8 in.) centres or screws on 150 mm (6 in.) centres. Lap joints 75 mm (3 in.) minimum and seal with compatible waterproof lap cement.
- .7 Exposed Rectangular Ducts: Secure rigid insulation with galvanized anchors or welded pins on 400 mm (16 in.) centres. Secure in place with retaining pins. Seal all insulation joints and breaks with joint tape. Seal adhesive; cover joints with 100 mm (4 in.) strips of open mesh cloth imbedded between two coats of lap seal adhesive. Use vapour barrier tape for insulation joints or breaks on cold ducts.
- .8 Round Ducts and Concealed Rectangular Ducts: Adhere flexible insulation to ductwork with adhesive applied in 150 mm (6 in.) wide strips on 400 mm (16 in.) centres. Provide annealed tie wire tied at 400 mm (16 in.) centres for securing duct insulation. Butt insulation and seal joints and breaks with lap seal adhesive; cover joints with joint tape. Use vapour barrier tape for cold ducts.
- .9 Acoustic Lining: Apply to interior of ducts where shown. Secure to ductwork with adhesive using 50% coverage and anchors or weld pins on 400 mm (16 in.) centres. Secure in place with retaining clips. Cut off excess fastener length and cover with brush coat of mastic over protrusions and all raw edges. Use 25 mm (1 in.) thick insulation unless otherwise noted. Provide vapour barrier located on the warm side for outside air intakes. Bevel corners at joints and butt together. Install acoustic gauze over all cut corners and joints and brush coat with lap seal adhesive.
- .10 Where duct velocities exceed 15 m/s (3,000 fpm), cover internal duct insulation with 0.8 mm (22 ga.) perforated galvanized steel with 24% free area.
- .11 Breeching Insulation: Face breeching with 9.5 mm (0.37 in.) rib lath turn out to provide 12 mm (0.5 in.) space between insulation and hot surface and 12.5 mm (0.5 in.) mesh expanded lath on the outside. Butt blankets firmly together and secure with 1.6 mm (16 ga.) galvanized wire. Lace metal mesh together. Coat with 12 mm (0.5 in.) thick insulating cement. Finish with a final 12 mm (0.5 in.) coat of insulating cement. Trowel to a smooth hard finish. Recover with aluminum jacket.
- .12 Fasten aluminum recovery jacket in place with aluminum banding on 200 mm (8 in.) centres or screws or rivets on 150 mm (6 in.) centres.

### 3.3 Insulation Installation Thickness Schedule

| Ducts and Equipment |  | Insulation Thickness<br>(mm)(in) | Recovery Jacket |
|---------------------|--|----------------------------------|-----------------|
| .1                  | Combustion Air & Relief Duct   | 50 (2)                           | Canvas          |
| .2                  | Evaporative Condenser Intake<br>and Exhaust Ducts                      | 25 (1)                           | Canvas          |
| .3                  | Exhaust Ducts within 3000 mm (10 ft.) of<br>Exterior Walls or Openings | 25 (1)                           | Canvas          |
| .4                  | Outside Air Intake Ducts   | 50 (2)                           | Canvas          |
| .5                  | Plenums (Heating Systems)  | 50 (2)                           | --              |
| .6                  | Plenums (Systems with Cooling Coils)                                   | 50 (2)                           | --              |
| .7                  | Supply Ducts Heating System  | 25 (1)                           | Canvas          |
| .8                  | Supply Ducts Heating/Cooling System                                    | 25 (1)                           | Canvas          |

- .9 Supply Ducts Ventilation Systems 25 **(1)** Canvas
- .10 Ducts Exposed to Outdoors 50 **(2)** Aluminum
- .11 Ventilation Equipment Casings 25 **(1)** Canvas
- .12 Acoustic Lining (where indicated) 25 **(1)** --
- .13 Boiler Breeching 50 **(2)** Aluminum
- .14 Domestic Hot Water Breeching  
(Atmospheric Burners) 25 **(1)** Aluminum
- .15 Domestic Hot Water Breeching  
(Forced Air Burners) 50 **(2)** Aluminum
- .16 Furnaces and Unit Heaters Breeching 25 **(1)** Aluminum
- .17 Indirect Gas Fired Air Handling Units  
Breeching (Atmospheric Burners) 25 **(1)** Aluminum
- .18 Indirect Gas Fired Air Handling Units  
Breeching (Forced Air Burners) 50 **(2)** Aluminum
- .19 Ventilation Equipment 50 **(2)** Canvas
- .20 Incinerator Breeching 50 **(2)** Aluminum
- .21 Exhaust Duct Between Heat Recovery  
Coil and Exhaust Louvre 25 **(10)** Canvas

**END OF SECTION**



## **1. GENERAL**

### **1.1 Scope**

- .1 Hot Equipment – Heat Exchangers (to be c/w packaged insulation jacket if possible).
- .2 Hot - valves, strainers, flow meters, control valves, valves, pump housings, domestic hot water heat exchangers, other heat exchangers, expansion joints, expansion compensators, etc.
- .3 Other equipment being part of this project scope of work.

### **1.2 Quality Assurance**

- .1 Insulation shall be installed by skilled workmen regularly engaged in this type of work.
- .2 Materials shall meet or exceed fire and smoke hazard ratings as stated in this section and defined in applicable building codes.

### **1.3 Submittals**

- .1 Submit shop drawings which indicate complete material data, "K" value temperature rating, density, finish, recovery jacket of materials proposed for this project and indicate thickness of material for individual services.
- .2 Submit samples of proposed insulating and recovering materials.

### **1.4 Job Conditions**

- .1 Deliver material to job site in original non-broken factory packaging, labelled with manufacturer's density and thickness.
- .2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

### **1.5 Alternatives**

- .1 Alternative insulations are subject to review and acceptance by the Consultant. Alternatives shall provide the same or better thermal resistance at normal conditions as material specified.

## **2. PRODUCTS**

### **2.1 General**

- .1 Insulation Materials, Recovery Jackets, Vapour Barrier Facings, Tapes and Adhesives: Composite fire and smoke hazard ratings shall not exceed 25 for flame spread and 50 for smoke developed.
- .2 All insulation materials shall meet current Building Code Standards, and packages or containers of such materials shall be appropriately labelled.
- .3 Insulate fittings and valve bodies with preformed removable insulated fittings.

### **2.2 Materials**

- .1 Hot Equipment: Rigid fibrous glass or mineral fibre insulation, "K" value maximum 0.035 W/m.°C (0.25 Btu-in/hr-ft<sup>2</sup>-°F) at 24° (75°F). Service temperature -14°C (7°F) to 200°C (392°F).

- .2 Provide velcro or zippered removable insulation coverings over equipment access ports, controls devices and connection fittings. Do not insulate over nameplates or other data plates. Finish all exposed edges to the exterior insulation finish specified
- .3 Recovery Jackets:
  - .1 \*ULC labelled thermo-canvas flamespread less than 25 smoke developed less than 50.
- .4 Insulation: TIAC Code C.2 Flexible Mineral Fibre Blanket for Medium and High Temperature Applications (Removable Thermal Blanket Insulation)
  - .1 Secondary Piping, all types, mechanical rooms.
  - .2 Materials
    - .1 Asbestos-free removable thermal blanket insulation to withstand temperatures up to 150°C (320°F)
    - .2 Minimum 50mm thickness
    - .3 Install insulation in sewn blanket coverings
    - .4 Design to allow for easy removal and reinstallation of same covering
    - .5 Mineral fibre: to CAB/ULC-S702, ASTM C 547
    - .6 Jacket: to CGSB 51-GP-52Ma
    - .7 Maximum "k" factor: to CAN/ULC-S702, ASTM C 547
    - .8 Acceptable Materials:
      - .1 Firwin Corporation
      - .2 INSULTECH®
      - .3 KeyMay Industries

### **3. EXECUTION**

#### **3.1 Preparation**

- .1 Do not install covering before piping and equipment has been tested and approved.
- .2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

#### **3.2 Installation**

- .1 Provide recovering jackets on exposed insulation throughout, including equipment rooms. Insulation located in crawl spaces, pipe shafts and suspended ceiling spaces is not considered exposed. Make smooth uneven insulated surfaces before recovering.
- .2 Equipment: Apply insulation with edges tightly butted, joints staggered and secured in place by metal bands. Where necessary, weld on suitable anchors. Provide sufficient clearance around openings for normal operation of equipment. Make uneven surfaces smooth with insulating cement.

#### **3.3 Insulation Thickness**

- .1 The insulation on all hot equipment shall be the same thickness as the connected piping, and not less than 50mm (2") thick.

**END OF SECTION**

## **1. GENERAL**

### **1.1 Scope**

- .1 Only tested firestop systems shall be used in specific locations as follows:
- .2 Penetrations for the passage of duct, piping, and other mechanical equipment through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
- .3 Repetitive plumbing penetrations in fire-rated floor assemblies. Penetrations exist for the installation of tubs, showers, aerators and other plumbing fixtures.

### **1.2 Quality Assurance**

- .1 A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.
- .2 Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.
- .3 Firestop System installation must meet requirements of CAN4-S115-M or ULC S-115-M tested assemblies that provide a fire rating.
- .4 Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- .5 Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.
- .6 For those firestop applications that exist for which no ULC or cUL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar ULC or cUL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineer judgment drawings must follow requirements set forth by the International Firestop Council (September 7, 1994).

### **1.3 Reference Standards**

- .1 Test Requirements: ULC-S115-M or CAN4-S115-M, "Standard Method of Fire Tests of Through Penetration Fire Stops".
- .2 CAN4-S115-M under their designation of ULC-S115-M.
- .3 Inspection Requirements: ASTM E 2174 – 01, "Standard Practice for On-site Inspection of Installed Fire Stops.
- .4 CAN/ULC-S102-M, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .5 All major building codes: NBC, and BCBC.
- .6 NFPA 101 - Life Safety Code

## **1.4 Submittals**

- .1 Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of ULC or cUL firestop systems to be used and manufacturer's installation instructions to comply with Section 15010.
- .2 Manufacturer's engineering judgment identification number and drawing details when no ULC or cUL system is available for an application. Engineer judgment must include both project name and contractor's name who will install firestop system as described in drawing.
- .3 Submit material safety data sheets provided with product delivered to job-site.

## **1.5 Job Conditions**

- .1 Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and ULC or cUL label where applicable.
- .2 Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
- .3 Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.
- .4 Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
- .5 Do not use damaged or expired materials.

## **1.6 Approved Manufacturers:**

- .1 Hilti, 3M, Other manufacturers listed in the U.L.C Fire Resistance Directory or UL Products Certified for Canada (cUL) Director.

## **2. PRODUCTS**

### **2.1 General**

- .1 Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
- .2 Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.
- .3 Firestopping Materials are either "cast-in-place" (integral with concrete placement) or "post installed." Provide cast-in-place firestop devices prior to concrete placement.

### **2.2 Materials**

- .1 Use only firestop products that have been ULC or cUL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
- .2 Cast-in place firestop devices are installed prior to concrete placement for use with non-combustible and combustible plastic pipe (closed and open piping systems) penetrating concrete floors, the following products are acceptable:
  - .1 Hilti CP 680 Cast-In Place Firestop Device
  - .1 Add Aerator adaptor when used in conjunction with aerator ("sovent") system.

- .2 Hilti CP 681 Tub Box Kit for use with tub installations.
- .3 Hilti CP 682 Cast-In Place Firestop Device for non-combustible pipe
- .4 Equivalent products listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory
- .3 Sealants or caulking materials for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:
  - .1 Hilti FS-ONE Intumescent Firestop Sealant
  - .2 Hilti CP 604 Self Leveling Firestop Sealant
  - .3 Hilti CP 620 Fire Foam
  - .4 Hilti CP 606 Flexible Firestop Sealant
  - .5 Hilti CP 601s Elastomeric Firestop Sealant
  - .6 Equivalent products listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory
- .4 Intumescent sealants or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe, the following products are acceptable:
  - .1 Hilti FS-ONE Intumescent Firestop Sealant
  - .2 Equivalent products listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory
- .5 Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems) tested to 50 Pa. differential, the following products are acceptable:
  - .1 Hilti CP 643N Firestop Collar
  - .2 Hilti CP 644 Firestop Collar
  - .3 Hilti CP 645/648 Wrap Strips
  - .4 Equivalent products listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory
- .6 Materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, the following products are acceptable:
  - .1 Hilti CP 637 Firestop Mortar
  - .2 Hilti FS 657 Fire Block
  - .3 Hilti CP 620 Fire Foam
  - .4 Hilti CP 675-T Firestop Board
  - .5 Equivalent products listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory
- .7 For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected, the following products are acceptable:
  - .1 Hilti FS 657 Fire Block (for walls and floors)
  - .2 Hilti CP 658T Firestop Plug (for walls and floors)
  - .3 Hilti CP 680 Cast-In Place Firestop Device (for floors only)

- .4 Equivalent products listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory
- .8 For penetrations through a Fire Separation wall provide a firestop system with a "F" Rating as determined by ULC or cUL as indicated below:

| Fire Resistance Rating of Separation | Required ULC or cUL "F" Rating of Firestopping Assembly |
|--------------------------------------|---|
| 30 minutes                           | 20 minutes  |
| 45 minutes                           | 45 minutes  |
| 1 hour                               | 45 minutes  |
| 1.5 hours                            | 1 hour  |
| 2 hours                              | 1.5 hours   |
| 3 hours                              | 2 hours   |
| 4 hours                              | 3 hours   |

- .9 For combustible pipe penetrations through a Fire Separation provide a firestop system with a "F" Rating as determined by ULC or cUL which is equal to the fire resistance rating of the construction being penetrated.
- .10 For penetrations through a Fire Wall or horizontal Fire Separation provide a firestop system with a "FT" Rating as determined by ULC or cUL which is equal to the fire resistance rating of the construction being penetrated.

### 3. EXECUTION

#### 3.1 General

- .1 Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
- .2 Verify penetrations are properly sized and in suitable condition for application of materials.
- .3 Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
- .4 Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
- .5 Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
- .6 Do not proceed until unsatisfactory conditions have been corrected.

#### 3.2 Coordination

- .1 Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.
- .2 Responsible trade to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.

#### 3.3 Installation

- .1 Regulatory Requirements: Install firestop materials in accordance with ULC Fire Resistance Directory or UL Products Certified for Canada (cUL) Directory.
- .2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration joint materials.
- .3 Seal all holes or voids made by penetrations to ensure an air and water resistant seal.

- .4 Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of ULC or cUL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
- .5 Protect materials from damage on surfaces subjected to traffic

**END OF SECTION**

## **1. GENERAL**

### **1.1 Scope**

- .1 All pumps except where integral with a manufactured piece of equipment.
- .2 Pumps controls where self contained.

### **1.2 Submittals**

- .1 Submit with shop drawings certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Show pump weights, motor and pump operating or efficiencies and electrical power characteristics.

### **1.3 Quality Assurance**

- .1 Pumps shall be aligned by qualified millwright and alignment certified.
- .2 Ensure pumps operate at specified system fluid temperatures without vapour binding and cavitation, are non-overloading in parallel or individual operation, operate within 25% of midpoint of published maximum efficiency curve.
- .3 Motors shall be high efficiency and/or inverter only as specified in Section 15010.

## **2. PRODUCTS**

### **2.1 Approved Manufacturers**

- .1 Pumps – In-Line Circulators: Armstrong, B&G.
- .2 Pumps – Vertical In-Line and Base Mounted: Armstrong, B&G.

### **2.2 General**

- .1 Statically and dynamically balance rotating parts.
- .2 Construction shall permit complete servicing without breaking piping or motor connections.
- .3 Pumps shall operate at 1750 r/min unless specified otherwise.
- .4 Pump connections shall be flanged.

### **2.3 Vertical In-Line Pump**

- .1 Type: Centrifugal, single stage, close coupled in-line, back pullout design, suitable for vertical operation.
- .2 Casing: Cast iron, rated for greater of 1200 kPa (175 psi) or 1.5 times actual discharge working pressure. Suction and discharge gauge port, air vent, wear rings, seal flush connection, drain plug, flanged suction and discharge.
- .3 Impeller: Bronze, fully enclosed, keyed to shaft and secured with locknut.
- .4 Shaft: Stainless steel or carbon steel with bronze or stainless steel sleeve through seal chamber.
- .5 Seals: High performance multiple spring outside type balanced mechanical seal, 1790 kPa (260 psi) maximum stuffing box pressure. Tungsten Carbide rotating face against stationary carbon seat. Viton secondary seat.



- .6 Provide external heat exchanger to cool seal flush water to below 90°C (195°F), when pumping fluids over 93°C (200°F).
- .7 Seals: Packing gland with minimum four rings teflon impregnated packing [and gland lantern rings] [Garlock 4875].
- .8 Motor: Open drip proof unless noted otherwise in pump schedule.
- .9 For pumps 3.7 kW (5 Hp) and larger, provide split spacer couplings.

#### **2.4 In-Line Circulator**

- .1 Casing: [Bronze] [cast iron] rated for 860 kPa (125 psi) working pressure.
- .2 Impeller: [Cadmium plated steel] [Bronze].
- .3 Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.
- .4 Seal: Carbon rotating against a stationary ceramic seat [Crane Type 2.]
- .5 Motor: Drip proof construction, resilient mounted oil lubricated journal bearings.

### **3. EXECUTION**

#### **3.1 Installation**

- .1 Provide drains for bases and stuffing boxes piped to and discharging into floor drains.
- .2 Provide air cock and drain connection on horizontal pump casings.
- .3 Decrease from line size, with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 100 mm (4 in.) and over.
- .4 Check and align pumps prior to start-up.
- .5 Provide line sized gate valve and strainer on suction and line sized soft seated check valve and memory stop balancing valve on discharge.
- .6 Shave or replace pump impellers to meet actual operating conditions.
- .7 Where remote control panels are used, this contractor shall allow for wiring from panel to pumps.
- .8 Provide spacer at inlet and outlet on vertical in-line pumps complete with screen diffuser.
- .9 Provide seismic restraints for pumps.
- .10 Secure control panels for seismic loads.

#### **3.2 Performance**

- .1 Refer to the Pump Schedule.

**END OF SECTION**

## **1. GENERAL**

### **1.1 Scope**

- .1 Cleanouts.
- .2 Air chambers or water hammer arresters.
- .3 Roof and floor drains.
- .4 Cooling equipment condensate drains.
- .5 Storm and sanitary sewer service connections.
- .6 Water service connections.
- .7 Natural gas service connection.
- .8 Backflow preventers.
- .9 Vacuum breakers.
- .10 Backwater valves.

### **1.2 General Requirements**

- .1 Provide materials, equipment and labour to install plumbing as required by Provincial and Local Codes and as specified herein.
- .2 Provide water and drainage connections to equipment furnished in other sections of this specification and as supplied by the Owner.
- .3 Provide an approved water meter and bypass installation conforming to Local Codes and Standards.
- .4 Provide and include charges for connections to Municipal and Utility Company Service.

### **1.3 Submittals**

- .1 Submit shop drawings for review by the Consultant, in accordance with the general conditions. Provide shop drawings for the following items:
  - .1 Roof Drains
  - .2 Floor Drains
  - .3 Backflow preventers
  - .4 Vacuum Breakers

## **2. PRODUCTS**

### **2.1 Approved Manufactures**

- .1 Backflow Preventers: Febco, Watts, Hersey, Singer, Ames.
- .2 Drains: Zurn, Ancon, PPP, J.R. Smith.
- .3 Hose Bibbs: Jenkins, Dahl, Crane, Toyo, Kitz, Mifab.
- .4 Meters Positive Displacement: Neptune, Rockwell.

## 2.2 Clean-Outs and Clean-Out Access Covers

- .1 Provide caulked or threaded type extended to finished floor or wall surface. Provide bolted coverplate clean-outs on vertical rainwater leaders only. Ensure ample clearance at clean-out for rodding of drainage system.
- .2 Floor cleanout access covers in unfinished areas shall be round with nickel bronze scoriated frames and plates. Provide round access covers in finished areas with depressed centre section to accommodate floor finish. Wall cleanouts to have chrome plated caps.
- .3 Supply and install cleanouts on all drains at all changes in direction, at the ends of all horizontal runs, at the base of every stack where drain leave the building; where shown on the drawings, 7.6 m apart in horizontal drainage lines of 50 mm and 65 mm nominal diameter, 15.2 m apart in horizontal lines of 75 mm or 100 mm nominal diameter and not more than 30 m apart for larger pipe sizes and as called for in the British Columbia Plumbing Code.
- .4 All outside cleanouts shall be extended to grade in cast iron. They shall be sufficiently anchored in a 300 mm x 300 mm x 100 mm thick concrete block of concrete to prevent rotation of the pipe. Concrete work shall be provided and installed by the General Contractor.
- .5 All cleanouts shall be full size for pipes up to 100 mm diameter and 100 mm size for larger pipes. Cleanouts shall be extended to a finished wall or floor. No cleanouts shall terminate at the ceiling of a room, sanitary and storm shall be extended to the floor above. Cleanouts shall not terminate in the floor of any sterile rooms.
- .6 The piping shall be extended beyond the room for cleanout installation. Where cleanouts occur in carpeted areas, they shall be extended to the finished walls unless the Consultant gives special permission for them to terminate the carpeted floor. In potentially wet areas such as washrooms, cleanouts shall be extended to the walls wherever possible. Where conditions do not permit wall cleanouts, the cleanout cover shall be waterproof, Jay R. Smith 4020-F-C with nickel bronze frame and cover and integral waterproofing clamping collar. All cleanouts passing through walls or floors with a waterproofing membrane shall have a clamping collar which shall be clamped to the membrane.
- .7 Cleanouts for copper pipe shall be cast brass, Crane 1816, 1817 or Emco 57-18190 with raised shoulder on plug and gasket.
- .8 Cleanouts for cast iron pipe shall be steel plug type, Associated Foundry.
- .9 Cover for cleanouts shall be as follows:
  - .1 Unfinished areas, such as concrete floors in equipment rooms and flush type C.O. in outside areas, Jay R. Smith 4220 with extra heavy duty adjustable cast iron cover suitable for heavy traffic.
  - .2 Finished floors Jay R. Smith 4100 heavy duty with adjustable N.B. frame and cover.
  - .3 Finished floors pedestrian duty only Jay R. Smith 4020 medium duty with adjustable N.B. frame and cover.
  - .4 Floors finished in lino or other such thin material Jay R. Smith 4140 round with adjustable N.B. frame and cover.
  - .5 Walls finished with ceramic tile, Acudor UF5000 stainless steel access door.
  - .6 All painted walls, provide prime coated covers as specified for access panels with minimum clear opening of 200 mm x 200 mm for cleanouts 50mm and smaller 300 mm x 300 mm for cleanouts larger than 50 mm. Avoid covers on feature walls; i.e.: wood panels. If unavoidable, the covers shall be for painted walls but with finish material secured to the cover to the satisfaction of the Consultant and finished flush with wall. In all sterile areas provided stainless steel finish on all access panel. All cleanouts shall have locations clearly indicated.

- .10 All barriers for cleanout plugs shall be securely anchored so that they do not rotate when plug is being removed.

## 2.3 Water Hammer Arresters

- .1 Fit water supply to each fixture or group of fixtures with an air chamber. Provide air chambers same size as supply line or **20 mm 3/4 in.** minimum, and minimum **450 mm 18 in.** long.
- .2 Install stainless steel bellows type water hammer arresters on water lines connected to solenoid valves [, flush valves] [and to fixture or group of fixtures] complete with accessible isolation valve.

## 2.4 Roof Drains

- .1 Flow Characteristics: [Full open flow.] [Controlled flow].
- .2 Material: All major components including body, flashing clamping flange, under deck clamping ring and dome strainer shall be cast iron or cast aluminum, lacquered. Bolts shall be galvanized or prime painted steel.
- .3 Body:
  - .1 Sump: minimum 180 mm 7 in. internal diameter, minimum 75 mm 3 in. deep.
  - .2 Discharge: nominal 100 non-threaded MJ.
  - .3 Bosses: solid, integrally cast, for under deck clamping ring and flashing flange bolts.
  - .4 Deck flange: nominal 300 mm 12 in. outside diameter, minimum 50 mm 2 in. width.
- .4 Flashing Clamping Flange: Outside diameter same as outside diameter of deck flange; Vnotched positive draining gravel stop lip, **15 mm 1/2 in.** high.
- .5 Dome Strainer: Minimum **150 mm 6 in.** high; **8 mm 0.3 in.** to **15 mm 1/2 in.** slotted openings, sides and top.
- .6 Example Spec's
  - .1 RD-1: Conventional roof drains: Jay R. Smith 1010Y-ERC-CIUD, Duco 375 mm dia. cast iron body, with membrane clamp collar and cast iron dome, fixed extension to suit insulation thickness, under deck clamp and sump receiver.
  - .2 RD-2: Insulated roof membrane assembly (inverted) roof drains: Jay R. Smith 1011Y-RC-CID, Duco 375 mm dia. cast iron body, with membrane clamp collar and cast iron dome, stainless steel drainage grid, under deck clamp and sump receiver.
  - .3 RD-3: Promenade deck drains: Jay R. Smith 1330DS-RC, Duco 200 mm dia. cast iron body, with membrane clamp collar, perforated stainless steel drainage extension to suit insulation and/or drainage coarse thickness, adjustable 200 mm square nickel bronze strainer, under deck clamp and sump receiver.

## 2.5 Floor Drains

- .1 Floor drains shall have lacquered cast iron body with double drainage flange, weep holes combined two piece body reversible clamping device and adjustable nickel/bronze strainer. Shower and washroom floor drains shall have a removable perforated sediment bucket.
- .2 Floor drains in equipment rooms shall have polished bronze funnel type strainer [, and extension for floating floor.]
- .3 Floor drains for warehouses and vehicle areas shall have lacquered extra heavy duty type drain body with 300 x 300 hinged grate and sediment bucket. The entire drain assembly, body, sump, and grate shall be factory coated with 3 M Scotchkote 206 standard for fusion bonded epoxy coating. Ancon FD-460AF.

## 2.6 Area Drains

- .1 Area drain shall have lacquered cast iron body with adjustable collar and galvanized ductile iron locking grate.

## 2.7 Equipment Drains

- .1 Provide a sloped connection from packaged equipment drain pans to nearest sanitary sewer trapped connection. Slope at minimum of 0.5% grade. Drains size to be **\*20 \*25 mm 3/4\*1 in.** complete with **100 mm 4 in.** deep trap at unit.
- .2 Provide in each section of a built-up air handling unit which maintains water carry over a \*galvanized water proof drain pan \*water proof concrete plenum with a minimum of **50 mm 2 in.** sides and a floor sloped to a **50 mm 2 in.** floor drain, to be full width of the plenum and a rim of 1/2 the plenum height in length. Drain is to be flashed into the water proof floor and is to slope to an open trapped sanitary connection at a rim of 0.5% grade. Floor drain trap is to be deep enough to ensure a water seal at a maximum pressure of the fan system with a rim depth of **100 mm 4 in.**

## 2.8 Backflow Preventer Assemblies

- .1 Provide backflow preventer assembly complete with shut-off valves before and after check valves and test cocks. Assembly shall meet current AWWA requirements and CSA B64 standards.
- .2 Provide complete reduced pressure principle type assembly, consisting of pressure differential relief valve, located between two (2) positive seating replaceable check valves with stainless steel or bronze seats Watts No. 909. Provide strainer between gate valve and first check valve on units **50 mm 2 in.** and smaller.
- .3 Provide complete double check valve type assembly consisting of two (2) positive sealing replaceable check valves with stainless steel or bronze seats. Provide check valve on units **50 mm 2 in.** and smaller. Watts No. 709.
- .4 Provide complete atmospheric vent backflow preventer assembly, consisting of two (2) positive sealing replaceable check valves with bronze seats, integral stainer and threaded vent connection. Watts No. 9D.

## 2.9 Vacuum Breaker Assemblies

- .1 Provide pressure type vacuum breaker assembly complete with shut-off valves before and after check valves and test cocks. Assembly shall consist of one (1) positive sealing check valve and one (1) atmospheric vent disk with stainless steel or bronze seats complete with shut-off valves before and after check valves and test cocks. Assembly shall meet AWWA requirements and CSA B64 standards. Watts No. 800.
- .2 Provide atmospheric type vacuum breaker assembly complete with shut-off valve before assembly. Assembly shall consist of one (1) free floating poppet to seal the atmospheric vent under flow conditions. Watts No. 288A. For bottom inlet and outlet, Watts No. 388ASC.
- .3 Provide hose connection type vacuum breaker assembly, consisting of a check valve disc assembly to be vandal proof and drainable. Watts No. 8A. For freezing conditions, Watts No. NF8.

## 2.10 Backwater Valve Assemblies

- .1 Provide complete assembly, epoxy coated, cast-iron body, bronze flapper check valve, bolted access cover with neoprene gasket \*extended floor access and neoprene gasketted heavy-duty nickel-bronze cover \*heavy gauge steel epoxy coated access housing and neoprene gasketted heavy-duty nickel-bronze cover.

## 2.11 Trap Seal Primers

- .1 Bronze automatic trap primer complete with sediment strainer, union and access door for concealed installations with **15 mm 1/2 in.** copper tubing connections between primer valve and floor drain.

## 2.12 Pressure Reducing Valves

- .1 **25 mm 1 in.** and smaller: Bronze body, SS integral strainer, renewable SS seat, high temperature rated diaphragm suitable for hot or cold water. Rated at maximum inlet pressure of **2100 kPa 300 psi**, maximum reduced pressure **175 kPa 25 psi**, maximum temperature **90°C 194°F**.
- .2 **30 mm 1 1/4 in.** and larger: Pilot operated, cast iron body, modified globe design, threaded ends to **50 mm 2 in.**, flanged ends **65 mm 2 1/2 in.** and larger. Maximum inlet pressure **\*1225 kPa \*2100 kPa \*175 psi\*300 psi**. Maximum temperature **90°C 194°F**. Bronze trim. Pilot control system: bronze with SS trim, hydraulically operated, diaphragm actuated.
- .3 Size to suit flow capacities and service.
- .4 Provide with gate valve and union on inlet and outlet, globe valve bypass, pressure gauge on inlet and outlet and pressure relief valve on reduced pressure side.

## 3. EXECUTION

### 3.1 Installation

- .1 Bury outside water and drainage pipe minimum [**1200 mm 4 ft.**] [**1800 mm 6 ft.**], unless noted otherwise.
- .2 Lubricate clean-out plugs with mixture of graphite and linseed oil. Prior to building turnover remove clean-out plugs, re-lubricate and reinstall using only enough force to ensure permanent leak-proof joint.
- .3 Install gas piping in open or ventilated spaces. Pitch lines and provide drip legs for condensation collection points. Where gas piping is run in a concealed space, provide ventilation grilles as required.
- .4 Where floor drains are located over occupied areas, provide waterproof installation.
- .5 Drainage lines shall grade **2 mm 2 in.** per **100 mm 100 in.** unless otherwise indicated on drawings.
- .6 Install pressure reducing valves to limit maximum static pressure at plumbing fixtures to **550 kPa 80 psi**.
- .7 Locate plumbing vents minimum **5 m 16 ft.** from air intakes.
- .8 Provide PRV in hot water supply to dishwasher.
- .9 Provide a heat trap loop in domestic hot water supply piping at domestic hot water storage tank.
- .10 Install cast iron connections from weeping tile to storm drainage system including backwater valve, and cleanout. Provide access for servicing of backwater valve.
- .11 Provide and install valved connections on hot and cold water lines to each hot water tank complete with vacuum breakers on cold water make-up and temperature pressure relief valve.
- .12 Install vacuum breakers or backflow preventers to AWWA standards on plumbing lines where contamination of domestic water may occur. Generally necessary on boiler make-up lines, hose bibbs and flush valves. All backflow preventers shall be installed at a maximum 1500 mm above the floor or ground level.

- .13 Install trap primer on all drains which do not receive water daily. Primers shall be installed in an area accessible for easy maintenance.
- .14 Provide seismic restraints for tanks and all high centre of gravity equipment.
- .15 Provide seismic valve on all gas meter installations.
- .16 All R.P. device backflow preventers shall be provided with daylight type drainage or full flow piping drain line or sump.
- .17 Do not run any wet piping through electrical machine rooms or other similar rooms.
- .18 Provide pump out drains in all elevator pits
- .19 Provide dielectric fittings in all dissimilar metal connections.

### 3.2 Services

- .1 Provide new [sanitary] [storm] sewer connections to site services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with sufficient slope for drainage and adequate cover to avoid freezing.
- .2 Provide new water service complete with water meter with by-pass valves [and sand strainer]. Provide necessary thrust blocks on underground water piping as required and detailed. [Provide sleeve in wall for service main and adequately support at wall with Reinforced Concrete Bridge. Caulk enlarged sleeve and make watertight with pliable material. Securely anchor service main inside to concrete wall. [Provide [1.2 mm **18 gauge**] galvanized sheet metal sleeve around service main to 150 mm **6 in.** above floor and 1800 mm **6 ft.** above floor and 1800 mm **6 ft.** minimum below grade. Size for minimum of 50 mm **2 in.** of loose fill insulation.
- .3 Provide new gas service complete with gas meter and regulators. Gas service distribution piping shall have initial minimum pressure of \_\_\_\_\_ kPa **psi**. Provide regulators on each line servicing gravity type appliance, sized in accordance with equipment. These regulators are in addition to normal controls.

### 3.3 Excavation & Backfilling

- .1 Provide any excavations necessary for the installation of the mechanical work. No cutting, boring or excavating necessary for this work in or about the building which may cause interference with the progress of the work or weaken the structure in any way, shall be undertaken without the approval of the Consultant before commencing work. Trenches or tunnels for all underground piping shall be excavated to a depth slightly more than required and graded so as to secure all available fall. Support each length of pipe with concrete blocks and bricks, or backfill the trench with gravel to the required depth and grade. Sanitary and storm lines outside of the building shall be kept as deep as practical. See Section 02200 for excavation requirements.
- .2 Backfilling in all trenches shall be with sand or pea gravel where approved, 150 mm below pipe and up to 150 mm (6") over top of piping, then flushed with water so as to ensure the total length of each pipe is resting on solid footing. Remainder of all trenches shall be filled by the General Contractor. See Section 02200 for backfilling requirements. Where sewer, water or storm pipes pass under a grade beam or footing the trench around the piping up to and in contact with the footing, provide a 450 kg concrete grouting so as to seal the outside trenching from normal storm runoff and backflow of rain water through the trenching and into the crawl space and/or under the basement floor.
- .3 Where sewer, water or storm pipes pass through exterior walls below grade, the General Contractor shall install corbels on the exterior walls and run bridging from corbel to undisturbed soil for the support of the pipes. One inch thick waterproof mastic shall be applied around the pipes which pass through the wall.

- .4 Repair concrete walls, pavement, walks, louvres, etc., where these have been damaged by the mechanical contractor

**END OF SECTION**



## **1. GENERAL**

### **1.1 Scope**

- .1 The entire building shall be fully sprinklered.
- .2 Provide a complete sprinkler system as required by current building codes. Provide piping, sprinkler heads, alarm check valve, zone valves, excess pressure pump and all other devices and accessories required to provide a completely functional system.
- .3 Tender documents do not contain complete sprinkler drawings. The sprinkler contractor shall prepare his own drawings. Where sprinkler head locations are shown, this is to indicate general intent only. It is the responsibility of the contractor to allow for in his bid and to install all heads required to satisfy the code. In laying out sprinkler system, the contractor shall review the contract documents and site conditions to ensure that piping systems do not conflict with other building elements. Any serious interferences shall be reported to the consultant prior to commencement of work.
- .4 Sprinkler system shall be hydraulically designed by the sprinkler subtrade with shop drawings (sealed and signed by a professional engineer practicing in the Province of BC and assuming full responsibility for the installed system) submitted showing all piping and sprinkler head locations. The contractor shall submit detailed installation drawings and design calculations for approval to the authorities having jurisdiction and to the Consultant to review, prior to commencing work. No work shall commence prior to obtaining approved drawings from authorities having jurisdiction. The sprinkler contractor shall supply letters of assurance for the fire protection systems, and submit same to the Consultant as well as the local authorities.
- .5 Contractor to confirm the flow and pressure available by conducting a hydrant flow test. Sprinkler system design to be based on the final flow test information.
- .6 Provide dry sprinkler systems/heads in areas subject to freezing temperature.
- .7 Provide signed and sealed letters of assurance, as required by the authority having jurisdiction, taking responsibility for the seismic restraints.
- .8 Provide these letters of assurance sealed by a registered professional engineer for the seismic restraints, "Assurance of Professional design and commitment for field review" as well as "Assurance of Professional field review and compliance".

### **1.2 General Requirements**

- .1 Run piping concealed above furred ceilings and in joist to minimize obstructions. Expose only heads.
- .2 A combined sprinkler - standpipe is to be provided. Refer to Section 15520 for Standpipe Specifications.
- .3 Prior to preparing shop drawings, sprinkler contractor shall review contract drawings of all disciplines and site conditions to ensure the piping systems do not conflict with other building systems. Report any serious interferences to engineer prior to commencement of work.
- .4 All inspections and tests required by the Authorities shall be arranged and paid for by the contractor.

### **1.3 Quality Assurance**

- .1 Sprinkler equipment and installation shall be in accordance with recommendations of \*IAO Insurers Advisory Organization, \*Owner's Underwriters, \_\_\_\_\_, and local Fire Commissioner.

- .2 Sprinkler equipment shall be installed by qualified Contractors licensed and regularly engaged in the installation of automatic fire sprinkler equipment.
- .3 Equipment and installation shall meet the requirements of current edition of NFPA No. 13 - Standard for the Installation of Sprinkler Systems.
- .4 Shop drawings shall include detailed installation drawings showing all piping and sprinkler head locations and design calculations outlined in NFPA 13.
- .5 Provide signed and sealed letters of assurance, as required by the authority having jurisdiction, taking responsibility for the Fire Protection Design.
- .6 Provide these letters of assurance sealed by a registered professional engineer for the Fire Protection, "Assurance of Professional design and commitment for field review" as well as "Assurance of Professional field review and compliance".

#### **1.4 Submittals**

- .1 Submit preliminary layout showing only head locations for review by the Architect and Consultant. Refer to architectural plans for ceiling coordinated head locations, space all others to Code Standards.
- .2 Submit shop drawings of entire sprinkler system after review of head locations, for approval by the Underwriters. Submit only Underwriter approval drawings to the Consultant.
- .3 No work shall commence prior to obtaining approved drawings from Authorities and Owners Underwriter.
- .4 Submit sample of all type of sprinkler heads to be used for review.

### **2. PRODUCTS**

#### **2.1 Sprinkler Head**

- .1 Temperature rating on fusible links shall suit specific hazard area with minimum margin of safety  $10^{\circ}\text{C}$  **18°F**.
- .2 All sprinkler heads shall be of quick response type, having a response time between 30 to 90 seconds.
- .3 For suspended ceilings, provide \*standard \*recessed \*semi-recessed pendant type with \*brass \*chrome plated finish and escutcheon.
- .4 For exposed areas, provide standard upright type with \*brass \*chrome plated finish. For sidewall application, provide sidewall type with \*brass \*chrome plated finish and escutcheon.
- .5 For the pool and chemical storage rooms, provide upright-type rated for a corrosive environment.
- .6 For steam and sauna rooms, provide a high temperature-type rated for a humid environment.

#### **2.2 Sprinkler Valve**

- .1 Provide approved automatic sprinkler valve with one or two pole (as required) flow detectors, pressure switch, outside water motor gong, \*outside electric gongs, inside electric gong and circuit breaker \*excess pressure pump \*air compressor.

#### **2.3 Excess Pressure Pump**

- .1 Provide pump capable of pumping sprinkler system to  $275\text{ kPa}$  **40 psi** in excess of normal pressure with supports, gauge, starter and connections to sprinkler system.

## 2.4 Air Compressor

- .1 Provide electric drive, horizontal tank mounted, single stage compressor, capable of restoring normal system air pressure within 30 minutes, two (2) pole air pressure operated electric pressure switch with 2-way release or breather valve, safety valve, check valve, tank drain, belt guard and controls.

## 2.5 Siamese Fire Department Connection

- .1 Provide two-way \*standard \*flush mounted siamese fire department connection with \*brass \*chrome plated finish, local fire department thread, dust caps and chains, *20 mm 3/4 in.* automatic drip \*connected to drain marked "Sprinkler Fire Department Connection".
- .2 Siamese fire department connection for sprinkler system shall match connection for standpipe and hose system.

## 3. EXECUTION

### 3.1 Installation

- .1 Protect sprinkler heads against mechanical injury with standard guards when necessary.
- .2 Locate outside alarms on walls of building adjacent to siamese fire department connection.
- .3 Provide on wall near sprinkler valve, cabinet containing extra sprinkler heads of each type and a wrench suitable for each head type. Six (6) extra sprinkler heads for less than 300 sprinklers, 12 for 300 to 1000 sprinklers, and 24 for over 1000 sprinkler heads of each type.
- .4 Provide *25 mm 1 in.* diameter nipple and *25 mm x 15 mm 1 in. x 1/2 in.* reducing fitting for each upright head.
- .5 Provide on sprinkler system take-off from water supply approved double check valve assembly with approved listed OS & y gate valves on both sides.
- .6 All sprinkler system isolation valves shall have contacts so that they can be monitored on the building fire alarm systems.
- .7 Centre heads in two directions in ceiling tile. Maintain code required spacing.
- .8 Locate zone shut-off valves visible from the floor. Do not conceal from view, locate in janitor, storage rooms, or stairwells as accepted by the Consultant.
- .9 Install all piping to minimize drops and furring requirements.
- .10 Arrange sprinkler piping and provide drain valves such that it is completely drainable. Extend drain lines to an accessible location above ceiling over housekeeping areas. Provide valved hose connection and access panel.
- .11 Provide sprinkler flow test connections as per NFPA 13.
- .12 Provide seismic restraints as required by NFPA-13, and Section 15050 of this specification.
- .13 Allow for additional sprinkler heads in mechanical rooms to accommodate field conditions.
- .14 Install approved monitored valves and flow switches for all zones. Monitored valves and flow switches shall be wired to central fire alarm system by Division 16. Identify each valve by indicating which portion of the system is controlled by each valve.
- .15 All sprinkler head locations shall be coordinated with the lighting, audio equipment, and all other obstacles on the ceilings.
- .16 Adjust sprinkler piping up or down if conflicts occur between structure, lighting, electrical, plumbing piping or ductwork.
- .17 Provide and install accelerators or exhausters on the dry pipe valve stations to ensure water flow to each system at most remote location within 60 seconds.

- .18 At each capped-off wet sprinkler location shown on the plans provide and install two bolted flanges with threaded female connection. Behind each cap-off there shall be installed a metal Blank and full gaskets punched for bolt holes. The metal Blank shall have a tab with 6 mm hole in tab for wire hanger connection. The metal Blank shall be fitted between the two bolted flanges and gaskets and made watertight. Bolted flanges shall be installed clear of ducts and other equipment.
- .19 A wrap around hanger or other approved means shall be provided at the end of each branch sprinkler line to prevent excessive movement.
- .20 Drop in inserts are not permitted. Use wedge type anchors or those indicated in Section 15090.
- .21 The built in vertical adjustment on sprinkler heads shall not be used so that all nipples are the same length and the piping grade is achieved by having various non uniform sprinkler head depths with respect to the escutcheons. All heads and cups shall be uniform in depth and elevation.
- .22 \*See Bulletin 93-1 Protection of Standpipes and Sprinkler Piping Against Freezing in City of Vancouver design.
- .23 Do not install any sprinkler heads until all piping systems have been flushed of all contaminants such as cutting oil.
- .24 Provide wire guards on all sprinkler heads subject to damage, i.e. closets, mechanical rooms, equipment rooms, etc.
- .25 Provide dry pendant or sidewall heads on all wet sprinkler systems with heads piped into cold areas.
- .26 Provide sprinkler heads in all elevator pits and at top of elevator shafts.
- .27 Provide breakaway sprinkler heads in all areas subject to damage such as security areas, prisons and psychiatric cells.
- .28 All off site prefabrication of sprinkler piping shall be at the contractor's own risk.

### 3.2 Testing

- .1 All tests required by this standard for the work shall be performed by this Contractor. When the authority having jurisdiction desires to be present during the conduct of tests, the Contractor shall give the authority having jurisdiction advance notification of time tests to be performed.
- .2 When the representative of authority having jurisdiction is not available and permission is granted by that authority, tests may be witnessed by the Owner or his representative and the Contractor's material and test certificate as per NFPA standards shall be completed and forwarded to the authority having jurisdiction.
- .3 The sprinkler system is subject to final inspection test, and approval by the Fire Marshall and Consultant.
- .4 Before requesting approval and acceptance testing of the equipment by the Fire Marshall, the installing company shall furnish a written statement to the effect that the work covered in this installation has been completed and tested in accordance with the approved plans and specifications, and shall provide a "Contractor's Material and Test Certificate" as required by the NFPA Standard No. 13, General Information.
- .5 All systems and piping shall be tested hydrostatically at not less than 1380 kPa pressure for two (2) hours, or at 345 kPa in excess of the maximum static pressure when the maximum static pressure is in excess of 1034 kPa.
- .6 The hydrostatic test pressure shall be measured at the low point of the individual system or zone being tested.

- .7 The inside piping shall be installed in such a manner that there will be no visible leakage when the system is subjected to the hydrostatic pressure test.
- .8 Provide flushing connections on all sprinkler systems.
- .9 Piping between the check valve in the fire department inlet pipe and the outside connection shall be tested the same as the balance of the system.
- .10 Brine or other corrosive chemicals shall not be used for testing systems.
- .11 \*The Contractor shall retain the services of a required independent testing agency (approved by the Local Municipality) to carry out or witness flow verification tests for residential sprinkler systems in one and two family dwellings and residential buildings up to four stories in height. The agency shall forward all necessary documentation to the Plumbing Inspection Department to be recorded on the plumbing permit.
- .12 No substance to stop leaks shall be introduced to any sprinkler system.

### 3.3 Final Approval

- .1 Before asking final approval of the automatic dry and wet sprinkler system by the authority having jurisdiction, the installing company shall furnish a written statement to the effect that the work covered by its contract has been completed and tested in accordance with the approved specifications and plans.
- .2 Contractor's Certificate - NFPA Testing Contractor's Certificate is to be completed and forwarded to the authority having jurisdiction and the Consultant as evidence that the necessary tests and materials have been provided. It is stressed that all sections of the certificate are to be completed.
- .3 There shall be maintained on the premises a supply of spare sprinklers (never less than six (6)). These sprinklers shall correspond as to types and temperature ratings with the sprinklers in the property. The sprinklers shall be kept in a cabinet. The cabinet shall be located in the mechanical room.
- .4 A special sprinkler wrench shall also be provided and kept in the cabinet, to be used in the removal and installation of sprinklers.
- .5 The stock of spare sprinklers shall be as follows for each type of sprinkler head used on the project:
  - .1 For systems not over 300 sprinklers, not less than six (6) sprinklers.
  - .2 For systems 300 to 1,000 sprinklers, not less than twelve (12) sprinklers.
  - .3 For systems above 1,000 sprinklers, not less than twenty-four (24) sprinklers.

### END OF SECTION

## **1. GENERAL**

### **1.1 Scope**

- .1 Fire extinguishers.
- .2 Fire extinguisher cabinets and mounting hardware

### **1.2 General Requirements**

- .1 Provide portable hand extinguishers where indicated on drawings and specified herein.

### **1.3 Quality Assurance**

- .1 Fire protection equipment and installation shall be approved by local Fire Commissioner.
- .2 Equipment and installation shall meet the requirements of NFPA No. 10 Portable Fire Extinguishers. – latest edition

### **1.4 Submittals**

- .1 Submit shop drawings for review. Submit with shop drawings Material Safety Data Sheets (MSDS) for each chemical used in the Fire Extinguishers.

## **2. PRODUCTS**

### **2.1 Portable Hand Fire Extinguishers**

- .1 Multi-Purpose Dry Chemical (Type 1): Pressurized with hose and shut-off nozzle or integral shut-off nozzle and mounting brackets 4.5 kg 10 lb. capacity rating 4A:60BC; 9.0 kg 20 lb. capacity rating 10A:80BC.
- .2 Water Pump Tank (Type 2): 11 L 3 US. gal. capacity \*copper \*stainless steel \*galvanized steel \*polyethylene plastic construction with mounting brackets. Rating 2A.
- .3 Carbon Dioxide (Type 3): Hose and horn discharge, self-closing lever or squeeze grip operated, insulated handle fully charge and complete with mounting brackets, 2.25 kg 5 lb capacity. Rating 5BC.
- .4 Potassium Bicarbonate Powder (Type 4): Pressurized with hose and shut-off nozzle or integral shut-off nozzle and mounting brackets (9.0 kg 20 lb capacity). Rating 80BC.

### **2.2 Fire Extinguisher Cabinets and Brackets.**

- .1 Fire Extinguishers Cabinet: \*Fully recessed \*Semi-recessed \*Surface type 16 gauge steel construction with 12 gauge fully opening door in adjustable frame, \*5 mm 1/5 in. glass full panel \*6 mm 1/4 in. wired glass full panel door, approved latching device, prime coat.

## **3. EXECUTION**

### **3.1 Installation**

- .1 Install extinguishers so that the bottom of extinguisher is no more than 1200 mm 4 ft. above floor.

### **3.2 Schedules**

- .1 Fire Extinguisher Cabinet: FE-1 - semi-recessed with glass door for 100 mm deep wall or semi-recessed in Block walls. National Fire Equipment CE-950 – 1.

- .2 Fire Extinguisher Cabinet: FE-2 – 200mm deep fully exposed with glass door for drywall and concrete block installation. National Fire Equipment Model 999

**END OF SECTION**

## **1. GENERAL**

### **1.1 Scope**

- .1 Air cooled water chiller package.
- .2 Charge of refrigerant and oil.
- .3 Controls and control panel.
- .4 Chilled water connections.
- .5 Starters.
- .6 Electrical power connection.
- .7 Energy manager control system.

### **1.2 Quality Assurance**

- .1 Provide hermetic air cooled water chillers, packaged type, factory assembled and produced by a recognized manufacturer regularly engaged in production of units of type and size specified, who issue complete catalogue data.
- .2 The manufacturer is responsible for selection and operation of all components furnished and for providing written certification that components not furnished have been selected in accordance with the manufacturers requirements.
- .3 Units shall be factory assembled, piped, wired, and charged with refrigerant, complete with compressor, evaporator, air cooled condenser, and starter, all mounted on a structural base suitable for continuous support.
- .4 Units must be CSA and ARI approved.
- .5 Test and rate in accordance with ARI 590-92.
- .6 Machines shall be factory run tested as a complete package at specified design conditions. Factory test results shall be made available upon request.

### **1.3 Use of Environmentally Safe Refrigerants**

- .1 Use R410A
- .2 Chiller shall be capable of operating with an environmentally safe refrigerant with an Ozone Depletion Factor (ODF) not exceeding 0.02. The reduction in cooling capacity shall not exceed 10%; and increase in energy consumption per unit of cooling shall not exceed 5%, when the chiller is filled with an environmentally safe refrigerant.
- .3 The chiller manufacturer shall submit the following information with the tender:
  - .1 Name the refrigerant and its ODF value presently used in chiller.
  - .2 Name of substitute environmentally safe refrigerant and its ODF value.
  - .3 Expected decrease in cooling capacity and increase in energy consumption with the use of the proposed environmentally safe refrigerant.
  - .4 Compatibility information on the materials used in chiller construction with the environmentally safe refrigerant.
  - .5 Hardware changes required and the estimated cost of each change, at the time of refrigerant conversion. This cost shall include all necessary changes to make the chiller operational with the substitute refrigerant.



- .6 Additional operational and maintenance requirements as a result of the use of substitute refrigerant.
- .7 Safety considerations for the use of substitute refrigerant.

#### **1.4 Submittals**

- .1 Shop drawings and approval submissions to include all specified performance data, unit dimensions, weights, sound pressure levels, electrical requirements, and part load performance data.
- .2 Drawings to include required piping and connections together with valves, strainers, and thermostatic valves required for complete installation.
- .3 Submit a complete wiring diagram showing all necessary field wiring.
- .4 Review submissions and shop drawings to clearly indicate any and all variances being taken with the specification.
- .5 Provide to the owner four (4) sets of Operation and Maintenance Manuals after project completion. The manuals shall contain a complete parts list and availability sources.

### **2. PRODUCTS**

#### **2.1 Approved Manufactures**

- .1 Aermec.
- .2 Chiller to come with fully compatible BACnet Interface for monitoring and control.

#### **2.2 Casing**

- .1 Each chiller shall be a single outdoor package which is completely factory assembled, piped, wired and charge with refrigerant.
- .2 Provide a completely self-contained weather tight mechanical room, man sized access door with lock, glycol heating unit, lights and utility plug. Entire mechanical room to be insulated with 50 mm, **2 in.**, 24 kg/m<sup>3</sup> **1.5 lb/ft<sup>3</sup>** density fibreglass insulation c/w perforated metal liner. Casing shall be galvanized steel and finished with vinyl paint.

#### **2.3 Compressor**

- .1 Provide four (4) scroll compressors.
- .2 Provide a field serviceable compressor casing such that excessive loads cannot be placed on shafts, bearings, or seals during assembly or disassembly.
- .3 Use babbitted sleeve main bearings. Provide compressor with force feed lubricating system arranged to ensure adequate lubrication during starting, stopping, and normal operational conditions, and include automatic oil heater and cooler.
- .4 Provide the compressor with automatic capacity reduction equipment consisting of [radial blade inlet vanes] making the machine capable of continuous operation down to 10% of specified capacity at 21°C/70°F ambient temperature.
- .5 Provide compressor motor of induction type operating at [3600 rpm], designed for reduced voltage starting, free from vibration, and not exceeding maximum design torque of compressor or gear. Cool by refrigerant and seal electric terminals hermetically.
- .6 Power to the oil pump motor to be supplied from a separately fused 120 V/60 Hz/1 Phase circuit from the control transformer.

## 2.4 Evaporator

- .1 Cooling only: Just one plate type, high efficiency dry expansion water-refrigerant exchanger braze welded AISI 316 stainless steel with two independent circuits on refrigerant side and one on the water side, with closed cell external insulation in order to prevent the formation of condensation and to reduce heat loss. The anti-freeze electric resistance is mounted as per standard: its functioning is controlled by a dedicated probe positioned in the heat exchanger itself; activation is managed by the circuit board and takes place when the temperature of the water is +3 °C (default value, which can be modified). Respect the PED standard.

## 2.5 Condenser

- .1 Condenser shall be air cooled type, using copper tubes with aluminum fins. Condenser to be designed for operation from 0° to 46°C. **32° to 115°F.**
- .2 Condenser shall include a liquid subcooler.
- .3 Condenser air flow shall be provided by propeller type fans with belt-driven drives selected for quiet operation. All fans shall be provided with protective guards.

## 2.6 Thermostatic valve

- .1 Standard mechanical thermostatic valve with external equaliser 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 to work with minimum temperature of the water produced at 39 °F.

## 2.7 Ventilation Unit

- .1 Increased ventilation unit made up from statically and dynamically balanced helical fans, activated directly by electric motors, which are protected electrically by magnet-circuit breakers and mechanically by anti-intrusion metal grids, according to IEC EN 60335-2-40 Standard and fixed on the upper part of the framework.

## 2.8 Number of fans

- .1 The ventilation unit for the disposal of the heat produced by the condensers is composed of 4 aligned fans.

## 2.9 Controls

- .1 Chiller to come with fully compatible BACnet Interface for control and monitoring.

## 2.10 Pump-Out Unit

- .1 Units operating with refrigerant at positive pressure at 23°C **73.4°F** shall be provided with valves for isolating the entire refrigerant charge in the condenser or the evaporator to permit servicing of either component. In lieu of this capability, manufacturer shall provide a pumpout system including a storage tank, compressor, and piping capable of removing and storing the entire refrigerant charge.

## 2.11 Pressure Ratings

- .1 Design the water side of the evaporator of 1033 kPa **150 psig** working pressure.
- .2 Test refrigerant side at 1960 kPa **285 psig** and water side at not less than 1.5 times maximum working pressure at not less than 310 kPa. **45 psig.**

## **2.12 Starter**

- .1 Provide a unit mounted Closed Transition Starter in a NEMA 12 enclosure. The starter shall be factory wired and factory load tested on the chiller.
- .2 Electronic Overloads: Provide an electronic inverse time overload system to provide the following protection for the compressor motor. All three phases shall be monitored and the highest output shall be used in the overload and current control systems.
  - .1 Excessive locked rotor current protection
  - .2 Excessive locked rotor time protection
  - .3 Maximum full load current protection
  - .4 Protection of equipment against transition resistor failure
- .3 Distribution Fault Protection: Provide a distribution fault system to protect the compressor motor from anomalies in the incoming power supply. System shall consist of a sensor on each of the three phases, and a monitoring device capable of detecting faults as low as 1 - 1/2 electrical cycles in the incoming power supply. System shall disconnect the compressor motor within 6 cycles of fault detection.
- .4 Starter shall contain a circuit breaker capable of breaking currents up to the chillers' design capacity, and to require only one 3-phase power connection for main power, and one auxiliary power connection for the heaters and utility use.
- .5 Provide a 3 kVA control power transformer mounted and wired within the starter.

## **3. EXECUTION**

### **3.1 Installation**

- .1 Adjust each chiller in alignment on foundations, sole plates, sub-bases, and spring isolation. Level and bolt in place.
- .2 Arrange piping so that piping can be easily dismantled to permit tube cleaning.
- .3 Provide and install drain valves and vent cocks on the water boxes.
- .4 Provide and install thermometers and pressure gauges on both the inlet and outlet connection to the evaporator.
- .5 Provide and wire separate chilled water flow switch for each chiller and electrical interlock to the chilled water pump.
- .6 Insulate evaporator, all chilled water piping both inside and outside the chiller, as well as any additional components that may require insulation to prevent sweating under normal conditions.

### **3.2 Start-Up and Operation**

- .1 Each unit shall be capable of mechanical operation down to -11°C. **12.2°F.**
- .2 Provide factory personnel to conduct run-in tests under full load and verify system operation with factory and external installed components. Provide minimum of four (4) days.
- .3 Provide minimum of two (2) days to instruct the Owner on proper operational procedures and attend operation and maintenance seminar.

### **3.3 Performance**

- .1 Refer to Equipment Schedules.

**END OF SECTION**

**Model: NRL0550°°°A°°803**
**Cooling**

|                                |       |          |
|--------------------------------|-------|----------|
| Capacity                       | ton   | 31.87    |
| Input power                    | kW    | 32.85    |
| Input current                  | A     | 41.58    |
| E.E.R.                         | Btu/W | 11.65    |
| I.P.L.V.                       | BTU/W | 14.86    |
| Pump input power               | kW    | 1,000.00 |
| Total input power              | kW    | 1,032.85 |
| Total input current            | A     | 1,307.33 |
| Dry bulb air inlet temperature | °F    | 84.99    |
| Inlet water temperature        | °F    | 55.00    |
| Temperature difference         | °F    | 10.01    |
| Outlet water temperature       | °F    | 45.00    |
| Propylene glycol               | %     | 25       |
| Water flow rate                | gpm   | 79.93    |
| Available pressure             | psi   | 21.54    |

**Seasonal energy efficiency (AHRI capacity ratings)**

| Load percentages | External air temperature | Weight coefficients | E.E.R. |
|------------------|--------------------------|---------------------|--------|
| %                | °F                       | %                   | BTU/W  |
| 100              | 95                       | 1                   | 9.90   |
| 75               | 80                       | 42                  | 13.42  |
| 50               | 65                       | 45                  | 15.64  |
| 25               | 55                       | 12                  | 17.32  |

Evaporator AHRI conditions: data referred to no pump version, leaving water 44 °F and flow rate 2.4 gpm/ton (full load).



Certified in accordance with the AHRI Air-Cooled Water Chilling Packages Using Vapor Compression Cycle Certification Program, which is based on AHRI Standard 550/590 (I-P). Certified units may be found in the AHRI Directory at [www.ahridirectory.org](http://www.ahridirectory.org)

NRL0550A803 has 2 circuits, and 3 compressors.

Sound data (with low sound package)

| NRL       | VERS. | Total sound levels |                  |                 | Octave band[Hz]                                |      |      |      |      |      |      |
|-----------|-------|--------------------|------------------|-----------------|--|------|------|------|------|------|------|
|           |       | Pot.<br>[dB (A)]   | Pressure         |                 | 125  | 250  | 500  | 1000 | 2000 | 4000 | 8000 |
|           |       |                    | [dB (A)]<br>10 m | [dB (A)]<br>1 m | Sound power by central band frequency [dB (A)] |      |      |      |      |      |      |
| HEAT PUMP |       |                    |                  |                 |  |      |      |      |      |      |      |
| 550       | E     | 76                 | 44               | 56              | 63,4   | 66,6 | 70,1 | 70,8 | 69,2 | 65,3 | 58,9 |

## **1. GENERAL**

### **1.1 Scope**

- .1 Water coils.
- .2 Coil installation.
- .3 Coil piping and accessories.

### **1.2 Quality Assurance**

- .1 Coils shall be the product of manufacturer regularly engaged in production of coils who issues complete catalogue data on such products.
- .2 Coil capacities, pressure drops, and selection procedures shall be certified in accordance with ARI Standards and bear ARI seal.

### **1.3 Submittals**

- .1 Shop drawings shall include dimensions, materials of construction and performance data to match specifications.
- .2 Submit coil selection sheets or computer calculations with shop drawings.

## **2. PRODUCTS**

### **2.1 Approved Manufacturers**

- .1 Trane, Aerofin, Engineered Air, Colmac, McQuay.

### **2.2 General**

- .1 Provide extended surface type coils with tubes of copper or brass, and plate of helical type fins of copper or aluminum.
- .2 Space fins 14 per 25 mm 1 in. maximum. Helical fins may be crimped.
- .3 Mount coil section in unit casing designed for bolting to other sections of ductwork.

### **2.3 Water and Glycol Heating Coils**

- .1 Ratings: ARI Standard 470-72 certified.
- .2 Design for maximum operating limits of 1380 kPa 200psig and 115°C. 240°F.
- .3 Coil headers shall be cast iron, copper tube or steel pipe.
- .4 Face length shall not exceed 3 m. 10 ft.
- .5 Fins: Aluminum fins continuous across entire coil width, with full fin collars for maximum fin-tube contact and even spacing. Fins mechanically bonded to tubes. Fins not to exceed 12 in 25 mm [1"].
- .6 Tubes: 16 mm [5/8"] O.D. Seamless copper tubes with return bends brazed into tube ends.
- .7 Headers: Cast iron or steel pipe.
- .8 Casing: Galvanized Steel, formed end supports and top and bottom channels with additional center support on coils over 1067 mm [42"].
- .9 Casing (cooling coils): Coil frames shall be 304 SS.
- .10 Connections: Drain and vent threaded plug connections.

- .11 Glycol Coils: Where glycol coils are specified, coils shall be suitable for use with ethylene or propylene glycol at the scheduled percentage by volume.

### **3. EXECUTION**

#### **3.1 Installation**

- .1 Support coil sections on steel channel or double angle frames and secure to casings. Arrange galvanized steel casings for bolting to other section or unit casings. Provide airtight seal between coils unit cabinets.
- .2 Make necessary connections to coils, including valves, air vents, and unions. Provide isolating valve on supply line and eccentric plug valve on return line to each water coil.
- .3 Locate water supply at bottom of supply header and return water connection at top to provide self-venting and reverse return arrangement. Provide manual air vents at high points complete with stop valves. Ensure water coils are drainable and provide drain connection at low points.
- .4 Protect coils so fins and flanges are not damaged. Replace loose and damaged fins. Comb out bent fins unless required to be replaced.
- .5 Install automatic air vents, drain valves, and means of isolation on each coil.

#### **3.2 Performance**

- .1 Refer to Equipment Schedules.

**END OF SECTION**

## **1. GENERAL**

### **1.1 Scope**

- .1 Centrifugal fans.
- .2 In-line duct fans.
- .3 Fan accessories.
- .4 Roof curbs.

### **1.2 Quality Assurance**

- .1 Conform to AMCA Bulletins regarding construction and testing. Fans shall bear AMCA certified rating seal.
- .2 Fans shall bear CSA label.
- .3 Motors to be high efficiency as specified in Section 15010.

### **1.3 Submittals**

- .1 Submit with shop drawings acoustical data and fan curves showing fan performance with fan and system operating point plotted on curves, including equipment weights and centre of gravity diagrams for suspended fans.

### **1.4 Job Conditions**

- .1 Do not operate fans for any purpose, temporary or permanent until ductwork is clean, filters are in place, bearings are lubricated and fan has been run under close supervision of unit manufacturer.

### **1.5 Alternates**

- .1 Equivalent fan selections shall not increase motor kilowatts, increase rpm, increase noise level, increase tip speed by more than 10%, or increase inlet air velocity by more than 20%, from that of the specified fan.

## **2. PRODUCTS**

### **2.1 Approved Manufacturers**

- .1 Fans – Centrifugal: Buffalo, Twin City, Trane, Chicago, Barry Flower, Norther.
- .2 Fans – In-Line Centrifugal: Greenheck, Jenn Air, Ammerman, ILG, Cook, Penn, Twin City, Carnes.
- .3 Fans – In-Line Centrifugal (Tubular): Chicago, Greenheck, Twin City, Barry/CML, Northern Blower.

### **2.2 General**

- .1 Statically and dynamically balance fans so no objectionable vibration or noise is transmitted to occupied areas of the building.
- .2 Provide balanced variable sheaves for motors 11.2 kW (15 HP) and under and fixed sheave for 15 kW (20 HP) and over.
- .3 Fans are to be capable of accommodating static pressure variations of +10% with no objectionable operating characteristics.



- .4 Fan suppliers to provide replacement sheaves for balancing purposes.
- .5 Provide cross linkage and inlet vanes on double inlet fan.
- .6 Size motors for parallel operating fans for non-overloading operation with only one fan operating.
- .7 Provide belt guards with tachometer holes.
- .8 Exhaust fans for the commercial kitchen exhaust must be listed by ULC or ULI as a "Power Ventilator for Restaurant Exhaust Systems", and meet current NFPA-96 requirements.
- .9 External static pressure means external to the fan cabinet and all accessories such as backdraft dampers, mixing boxes, filters and coils, etc. These accessories if supplied as part of the unit are considered as internal losses for fan.
- .10 Two speed motors shall have separate winding for each speed. Variable speed applications: Small ( $\geq 1/3$  HP) shall be ??? duty c/w variable speed drive matched to fan motor.

### **2.3 Centrifugal Fans**

- .1 Fabricate with multi-blade wheels in heavy gauge steel housing reinforced for service encountered.
- .2 Provide V-belt drives with fan and motor mounted on reinforced, rigid steel base with adjustable motor mount.
- .3 Provide heavy duty, self-aligning, anti-friction bearings. Extend lubrication fittings to outside of fan casing.
- .4 Provide where indicated variable inlet vanes complete with linkage and pneumatic operators.
- .5 Provide access door and drain connection to scroll.
- .6 Unless noted otherwise, centrifugal fans over 425 mm (17 in.) diameter shall have die formed air foil blades welded to side and back plate.
- .7 Provide fan cabinets lined with minimum 25 mm (1 in.) acoustic insulation, unless noted otherwise elsewhere in the specifications.

## **3. EXECUTION**

### **3.1 Installation**

- .1 Where inlet or outlet is exposed, provide safety screen.
- .2 Provide belt guards on belt driven fans complete with tachometer access.
- .3 Supply and install sheaves as necessary for final air balancing.
- .4 Set roof mounted fans on curbs 200 mm (8 in.) minimum above roof. Provide acoustic insulation on duct to below roof line and on fan inlet plenum and drip pan for collecting condensation with drain line to nearest drain.
- .5 Provide 100 mm (4 in.) high housekeeping base for floor mounted units.

### **3.2 Priming**

- .1 Prime coat fan wheels and housing at factory inside and outside. Prime coating on aluminum part is not required.
- .2 Provide two additional coats of paint on fans handling air downstream of humidifiers.

### **3.3 Performance**

- .1 Fan performance based on \*sea level \*\_\_\_\_\_ m (ft) conditions.
- .2 Refer to Equipment Schedule.

**END OF SECTION**

## **1. GENERAL**

### **1.1 Scope**

- .1 Access doors.
- .2 Fire dampers.
- .3 Fire stop flaps.
- .4 Balancing dampers.
- .5 Flexible connections.
- .6 Backdraft dampers.

### **1.2 Quality Assurance**

- .1 Fire dampers shall be ULC listed and constructed in accordance with ULC Standard S 112 "Fire Dampers".
- .2 Fusible links on fire dampers shall be constructed to ULC Standard S 505.
- .3 Demonstrate re-setting of fire dampers to authorities having jurisdiction and Owner's representative.
- .4 Access doors shall be ULC labelled.
- .5 Accessories shall meet the requirements of NFPA 90A, Air Conditioning and Ventilating Systems. Fabricate in accordance with ASHRAE Handbooks and SMACNA Duct Manuals.
- .6 Prove all dampers to inspector at job completion.

### **1.3 Submittals**

- .1 Submit shop drawings of factory fabricated assemblies.

## **2. PRODUCTS**

### **2.1 Acceptable Manufactures**

- .1 Backdraft Dampers: Airolite, Vent-Aire, Penn, T.A. Morrison.
- .2 Balancing Dampers: Maxam, Ruskin.
- .3 Control & Backdraft Dampers: Ruskin, Tamco.
- .4 Smoke-Fire Combination Dampers: Ruskin, Controlled Air, Prefco.
- .5 Dust Collectors: Murphy.
- .6 Fire Dampers: Controlled Air, Ruskin, Canadian Advanced Air, Maxam, Nailor.
- .7 Vent Caps: Jenn-Air, Penn Ventilator.
- .8 Vent Sets: Greenheck, Trane, Sheldons, Buggalo, New York, Brundage, Loren Cook, Lau.
- .9 Silencers: Vibro Acoustics, Vibron, Korfund, I.A.C., Koopers.

### **2.2 Duct Access Doors**

- .1 Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and suitable quick fastening locking devices. Duct access panels with screws are not acceptable. Install minimum 25 mm (1 in.) thick insulation with suitable sheet metal cover frame for insulated ductwork.

- .2 Fabricated with two butt hinges and two sash locks for sizes up to **450 mm (18 in.)**, two hinges and two compression latches with outside and inside handles for sizes up to **600 mm x 1200 mm (24 in. x 48 in.)** and an additional hinge for larger sizes.

### 2.3 Fire Dampers

- .1 Fabricate of galvanized steel or prime coated black steel weighted to close and lock in closed position when released by fusible link.
- .2 Fire dampers shall be curtain type with damper blades retained out of air stream in a recess so free area of connecting ductwork is not reduced.
- .3 Fusible links shall be set for **71° C (160° F.)**.

### 2.4 Fire Stop Flaps.

- .1 Fabricate of heat retardant fabric in galvanized or prime coated black steel frame, spring loaded action to close and lock in closed position when released by fusible link.
- .2 Blanket shall be retained in a recess so free area of connecting ductwork is not reduced.
- .3 Fusible links shall be set for **71° C (160° F.)**.

### 2.5 Balancing Dampers

- .1 Fabricate of galvanized steel, minimum **1.6 mm (16 ga.)** Full blade-length shafts of hollow square construction with blades rigidly fastened along entire blade length.
- .2 Lockable quadrant type operating mechanism with end bearings on accessible rectangular ducts up to **400 mm (16 in.)** deep and on accessible round ducts.
- .3 Wide pitch screw operating mechanism with crank operator and end bearings on accessible rectangular ducts **425 mm (17 in.)** and over in depth and on all inaccessible rectangular and round ducts.
- .4 On rectangular ducts up to **275 mm (11 in.)** deep construct of single blade (butterfly) type.
- .5 On rectangular ducts **300 mm to 400 mm (12 in. to 16 in.)** deep construct of two opposed blades mechanically interlocked with pivots at quarter points.
- .6 On rectangular ducts over **425 mm (17 in.)** deep construct of multiple opposed blades mechanically interlocked with blades no greater than 200 mm deep and pivots equally spaced.
- .7 On round ducts construct of single blade (butterfly) type. On **500 pascal (2 in.wg.)** class and on all dampers over **300 mm (12 in.)** diameter fabricate with full blade-length shaft.
- .8 Construct damper blades for medium and high pressure systems to block air passage 70% maximum. Provide complete with locking type handles.
- .9 Provide over-ride limiting stops on all operating mechanisms.
- .10 Identify the air flow direction and blade rotation and open and close positions on operating mechanism.
- .11 On round ductwork install operating mechanism on a steel mounted base firmly secured to the ductwork.
- .12 On externally insulated ductwork, install operating mechanisms on a steel bridge type mounting base to permit continuity of insulation under the mechanism.

## 2.6 Flexible Connections

- .1 Fabricate of ULC approved neoprene coated flameproof glass fabric approximately *150 mm (6 in.)* wide tightly crimped into metal edging strip and attached to ducting and equipment by screws or bolts at *150 mm (6 in.)* intervals. Flexible connection airtight at *500 Pa (2 in.wg.)*.
- .2 Do not use flexible connections to connect kitchen ductwork to kitchen fans where the fan is mounted inside the building enclosure. Fan connections in these cases shall be governed by NFPA 96 (flanged connections).

## 2.7 Backdraft Dampers

- .1 Construct of minimum *1.3 mm (18 ga.)* aluminum channel frame.
- .2 Construct of minimum *0.6 mm (24 ga.)* aluminum blades, complete with stiffeners along trailing edge. Fabricate single blade dampers for duct sizes to *240 mm (9.5 in.)*, multiblade dampers for ducts greater than *240 mm (9.5 in.)*.
- .3 Provide full blade-length shafts complete with brass or nylon bearings.
- .4 Provide neoprene anti-clatter blade strips on pivot side of blades.
- .5 Construct blade connecting linkage of minimum *2.0 mm (12 ga.)* aluminum rod with eyelet, pin bearings, and adjustable counter weight to assist blade opening action.
- .6 Maximum blade length of *750 mm (30 in.)*.
- .7 Backdraft damper suitable for *10 m/s (2000 fpm)* face velocity.

## 3. EXECUTION

### 3.1 Application

- .1 Provide access door minimum *450 mm x 350 mm (18 in. x 14 in.)* or *50 mm (2 in.)* smaller than duct dimension for cleaning and inspection at positions indicated by drawings and as follows:
  - .1 Both sides of turning vanes in all ducts.
  - .2 At each fire damper location.
  - .3 At each side of all heating or cooling coils.
  - .4 At all locations of internally duct mounted devices including automatic dampers, damper motors and control sensors and devices.
- .2 Provide fire dampers at locations shown, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Fire dampers shall be complete with required perimeter mounting angles sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- .3 At each point where ducts pass through duct shall be sealed with non-combustible material.
- .4 Provide balancing dampers at points on supply and exhaust systems where branches are taken from larger ducts as required for proper air balancing.
- .5 Install ducts associated with fans and equipment subject to forced vibration with flexible connections, immediately adjacent to equipment and/or where indicated on drawing.
- .6 All fire dampers and fire stop flaps are to be left in the closed position for balancing contractor to fix open.
- .7 Support ceiling fire stops from the structure above the fire stop and not from air outlets on associated ductwork.

**END OF SECTION**

## 1. GENERAL

### 1.1 Scope

- .1 When the duct systems are completed and before any fan systems are operated, all ductwork, plenums, coils and air handling equipment shall be cleaned by compressed air and mechanical equipment; or compressed air and high power suction equipment. No special cleaning is required for exhaust ductwork systems that convey air directly to the outside at all times without recirculation.
- .2 Clean all new and existing ductwork.
- .3 A letter shall be submitted by the cleaning company certifying that all systems have been completely cleaned.

### 1.2 Quality Assurance

- .1 Firms to be specialists in this field. Submit list of equipment, capacities, method and sequence of cleaning to the Engineer for approval prior to beginning work.

## 2. PRODUCTS

### 2.1 Materials

- .1 The sheet metal subtrade shall provide all necessary access doors to facilitate efficient ductwork cleaning as listed under installation.
- .2 Provide approved filters to protect equipment during cleaning operation. Submit shop drawings indicating which type of filters are to be utilized to protect equipment during construction and cleaning operation.
- .3 The contractor shall sample and analyze the contamination in the ductwork as requested by the Engineer. The results may be verified by an independent laboratory, paid for by the Contractor, specializing in this type of work.

## 3. EXECUTION

### 3.1 Installation

- .1 Ductwork access doors for ductwork cleaning shall be installed as follows:
  - .1 At **10 m33 ft.** intervals in all duct systems.
  - .2 At the base of all duct risers.
  - .3 Both sides of turning vanes in all ducts.
  - .4 At each fire damper location.
  - .5 At each side of all heating or cooling coils.
  - .6 At all locations of internally duct mounted equipment or devices including balancing dampers, automatic dampers, damper motors and controls.
- .2 Access doors shall be as specified in Section 15860, "Duct Accessories". Access panels with screws are not acceptable.
- .3 Access door size shall be a minimum **450 mm18 in.** x **350 mm14 in.** or **50 mm2 in.** smaller than duct dimension.

- .4 For duct cleaning system utilizing compressed air and mechanical brush, suitably sized access points with positive locking cover shall be installed at **3 m10 ft.** interval in the duct work and on both sides of dampers, coils, turning vanes, etc.
- .5 Access system shall be reusable to allow for future inspection or cleaning.
- .6 All ductwork outlets shall be sealed with suitable cover after ductwork has been cleaned. All plenums to be sealed after plenums have been cleaned.
- .7 Prior to any work being started on the system, filter media shall be installed behind every supply grille or diffuser. This will act as a safety net for contamination which may be disturbed during cleaning. After a settling down period of two to five days, the filter media will be removed.
- .8 Each aspect of the system shall be cleaned regardless of the size, type or configuration. Dirt clinging to the sides or top of ducting must be removed and left as clean as the bottom. Spiral ducting should be as clean as flat.
- .9 After completion of cleaning and approval by the owner's representative, the complete system shall be disinfected with a chemical directly applied to the ductwork. The chemical shall be applied using compressed air and spray wand that emits a 360° spray pattern. Mist or fog applications will not be allowed. Chemical to be used is JOHNSON ENDBAC 128, or approved equal.
- .10 A monitoring probe should be fitted to each system as part of the warranty program. Visible monitoring will enable the owner to easily and accurately watch future build-up of contamination.

### **3.2 Inspection**

- .1 The cleanliness of ductwork shall be inspected using a borescope supplied by the contractor. This shall be made available to the owner at all times.
- .2 Any ductwork found to be dirty shall be redone through its entire length at no extra cost to the Owner.

**END OF SECTION**



## **1. GENERAL**

### **1.1 Scope**

- .1 Diffusers.
- .2 Grilles and registers.
- .3 Outside louvres.
- .4 Door grilles.
- .5 Diffuser boots.
- .6 Roof hoods.
- .7 Goosenecks.

### **1.2 Quality Assurance**

- .1 Air flow tests and sound level measurement shall be made in accordance with applicable ADC equipment test codes, ASHRAE Standards and AMCA Standards.
- .2 Unit rating shall be approved by ADC and AMCA.
- .3 Manufacturer shall certify catalogued performance and ensure correct application of air outlet types.
- .4 Outside louvres shall bear AMCA seal for free area and water penetration.

### **1.3 Project Conditions**

- .1 Review requirements of outlets as to size, finish and type of mounting prior to submitting shop drawings and schedules of outlets.
- .2 Positions indicated are approximate only. Check locations of outlets and make necessary adjustments in position to conform with Architectural features, symmetry and lighting arrangement.

### **1.4 Submittals**

- .1 Submit shop drawings with complete catalogue information, materials of construction, dimensions and accessories.
- .2 Submit colour selection charts of finishes for approval prior to fabrication.

## **2. PRODUCTS**

### **2.1 Approved Manufactures**

- .1 Air Terminals – Grilles, Registers, Diffusers: E.H. Price, Titus, Amenostat, Nailor.
- .2 Louvres: Airolite, Penn, Airstream, West Vent, Nailor, Ruskin.

### **2.2 General**

- .1 Base air outlet application on space noise level of NC 30 maximum.
- .2 Provide supply outlets with sponge rubber seal around the edge.
- .3 Provide baffles to direct air away from walls, columns or other obstructions within the radius of diffuser operation.
- .4 Provide plaster frame for diffusers located in plaster surfaces.

- .5 Provide anti-smudge frames or plaques on diffusers located in rough textured surfaces such as acoustical plaster.
- .6 Provide 30 mm margin frame with (countersunk screw holes) (concealed fastening).
- .7 \*Fabricate of (steel with 1.0 mm minimum frames and 0.8 mm minimum blade),(steel and aluminum with 1.0 mm minimum frame), (or heavy aluminum extrusions).
- .8 Provide grilles with integral, gang-operated opposed blade dampers with removable key operator, operable from face.
- .9 In gymnasium, Aquatic Centres, front blades shall be front pivoted, welded in place or securely fastened to be immobile.
- .10 \*Finish in factory (baked enamel) (prime coat) finish.
- .11 Refer to Air Outlet Schedule for specifications of air outlets.

### 2.3 Door Grilles

- .1 Fabricate of V-shaped louvres of 1.0 mm (20 ga.) steel, 25 mm (1 in.) deep on 15 mm (1/2 in.) centres.
- .2 Provide 1.0 mm (20 ga.) steel frame with auxiliary frame to give finished appearance on both sides of door.
- .3 Factory finish in prime coating.

### 2.4 Outside Louvres

- .1 Louvres \*100 mm (4 in.) \*150 mm (6 in.) deep with blades on 45° slope \*with centre baffle and return bend heavy channel frame, birdscreen with 15 mm (1/2 in.) square mesh.
- .2 \*Fabricate of 1.6 mm (16 ga.) galvanized steel blades and frame. Provide welded assembly.  
\*Fabricate of 2.0 mm (14 ga.) extruded aluminum blades and frame. Where openings exceed 1800 mm (72 in.) in height, jamb frames shall be 2.0 mm (14 ga.) Provide welded assembly.
- .3 Finish in factory \*prime coat \*baked enamel \*anodized finish. Colour shall be selected by the Architect.
- .4 Fabricate louvered penthouses with mitered corners and sheet roof reinforced with structural angles.

### 2.5 Roof Hoods

- .1 Air inlet or exhaust hoods shall have removable hood, curb flange and birdscreen with 15 mm (1/2 in.) square mesh.
- .2 Fabricate of \*galvanized steel minimum 1.6 mm (16 ga.) base and 1.0 mm (20 ga.) hood or \*aluminum 1.6 mm (16 ga.) base and 1.3 mm (18 ga.) hood. Provide suitable reinforcing to hood. Louvres shall be storm proof.
- .3 Mount unit on minimum 300 mm (12 in.) high curb base with insulation between duct and curb.
- .4 Finish in factory \*prime coat \*baked enamel \*anodized finish.
- .5 Hood outlet area shall be minimum twice throat area.

### 2.6 Goosenecks

- .1 Fabricate goosenecks of minimum 1.3 mm (18 ga.) galvanized steel.

- .2 Mount on minimum 300 mm (12 in.) high curb base where size exceeds 225 mm x 225 mm (9 in. x 9 in.).

### **3. EXECUTION**

#### **3.1 Priming**

- .1 Paint ductwork visible behind air outlets matte black.

#### **3.2 Sizing**

- .1 Size outside air louvres as indicated on drawings.
- .2 Size air outlets as indicated on drawings.

#### **3.3 Seismic Requirements**

- .1 All air outlets mounted in a t'bar ceiling shall be seismically restrained by:
  - .1 Secure attachment to solid ductwork which is braced at the outlet.
  - .2 Wire hangers attached to structure. Minimum of two (2) per outlet and one per 1200 mm length.
- .2 Air outlets other than t'bar mounting must be securely attached to the building elements.

#### **3.4 Air Outlets Schedule**

- .1 Refer to Equipment Schedules.

**END OF SECTION**

## 1. GENERAL

### 1.1 Scope

- .1 Panel filters.
- .2 Cube filters.
- .3 Pleated filters.
- .4 High efficiency bag filters.
- .5 Roll filters.
- .6 Electronic air filters.
- .7 Hepa filters.

### 1.2 Quality Assurance

- .1 Filters shall be product of and supplied by one manufacturer.
- .2 Filter media shall be UL listed, Class I or Class II.
- .3 Filter components assembled to form filter banks shall be products of same manufacturer.
- .4 All filters except HEPA shall be in accordance with ASHRAE Standard 52.76.
- .5 Filters containing asbestos, urea formaldehyde or fibreglass shall not be acceptable.

### 1.3 Alternatives

- .1 Size, media face area, material, test efficiency, initial and final air resistance of alternative manufacturers shall be as specified.

## 2. PRODUCTS

### 2.1 Frames

- .1 Fabricate filter frames and supporting structures of galvanized steel or extruded aluminum with necessary gasketing between frames and walls. Provide holding frames **1.6 mm, 16 gauge**, "T" section construction.
- .2 Provide standard size frames to provide interchangeability of filter media of other manufacturers.

### 2.2 Panel Filters

- .1 Media: The air filter shall consist of a 3 ply panel filter element in a uniform non woven structure. The filter shall be fabricated from variable denier Dacron fibres offering a graduated media with minimum loft of **40 mm 1 1/2 in.** and shall be progressively bonded with a fire retardant latex binder.
- .2 The filter shall contain a non migrating tackifier impregnated between the second and third ply to prevent unloading of the tackifier downstream.
- .3 Holding Frames: **1.3 mm 18 gauge** minimum galvanized frame with expanded metal grid on leaving air side and steel rod grid on air entering side, hinged with pull and retaining handles.
- .4 The filter shall be Class II listed by UL.
- .5 Filters containing asbestos, urea formaldehyde or fibreglass will not be accepted.

- .6 The filter shall have an average dust spot efficiency of 45% (ASHRAE 52-76) at 2.54 m/s **500 fpm** maximum face velocity at a final resistance of 125 Pa. **0.5 in.w.g.**

### 2.3 Cube Filters

- .1 Media: The air filter shall consist of a 3 ply filter element in a uniform non woven weave structure.
- .2 The filter shall be fabricated from variable denier Dacron fibres offering a graduated media with a minimum loft of 25 mm **1 in.** and shall be progressively bonded with a fire retardant latex binder.
- .3 The filter shall be welded around an internal wire header that requires no additional hardware to install in the frame. The filter shall contain non migrating tackifier impregnated between 2nd and 3rd plies to prevent unloading of tackifier downstream.
- .4 The filter shall have an efficiency of 45% based on ASHRAE 52-76 at 2.03 m/s **400 fpm** maximum face velocity.
- .5 The filter shall be Class II listed by UL.
- .6 Filters containing asbestos, urea formaldehyde, or fibreglass will not be accepted.

### 2.4 Pleated Filters

- .1 Media: The filter shall be constructed of non-woven reinforced cotton rayon. A diamond grid with 98% open area shall provide support for the media. The media shall be bonded to media support to ensure pleat stability. A rigid, moisture resistance heavy duty kraft board shall enclose the media. The filter pack shall be bonded to the inside periphery of the frame to eliminate air bypass.
- .2 The efficiency shall be (30-35%) (50-55%) based on ASHRAE 52-76 up to 2.54 m/s **500 fpm** for 25 mm **1 in.** and 50 mm **2 in.** thick and up to 3.05 m/s **600 fpm** for 100 mm **4 in.** thick.
- .3 Filters containing asbestos, urea formaldehyde or fibreglass will not be accepted.

### 2.5 High Efficiency Bag Filters

- .1 Media: The filter shall consist of 3 layers of progressively structured filter media combining synthetic unbreakable micro wires with prefilter media layer. Packets are to be self supported, leak free welded and an integral part of the header frame which shall be made of corrosion resistant hard polyurethane foam constructed to withstand up to 100% relative humidity, high velocity and turbulence.
- .2 The filter shall have an efficiency of 90% based on ASHRAE 52-76 at a face velocity of 2.54 m/s **500 fpm** maximum and an initial resistance of 105 Pa. **0.4 in.w.g.**
- .3 The filter shall be Class II listed by UL.
- .4 No filter containing asbestos, urea formaldehyde or fibreglass will be accepted.
- .5 Holding Frames: 1.6 mm **16 gauge** galvanized steel with sealing grooves and gaskets, locking clips and provision for (front mounted) panel prefilter and (front) (rear) removal of filter media.

### 2.6 Roll Filters

- .1 General Assembly: Heavy gauge galvanized steel assembly with drive, controls and media which feeds media across-air stream and winds and compresses used media for disposal. Enclosed the clean media roll with a hinged roll cover. Include tension panel to allow compression of used media as it is spooled. Arrange to allow upstream replacement of filter media.

- .2 Media: Rolled and compressed non breakable, no shredding polyester fibres available on one or two ply with scrim backing. Efficiency shall be (15%) (25%) based on N.B.S. atmosphere test.
- .3 Filters containing asbestos, urea formaldehyde or fibreglass will not be accepted.
- .4 Drive Mechanism: (Electric gear reducer motor) (Hand crank for manual operation) to wind rewind spool through chain and sprocket.
- .5 Controls: Provide manual switch to advance media.

## 2.7 Electronic Air Cleaners

- .1 General Assembly: Heavy gauge galvanized steel assembly containing electronic agglomerator and (panel) (roll) (high efficiency) bag filters.
- .2 Electronic Agglomerator: Independently supported and nested collection cells of aluminum construction including ionizing wires, grounded struts, positive and negative plates, insulators, ionizer and plate contacts. Locate insulators out of air stream.
- .3 Power Pack: Self-contained, pre-wired rectifying unit to convert 115V AC to approximately 1200 V DC for ionizer and 6000 V DC for collector, including overload protection, on-off switch, pilot light indicating operating status and safety accessories.
- .4 Safety Accessories: For filter plenum access doors, provide manual reset safety switches and warning lights and enameled high voltage warning signs. Provide signal lights and safety switching upstream and downstream of unit within duct.
- .5 Efficiency: Media efficiency minimum (85%) (90%) (95%) NBS (atmospheric) type tests.

## 2.8 HEPA Filters

- .1 The filter shall be constructed of fire retardant water proof glass paper folded sheets with string separators to ensure constant spacing of the folds. Folds are sealed in the frame by means of (mineral seal, PVC or silicon).
- .2 The frame shall be (galvanized/stainless steel).
- .3 Gaskets shall be half round *10 mm0.4 in.* (neoprene foam/silicon) moulded in one piece.
- .4 The filters shall be individually tested and certified to have an efficiency of not less than (95%/99.97%/99.9%) when tested with 0.3 micro dioctylphthalate smoke. The initial pressure drop will not exceed *250 Pa1 in.w.g.* when operating at a velocity of *2.54 m/s.500 fpm.*
- .5 The filter shall be Class II listed by UL.
- .6 Filters containing asbestos, urea formaldehyde or fibreglass will not be accepted.

## 3. EXECUTION

### 3.1 Installation

- .1 Construct and install filters to prevent passage of unfiltered air. Provide felt, rubber or neoprene gaskets.
- .2 Do not operate fan system connected to filter banks until filters (temporary or permanent) are in place. Provide new filters at take-over by the Owner. Replace filters used during construction.
- .3 Provide filter banks in arrangement shown with removal and access indicated.

### **3.2 Performance**

- .1 Refer to Equipment Schedules.

**END OF SECTION**

## **1. GENERAL**

### **1.1 Scope**

- .1 Dry steam humidifier with distribution manifold.
- .2 Controls connections.
- .3 Steam and condensate connections.
- .4 Duct mounting.

### **1.2 Quality Assurance**

- .1 Units shall be products of manufacturer regularly engaged in production of such units who issues complete catalogue data on such products and who can provide local service personnel.

### **1.3 General Requirements**

- .1 Factory assemble units prior to shipment.

### **1.4 Submittals**

- .1 Submit shop drawings for review.

## **2. PRODUCTS**

### **2.1 Approved Manufacturers**

- .1 Humidifiers – Electric
  - .1 Armstrong, Vapac, Nortec, Dri-Steam.
- .2 Humidifiers – Steam
  - .1 Armstrong, Sarco, Dri-Steam.

### **2.2 General**

- .1 Humidifiers shall be suitable for (pneumatic) (electric) (electronic) modulating control.
- .2 Humidifier shall be steam separator type providing full separation ahead of integral steam jacketed control valve which discharge through internal steam jacketed drying and silencing chambers and a steam jacketed distribution manifold.
- .3 Humidifier shall receive steam at supply pressure and discharge at atmospheric pressure.

### **2.3 Steam Separator**

- .1 Separating chamber shall disengage and remove water droplets and particulate matter larger than 3 microns when humidifier is operating at maximum capacity.
- .2 Integral metering valve shall be steam jacketed parabolic plug, capable of modulating flow of steam over entire stroke of operator.
- .3 Internal drying and silencing chamber shall receive steam at atmospheric pressure and be jacketed by steam at supply pressure. Silencing chamber shall utilize stainless steel silencing medium.



**2.4 Distribution Manifold**

- .1 The distribution manifold shall provide uniform distribution over entire length and be jacketed by steam at supply pressure.

**2.5 Controls**

- .1 Supply units with integral (pneumatic) (electric) (electronic) operator.
- .2 Equip with interlocked temperature switch to prevent humidifier from operating before start-up condensate is drained.

**3. EXECUTION**

**3.1 Installation**

- .1 Furnish with inlet strainers and external inverted bucket steam trap.
- .2 Provide galvanized steel rods to support distribution manifolds in air plenums.
- .3 In-duct humidifiers shall be installed in a min. 60" (1.5m) long section of stainless steel duct with the bottom section sloped at 5% down to a drain point below the humidifier distributor bar.

**3.2 Performance**

- .1 Refer to Equipment Schedules.

**END OF SECTION**

## **1. GENERAL**

### **1.1 General**

- .1 The project will achieve or exceed following temperature, humidity and acoustical requirements:
- .2 Commissioning and stabilization of HVAC function in museums: Environment standards for a Class A museum tolerate only a minimal variation of temperature and humidity over the course of 24 hours. Proof of stability is a requirement using these charts, by lenders such as the National Gallery of Canada for approval of artwork loans to the Surrey Art Gallery: Requirements for proving consistency are the paper hygrothermograph charts sourced from a number of machines placed throughout the Gallery's art handling/storage, exhibition and preparation spaces at the height of art storage and display.
- .3 Temperature: should be set at a steady temperature within this range 18-24°C and controlled with a variation no more than  $\pm 1^{\circ}\text{C}$  over 24 hours. The Gallery recommends 20C.
- .4 Relative Humidity: 40-55% and should be set within this range and not vary more than the control value variation of  $\pm 5\%$  over 24 hours. The Gallery recommends 50%.
- .5 New HVAC units meet CCI requirements for a Class A museum - Fluctuations must be within minimal tolerances over limited passages of time
- .6 HVAC units operate to museum standard until scheduled removal - No fluctuations can occur while artwork is on display or in gallery art holding or prep areas
- .7 HVAC units and air systems need to be very quiet as the Gallery presents audio art. - The HVAC needs to be almost silent

### **1.2 Summary**

- .1 Section Includes:
  - .1 Control devices integral to the Building Energy Monitoring and Control System (EMCS).
  - .2 Control devices integral to the low voltage control panel and emergency stop buttons.

### **1.3 References**

- .1 National Electrical Manufacturer's Association (NEMA).
  - .1 NEMA 250-[03], Enclosures for Electrical Equipment (1000 Volts Maximum).
- .2 Canadian Standards Association (CSA International).
  - .1 CSA-C22.1-[02], Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

### **1.4 Definitions**

- .1 Acronyms and Definitions: refer to General Requirements.

### **1.5 Submittals**

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section Submittals and Review Process.

## **2. PRODUCTS**

### **2.1 General**

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, assembly.
- .3 Operating conditions: 0 - 32 degrees C with 10 - 90% RH (non-condensing) unless otherwise specified.
- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.
- .8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.
- .9 Range: including temperature, humidity, and pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

### **2.2 Temperature Sensors**

- .1 General: contractor shall provide standard 10k ohm type-3 thermistor temperature sensors. Room sensors and displays to be Delta DNS-24L LCD display.
  - .1 Thermocouples: limit to temperature range of 200 degrees C and over.
  - .2 RTD's: 100 or 1000 ohm at 0 degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.
  - .3 Sensing element: hermetically sealed.
  - .4 Stem and tip construction: type 304 stainless steel.
  - .5 Time constant response: less than 3 seconds to temperature change of 10 degrees C.
  - .6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length as indicated.
- .2 Room temperature sensors and display wall modules.
  - .1 Temperature sensing and display wall module. (All Spaces except Area)
    - .1 LCD display to show space temperature, temperature setpoint, occupied/unoccupied mode, Unit status.
    - .2 Buttons for occupant selection of temperature setpoint.
    - .3 Motion sensor for Occupied / Unoccupied mode.
    - .4 Integral thermistor sensing element 10,000 ohm at 24 degrees.
    - .5 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.
    - .6 Stability 0.02 degrees C drift per year.
    - .7 Separate mounting base for ease of installation.

- .8 Wall mounting, in slotted type covers with lockable guard.
- .9 Able to provide a dead band of at least 5°F within of which the supply of heating and cooling energy to the space is reduced to a minimum.
- .2 Room temperature sensors. (Space)
  - .1 Wall mounting, in slotted type covers having brushed aluminum finish, with lockable guard.
  - .2 Element 10-50 mm long RTD with ceramic tube or equivalent protection or thermistor, 10,000 ohm, accuracy of plus or minus 0.2 degrees C.
- .3 Duct temperature sensors:
  - .1 General purpose duct type: suitable for insertion into ducts at various orientations.
  - .2 Averaging duct type: incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum insertion length 6000 mm. Bend probe at field installation time to 100 mm radius at point along probe without degradation of performance.
- .4 Outdoor air temperature sensors:
  - .1 Outside air type: complete with probe length 100 - 150 mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, weatherproof construction in NEMA 4 enclosure.

## 2.3 Temperature Transmitters

- .1 Requirements:
  - .1 Temperature transmitters not required where thermistors are used.
  - .2 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.
  - .3 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01 degrees C per volt change.
  - .4 Output signal: 4 - 20 mA into [500 ohm maximum load.
  - .5 Input and output short circuit and open circuit protection.
  - .6 Output variation: less than 0.2 % of full scale for supply voltage variation of plus or minus 10 %.
  - .7 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5 % of full scale output.
  - .8 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.
  - .9 Integral zero and span adjustments.
  - .10 Temperature effects: not to exceed plus or minus 1.0 % of full scale/ 50 degrees C.
  - .11 Long term output drift: not to exceed 0.25 % of full scale/ 6 months.
  - .12 Transmitter ranges: select narrowest range to suit application from following:
    - .1 Minus 20 degrees C to plus 50 degrees C, plus or minus 0.5 degrees C.

## 2.4 Humidity Sensors

- .1 Room and Duct Requirements:
  - .1 Range: 5 - 90 % RH minimum.
  - .2 Operating temperature range: 0 - 60 degrees C.

- .3 Absolute accuracy:
  - .1 Duct sensors: plus or minus 3 %.
  - .2 Room sensors: plus or minus 1 %.
- .4 Sheath: stainless steel with integral shroud for specified operation in air streams of up to 10 m/s.
- .5 Maximum sensor non-linearity: plus or minus 2% RH with defined curves.
- .6 Room sensors: wall mounted as indicated. Provide in slotted type covers having brushed aluminum finish, with lockable guard.
- .7 Duct mounted sensors: locate so that sensing element is in air flow in duct.
- .2 Outdoor Humidity Requirements:
  - .1 Range: 0 - 100 % RH minimum.
  - .2 Operating temperature range: -40 - 50 degrees C.
  - .3 Absolute accuracy: plus or minus 2 %.
  - .4 Temperature coefficient: plus or minus 0.03%RH/ degrees C over 0 to 50 degrees C.
  - .5 Must be unaffected by condensation or 100% saturation.
  - .6 No routine maintenance or calibration is required.

## 2.5 Humidity Transmitters

- .1 Requirements:
  - .1 Input signal: from RH sensor.
  - .2 Output signal: 4 - 20 mA onto 500 ohm maximum load.
  - .3 Input and output short circuit and open circuit protection.
  - .4 Output variations: not to exceed 0.2 % of full scale output for supply voltage variations of plus or minus 10 %.
  - .5 Output linearity error: plus or minus 1.0% maximum of full scale output.
  - .6 Integral zero and span adjustment.
  - .7 Temperature effect: plus or minus 1.0 % full scale/ 6 months.
  - .8 Long term output drift: not to exceed 0.25 % of full scale output/ 6 months.

## 2.6 Pressure Transducers

- .1 Requirements:
  - .1 Combined sensor and transmitter measuring pressure.
    - .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
  - .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
  - .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
  - .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
  - .5 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.
  - .6 Over-pressure input protection to at least twice rated input pressure.

- .7 Output short circuit and open circuit protection.
- .8 Accuracy: plus or minus 1% of Full Scale.

## **2.7 Static Pressure Sensors**

- .1 Requirements:
  - .1 Multipoint element with self-averaging manifold.
    - .1 Maximum pressure loss: 160 Pa at 10 m/s. (Air stream manifold).
  - .2 Accuracy: plus or minus 1 % of actual duct static pressure.

## **2.8 Static Pressure Transmitters**

- .1 Requirements:
  - .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
  - .2 Calibrated span: not to exceed 150 % of duct static pressure at maximum flow.
  - .3 Accuracy: 0.4 % of span.
  - .4 Repeatability: within 0.5 % of output.
  - .5 Linearity: within 1.5 % of span.
  - .6 Deadband or hysteresis: 0.1% of span.
  - .7 External exposed zero and span adjustment.
  - .8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit

## **2.9 Pressure and Differential Pressure Switches**

- .1 Requirements:
  - .1 Internal materials: suitable for continuous contact with compressed air, water, steam, etc., as applicable.
  - .2 Adjustable setpoint and differential.
  - .3 Switch: snap action type, rated at 120V, 15 amps AC or 24 V DC.
  - .4 Switch assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.
  - .5 Accuracy: within 2 % repetitive switching.
  - .6 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source.
  - .7 Switches on steam and high temperature hot water service: provide pigtail syphon.

## **2.10 Temperature Switches**

- .1 Requirements:
  - .1 Operate automatically. Reset automatically, except as follows:
    - .1 Low temperature detection: manual reset.
  - .2 Adjustable setpoint and differential.
  - .3 Accuracy: plus or minus 1 Degrees C.
  - .4 Snap action rating: 120V, 15 amps or 24V DC as required. Switch to be DPST for hardwire and EMCS connections.

- .5 Type as follows:
  - .1 Duct, general purpose: insertion length = 460 mm.
  - .2 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.
  - .3 Low temperature detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.
  - .4 Strap-on: with helical screw stainless steel clamp.

## **2.11 Air Pressure Gauges**

- .1 Diameter: 38 mm minimum.
- .2 Range: zero to two times operating pressure of measured pressure media or nearest standard range.

## **2.12 Electromechanical Relays**

- .1 Requirements:
  - .1 Double voltage, DPDT, plug-in type with termination base.
  - .2 Coils: rated for 24V DC. Other voltage: provide transformer.
  - .3 Contacts: rated at 5 amps at 120V AC.
  - .4 Relay to have visual status indication

## **2.13 Solid State Relays**

- .1 General:
  - .1 Relays to be socket or rail mounted.
  - .2 Relays to have LED Indicator
  - .3 Input and output Barrier Strips to accept 14 to 28 AWG wire.
  - .4 Operating temperature range to be -20 degrees C to 70 degrees C.
  - .5 Relays to be CSA Certified.
  - .6 Input/output Isolation Voltage to be 4000 VAC at 25 degrees C for 1 second maximum duration.
  - .7 Operational frequency range, 45 to 65 HZ.
- .2 Input:
  - .1 Control voltage, 3 to 32 VDC.
  - .2 Drop out voltage, 1.2 VDC.
  - .3 Maximum input current to match AO (Analog Output) board.
- .3 Output.
  - .1 AC or DC Output Model to suit application.

## **2.14 Current Transducers**

- .1 Requirements:
- .2 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:
  - .1 4-20 mA DC.

- .2 0-1 volt DC.
- .3 0-10 volts DC.
- .4 0-20 volts DC.
- .3 Frequency insensitive from 10 - 80 hz.
- .4 Accuracy to 0.5% full scale.
- .5 Zero and span adjustments. Field adjustable range to suit motor applications.
- .6 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

## **2.15 Current Sensing Relays**

- .1 Requirements:
  - .1 Suitable to detect belt loss or motor failure.
  - .2 Trip point adjustment, output status LED.
  - .3 Split core for easy mounting.
  - .4 Induced sensor power.
  - .5 Relay contacts: capable of handling 0.5 amps at 30 VAC / DC. Output to be NO solid state.
  - .6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.
  - .7 Adjustable latch level.

## **2.16 Control Dampers**

- .1 Construction: blades, 152 mm wide, 1500 mm long, maximum. Modular maximum size, 1500 mm wide x 1500 mm high. Three or more sections to be operated by jack shafts.
- .2 Materials:
  - .1 Frame: 2.03 mm minimum thickness extruded aluminum. For outdoor air and exhaust air applications, frames to be insulated.
  - .2 Blades: extruded aluminum. For outdoor air/exhaust air applications, blades to be internally insulated.
  - .3 Bearings: maintenance free, synthetic type of material.
  - .4 Linkage and shafts: aluminum.
  - .5 Seals: synthetic type, mechanically locked into blade edges.
    - .1 Frame seals: synthetic type, mechanically locked into frame sides.
- .3 Performance: minimum damper leakage meet or exceed AMCA Standard 500-D ratings.
  - .1 Size/Capacity: refer to damper schedule
  - .2 25 L/s/m<sup>2</sup> maximum allowable leakage against 1000 Pa static pressure for outdoor air and exhaust air applications.
  - .3 Temperature range: minus 40 degrees C to plus 100 degrees C.
- .4 Arrangements: dampers mixing warm and cold air to be parallel blade, mounted at right angles to each other, with blades opening to mix air stream.
- .5 Jack shafts:



- .1 25 mm diameter solid shaft, constructed of corrosion resistant metal complete with required number of pillow block bearings to support jack shaft and operate dampers throughout their range.
- .2 Include corrosion resistant connecting hardware to accommodate connection to damper actuating device.
- .3 Install using manufacturers installation guidelines.
- .4 Use same manufacturer as damper sections.

## **2.17 Electronic Control Damper Actuators**

- .1 Requirements:
  - .1 Direct mount proportional type as indicated.
  - .2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.
  - .3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.
  - .4 Power requirements: 5 VA maximum at 24 V AC.
  - .5 Damper actuator to drive damper from full open to full closed in less than 120 seconds.

## **2.18 Control Valves**

- .1 Body: globe style.
  - .1 Flow characteristic per equipment being served.
  - .2 Flow factor (KV): CV in imperial units.
  - .3 Normally open or Normally closed, as indicated in control sequences.
  - .4 Two or Three port, as indicated on drawings.
  - .5 Leakage rate ANSI class IV, 0.01% of full open valve capacity.
  - .6 Packing easily replaceable.
  - .7 Stem, stainless steel.
  - .8 Plug and seat, bronze.
  - .9 Disc, replaceable, material to suit application.
- .10 NPS 2 and under:
  - .1 Screwed National Pipe Thread (NPT) tapered female connections.
  - .2 Valves to ANSI Class 250, valves to bear ANSI mark.
  - .3 Rangeability 50:1 minimum.
- .11 NPS 22 and larger:
  - .1 Flanged connections.
  - .2 Valves to ANSI Class 250, valves to bear ANSI mark.
  - .3 Rangeability 100:1 minimum.

## **2.19 Electronic / Electric Valve Actuators**

- .1 Requirements:

- .1 Construction: aluminum.
- .2 Control signal: 0-10V DC or 4-20 mA DC.
- .3 Positioning time: to suit application. 90 sec maximum.
- .4 Fail to normal position as indicated.
- .5 Scale or dial indication of actual control valve position.
- .6 Size actuator to meet requirements and performance of control valve specifications.
- .7 For interior and perimeter terminal heating and cooling applications floating control actuators are acceptable.
- .8 Minimum shut-off pressure: refer to control valve schedule.

## **2.20 Wiring**

- .1 In accordance with Section 26 27 10 - Modular Wiring System and / or 26 27 26 - Wiring Devices.
- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
- .3 Wiring must be continuous without joints.
- .4 Sizes:
  - .1 Field wiring to digital device: #20AWG stranded twisted pair.
  - .2 Analog input and output: shielded #20 minimum stranded twisted pair.

## **3. EXECUTION**

### **3.1 Installation**

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
- .3 Duct static pressure sensors are to be placed in a location such that the controller set-point is no greater than one-third the total design fan static pressure.
- .4 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
- .5 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .6 Fire stopping: provide space for fire stopping. Maintain fire rating integrity.
- .7 Electrical:
  - .1 Complete installation in accordance with Section 26 05 01 - Common Work Results - Electrical.
  - .2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
  - .3 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
  - .4 Install communication wiring in conduit.

- .1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).
- .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
- .3 Maximum conduit fill not to exceed 40%.
- .4 Design drawings do not show conduit layout.
- .5 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.

### **3.2 Temperature and Humidity Sensors**

- .1 Stabilize to ensure minimum field adjustments or calibrations.
- .2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.
- .3 Outdoor installation:
  - .1 Protect from solar radiation and wind effects by non-corroding shields.
  - .2 Install in NEMA 4 enclosures.
- .4 Duct installations:
  - .1 Do not mount in dead air space.
  - .2 Locate within sensor vibration and velocity limits.
  - .3 Securely mount extended surface sensor used to sense average temperature.
  - .4 Thermally isolate elements from brackets and supports to respond to air temperature only.
  - .5 Support sensor element separately from coils, filter racks.
- .5 Averaging duct type temperature sensors.
  - .1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
  - .2 Wire multiple sensors in series for low temperature protection applications.
  - .3 Wire multiple sensors separately for temperature measurement.
  - .4 Use software averaging algorithm to derive overall average for control purposes.
- .6 Thermowells: install for piping installations.
  - .1 Locate well in elbow where pipe diameter is less than well insertion length.
  - .2 Thermowell to restrict flow by less than 30%.
  - .3 Use thermal conducting paste inside wells.

### **3.3 Panels**

- .1 Arrange for conduit and tubing entry from top, bottom or either side.
- .2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.
- .3 Identify wiring and conduit clearly.

### **3.4 Pressure and Differential Pressure Switches and Sensors**

- .1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.
  - .1 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

### **3.5 I/P Transducers**

- .1 Install air pressure gauge on outlet.

### **3.6 Air Pressure Gauges**

- .1 Install pressure gauges on pneumatic devices, I/P, pilot positioners, motor operators, switches, relays, valves, damper operators, valve actuators.
- .2 Install pressure gauge on output of auxiliary cabinet pneumatic devices.

### **3.7 Identification**

- .1 Identify field devices in accordance with Section Identification.

## **4. GENERAL**

### **4.1 Summary**

- .1 Section Includes:
  - .1 At minimum detailed narrative description of Sequence of Operation of each system including ramping periods and reset schedules.
    - .1 Control Description Logic (CDL) for each system.
    - .2 Input/Output Point Summary Tables for each system.
    - .3 System Diagrams consisting of the following; EMCS System architectural diagram, Control Design Schematic for each system (as viewed on OWS), System flow diagram for each system with electrical ladder diagram for MCC starter interface.
  - .2 The control sequences contain a general description of the intent of the operation of the systems to be controlled. The Contractor shall review individual systems to ensure equipment and life safety interlocks are not overridden.
  - .3 The relationships between the points, systems and building are described in the control sequences.
  - .4 Review with the Consultant during the shop drawing stage to finalize the control sequences for each system.
  - .5 The attached points list is a summary of EMCS points. They should be considered as an accurate estimate and not the final quantity. Should additional points be required as described in other sections within the EMCS specification then the contractor shall include the larger quantity.

## **5. EXECUTION**

### **5.1 Data Archiving (SEPARATE PRICE)**

- .1 Provide a Coppertree CuCube Data archiving appliance and connect to the BACnet network on site. The CuCube shall store a minimum of 5 years of trend data on site.

- .2 Provide Coppertree Cloud services for:
  - .1 Offsite Data Archiving of all Trend Logs
    - .1 The Coppercube will automatically push the archived data in its memory to the Coppertree cloud for backing up the archived data. This will be performed on a daily basis or more frequently depending on the dashboard requirement for data display (archived versus near real time).
    - .2 The Client will be able to retrieve this data at any time through the client portal web access to the Coppertree Cloud data.
  - .2 DDC System Integrity Analysis Reporting
    - .1 The Coppertree Cloud service shall provide the following system checks and provide a report to the Fortis designate desktop via email for the following:
      - .1 Analog/binary inputs in manual override
      - .2 Analog/binary outputs in manual override
      - .3 Analog/binary inputs in decommissioned mode
      - .4 Analog/binary outputs in decommissioned mode
      - .5 Firmware version check
      - .6 Firmware uniformity check
      - .7 Device time synchronization check
      - .8 Device low memory check
      - .9 Device system status check
      - .10 Schedule in manual override
      - .11 Calendar in manual override
      - .12 Control loop object in manual override
      - .13 Control loop object tuning (simple) check
  - .3 Benchmark Analysis Reporting
    - .1 Analog input calibration changed
    - .2 Analog input sensor type (scale-range) changed
    - .3 Binary input action changed
    - .4 Analog/binary output action changed
    - .5 Device reset count increased
    - .6 Weekly schedule modified
    - .7 Calendar modified
    - .8 GCL program modified
    - .9 Control loop object settings modified
    - .10 Trendlog settings modified
    - .11 Totalizer settings modified
    - .12 Event settings modified
    - .13 Device settings modified
    - .14 Network settings modified

- .4 Automatic DDC System Database Backups
  - .1 The DDC System controller database will be automatically backed up to the Coppertree Cloud once per week.
  - .2 The Client will be able to retrieve this data at any time through the client portal web access to the Coppertree Cloud data.
- .5 Historical Analysis Reporting
  - .1 Historical reporting to include:
    - .1 Input out-of-range check
    - .2 Control loop object tuning (complex) check
    - .3 Zone temperature control KPI reporting
    - .4 Control Loop KPI reporting
- .6 Fault Detection Diagnostics Reporting Tool
  - .1 Provide Dataflow development tool to create fault detection diagnostics rules that will analyse and report based on the FDD rules required.
- .7 Gold Standard Comparison Report
  - .1 Upon completion of the installation and after commissioning of the building, the Coppertree Analytics engine shall be set to take a snap shot of the entire DDC system parameters available to the building operators and/or service agents. Any change from these parameters will be reported by the Coppertree Analytics engine in a weekly report and prioritized by potential impact to energy or comfort.
- .8 Energy Dashboard Display and Calculations (Note: dashboard hardware not in scope)
  - .1 The Coppertree Cloud service shall be able to provide public dashboard display of energy information based on:
    - .1 Historical archived data from metering that is connected to the DDC system
    - .2 Historical Archived data from virtual meters that are calculated from hardware status points that are connected to the DDC system (ie. VFD feedback for motor loads, magnetic starter operation, auxiliary contact from packaged equipment, BACnet information collection via integration from 3rd party systems, etc.)
    - .3 The Coppertree Cloud service engine shall provide the mathematics, normalization, Qsum analysis, and other features to allow the raw historical archived data to be analysed and displayed for meaningful viewing
    - .4 The system shall be capable of connecting to a (future) Dashboard display with the following potential displays at minimum:
      - .1 Graphical plots, pie charts , bar carts etc
      - .2 Base line analysis of actual against target.
      - .3 Historical analysis by year , month , week , day , hour or minute (dependent on the trend sample timing of the physical point)
      - .4 Current year performance displays as compared to previous year

- .9 Provide the Coppercube hardware, configuration setup of data archiving, and Coppertree Analytics annual service fees for a period of 3 years in the control price for this project.

## 5.2 General Requirements

- .1 Provide the database for all physical points listed in the drawings, on the points list and as described in the control sequence.
- .2 Provide the database for all virtual points identified in this section. Virtual points are shown in bold capitalized italic. Provide all necessary controllers, display screens, trend logs as well as any other item as may be required to create, test and modify the control strategies.
- .3 Provide all programming required to implement the control sequences described in this section.
- .4 Programming style is to be of a form that enables the control strategies to be easily followed. Clarity, simplicity and elegance are more important than program size.
- .5 Programs shall be modular in nature and shall be as structured as the language will permit.
- .6 All programs must include a sufficient number of comments to allow another person to make changes to the strategies at some later time.
- .7 Additional programming may be provided by the Contractor as desired, so long as it does not affect the intended operation of the specified sequences. Ensure that all equipment will operate in a safe manner.
- .8 Programming required for equipment safety may be installed by the Contractor as necessary. The Owner shall be notified of these changes as soon as practical.
- .9 All deviations from the specified programming, except those related to equipment safety, must receive prior written approval from the Engineer.
- .10 All control loops shall be tuned such that they are stable through all seasons and operating conditions including startup.
- .11 All HVAC controls shall implement Building operating modes. Unit system description is modifications to the Building operation modes.

## 5.3 Miscellaneous Requirements

- .1 Staggered starting - Motors must not be allowed to start at the same time. Under all conditions of startup, return from power failure or panel reset, there must be at least a 15 second delay between the time one motor starts and another is allowed to start.

## 5.4 Global Programs

- .1 Define a space temperature objective value STOBJ. Program it with a default value of 21 deg C such that the value returns to 21 if the point is not manually commanded to some other value.
- .2 Define a space temperature objective user adjust value STOBJ\_UA (limited – 0.5 to +0.5 deg C). Program it with a default value of zero deg C such that the value returns to zero if the point is not manually commanded to some other value.
- .3 Obtain some basic information from the room temperature sensors:
  - .1 STMAX warmest space temperature.
  - .2 STAVG average of the four sensors.
  - .3 STMIN coolest space temperature
- .4 Define an effective space temperature STEFF, for the building as follows:

- .1 If the outside air temperature OAT is less than 5 deg C then STEFF is the average of STMIN and STAVG.
- .2 If OAT is greater than 20 deg C then STEFF is the average of STMAX and STAVG.
- .3 Otherwise STEFF equals STAVG.
- .4 Smooth STEFF so that it cannot change faster than about 1 deg C per hour.
- .5 Provide an outside air temperature prediction routine which provides the following data:
  - .1 OAPHT predicted high temperature.
  - .2 Oaplt predicted low temperature.
  - .3 Oadh day's high temperature.
  - .4 Oahdh hour that day's high occurred.
  - .5 Oadl day's low temperature.
  - .6 Oahdl hour that day's low occurred.
  - .7 Oaytd yesterday's temperature difference.
  - .8 Oaodh old (previous) day's high temperature.
  - .9 Oaodl old (previous) day's low temperature.
- .6 Provide the following critical dial-out alarms:
  - .1 Low space temperature via STMIN < 12 degC.

## 5.5 Verification of Custom Control Software

- .1 Provide copies of trend logs that clearly indicate the:
  - .1 stability of each control loop under various load conditions including modest step setpoint changes.
  - .2 adequacy of system startup during summer and winter conditions.
  - .3 proper operation of the outside air temperature prediction routines.
  - .4 adequacy of space comfort conditions.

## 5.6 Chilled Water System

- .1 In general, all chiller controls and monitoring points are to be hard wired, as preferred by City of Surrey (Building DDC system uses BACNET protocol).
- .2 Chilled water system is to maintain chilled water temperature at 44F during cooling season (on call for cooling).
- .3 Inline circulators are to work in lead/lag fashion.
- .4 Monitor temperature in storage buffer tank, and incorporate sequence for storage tank to act as a buffer tank (to avoid chiller cycling at partial loads).
- .5 Monitor status of all electrically powered equipment.
- .6 For energy consumption purposes measure Chilled water Loop supply and return temperature and calculate energy consumption based on constant balanced pump flows.
- .7 Energy consumption is to be trend logged.
- .8 Update DDC graphics as necessary to accommodate new chilled water system addition.



- 5.7     The remaining of the sequence of operation shall be generated to achieve the noted project design intend during shop drawing phase.**

**END OF SECTION**




**ATTACHMENT #2**

to

**ADDENDUM #1**

**VISION AIR HANDLING UNIT SPECIFICATIONS**



A 3D perspective view of a containerized system. It shows a blue base with a grey frame. Inside, there are yellow and red rectangular components, and a blue ladder-like structure. The system is mounted on a blue base.

## Unit Overview


| Model Number | Supply            |                  |               |                     |             |              |
|--------------|-------------------|------------------|---------------|---------------------|-------------|--------------|
|              | Air Volume<br>cfm | Static Pressure  |               | External Dimensions |             |              |
|              |                   | External<br>inWc | Total<br>inWc | Height<br>in        | Width<br>in | Length<br>in |
| CAH004GDGM   | 2000              | 0.50             | 2.87          | 30*                 | 40*         | 108          |

*\*Not including base rails, coil connectors, drain connectors and control boxes.*

## Unit

|                            |   |                                   |  |
|----------------------------|---|-----------------------------------|--|
| <b>Model Number:</b>       | CAH004GDGM  |                                   |  |
| <b>Approval:</b>           | ETL Listed / ETL Listed to Canadian Safety Standards (ETL Label / ETLc Label) |                                   |  |
| <b>Outer Panel:</b>        | Standard G90 Galvanized Steel (unpainted)                                     |                                   |  |
| <b>Liner:</b>              | Galvanized Steel (unless noted per section)                                   |                                   |  |
| <b>Insulation:</b>         | R-13 Injected Foam  |                                   |  |
| <b>Sound Baffles:</b>      | Included in Fan, Plenum, Access and Manual section (unless noted per section) |                                   |  |
| <b>Unit Configuration:</b> | Inline horizontal   | <b>Drive (Handling) Location:</b> | Right  |
| <b>Base:</b>               | 4" formed channel   | <b>Wall Thickness:</b>            | 2 in   |
| <b>Shrink Wrapping:</b>    | Yes   | <b>Tread Plate Floor Liner:</b>   | Tread plate installed (unless noted per section) |
| <b>Altitude:</b>           | 0 ft  | <b>Parts Warranty:</b>            | Standard One Year                                |

| Panel Filter                      |            | Component: 1  |                   | Length: 12 in |                | Shipping Section: 1 |  |
|-----------------------------------|------------|---------------|-------------------|---------------|----------------|---------------------|--|
| Type                              | Efficiency | Face Velocity | Face Area         | Air Volume    | Filter Loading |                     |  |
| Pleated                           | MERV 8     | 355 ft/min    | 5.6 ft²           | 2000 cfm      | Side           |                     |  |
| Air Pressure Drop                 |            |               | Number of Filters | Height        | Width          | Depth               |  |
| Clean Air                         | Mean Air   | Dirty Air     |                   |               |                |                     |  |
| 0.23 inWc                         | 0.61 inWc  | 1.00 inWc     | 1                 | 24 in         | 24 in          | 2 in                |  |
|                                   |            |               | 1                 | 24 in         | 12 in          | 2 in                |  |
| Door                              |            |               |                   |               |                |                     |  |
| Location                          |            | Width         |                   | Opening       |                |                     |  |
| Drive side                        |            | 8 in          |                   | Outward       |                |                     |  |
| Special Options                   |            |               |                   |               |                |                     |  |
| Tread Plate Floor Liner           |            |               | Filter Gauge      |               |                |                     |  |
| (As casing details)               |            |               | Minihelic II 0-2" |               |                |                     |  |
| Special Text                      |            |               |                   |               |                |                     |  |
| Intersept Antimicrobial treatment |            |               |                   |               |                |                     |  |

| Hot Water Coil  |                 | Component: 2  |                        | Length: 12 in  |                        | Shipping Section: 1          |                           |
|---|-----------------|---|------------------------|----------------|------------------------|------------------------------|---------------------------|
| Coil Model  |                 | Total Capacity  | Number of Coils        | Number of Rows | Fins per Inch          | Tube Diameter                | Tube Spacing (Face x Row) |
| 5WH1402B  |                 | 127286 Btu/hr   | 1                      | 2              | 14                     | 0.625 in                     | 1.50 in x 1.299 in        |
| Air Volume  | Air Temperature |   | Coil Air Pressure Drop | Finned Height  | Finned Length          | Face Area                    | Face Velocity             |
|   | Entering        | Leaving   |                        |                |                        |                              |                           |
|   | Dry Bulb        | Dry Bulb  |                        |                |                        |                              |                           |
| 2000 cfm  | 15.0 °F         | 73.2 °F   | 0.30 inWc              | 21 in          | 24 in                  | 3.50 ft²                     | 571 ft/min                |
| Water   |                 | Flow Rate   | Pressure Drop          | Velocity       | Volume                 | Weight                       |                           |
| Entering  | Leaving         |   |                        |                |                        |                              |                           |
| 140.0 °F  | 119.7 °F        |   |                        |                |                        |                              |                           |
|   |                 | 12.50 gpm   | 0.70 ftHd              | 1.90 ft/s      | 2.0 gal                | 17.00 lb                     |                           |
| Connection  |                 |   |                        |                | Min. Fin Surface Temp. | Min. Tube Wall Surface Temp. | Fouling Factor            |
| Type  | Quantity        | Size  | Location               | Material       |                        |                              |                           |
| Threaded  | 2               | 2.50 in   | Drive side             | Carbon steel   | 119.7 °F               | 119.7 °F                     | 0.000                     |
| Material  |                 |   |                        |                |                        |                              |                           |
| Fin   |                 | Tube  |                        | Header         |                        | Case                         |                           |
| Aluminum .0075 in   |                 | Copper .020 in  |                        | Copper         |                        | Galvanized track             |                           |
| AHRI 410 Certification  |                 |   |                        |                |                        |                              |                           |
|  |                 | Certified in accordance with the AHRI Forced-Circulation Air-Cooling and Air-Heating Coils Certification Program which is based on AHRI Standard 410 within the Range of Standard Rating Conditions listed in Table 1 of the Standard. Certified units may be found in the AHRI Directory at <a href="http://www.ahridirectory.org">www.ahridirectory.org</a> |                        |                |                        |                              |                           |
| Special Options   |                 |   |                        |                |                        |                              |                           |
| Tread Plate Floor Liner   |                 |   |                        |                |                        |                              |                           |
| (As casing details)   |                 |   |                        |                |                        |                              |                           |

| Chilled Water Coil            |                 | Component: 3      |                 |                 | Length: 28 in          |                        | Shipping Section: 1          |                |               |
|-------------------------------|-----------------|-------------------|-----------------|-----------------|------------------------|------------------------|------------------------------|----------------|---------------|
| Coil Model                    | Total Capacity  | Sensible Capacity | Number of Coils | Number of Rows  | Fins per Inch          | Tube Diameter          | Tube Spacing (Face x Row)    |                |               |
| 5WH1012B                      | 90939 Btu/hr    | 67553 Btu/hr      | 1               | 12              | 10                     | 0.625 in               | 1.50 in x 1.299 in           |                |               |
| Air Volume                    | Air Temperature |                   |                 |                 | Coil Air Pressure Drop | Finned Height          | Finned Length                | Face Area      | Face Velocity |
|                               | Entering        |                   | Leaving         |                 |                        |                        |                              |                |               |
|                               | Dry Bulb        | Wet Bulb          | Dry Bulb        | Wet Bulb        |                        |                        |                              |                |               |
| 2000 cfm                      | 83.0 °F         | 67.0 °F           | 52.1 °F         | 51.9 °F         | 1.46 inWc              | 21 in                  | 27 in                        | 3.94 ft²       | 508 ft/min    |
| Fluid                         |                 | Flow Rate         | Pressure Drop   | Velocity        | Volume                 | Weight                 |                              |                |               |
| Entering                      | Leaving         |                   |                 |                 |                        |                        |                              |                |               |
| 45.0 °F                       | 55.1 °F         |                   |                 |                 |                        |                        | 18.50 gpm                    | 11.00 ftHd     | 2.80 ft/s     |
| Connection                    |                 |                   |                 |                 | Glycol Type            | Min. Fin Surface Temp. | Min. Tube Wall Surface Temp. | Fouling Factor |               |
| Type                          | Quantity        | Size              | Location        | Material        |                        |                        |                              |                |               |
| Threaded                      | 2               | 1.50 in           | Drive side      | Carbon steel    | Propylene (25%)        | 45.0 °F                | 45.0 °F                      | 0.000          |               |
| Material                      |                 |                   |                 |                 | Drain Pan              | Drain Side             |                              |                |               |
| Fin                           | Tube            | Header            | Case            |                 |                        |                        |                              |                |               |
| Aluminum .0075 in             | Copper .020 in  | Copper            | Galv. steel     | Stainless steel |                        |                        | Drive side                   |                |               |
| AHRI 410 Certification        |                 |                   |                 |                 |                        |                        |                              |                |               |
| Coil is NOT certified by AHRI |                 |                   |                 |                 |                        |                        |                              |                |               |

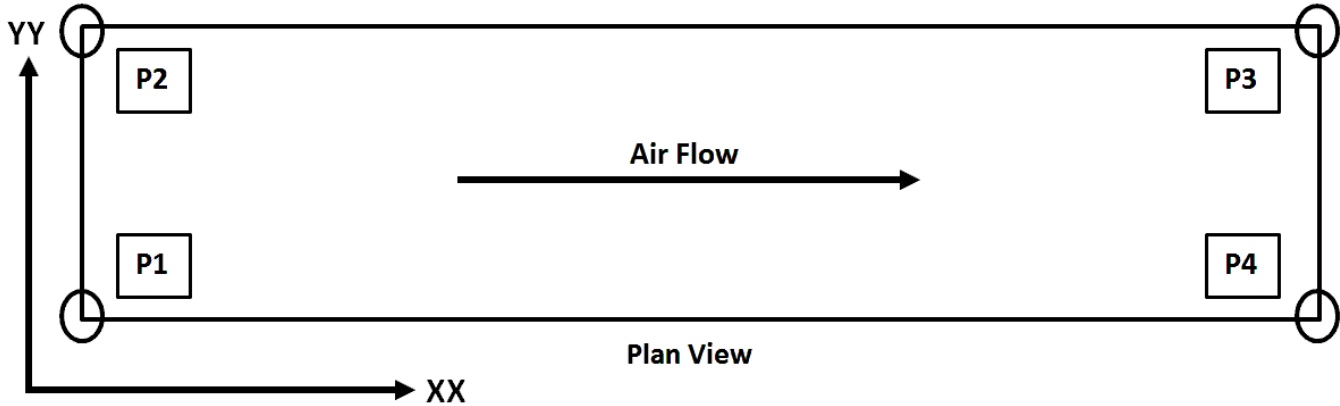
| Access Section    | Component: 4 | Length: 16 in | Shipping Section: 1 |
|-------------------|--------------|---------------|---------------------|
| Air Pressure Drop |              |               |                     |
| 0.00 inWc         |              |               |                     |
| Door              |              |               |                     |
| Location          | Width        | Opening       |                     |
| Drive side        | 12 in        | Outward       |                     |

| Supply Fan                  |                     | Component: 5   |                | Length: 40 in    |                         |           | Shipping Section: 1          |                    |                   |
|-----------------------------|---------------------|--|----------------|------------------|-------------------------|-----------|------------------------------|--------------------|-------------------|
| Fan Performance             |                     |  |                |                  |                         |           |                              |                    |                   |
| Air Volume                  | Static Pressure     |  |                | Brake Horsepower | Speed                   |           | Outlet Velocity              |                    |                   |
|                             | External            | Total  | Cabinet        |                  | Operating               | Maximum   |                              |                    |                   |
| 2000 cfm                    | 0.50 inWc           | 2.87 inWc  | 0.00 inWc      | 1.68 BHP         | 2573 rpm                | 3909 rpm  | 0 ft/min                     |                    |                   |
| Fan Data                    |                     |  |                |                  |                         |           |                              |                    |                   |
| Fan Type                    | Blade Type / Class  | Quantity of Fans   | Wheel Diameter | Material Type    | Number of Blades        | Discharge | Motor Location               |                    |                   |
| Centrifugal - Plenum        | Airfoil / 2         | 1  | 14.00 in       | Aluminium        | 12                      | Axial     | Behind Fan                   |                    |                   |
| Motor Data                  |                     |  |                |                  |                         |           |                              |                    |                   |
| Power                       | Electrical Supply   | Speed  | Efficiency     | Enclosure        | Frame Size              | Supplier  | Number of Poles              | Lock Rotor Current | Full Load Current |
| 2.0 HP                      | 575/60/3 V/Hz/Phase | 1750 rpm   | Premium        | ODP              | 145 T frame             | Generic   | 4                            | 20 A               | 2.2 A             |
| Fan Options                 |                     |  |                |                  |                         |           |                              |                    |                   |
| Wheel Guard:                |                     | Provided   |                |                  | Seismic Restraint:      |           | With snubbers                |                    |                   |
| Inlet Screen:               |                     | Provided   |                |                  | Piezometer Ring:        |           | Provided on Drive Side Fan   |                    |                   |
| Piezometer Delta P:         |                     | 2.74   |                |                  | Shaft Grounding Kit:    |           | Provided                     |                    |                   |
| Transducer:                 |                     | Output signal = 4-20 mA Input power = 10-35 VDC or 16-26 VAC |                |                  | Isolator Type:          |           | Spring                       |                    |                   |
| VFD/Starter/Disconnect Data |                     |  |                |                  |                         |           |                              |                    |                   |
| Selection Type:             |                     | VFD  |                |                  | Vendor:                 |           | Daikin Applied               |                    |                   |
| Auxiliary Control:          |                     | Disconnect   |                |                  | Voltage:                |           | 575 v                        |                    |                   |
| Disconnect Type:            |                     | Fused  |                |                  | Height x Width x Depth: |           | 19.09 in x 6.42 in x 9.89 in |                    |                   |
| Mounting:                   |                     | Door Side  |                |                  | Enclosure:              |           | NEMA 1                       |                    |                   |
| VFD Quantity:               |                     | 1  |                |                  |                         |           |                              |                    |                   |
| Door                        |                     |  |                |                  |                         |           |                              |                    |                   |
| Location                    |                     |  | Width          |                  |                         | Opening   |                              |                    |                   |
| Drive side                  |                     |  | 14 in          |                  |                         | Outward   |                              |                    |                   |
| Special Options             |                     |  |                |                  |                         |           |                              |                    |                   |
| Tread Plate Floor Liner     |                     |  |                |                  |                         |           |                              |                    |                   |
| (As casing details)         |                     |  |                |                  |                         |           |                              |                    |                   |

| Unit Sound Power (dB) |       |        |        |        |         |         |         |         |
|-----------------------|-------|--------|--------|--------|---------|---------|---------|---------|
| Type                  | 63 Hz | 125 Hz | 250 Hz | 500 Hz | 1000 Hz | 2000 Hz | 4000 Hz | 8000 Hz |
| Radiated:             | 67    | 64     | 60     | 62     | 56      | 50      | 46      | 51      |
| Unit Discharge:       | 77    | 73     | 76     | 80     | 78      | 78      | 78      | 69      |
| Unit Return:          | 70    | 67     | 70     | 75     | 63      | 67      | 67      | 54      |

### Shipping Section Details

| Section     | Length<br>in | Weight<br>lb | Corner Weights (lb) |     |     |     | Center of Gravity (in) |    |    |
|-------------|--------------|--------------|---------------------|-----|-----|-----|------------------------|----|----|
|             |              |              | P1                  | P2  | P3  | P4  | XX                     | YY | ZZ |
| 1           | 108          | 1228         | 333                 | 304 | 282 | 309 | 52                     | 19 | 16 |
| Entire Unit | 108          | 1228         | 333                 | 304 | 282 | 309 | 52                     | 19 | 16 |



NOTE: Special components aren't included in the corner weights and center of gravity data.

### AHRI Certification



Supply fan performance is certified in accordance with the Central Station Air-Handling Unit Certification Program, which is based on AHRI Standard 430.

### Notes

#### Standard

1. As a standalone component, unit meets or exceeds requirements of ASHRAE 90.1 - 2007. The approving authority is responsible for compliance of multi-component building systems.



**ATTACHMENT #3**

to

**ADDENDUM #1**

**ARCHITECTURAL ADDENDUM**

**ADDENDUM NO. 1**

**Surrey Art Gallery Mechanical Upgrade**

**CTA PROJECT NO. 35022.0**

**CHERNOFF THOMPSON ARCHITECTS**

**September 30, 2016**

Total pages  
Including this page 7



## **ADDENDUM NO. 1**

Date: September 30, 2016

Surrey Art Gallery Mechanical Upgrade  
SURREY, BRITISH COLUMBIA

CTA PROJECT NO. 36022.0

### **CHERNOFF THOMPSON ARCHITECTS**

---

The following revisions supersede the information contained in the original drawings and specification issued for the above named project, and shall become part thereof. No consideration will be allowed for extras due to the contractor or any subcontractor not being familiar with this Addendum.

---

#### **1. Refer to revision clouds in attached drawing sheets:**

- A-02 Floor Plans/Sections
- A-03 Details
- A-04 Specifications

#### **2. Received Questions:**

**Q:** Please provide a size and guage/thickness for the angle in detail 1 – 5 / A03.

**A:** Steel angel is to be 75x75x8

**Q:** On behalf of our trade we would like to request an alternate to the metal decking.

**A:** Based on Addendum #1, structural steel deck (Vicwest 938) is no longer required.

**Q:** Please provide further details/specifications for the security gate i.e. HSS size, metal panel specs or if this is prefabricated please provide a manufacturer.

**A:** See revised detail on A-03.

**Q:** Drawing A04 Specifications Division 1, item C states that the Owner shall provide and pay for course of construction insurance. However, In the RFQ document, on page 21, item 24.1 (g) the contractor is to obtain and carry course of constriction insurance. Which is correct?

**A:** Provide construction insurance as per RFQ document. See architectural addendum #1.

**Q:** As per floor plan 1/A02 it shows the side walk terminating into the block wall, will there need to be any other provision to get this sidewalk to tie into any other existing component other than the wall?

**A:** No. There is no existing block wall at the current side walk. The new sidewalk is to be flush with the existing sidewalk.

## **ADDENDUM NO. 1**

Date: September 30, 2016

Surrey Art Gallery Mechanical Upgrade  
SURREY, BRITISH COLUMBIA

CTA PROJECT NO. 36022.0

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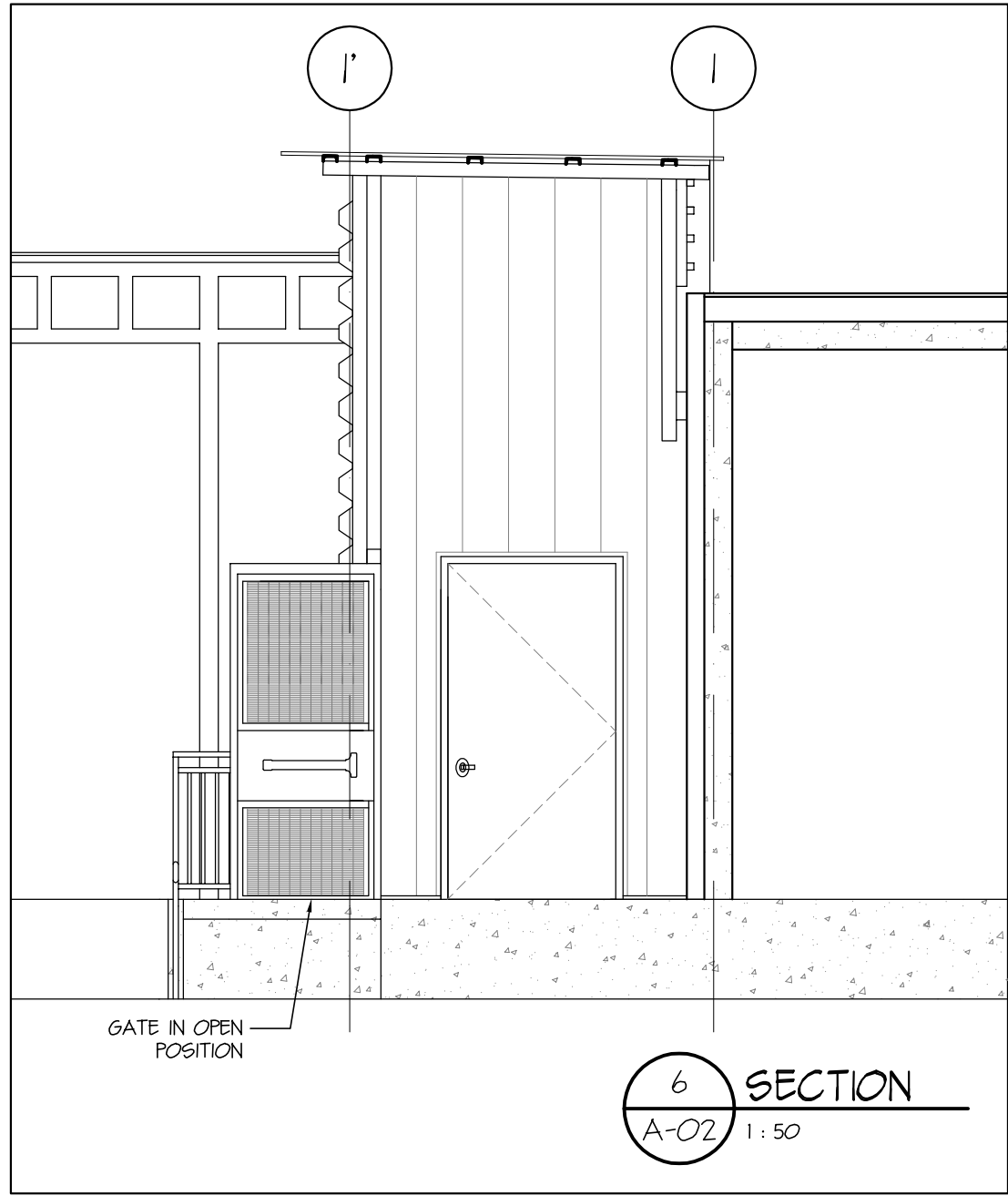
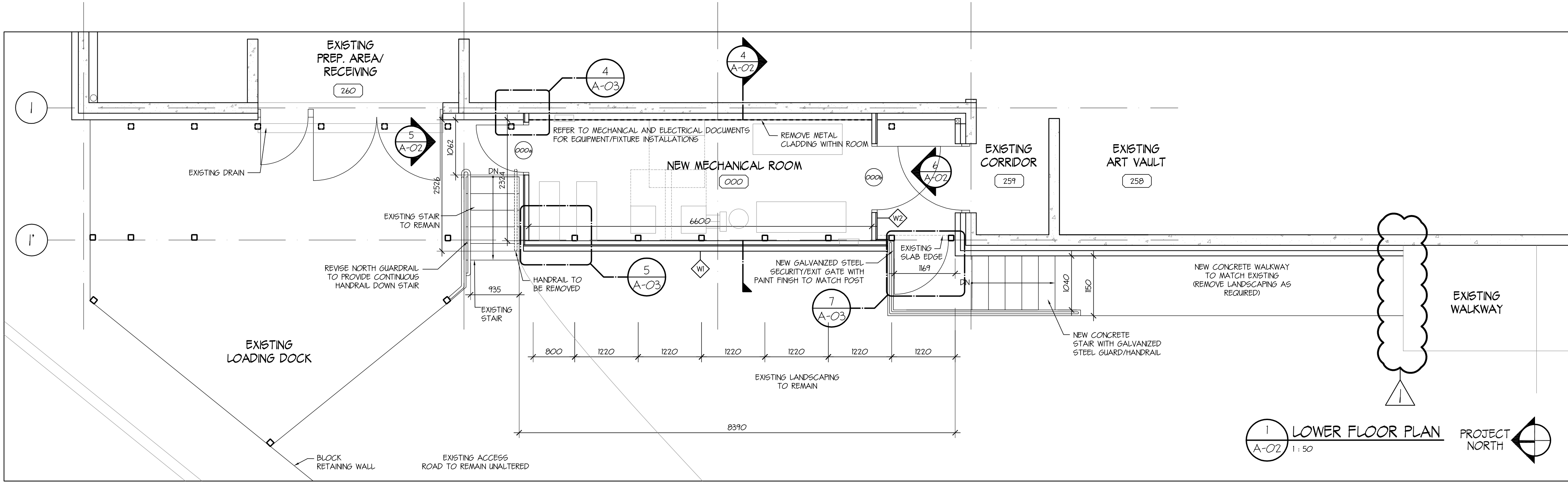
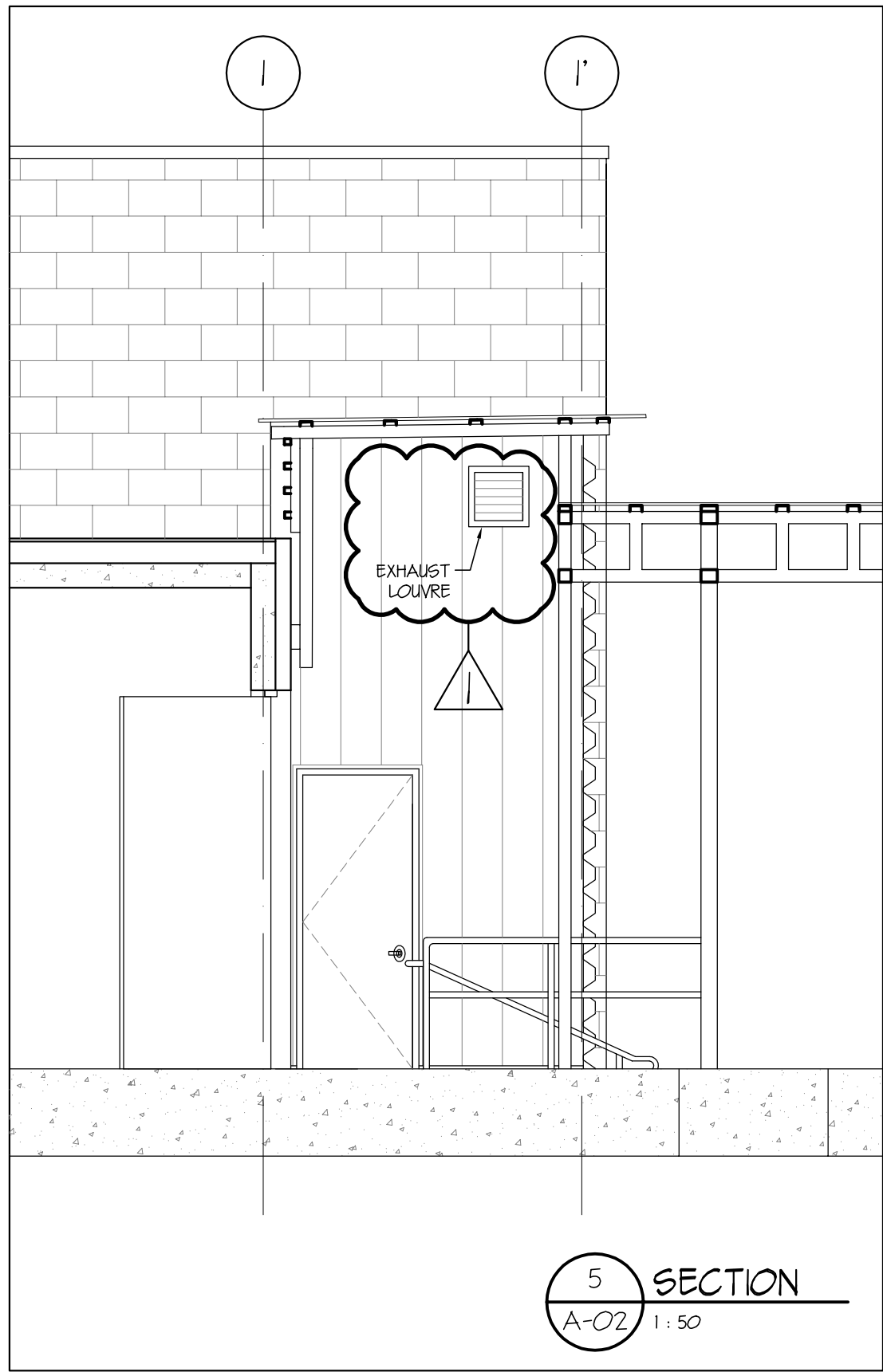
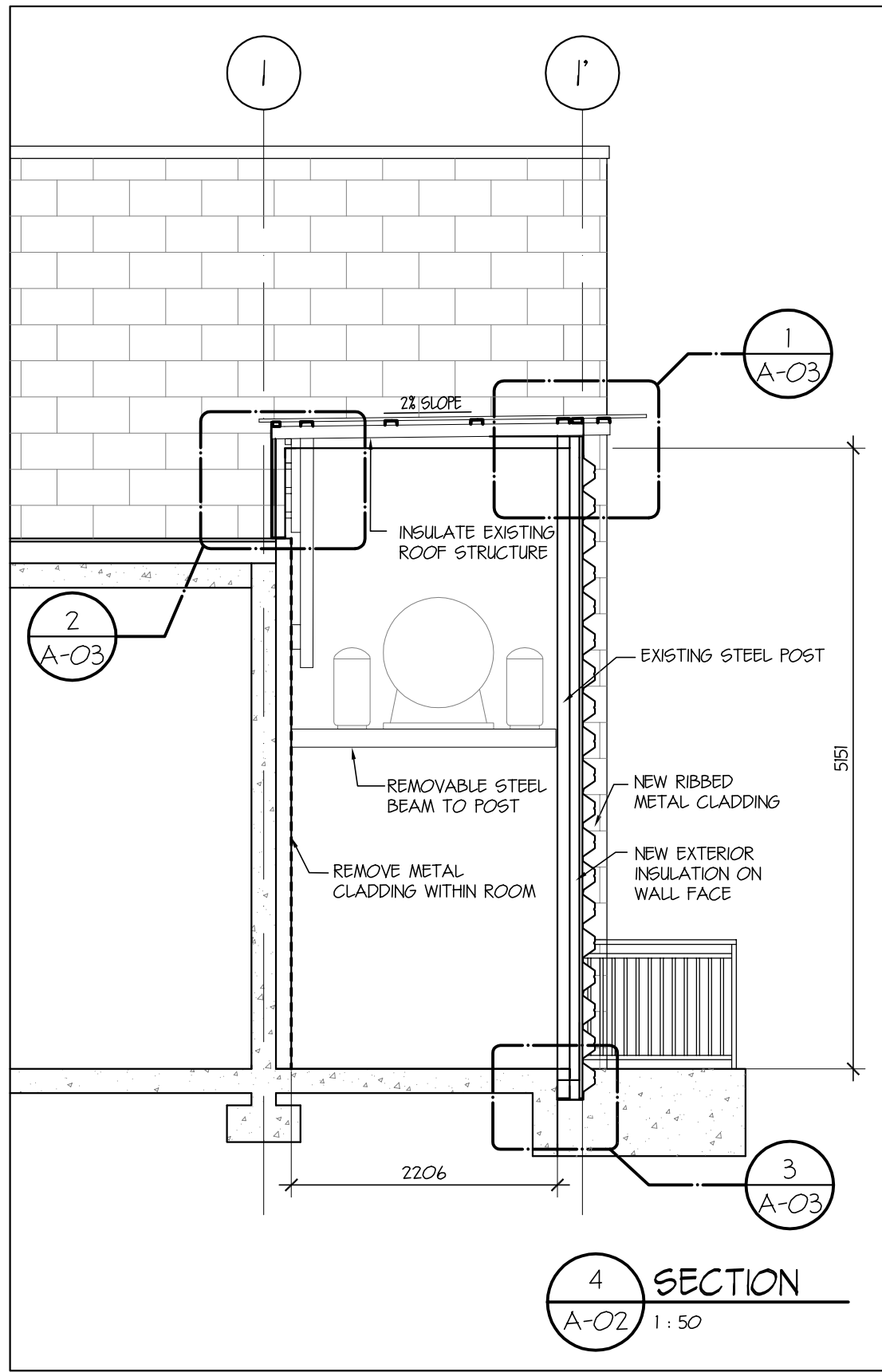
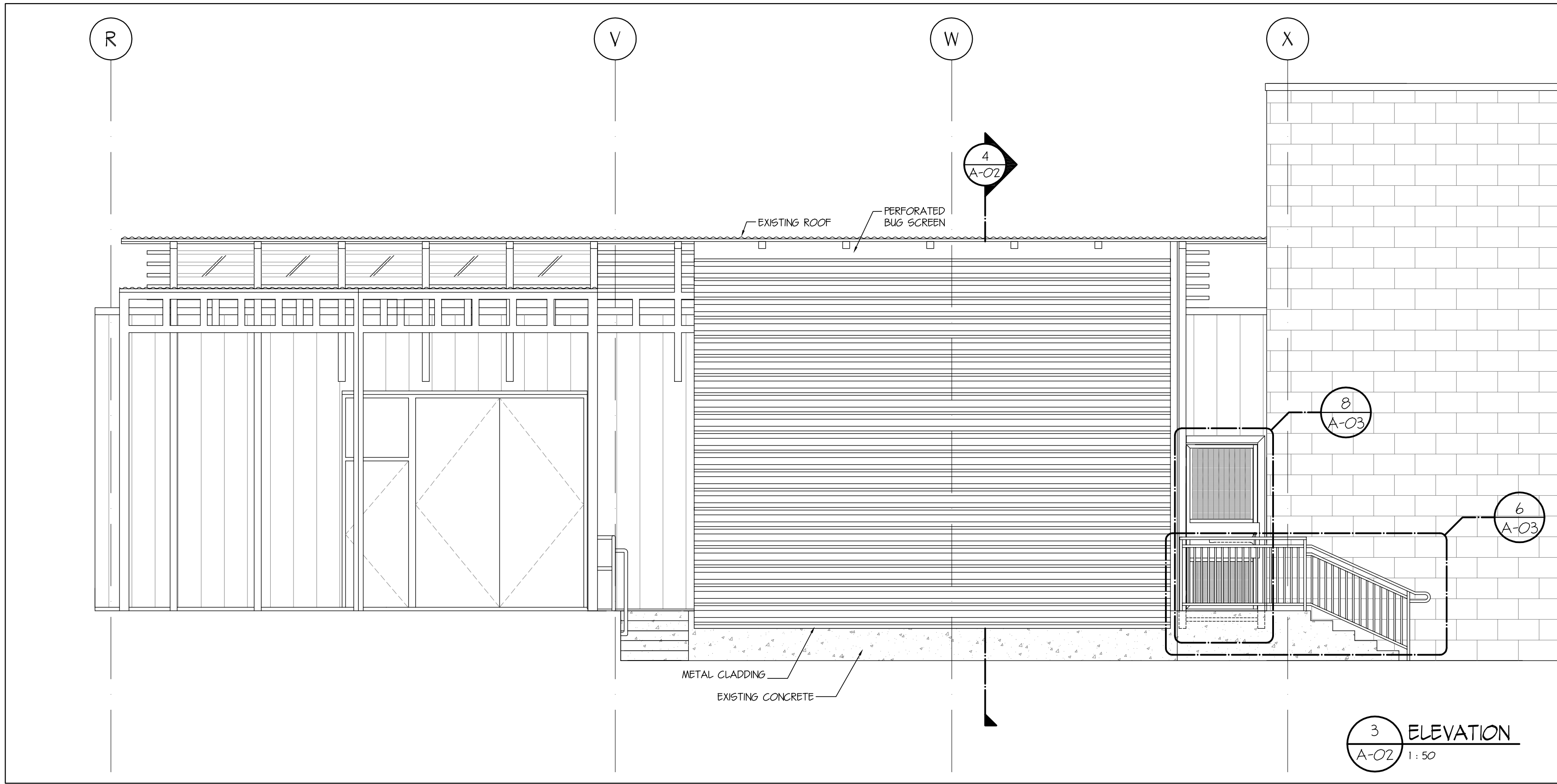
Q: Photo 06 on drawing A-05 indicates that the existing roof canopy is to remain in place above the mechanical room addition, but on drawing S2 roof plan a new roof deck is indicated. Which is correct?

A: Architectural drawing is correct, the existing roof canopy is to remain in place above the mechanical room addition. Structural drawing has been revised.

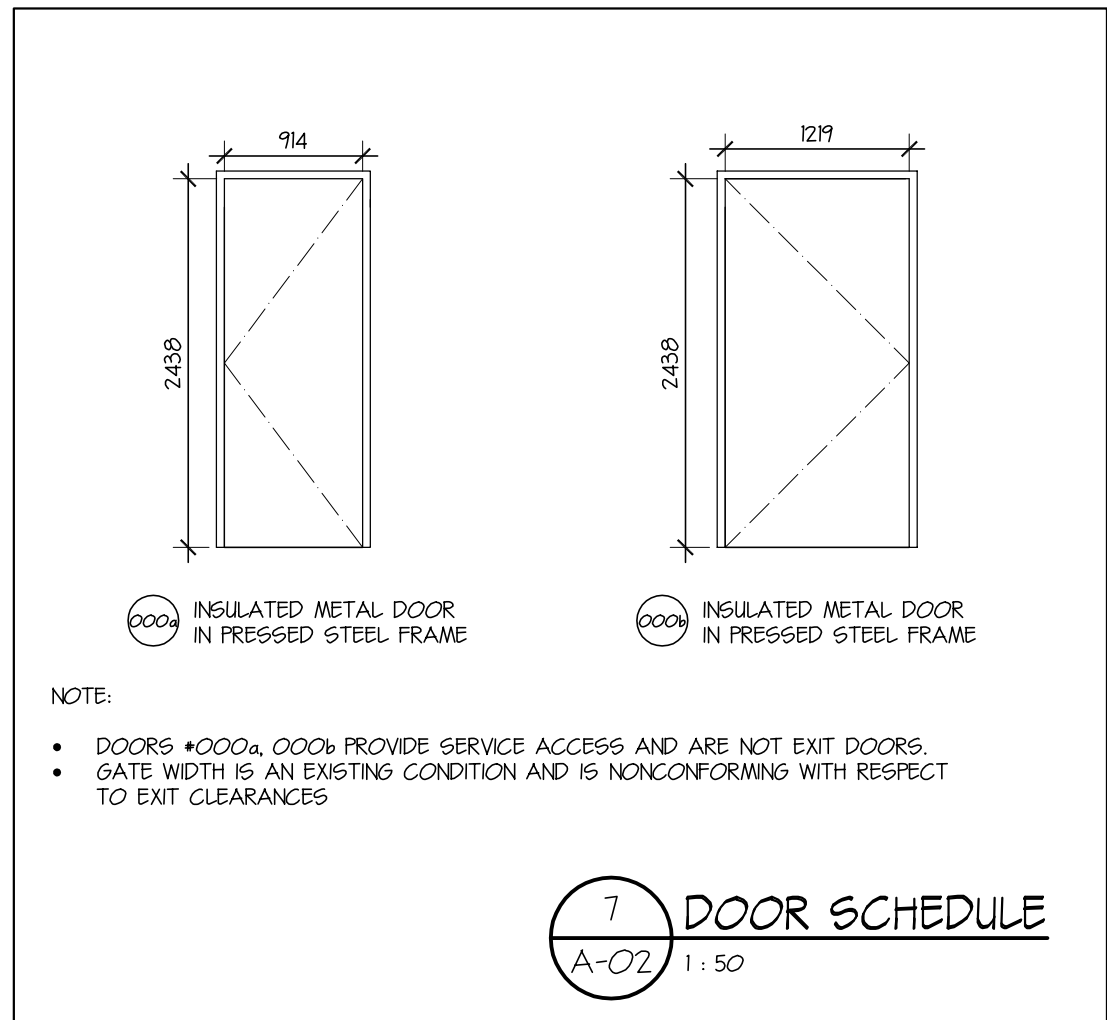
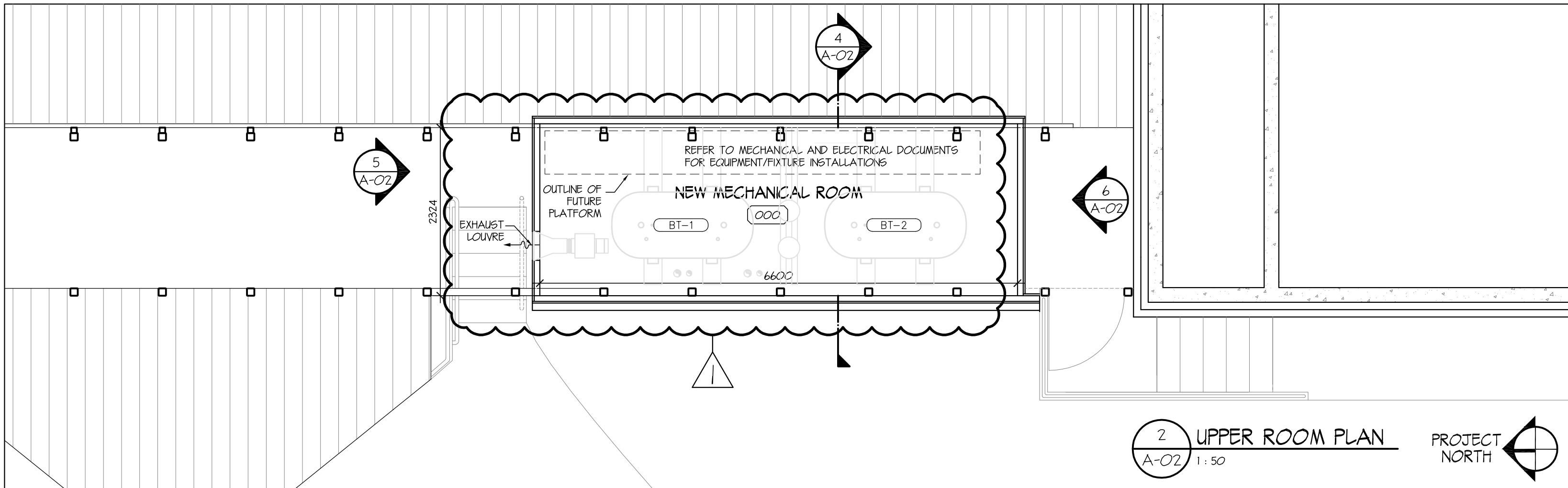
### **3. Alternate Products – Not Approved:**

- Westform Metals – WF Roof Deck A&B.  
(There is no metal deck required on this project. The new mechanical enclosure is to the underside of existing metal roof.)
- Westform Metals – WF HF 12.

END OF ADDENDUM #1



| NEW WALL | CONSTRUCTION DETAIL | DESCRIPTION  |
|----------|---------------------|--|
| W1       |                     | <ul style="list-style-type: none"><li>EXISTING COLUMN</li><li>VICWEST 1800 LINER (FUNCTIONS AS VAPOUR BARRIER) IN HORIZONTAL INSTALLATION. CAULK JOINTS.</li><li>75mm SEMI RIGID FIBERGLASS INSULATION WITH CASCADIA FIBERGLASS SPACER</li><li>25mm VENTILATED AIR SPACE WITH VERTICAL Z-GIRT</li><li>WITH VICWEST CL 300 METAL CLADDING TO MATCH EXISTING</li></ul> |
| W2       |                     | <ul style="list-style-type: none"><li>VICWEST 1800 LINER (FUNCTIONS AS VAPOUR BARRIER) IN HORIZONTAL INSTALLATION</li><li>42mm STEEL STUD WITH SEMI RIGID FIBERGLASS INSULATION</li><li>HORIZONTAL HAT TRACK 600mm O.C.</li><li>WITH FLAT METAL CLADDING TO MATCH EXISTING</li></ul>   |



E. 30/09/16 ISSUED FOR ADDENDUM #1  
D. 16/09/16 ISSUED FOR RFP AND BP SUBMISSION  
No. DATE REVISION  
(dd/mm/yr)

PROJECT TITLE  
**SURREY ARTS CENTRE HVAC UPGRADE**  
13750 88th AVENUE  
SURREY, B.C.

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SHEET TITLE  
**FLOOR PLANS/ SECTIONS**

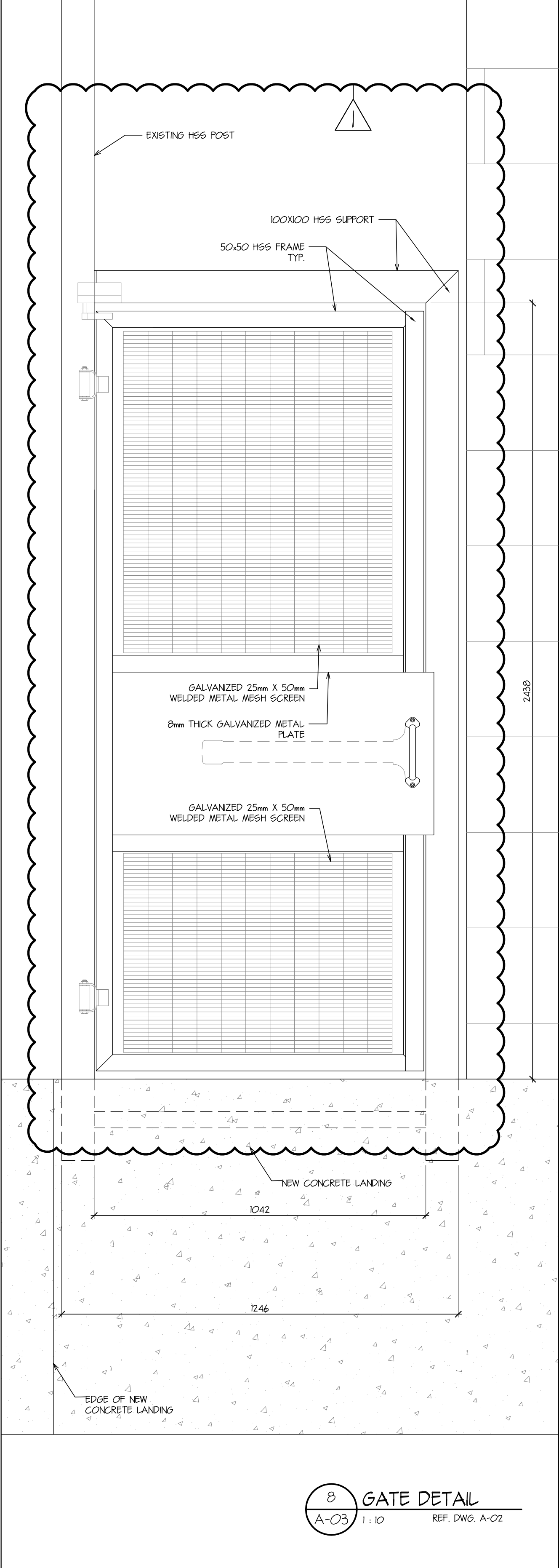
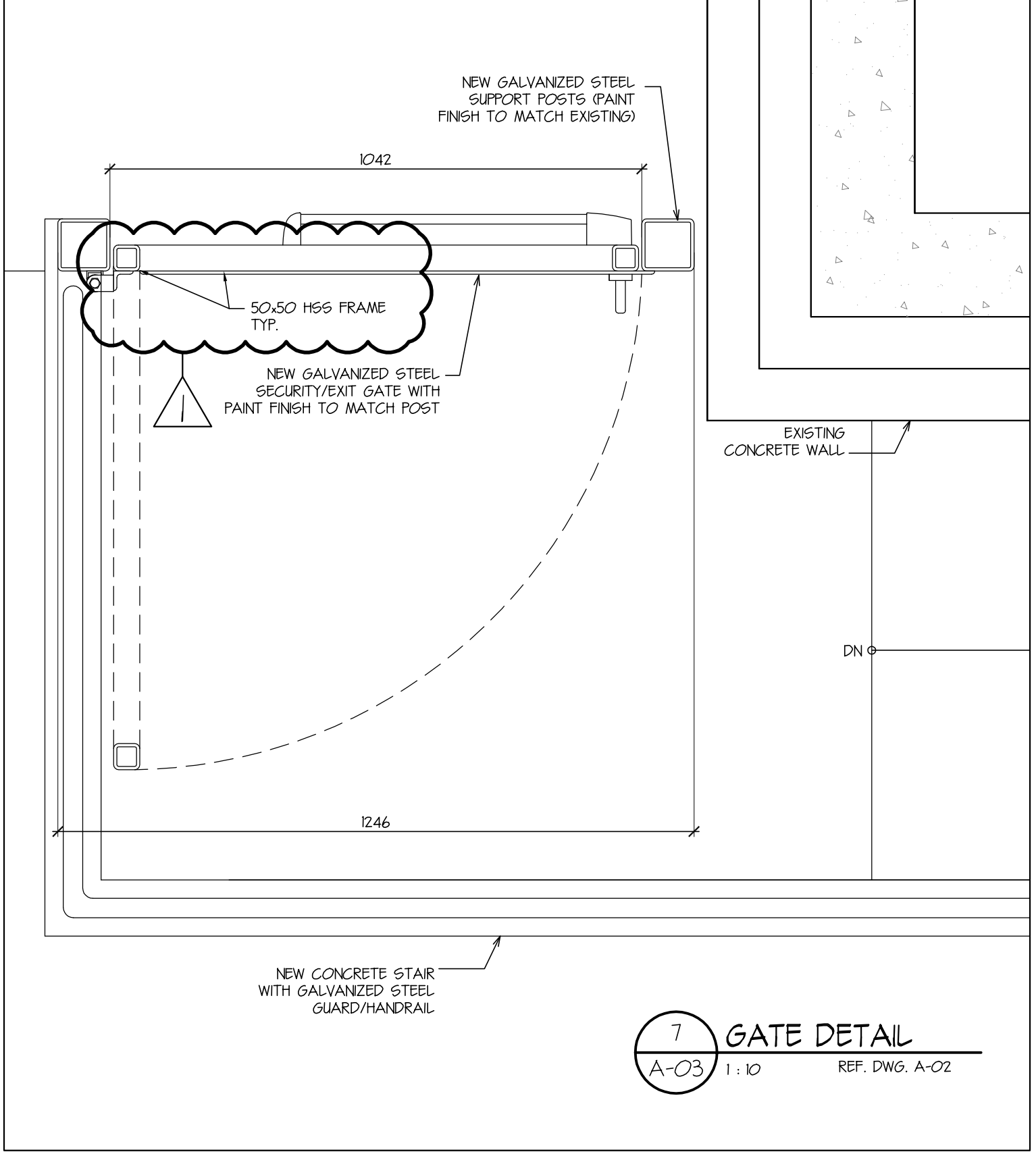
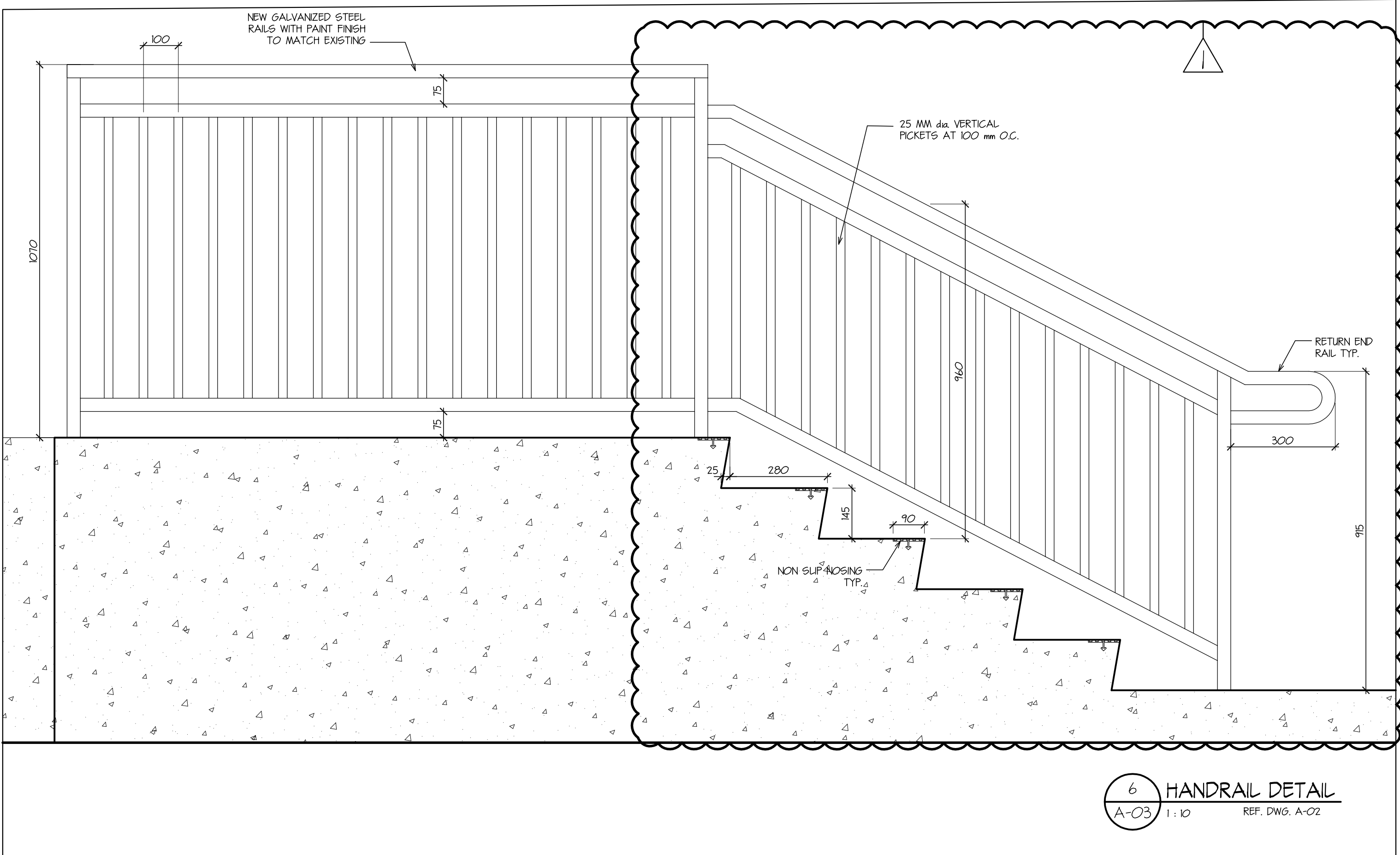
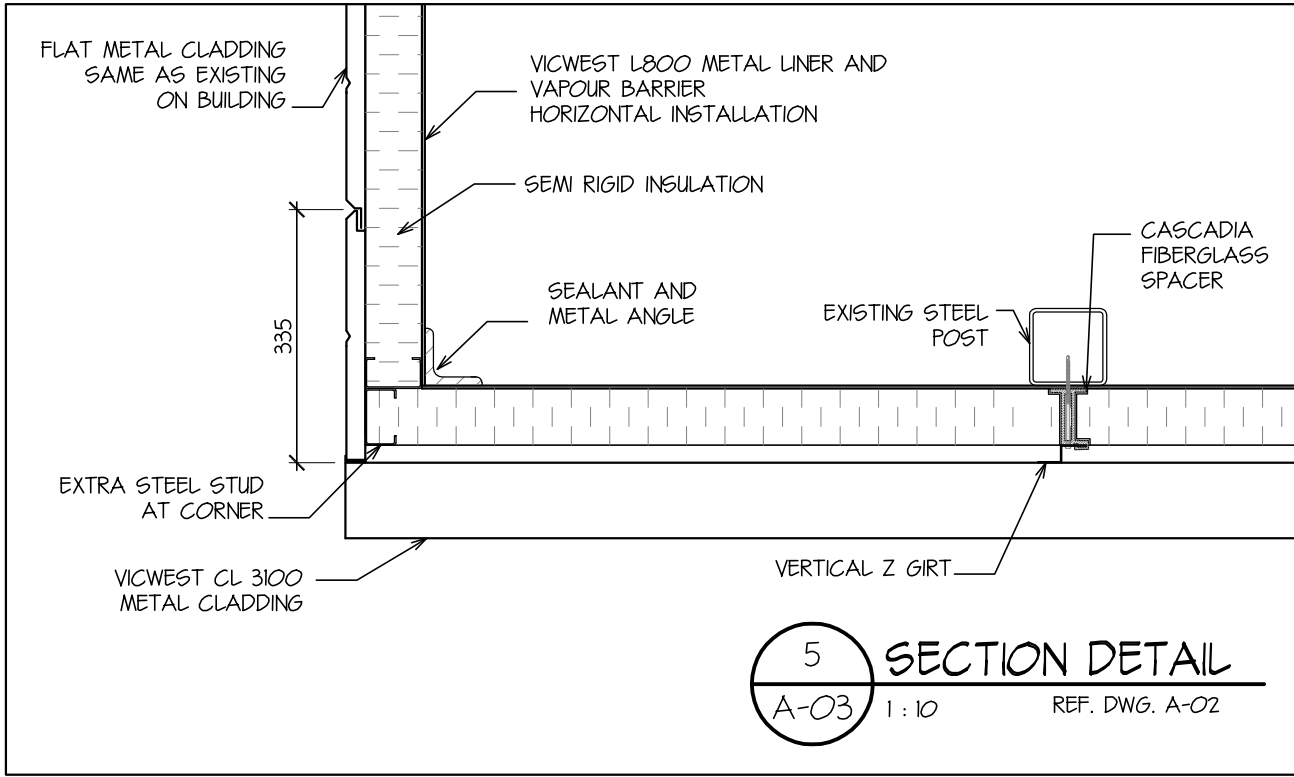
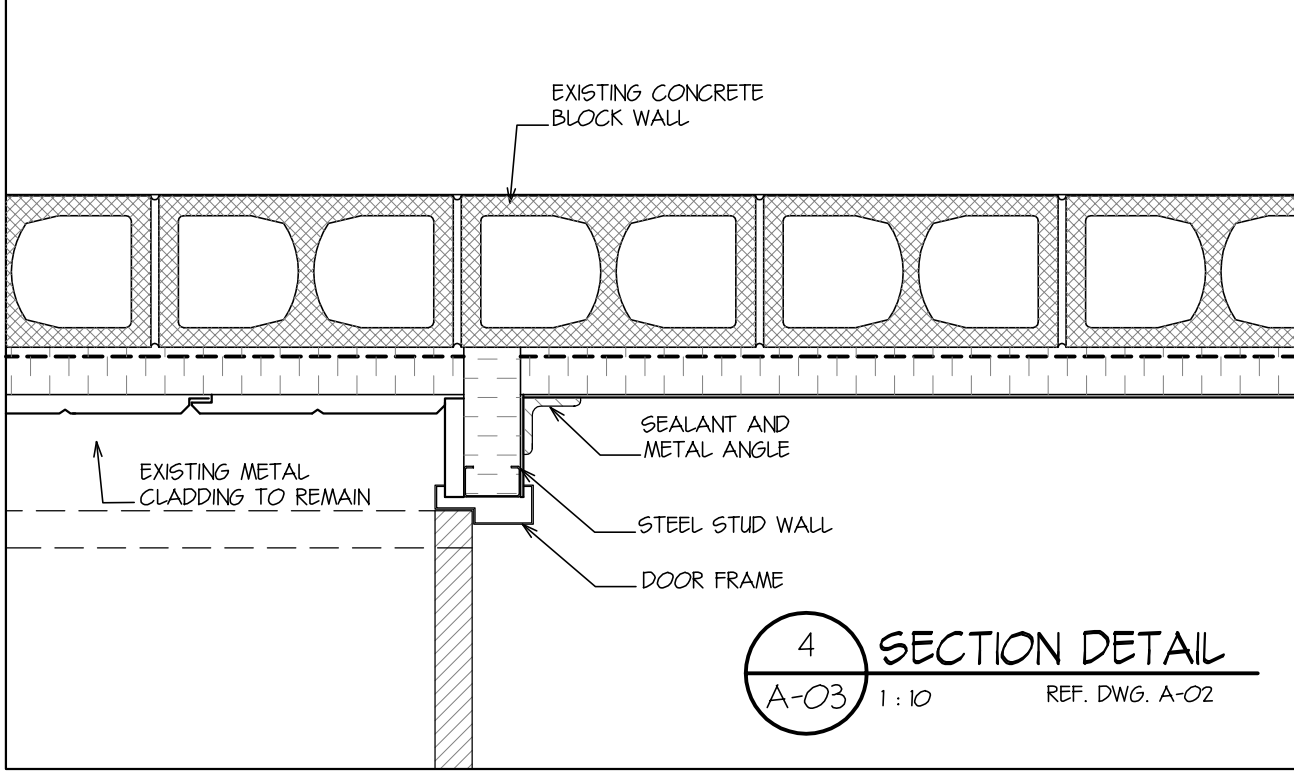
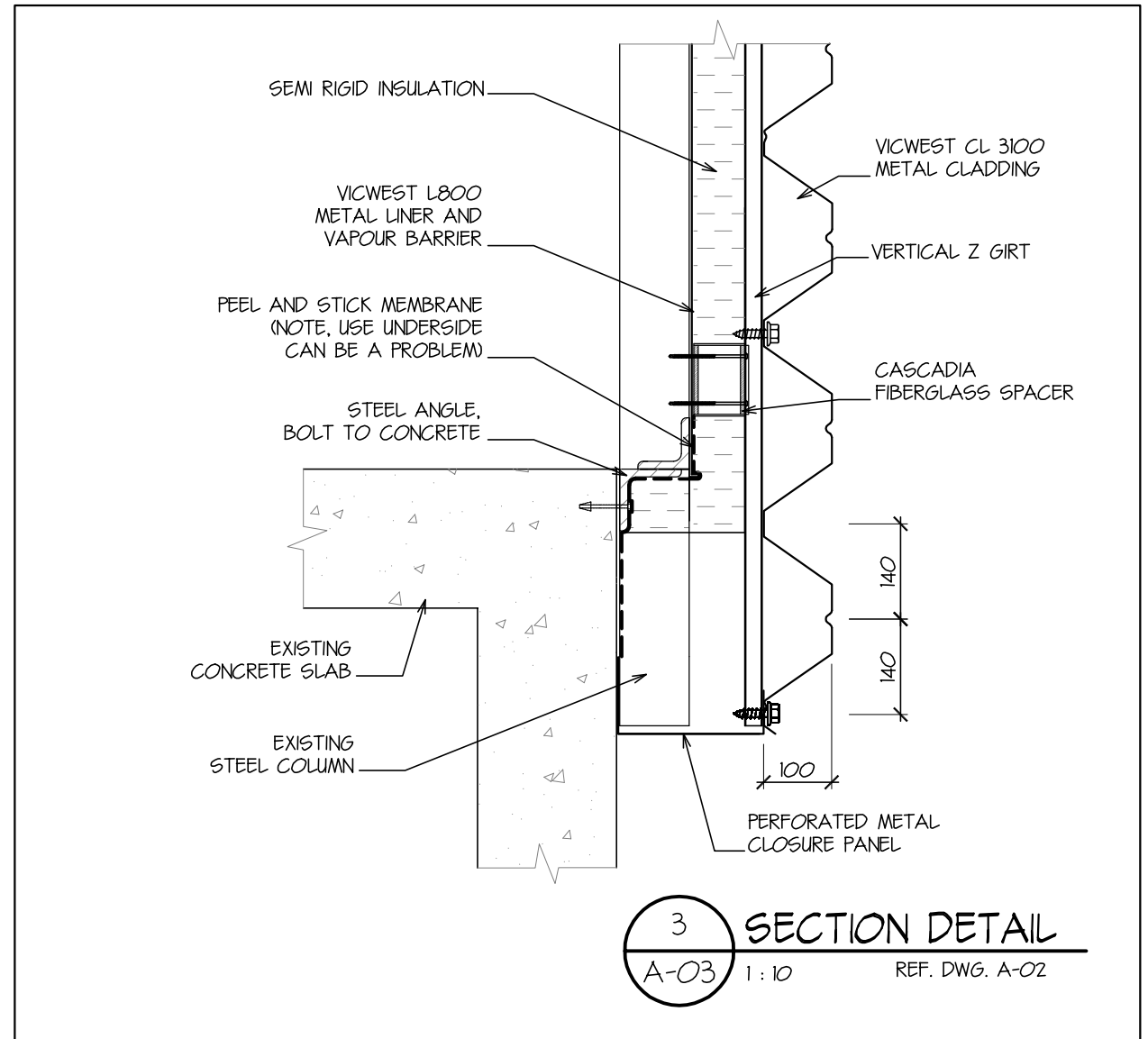
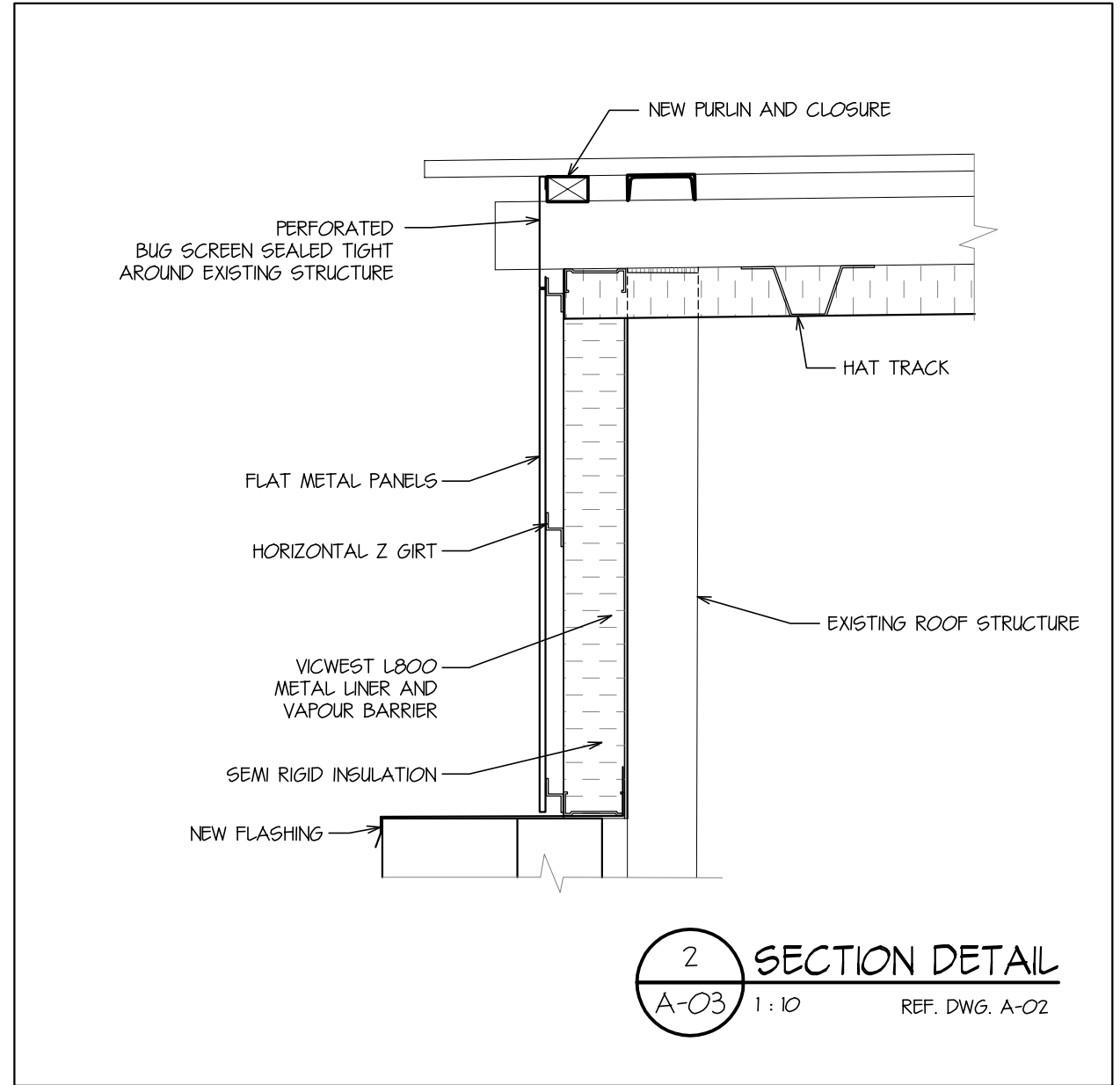
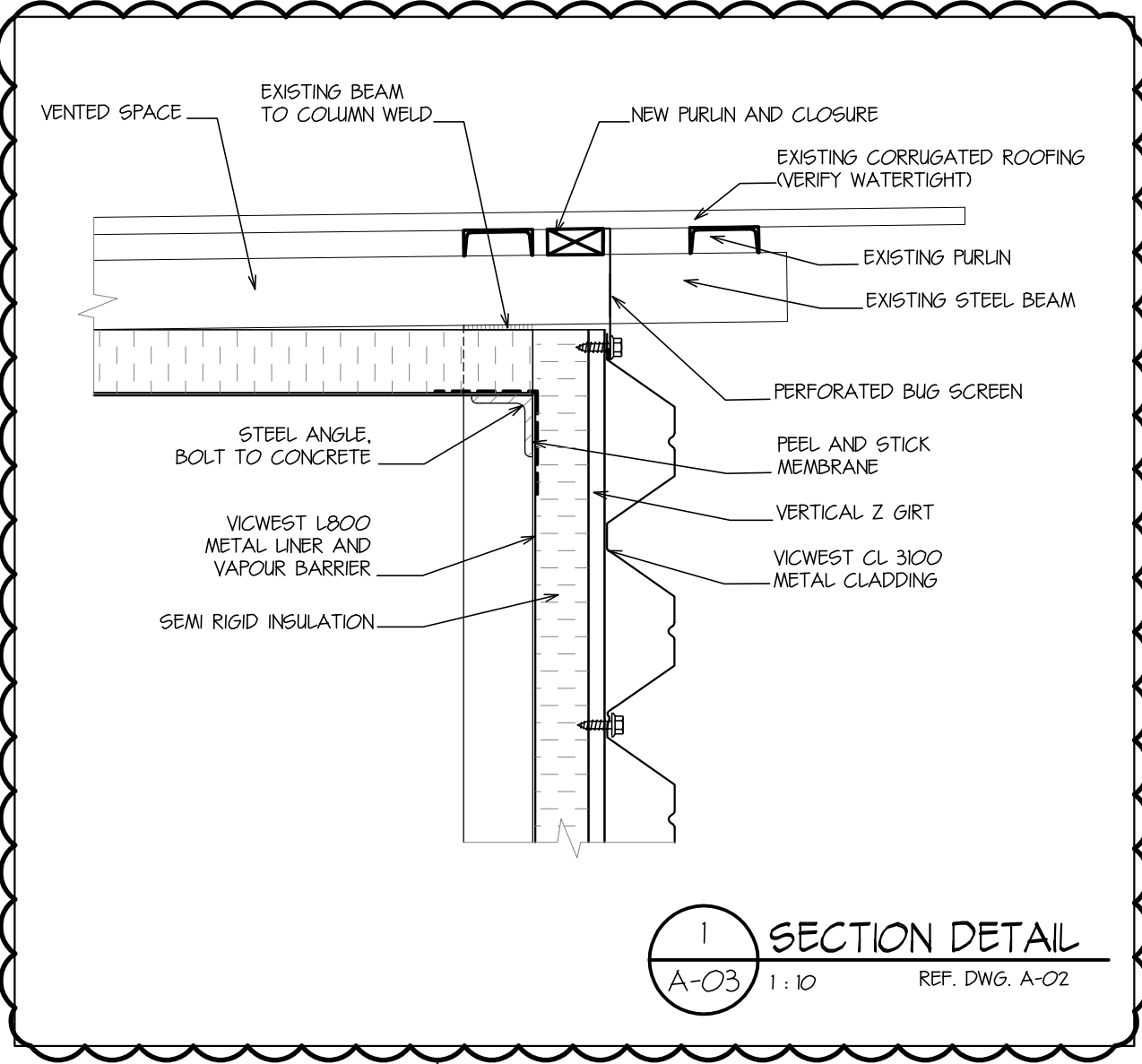
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DATE 30/09/16  
PRINTED 30/09/16

REVISION No. E

**A-02**

110-1281 WEST GEORGIA, VANCOUVER, B.C. V6E 3J5  
TELEPHONE (604) 669-9460 FAX. (604) 683-7684

CHERNOFF THOMPSON ARCHITECTS



|     |                 |                                  |
|-----|-----------------|----------------------------------|
| E.  | 30/09/16        | ISSUED FOR ADDENDUM #1           |
| D.  | 16/09/16        | ISSUED FOR RFO AND BP SUBMISSION |
| No. | DATE (dd/mm/yr) | REVISION                         |

PROJECT TITLE  
**SURREY ARTS CENTRE HVAC**  
13750 88th AVENUE  
SURREY, BC.

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clat:                      date:

SHEET TITLE  
**DETAILS**

PROJECT No. 36022.1  
DRAWN EA/BT  
CHECKED GP  
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DATE 30/09/16  
PRINTED 30/09/16

REVISION No. E

**A-03**


CHERNOFF THOMPSON ARCHITECTS

110-1281 WEST GEORGIA, VANCOUVER, B.C. V6E 3J5  
TELEPHONE (604) 669-9460 FAX. (604) 683-7684



DIVISION 1 - GENERAL

- C. ~~INSURANCE.~~  
~~THE OWNER SHALL PROVIDE AND PAY FOR THE COURSE OF CONSTRUCTION INSURANCE. THE INSURANCE SHALL BE IN THE JOINT NAMES OF THE OWNER, THE CONTRACTOR AND THE CONSULTANTS.~~


- D. PERMITS.  
THE OWNER SHALL OBTAIN AND PAY FOR THE BUILDING PERMIT. THE CONTRACTOR SHALL BE RESPONSIBLE FOR AND PAY ALL OTHER PERMITS RELATED TO THE SCOPE-OF-WORK DESCRIBED IN THE DRAWINGS.
- E. CODES & REGULATIONS.  
ALL WORK SHALL BE CARRIED OUT IN STRICT ACCORDANCE WITH ALL PROVINCIAL AND MUNICIPAL BY-LAWS. THE CONTRACTOR MUST KNOW AND UNDERSTAND ALL SAID REGULATIONS AND WILL HAVE AVAILABLE ON-SITE A COPY OF THE CURRENT EDITION OF THE NATIONAL BUILDING CODE, BRITISH COLUMBIA BUILDING CODE, AND LOCAL BUILDING BYLAWS COMPLETE WITH ALL AMENDMENTS.
- F. OBSERVE AND ENFORCE ALL CONSTRUCTION SAFETY MEASURES REQUIRED BY WORKSAFE BC AND PROVIDE A CURRENT CLEARANCE LETTER FOR THE PURPOSES OF SECTION 51 OF THE WORKERS COMPENSATION ACT WITH ALL APPLICATIONS FOR PAYMENT.
- G. HOURS OF WORK.  
CONDUCT ALL CONSTRUCTION ACTIVITIES IN FULL COMPLIANCE WITH THE CITY OF SURREY NOISE CONTROL BY-LAW, 1982, NO. 7044.
- H. DISCREPANCIES.  
THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE CONSULTANT OF ANY DISCREPANCIES OR AMBIGUITIES IN THE CONTRACT DOCUMENTS.
- I. SUBMITTALS.  
SUBMIT FOR CONSULTANT AND OWNER REVIEW SEVEN (7) COPIES OF DRAWINGS, DIAGRAMS, ILLUSTRATIONS, SCHEDULES, PERFORMANCE CHARTS, BROCHURES AND OTHER DATA AS NECESSARY TO ILLUSTRATE DETAILS OF A PORTION OF THE WORK. INDICATE MATERIALS, METHOD OF CONSTRUCTION AND ATTACHMENT OR ANCHORAGE, ERECTION DIAGRAMS, CONNECTIONS, EXPLANATORY NOTES AND OTHER INFORMATION NECESSARY FOR COMPLETION OF WORK. INDICATE CROSS REFERENCES TO CONSULTANT DRAWINGS AND SPECIFICATIONS.
- J. WORKMANSHIP.  
ALL WORK SHALL BE PERFORMED BY SKILLED AND EXPERIENCED TRADESMEN. GIVE TIMELY NOTICE REQUESTING INSPECTION IF WORK IS DESIGNATED FOR CONSULTANT OR OWNER REVIEW. REMOVE DEFECTIVE WORK, WHETHER THE RESULT OF POOR WORKMANSHIP, USE OF DEFECTIVE PRODUCTS OR DAMAGE AND WHETHER INCORPORATED IN THE WORK OR NOT, WHICH HAS BEEN REJECTED BY THE CONSULTANT AS FAILING TO CONFORM TO THE CONTRACT DOCUMENTS. REPLACE OR RE-EXECUTE.
- K. PROTECTION OF WORK.  
THE CONTRACTOR SHALL PROTECT HIS WORK FROM THE ELEMENTS AND ONGOING CONSTRUCTION AND SHALL REPLACE OR MAKE GOOD ANY DAMAGED WORK RESULTING FROM HIS OWN NEGLIGENCE. TEMPORARY INSULATED HOARDING SHALL BE PROVIDED AS REQUIRED TO SAFEGUARD AND SECURE THE FACILITY DURING THE EXECUTION OF THE WORK; CLOSE OFF TEMPORARILY SUSPENDED WORK THAT IS WITHOUT CONTINUOUS SUPERVISION TO PREVENT ENTRANCE OF UNAUTHORISED PERSONS.
- L. PROTECTION OF THE PUBLIC.  
THE CONTRACTOR SHALL TAKE ALL PRECAUTIONS TO PROTECT THE PUBLIC AS REQUIRED BY LAW. ALL EXISTING GROUNDS, CURBS, WALKS, ETC. ARE TO BE PROTECTED FROM DAMAGE. CONTRACTOR SHALL MAKE GOOD ANY DAMAGED AREAS.
- M. TEMPORARY FACILITIES.  
THE CONTRACTOR SHALL PROVIDE AND MAINTAIN IN GOOD CONDITION TEMPORARY FACILITIES AND EQUIPMENT REQUIRED FOR THE PROPER EXECUTION OF THE WORK, INCLUDING A TEMPORARY SITE TOILET AND SHALL REMOVE SAME FROM THE SITE AT COMPLETION OF THE CONTRACT. SUCH FACILITIES SHALL MEET ALL REQUIREMENTS OF GOVERNING LAWS OR REGULATIONS.
- N. CLEANING.  
THE CONTRACTOR SHALL BE RESPONSIBLE FOR AND MAINTAIN ALL SURFACES UNTIL THE ADVERTISED DATE OF SUBSTANTIAL COMPLETION. IN ADDITION TO GENERAL CLEANING WITH THE REMOVAL OF ALL DEBRIS FROM SITE, PROVIDE FINAL CLEANING TO ALL NEW SURFACES BEFORE SUBSTANTIAL COMPLETION.
- O. AS-BUILT (RECORD) DRAWINGS.  
THE GENERAL CONTRACTOR AND SUB-TRADES ARE TO MAINTAIN AND SAFEGUARD A PRINTED SET OF "ISSUED FOR CONSTRUCTION" DOCUMENTS ON-SITE WHICH ARE TO BE LABELLED "AS-BUILT DRAWINGS WITH ALL REVISIONS OR CONCEALED INSTALLATIONS CLEARLY NOTED IN RED ON THE APPROPRIATE SHEETS AS CONSTRUCTION PROCEEDS. THESE DRAWINGS ARE TO BE AVAILABLE FOR CONSULTANT REVIEW DURING CONSTRUCTION AND, PRIOR TO SUBSTANTIAL COMPLETION, COMPLETED AND PROVIDED TO THE CONSULTANTS FOR THE CREATION OF DIGITAL "RECORD DOCUMENTS".
- THE CONTRACTOR SHALL INCLUDE A CASH ALLOWANCE OF \$6,000 (WHICH DOES NOT INCLUDE GST) TO BE PAID DIRECT TO THE MANAGING CONSULTANT AT SUBSTANTIAL COMPLETION FOR THE COORDINATION OF REVISIONS (AND DELIVERY OF) REVISED DWG AND PDF "RECORD DOCUMENTS" TO THE CITY OF SURREY.
- P. OPERATIONS & MAINTENANCE MANUALS.  
SUBMIT TWO COMPLETE OPERATION AND MAINTENANCE MANUALS FOR BUILDING (ARCHITECTURAL/STRUCTURAL), MECHANICAL, AND ELECTRICAL DIVISIONS TO THE OWNER'S REPRESENTATIVE FOUR WEEKS PRIOR TO THE APPLICATION FOR CERTIFICATION OF COMPLETION. MANUALS ARE TO BE VINYL, HARD COVERED, 3 D-RING BINDERS SIZED FOR 215 X 280 MM PAPER WITH DURABLE EXTERIOR LABELLING ON THE BINDER FACE AND SPINE. MANUALS ARE TO INCLUDE A COVER SHEET WITH PROJECT INFORMATION INCLUDING CONTACT INFORMATION, TABLE OF CONTENTS, AND TABBED SECTIONS. ALL DRAWINGS, DIAGRAMS AND MANUFACTURERS LITERATURE & WARRANTY INFORMATION MUST BE LEGIBLE.

THE CONTRACTOR SHALL INCLUDE A CASH ALLOWANCE OF \$6,000 (WHICH DOES NOT INCLUDE GST) TO BE PAID DIRECT TO THE MANAGING CONSULTANT AT SUBSTANTIAL COMPLETION FOR THE COORDINATION OF REVISIONS (AND DELIVERY OF) REVISED DWG AND PDF "RECORD DOCUMENTS" TO THE CITY OF SURREY.

P. OPERATIONS & MAINTENANCE MANUALS.  
SUBMIT TWO COMPLETE OPERATION AND MAINTENANCE MANUALS FOR BUILDING (ARCHITECTURAL/STRUCTURAL), MECHANICAL, AND ELECTRICAL DIVISIONS TO THE OWNER'S REPRESENTATIVE FOUR WEEKS PRIOR TO THE APPLICATION FOR CERTIFICATION OF COMPLETION. MANUALS ARE TO BE VINYL, HARD COVERED, 3 D-RING BINDERS SIZED FOR 215 X 280 MM PAPER WITH DURABLE EXTERIOR LABELLING ON THE BINDER FACE AND SPINE. MANUALS ARE TO INCLUDE A COVER SHEET WITH PROJECT INFORMATION INCLUDING CONTACT INFORMATION, TABLE OF CONTENTS, AND TABBED SECTIONS. ALL DRAWINGS, DIAGRAMS AND MANUFACTURERS LITERATURE & WARRANTY INFORMATION MUST BE LEGIBLE.

DIVISION 2 SITE WORK

- A. REMOVE THE EXISTING LANDSCAPE ADJACENT TO THE WEST WALL OF SURREY ARTS CENTRE TO ACCOMMODATE CONSTRUCTION OF THE NEW CONCRETE WALKWAY AND STAIRS.
- B. RESTORE THE LANDSCAPING WHERE AFFECTED BY THE WORK TO THE GRADES, ELEVATIONS AND FINISHES THAT EXISTED PRIOR TO CONSTRUCTION.
- C. ALL BACKFILL MATERIAL TO BE FROST-FREE.

- D. PROVIDE GRANULAR FILL TO A DEPTH OF 6" TO UNDERSIDE OF WALKWAY COMPACTED TO 100% CORRECTED MAXIMUM DRY DENSITY.
- E. PROTECT ALL SITE FEATURES TO REMAIN UNAFFECTED BY CONSTRUCTION, INCLUDING TREES, LAMP STANDARDS, WALKWAYS/TERRACES, LAWN AND OTHER PLANTINGS. REPAIR ANY CONSTRUCTION-RELATED DAMAGE AND PROVIDE A FINAL CLEANING TO REMOVE DIRT AND DEBRIS.
- F. DEMOLISH PORTIONS OF THE EXISTING BUILDING AS NECESSARY TO MAKE WAY FOR NEW CONSTRUCTION, INCLUDING REMOVAL OF HORIZONTAL LATTICE, CONCRETE SLAB (FOR NEW FLOOR DRAINS), AND REMOVAL OF METAL CLADDING AT FORMER EXTERIOR WALL WITHIN NEW MECHANICAL ROOM.
- G. CARRY OUT ALL DEMOLITION WORK IN ACCORDANCE WITH THE B.C. BUILDING CODE AND WORKSAFE BC AND ENSURE SAFE PASSAGE OF THE PUBLIC AND BUILDING OCCUPANTS. THE CONTRACTOR SHALL VISIT THE SITE AND CAREFULLY EXAMINE AND NOTE ALL BUILDING COMPONENTS TO BE DEMOLISH AND TO SATISFY HIMSELF OF ALL CONDITIONS, CHARACTERISTICS, AND IRREGULARITIES AFFECTING THE WORK.
- H. PREVENT DAMAGE TO, MOVEMENT OR SETTLEMENT OF STRUCTURE AND INSTALLATIONS TO REMAIN, SERVICES, WALKS, PAVING, FINISHES AND LANDSCAPING. PROVIDE AND PLACE BRACING, SHORING AND/OR UNDERPINNINGS AS NOTED ON THE STRUCTURAL DRAWINGS AND AS REQUIRED. IN THE EVENT OF DAMAGE, IMMEDIATELY REPLACE OR MAKE REPAIRS TO THE APPROVAL OF THE CONSULTANT AND AT NO ADDITIONAL COST TO THE OWNER.
- I. LANDSCAPE IRRIGATION.  
COORDINATE DIRECT WITH THE CITY OF SURREY ANY REQUIRED REVISIONS TO THE EXISTING LANDSCAPE IRRIGATION SYSTEM WHERE AFFECTED BY THE NEW CONCRETE WALKWAY AND STAIR.

DIVISION 3 CONCRETE

- A. REFER TO STRUCTURAL ENGINEER'S DRAWINGS AND NOTES FOR ALL SPECIFICATIONS AND SPECIFIC REQUIREMENTS RELATING TO THE CONCRETE WORK, STEEL REINFORCING AND GROUT.
- B. WHERE THE EXISTING INTERIOR CONCRETE SLAB-ON-GRADE IS REMOVED TO PROVIDE ACCESS FOR MECHANICAL INSTALLATIONS, RESTORE THE SUB-FLOOR BY PROVIDING SIMILAR FILL MATERIAL COMPACTED TO 100% STANDARD PROCTOR DENSITY AND PROVIDE A 6 MIL POLYETHYLENE SHEET WITH SIDES AND ENDS LAPPING ALONG THE UNDERSIDE OF THE REPLACEMENT CONCRETE SLAB-ON-GRADE.
- C. NEW CONCRETE SLAB-ON-GRADE IS TO BE STEEL TROWEL FINISHED TO PROVIDE A SMOOTH, DENSE SURFACE FLUSH TO THE EXISTING SLAB BEYOND.
- D. SEAL THE EXTERIOR FACE OF ALL NEW CONCRETE WITH A CLEAR SEALER DESIGNED FOR EXTERIOR, SLIP-RESISTANT EXPOSED APPLICATIONS.

DIVISION 5 METALS

- A. SUPPLY STRUCTURAL AND MISCELLANEOUS METAL WORK INDICATED ON THE DRAWINGS AND IN THE SPECIFICATIONS; REFER TO THE STRUCTURAL DOCUMENTS FOR STANDARDS AND DETAILS, INCLUDING ANCHORS, BOLTS, SEATS AND BEAM CONNECTIONS AS REQUIRED.
1. ALL NEW STEEL COMPONENTS COMPLETE WITH CONNECTORS/ANCHORS/BOLTS ETC. ARE TO BE HOT-DIPPED GALVANIZED (NO EXCEPTIONS).
- B. INTERIOR METAL PANELS:
1. APPROVED PRODUCT: VICWEST L800 LIINER (HORIZONTAL INSTALLATION)
- C. CORRUGATED METAL PANELS:
1. AT THE CLADDING ALONG THE NEW WEST EXTERIOR WALL (REFER TO ELEVATIONS AND DETAILS), INSTALL PREFINISHED, DEEP PROFILE CORRUGATED METAL PANELS COMPLETE WITH ALL COORDINATING TRIMS, FLASHING AND ACCESSORIES.
2. APPROVED PRODUCT: 18 GAUGE VICWEST CL3100/400 (HORIZONTAL INSTALLATION)
3. COLOUR: CONSULTANTS TO SELECT FROM MANUFACTURER'S STANDARD RANGE (MINIMUM 24 CHOICES).
- D. SMOOTH METAL PANELS:
1. AT THE CLADDING ALONG THE NEW SOUTH AND NORTH EXTERIOR WALLS (REFER TO EXTERIOR ELEVATIONS AND DETAILS), INSTALL PREFINISHED SMOOTH METAL PANELS.
2. METAL PANELS TO MATCH EXISTING SMOOTH EXTERIOR PANELS AT WEST WALL OF ARTS CENTRE ADJACENT TO ADDITION. NOTE: CONTRACTOR CAN RE-USE EXISTING PANELS TO BE REMOVED AS PART OF SELECTIVE DEMOLITION WORK.

DIVISION 6 CARPENTRY

- A. SUPPLY AND INSTALL ALL CARPENTRY.
- B. ROUGH CARPENTRY.
1. MATERIALS - ALL MATERIALS SHALL BE NEW AND PROPERLY DRIED TO 19% MOISTURE CONTENT FOR EXTERIOR USE AND 12% FOR INTERIOR USE;
2. REFER TO STRUCTURAL FOR NOTES RELATING TO THE MATERIAL/GRADES FOR FRAMING LUMBER AND WALL SHEATHING.
- E. WORKMANSHIP.
1. NO BORING, CUTTING OR NOTCHING OF ANY STRUCTURAL MEMBER SHALL BE DONE WITHOUT THE CONSENT OF THE CONSULTANT;
2. ALL FRAMING MEMBERS SHALL BE PLUMB, SQUARE AND TRUE, FOR RECEIVING FINISH SO A FIRST CLASS JOB CAN BE DONE;
3. ALL FRAMING AND SHEATHING SHALL BE ATTACHED IN ACCORDANCE WITH THE NATIONAL AND PROVINCIAL BUILDING CODES;
4. INSTALL A 45 LB. FELT DAMP COURSE UNDER ALL SILLS, PLATES, LEDGES AND ALL WOOD MEMBERS IN CONTACT WITH CONCRETE. ALL WOOD SILL PLATES, LEDGERS, ETC. IN CONTACT WITH CONCRETE AND MASONRY SHALL BE PWF TREATED MATERIAL;
5. SHEATHING MEMBRANE SHALL BE A SELF-ADHERED AIR/VAPOUR BARRIER MEMBRANE. APPROVED PRODUCT: "BLUESKIN SA" BY BAKOR. PERFORM ALL WORK IN ACCORDANCE WITH MANUFACTURER'S WRITTEN INSTRUCTIONS. COMPONENTS USED SHALL BE SOURCED FROM ONE MANUFACTURER, INCLUDING SHEET MEMBRANE, AIR/VAPOUR BARRIER SEALANTS, PRIMERS, MASTICS AND ADHESIVES.

DIVISION 7 THERMAL AND MOISTURE PROTECTION

- A. INSULATION.  
SUPPLY AND INSTALL MOISTURE RESISTANT, RIGID, NON-COMBUSTIBLE MINERAL WOOL INSULATION BOARD PROVIDING (MINIMUM RSI 0.74 PER 25MM TO THE THICKNESS AND LOCATIONS AS SHOWN ON DRAWINGS).
1. APPROVED PRODUCT: "ROCKBOARD 60" BY ROXUL INC.
2. FOLLOW ALL MANUFACTURER'S RECOMMENDATIONS FOR INSTALLATION TO PROVIDE THE INSULATING VALUE OVER THE ENTIRE SURFACE.
3. USE FIBERGLASS THERMAL SPACERS ("CASCADIA CLIP" OR EQUIVALENT) AT THE EXTERIOR INSULATED ASSEMBLIES TO PROVIDE LOW CONDUCTIVITY FASTENERS.
- B. AIR/VAPOUR BARRIER ON THE WARM SIDE OF INSULATED ASEMBLIES AND BELOW THE CONCRETE SLAB-ON-GRADE SHALL BE CONTINUOUS 6-MIL POLYETHYLENE FILM:
1. SEAL PERIMETER OF SHEET VAPOUR BARRIER BY APPLYING A CONTINUOUS BEAD OF SEALANT TO THE SUBSTRATE. LAP THE VAPOUR BARRIER OVER THE SEALANT, THEN INSTALL TAP OVER LAPPED SHEETS AND ENSURE THAT NO GAP EXISTS IN THE SEALANT BAD (SMOOTH OUT FOLDS AND RIPPLES).
2. SEAL LAP JOINTS OF SHEET VAPOUR BARRIERS BY ATTACHING FIRST SHEET TO THE SUBSTRATE, THEN APPLYING A CONTINUOUS BEAD OF SEALANT OVER SOLID BACKING AT THE JOINT AND LAP THE ADJOINING SHEET A MINIMUM OF 150MM (6") OR ONE FULL STUD SPACE WHERE UNBACKED AND PRESS INTO SEALANT BEAD. ENSURE THAT NO GAPS EXIST IN THE SEALANT BEAD AND SMOOTH OUT FOLD AND RIPPLES, THEN TAPE JOINTS WITH JOINT SEALING TAPE.
3. SEAL ALL ELECTRICAL SWITCH AND OUTLET DEVICE BOXES THAT PENETRATE THE VAPOUR BARRIER BY INSTALLING A MOULDED POLYETHYLENE BOX AND WRAP WITH FILM SHEET PROVIDING MINIMUM 300MM (12") PERIMETER LAP AT FLANGE. APPLY SEALANT TO SEAL EDGES OF FLANGE TO MAIN VAPOUR BARRIER AND SEAL WIRING PENETRATIONS THROUGH THE BOX COVER, THEN TAPE ALL LOCATIONS. (NOTE: ELECTRICAL INSTALLATION BY OTHERS; COORDINATE RENOVATION WORK WITH CONTRACTORS ASSIGNED TO COMPLETE THAT ASPECT OF THE PROJECT).
4. INSPECT SHEETS FOR CONTINUITY. REPAIR PUNCTURES AND TEARS WITH SEALING TAPE BEFORE WORK IS CONCEALED. NEATLY CUT SHEET VAPOUR BARRIER AROUND ALL OPENINGS AND ENSURE MATERIAL IS LAPPED AND SEALED TO BLOCKING.
5. INSTALL SELF-A DHERED AIR/VAPOUR MEMBRANE AT ALL CHANGES OF PLANE. PROVIDE MINIMUM 150MM (6") LAP AT ALL JUNCTIONS.
- C. CAULK CHANGES OF MATERIAL, EXPANSION JOINTS AND REVEALS TO MAKE THE NEW INSTALLATIONS WEATHERPROOF.
- D. ALL EXTERIOR CONDITIONS; ONE COMPONENT, MODIFIED POLYURETHANE JOINT SEALANT, MOISTURE CURING TO CAN 2 1913 M82; WITH BACK-UP ROD RECOMMENDED BY SEALANT MANUFACTURER.
- E. ALL FLASHING TO BE 24 GA. GALVANIZED STEEL WITH FINISH/COLOUR TO MATCH EXISTING.

DIVISION 8 DOORS

- A. FOR DOOR SIZE AND LOCATIONS, REFER TO DRAWINGS AND NOTES.
- B. SUPPLY AND INSTALL NEW INSULATED METAL DOORS COMPLETE WITH PRESSED STEEL FRAMES AND THE FOLLOWING HARDWARE:
1. HARDWARE SET 1: DOOR 000A
- |                  |                             |      |      |
|------------------|-----------------------------|------|------|
| 3 HINGES         | FBF199 114 x 114 NRP        | 32D  | CST  |
| 1 LOCKSET        | L9480P 06B 50-210-MK 50-211 | 626  | CSC  |
| 1 CLOSER         | 4040 XP SCUSH               | 689  | CLC  |
| 1 KICK PLATE     | GSH 80A 254 x 864           | C32D | CGA  |
| 1 KICK PLATE     | GSH 80A 254 x 889           | C32D | CGA  |
| 1 WALL STOP      | GSH 250                     | C32D | CGA  |
| 1 WEATHERSTRIP   | DS130C 1 x 914 / 2 x 2438   |      | AKDS |
| 1 DOOR BTM SWEEP | DS138C 914                  |      | AKDS |
| 1 THRESHOLD      | DS500H 914                  |      | AKDS |
2. HARDWARE SET 2: DOOR 000B
- |                  |                             |      |      |
|------------------|-----------------------------|------|------|
| 3 HINGES         | FBF199 127 x 114 NRP        | 32D  | CST  |
| 1 LOCKSET        | L9480P 06B 50-210-MK 50-211 | 626  | CSC  |
| 1 CLOSER         | 4040 XP SCUSH               | 689  | CLC  |
| 1 KICK PLATE     | GSH 80A 254 x 1169          | C32D | CGA  |
| 1 KICK PLATE     | GSH 80A 254 x 1194          | C32D | CGA  |
| 1 WEATHERSTRIP   | DS130C 1 x 1219 / 2 x 2438  |      | AKDS |
| 1 DOOR BTM SWEEP | DS138C 1219                 |      | AKDS |
| 1 THRESHOLD      | DS500H 1219                 |      | AKDS |
3. HARDWARE SET 3: EXTERIOR SECURITY/EXIT GATE  
CONTINUOUS HINGE BY GATE SUPPLIER
- |               |            |     |     |
|---------------|------------|-----|-----|
| 1 EXIT DEVICE | 8810 J     | 32D | CSA |
| 1 CLOSER      | 4040 XP TJ | 689 | CLC |
- C. ALL FINISH HARDWARE SHALL BE GUARANTEED IN WRITING BY THE MANUFACTURER AGAINST DEFECTS IN DESIGN, WORKMANSHIP, MATERIALS AND FINISHES FOR A PERIOD OF ONE YEAR FROM THE POSTED CERTIFICATION OF COMPLETION DATE (EXCEPT FOR CLOSERS WHICH ARE TO HAVE A TEN YEAR WARRANTY), AND THAT ANY DEFECTS WILL BE MADE GOOD AT NO ADDITIONAL COST TO THE OWNER.

DIVISION 9 FINISHES

- A. PAINTING: ALL MATERIAL AND WORKMANSHIP TO BE IN ACCORDANCE WITH THE MPDA OF B.C. PAINTING STANDARDS MANUAL REQUIREMENTS FOR "PREMIUM" GRADE WORK.
1. REPAINT ALL EXISTING PAINTED SURFACES AFFECTED BY THE RENOVATION WORK WITH COLOR TO MATCH EXISTING. WHERE ONLY A PORTION OF A SURFACE HAS BEEN AFFECTED, REPAINT THE ENTIRE SURFACE TO THE NEAREST CORNER.
2. PROVIDE PAINT FINISH TO NEW METAL DOORS AND FRAMES INTO THE MECHANICAL ROOM ADDITION.
3. REFER TO MECHANICAL AND ELECTRICAL DOCUMENTS FOR PAINT FINISH REQUIREMENTS RELATED TO EQUIPMENT, PIPING, AND FIXTURE INSTALLATIONS.

DIVISION 15 MECHANICAL

- A. REFER TO MECHANICAL DOCUMENTS.

DIVISION 16 ELECTRICAL

- A. REFER TO MECHANICAL DOCUMENTS.

E. 30/09/16 ISSUED FOR ADDENDUM #1

A. 20/06/16 ISSUED FOR DESIGN

No. DATE (dd/mm/yr) REVISION

PROJECT TITLE

SURREY ARTS CENTRE HVAC

13750 88th AVENUE SURREY, BC.

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All dimensions on the project must be checked by the contractor.

This drawing must not be used for construction purposes until here counter-signed.

clat:                      date:

SHEET TITLE

SPECIFICATIONS

PROJECT No. 36022.1

DRAWN EA

CHECKED GP

SCALE

DATE 30/09/16

PRINTED 30/09/16

REVISION No. E

A-04



**ATTACHMENT #4**

to

**ADDENDUM #1**

**STRUCTURAL ADDENDUM**

# STRUCTURAL ADDENDUM 01



**Project:** Surrey Arts Centre HYAC Upgrade **Date:** September 30, 2016  
**Project No:** 16169 **From:** Tim Verkerk  
**No. Pages:** 3 (incl Cover Page) **Via:** Email ☒ Fax ☐ Courier ☐ Mail ☐

| To                                  | cc                       | Attention   | Company/Address              | Telephone/Email |
|-------------------------------------|--------------------------|-------------|------------------------------|-----------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Bob Tam     | Chernoff Thompson Architects | 604 669-9460    |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Jarrold Yip | AME Group                    | 604 684-5995    |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Lorne Anuik | City of Surrey               | 604 591-4325    |

## Structural Addendum #1

Roof Plan and associated sections removed.  
Tanks Relocated and Tank Support Plan Revised  
Section 4 revised

- End of Addendum

WEB  
info@whmengineers.com  
www.whmengineers.com  
2227 Douglas Road,  
Burnaby, BC V5C 5A9  
T 604.484.2859  
F 604.484.2861



|    |                          |
|----|--------------------------|
| S1 | GENERAL NOTES AND TABLES |
| S2 | PLANS AND DETAILS        |

### GENERAL / NON MATERIAL SPECIFIC

|          |   |                            |       |   |                                     |
|----------|---|----------------------------|-------|---|-------------------------------------|
| AF       | - | FACTORED AXIAL FORCE       | MECH  | - | MECHANICAL DRAWINGS                 |
| ARCH     | - | ARCHITECTURAL DRAWINGS     | MI    | - | FACTORED MOMENT                     |
| BM       | - | BEAM                       | MIN.  | - | MINIMUM                             |
| BOT      | - | BOTTOM                     | NIC   | - | NOT IN CONTRACT                     |
| CANT     | - | CANTILEVERED               | NTS   | - | NOT TO SCALE                        |
| CI       | - | FACTORED COMPRESSION FORCE | O/C   | - | ON CENTRE                           |
| CL       | - | CENTRELINE                 | OPNG  | - | OPENING                             |
| CLAR     | - | CLEAR                      | OPPT  | - | OPPOSITE                            |
| COL      | - | COLUMN                     | REQD  | - | REQUIRED                            |
| CONT     | - | CONTINUOUS                 | RTU   | - | ROOF TOP UNIT                       |
| CW       | - | COMPLETE WITH              | RW    | - | REINFORCED WITH                     |
| DIA OR Ø | - | DIAMETER                   | SDF   | - | STEPPED DOWN FOOTING                |
| DL       | - | DEAD LOAD                  | SDI   | - | SUPERIMPOSED DEAD LOAD              |
| DP       | - | DEEP                       | SIM   | - | SIMILAR                             |
| DTS      | - | DEPTH TO SUIT              | SYMM  | - | SYMMETRICAL                         |
| EXP JT   | - | EXPANSION JOINT            | TBC   | - | TO BE CONFIRMED                     |
| ELEC     | - | ELECTRICAL DRAWINGS        | T&B   | - | TOP AND BOTTOM                      |
| EQ       | - | EQUAL                      | TT    | - | FACTORED TENSION FORCE              |
| EX       | - | EXISTING                   | TYP   | - | TYPICAL                             |
| EXT      | - | EXTERIOR                   | UNO   | - | UNLESS NOTED OTHERWISE              |
| GA       | - | GAUZE                      | U/S   | - | UNDERSIDE                           |
| GALV     | - | GALVANIZED                 | VERT. | - | VERTICAL                            |
| GEOTECH. | - | GEOTECHNICAL ENGINEER      | V/I   | - | FACTORED SHEAR FORCE                |
| HOR.     | - | HORIZONTAL                 | W/    | - | WITH                                |
| LG       | - | LONG                       | W/P   | - | WORKING POINT                       |
| LL       | - | LIVE LOAD                  | WHM   | - | WICKER HERPST MAYER CONSULTING INC. |
| LV       | - | LENGTH VARIES              |       |   |                                     |
| MAX.     | - | MAXIMUM                    |       |   |                                     |

## STEEL

|     |   |                        |       |   |                      |
|-----|---|------------------------|-------|---|----------------------|
| BCE | - | BOTTOM CHORD EXTENSION | OWSJ  | - | OPEN WEB STEEL JOIST |
| BFB | - | BOTTOM FLANGE BRACE    | PL    | - | PLATE                |
| DS  | - | DRAG STRUT             | STIFF | - | STIFFENER            |
| LLH | - | LONG LEG HORIZONTAL    | TOS   | - | TOP OF STEEL         |
| LLV | - | LONG LEG VERTICAL      |       |   |                      |

## CONCRETE / REINFORCEMENT

|      |   |                        |        |   |                       |
|------|---|------------------------|--------|---|-----------------------|
| ALT  | - | ALTERNATING            | REINF  | - | REINFORCING           |
| B    | - | BOTTOM                 | S.O.G. | - | SLAB ON GRADE         |
| BEW  | - | BOTTOM EACH WAY        | STAG   | - | STAGGERED             |
| BL   | - | BOTTOM LOWER LAYER     | STIR   | - | STIRRUP               |
| BUL  | - | BOTTOM UPPER LAYER     | S      | - | SHORT WAY             |
| CONC | - | CONCRETE               | TOP    | - | TOP                   |
| DWLS | - | DOWELS                 | TEW    | - | TOP EACH WAY          |
| EF   | - | EACH FACE              | TLL    | - | TOP LOWER LAYER       |
| EW   | - | EACH WAY               | TOC    | - | TOP OF CONCRETE       |
| FTG  | - | FOOTING                | TOF    | - | TOP OF FOOTING        |
| H    | - | HORIZONTAL             | TUL    | - | TOP UPPER LAYER       |
| H1E  | - | HOOK ONE END           | V      | - | VERTICAL              |
| H2E  | - | HOOK TWO ENDS          | VEF    | - | VERTICAL EACH FACE    |
| HEF  | - | HORIZONTAL EACH FACE   | VIF    | - | VERTICAL INSIDE FACE  |
| HOF  | - | HORIZONTAL INSIDE FACE | VOF    | - | VERTICAL OUTSIDE FACE |
| LW   | - | LONG WAY               |        |   |                       |
| P/T  | - | POST TENSIONING        |        |   |                       |

**1. GENERAL:**

- ALL STRUCTURAL DOCUMENTS, WHICH INCLUDE NOTES, PLANS, SPECIFICATIONS AND DETAILS, SHALL BE READ AS ONE DOCUMENT. FURTHER, THESE DOCUMENTS SHALL BE READ IN CONJUNCTION WITH ALL APPLICABLE ARCHITECTURAL, MECHANICAL, ELECTRICAL AND PIPING DRAWINGS. ANY DISCREPANCIES, INCLUDING AND ESPECIALLY WITH RESPECT TO DIMENSIONS, BETWEEN THE STRUCTURAL DOCUMENTS AND THOSE OF OTHER DISCIPLINES SHALL BE BROUGHT TO WHM'S ATTENTION IMMEDIATELY FOR INTERPRETATION AND/OR CORRECTION.
- THESE DRAWINGS SHOW THE DESIGN INTENT FOR THE COMPLETED BASE BUILDING STRUCTURE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY TEMPORARY WORKS NECESSARY FOR THE COMPLETION OF CONSTRUCTION, THE MAINTENANCE OF STRUCTURAL STABILITY DURING CONSTRUCTION, AND FOR ALL SAFETY CONSIDERATIONS IN AND AROUND THE CONSTRUCTION SITE.
- PROPOSED SUBSTITUTIONS OF PROPRIETARY PRODUCTS WILL NOT BE PERMITTED UNLESS PRE-APPROVED BY WHM.
- STRUCTURAL MEMBER AND JOINT ASSEMBLIES SPECIFIED ON THESE DRAWINGS HAVE BEEN DESIGNED IN ACCORDANCE WITH **PART 4 OF THE BRITISH COLUMBIA BUILDING CODE 2012**.
- THE DESIGN LOADS OF THE COMPLETED STRUCTURE ARE THE FOLLOWING: 1.0 kPa SUPERIMPOSED DEAD LOAD,  $Ss=2.4$  kPa and  $Sr=0.3$  kPa.
- STRUCTURE HAS BEEN DESIGNED WITH THE FOLLOWING SEISMIC PARAMETERS:  $Sa(0.2) = 1.0$ ,  $Fa(1.0) = 1.0$ ,  $I = 1.0$ .
- SITE CLASS C HAS BEEN ASSUMED (GEOTECH TO VERIFY).
- ALL STRUCTURAL MEMBERS AND FRAMING ASSEMBLIES SHALL COMPLY WITH THE CODE AND ALL CSA STANDARDS AND DESIGN GUIDES REFERENCED THEREIN. ALL CSA AND ASTM STANDARDS APPLICABLE TO THE WORK, WHETHER REFERENCED IN THESE DRAWINGS OR NOT, SHALL BE THE MOST CURRENT EDITIONS ENACTED IN THE JURISDICTION IN WHICH THE PROJECT IS TO BE PERFORMED.
- THIS PROJECT INVOLVES THE ADDITION OF A NEW MECHANICAL ROOM AND A SET OF STAIRS TO AN EXISTING STRUCTURE.
- THESE STRUCTURAL DRAWINGS ARE BASED ON ARCHITECTURAL DRAWINGS BY CHERNOFF THOMPSON ARCHITECTS.
- THE CONTRACTOR SHALL ARRANGE ADEQUATE OPPORTUNITY FOR WHM TO UNDERTAKE FIELD REVIEW OF THE STRUCTURAL COMPONENTS AND ASSEMBLIES SET FORTH IN THESE DRAWINGS SHALL REMAIN UNCONCEALED AND VISIBLE UNTIL REVIEWED IN THE FIELD BY WHM.

- THE CONTRACTOR SHALL ENSURE CONCRETE AND REINFORCEMENT IS DELIVERED, INSTALLED, AND CURED TO ALL CODE REQUIREMENTS AND TO REQUIREMENTS ON THESE DRAWINGS.
- NON-STRUCTURAL CONCRETE SUCH AS ARCHITECTURAL TOPPINGS, CIVIL WORK, ETC. IS SPECIFIED BY OTHERS.
- ALL REINFORCEMENT:
  - a. SHALL BE CHAIRED AND TIED SECURELY IN PLACE SUCH THAT IT WILL NOT DISPLACE AT ALL DURING CONCRETE PLACEMENT. SEE TABLES FOR COVER REQUIREMENTS. CHAIRS SHALL BE SECURED TO FORMS AND SHALL NOT BE DETECTABLE EITHER DIRECTLY OR THROUGH LONG-TERM DISCOLOURING OR RUSTING ON THE FINISHED SURFACE - USE PLASTIC OR RUBBER COATED CHAIRS AS NECESSARY TO COMPLY.
  - b. CONCRETE SHALL NOT BE CAST UNTIL WHM REVIEWS THE REINFORCEMENT AND FINDS IT IN GENERAL CONFORMANCE WITH THE STRUCTURAL DRAWINGS.
- AGGREGATE SHALL BE STONE AGGREGATE WITH A UNIT WEIGHT OF 23.6 kN PER CUBIC METRE (150 LBS PER CUBIC FOOT).
- MAXIMUM AGGREGATE SIZE SHALL BE 3/4" (20mm).
- CONCRETE SHALL BE REGULAR WEIGHT.
- CONCRETE SHALL HAVE 32 MPa MIN. 28 DAY STRENGTH.
- CONCRETE SHALL BE EXPOSURE CLASS C-2 OR BETTER.

EXPANSION ANCHORS:

- EXPANSION ANCHORS SHALL BE HILTI KWIK BOLT 3 (K83) INSTALLED INTO SOLID CONCRETE SUBSTRATE IN STRICT ACCORDANCE WITH HILTI'S LATEST PUBLISHED RECOMMENDATIONS.
- SEE TABLES FOR STANDARD EMBEDMENTS.
- K83 ANCHORS SHALL BE CARBON STEEL WITH ELECTROPLATED ZINC EXCEPT IN CASES WHERE THE ANCHORS WOULD BE SUBJECTED TO MOISTURE, SUCH AS IN EXTERIOR APPLICATIONS. IN SUCH CASES, CARBON STEEL ANCHORS WITH A HOT-DIP GALVANIZED COATING SHALL BE USED. STAINLESS STEEL ANCHORS ARE NOT PERMITTED.
- THE LENGTH IDENTIFICATION MARK ON THE END OF EACH ANCHOR SHALL REMAIN CLEARLY VISIBLE UNTIL SATISFACTORY FIELD REVIEW IS COMPLETE. ANCHORS WITHOUT THE PROPER LENGTH IDENTIFICATION MARK WILL BE REJECTED.
- **ADHESIVE ANCHORS:**
- ADHESIVE ANCHORS CONSIST OF AN ANCHOR ROD AND AN ADHESIVE INSTALLED INTO SOLID CONCRETE SUBSTRATE IN STRICT ACCORDANCE WITH HILTI'S LATEST PUBLISHED RECOMMENDATIONS.
- **ANCHOR RODS** SHALL BE SUPPLIED WITH CHAMFERED ENDS SO THAT EITHER END WILL ACCEPT A NUT AND WASHER. RODS SHALL COME COMPLETE WITH NUT AND STANDARD-CUT WASHER SIZED TO SUIT ROD DIAMETER AND SHALL BE OF ONE OF THE FOLLOWING TYPES:
  - HILTI HAS E FULLY THREADED ROD.
  - HILTI HAS SUPER (B7) FULLY THREADED ROD.
  - ASTM A 193, GRADE B7, FULLY THREADED ROD.
  - HILTI HIT-TZ THREADED ROD.
- USE HILTI PROFIT KIT FOR PROPER HOLE PREPARATION.
- OVERHEAD ANCHORS SHALL BE INSTALLED USING THE HILTI PROFIT ACCESSORIES TO ENSURE PROPER ADHESIVE INSTALLATION.
- NUTS SHALL NEITHER BE TIGHTENED NOR THE ANCHOR OTHERWISE STRESSED OR DISTURBED UNTIL THE ADHESIVE IS FULLY CURED.

**MATERIALS - BAR REINFORCEMENT:**

- SHALL CONFORM TO THE TABLES AND AS FOLLOWS:
- SHALL BE RATED FOR 400 MPa YIELD STRESS.
- SHALL BE STANDARD DEFORMED BILLET STEEL BARS.
- SHALL NOT BE WELDED IN ANY WAY EXCEPT AS SPECIFIED, IN WHICH CASE WELDABLE REINFORCEMENT SHALL BE USED.
- SHALL BE FREE OF DIRT, OIL, AND OTHER DELETERIOUS MATERIAL THAT MAY INHIBIT PROPER BONDING WITH CONCRETE.
- THE CONTRACTOR SHALL RETAIN MILL CERTIFICATES FOR ALL REINFORCEMENT AND SHALL FURNISH THESE TO WHM FOR REVIEW UPON REQUEST.

## 1. RESPONSIBILITY:

- THE CONTRACTOR SHALL ENSURE ALL STEEL WORK IS FABRICATED, DELIVERED, ERECTED, INSTALLED, AND TESTED TO ALL CODE REQUIREMENTS AND TO REQUIREMENTS ON THESE DRAWINGS.
- WHM'S DRAWINGS ILLUSTRATE THE DESIGN INTENT OF THE COMPLETED STRUCTURE. ERECTION SEQUENCING AND ANY TEMPORARY BRACING, GUYING, COUNTERBALANCING, ETC., REQUIRED TO MAINTAIN THE UNFINISHED STRUCTURE IN STABLE, SAFE, PLUMB, AND LEVEL CONDITIONS AT ALL TIMES SHALL BE DETERMINED, SUPPLIED, AND INSTALLED BY THE CONTRACTOR AND AT IT'S SOLE RESPONSIBILITY. THE CONTRACTOR SHALL PROVIDE INDEPENDENT DOCUMENTATION AND/OR FIELD REVIEW BY AN INDEPENDENT PROFESSIONAL ENGINEER AS REQUIRED BY THE BUILDING OFFICIAL OR OTHER GOVERNING AUTHORITY.
- THE CONTRACTOR SHALL COORDINATE ALL STEEL WORK WITH THE REQUIREMENTS OF OTHER DISCIPLINES INCLUDING BUT NOT LIMITED TO SLEEVES, CONDUIT, PIPES, DUCTS, CHASES, OPENINGS, INSERTS, ETC.
- STEEL WORK NOT COMPRISING PART OF THE BASE BUILDING STRUCTURE MAY BE SPECIFIED ON OTHER DISCIPLINES DRAWINGS.
- NO STEEL MAY BE CONCEALED UNTIL WHM FIELD REVIEW OBLIGATIONS HAVE BEEN SATISFIED. SEE NOTE SECTION 1.

## 2. CODES:

- STRUCTURAL STEEL WORK SHALL CONFORM IN ALL RESPECTS TO THE CODE AND ALL REFERENCED DOCUMENTS.
- MATERIALS AND PRACTICE SHALL CONFORM TO CSA S16-01.

### 3. WORKMANSHIP:

- ALL STEEL WORK:
  - a. SHALL BE CONSTRUCTED BY EXPERIENCED ERECTORS AND WELDERS SUPERVISED BY EXPERIENCED FOREMEN. CREDENTIALS SHALL BE FURNISHED TO WHM UPON REQUEST.
  - b. SHALL BE BUILT LEVEL, PLUMB AND TO THE DIMENSIONS SPECIFIED IN THE CONTRACT DOCUMENTS.
  - c. SHALL BE APPROPRIATELY PROTECTED FROM ADVERSE CONDITIONS SUCH AS RAIN AND DELETERIOUS CHEMICALS, ETC. IN CONFORMANCE WITH THE CODE.
- THE FABRICATOR SHALL BE EXPERIENCED IN THIS TYPE OF WORK. CREDENTIALS SHALL BE FURNISHED TO WHM UPON REQUEST.

#### 4. MATERIALS - FRAMING:

- |  |   |
|--|---|
| • ROLLED WIDE-FLANGES (W):   | G40.21M—350W OR EQUIVALENT (Fy=350 MPa) |
| • CHANNELS (C):  | G40.21M—300W OR EQUIVALENT (Fy=300 MPa) |
| • ANGLES (L):  | G40.21M—300W OR EQUIVALENT (Fy=300 MPa) |
| • TEES (WT):   | G40.21M—350W OR EQUIVALENT (Fy=350 MPa) |
| • RECTANGULAR, ROUND, AND SQUARE HOLLOW STRUCTURAL SECTIONS (HSS): |   |
|  | G40.21M—350W (Fy=350 MPa) CLASS C.      |
| • PLATES, BARS, AND SMOOTH RODS:                                   | G40.21M—300W OR EQUIVALENT (Fy=300 MPa) |

## 5. CONNECTIONS - GENERAL:

- ALL CONNECTIONS SHALL BE DESIGNED BY THE FABRICATOR'S PROFESSIONAL ENGINEER UNLESS SPECIFICALLY DETAILED ON THESE DRAWINGS.
- CONNECTION CONFIGURATIONS, BOTH FOR GRAVITY AND SEISMIC LOADS, SHALL BE AS SHOWN IN THE STANDARD DETAILS.
- THE FABRICATOR SHALL SUBMIT SUMMARY DESIGN DRAWINGS TO WHM FOR REVIEW SHOWING THE CONFIGURATION AND CAPACITY RANGES OF CONNECTIONS THEY INTEND TO UTILIZE. THESE DRAWINGS ARE IN ADDITION TO THE REGULAR SHOP DRAWINGS, AND SHALL PRECEDE THEM.

**6. CONNECTIONS - WELDED:**

- ALL WELDING SHALL CONFORM TO ALL REQUIREMENTS OF THE CANADIAN WELDING BUREAU (CWB) AS LISTED IN CSA STANDARD W59.
- ALL WELDING SHALL BE PERFORMED BY CWB CERTIFIED WELDERS UNDER THE REQUIREMENTS OF CSA STANDARD W47.1. THE CONTRACTOR SHALL FURNISH FOR REVIEW CERTIFICATES OF ALL WELDERS UPON REQUEST.
- ALL WELDING SHALL BE PERFORMED IN COMPLIANCE WITH THE FABRICATOR'S WRITTEN WELDING PROCEDURE SPECIFICATIONS (WPS), WHICH SHALL BE QUALIFIED IN ACCORDANCE WITH CSA STANDARDS. THE CONTRACTOR SHALL FURNISH FOR REVIEW THE WPS UPON REQUEST.
- ELECTRODES AND FILLER METAL SHALL BE RATED E480xx (E70xx) OR BETTER.
- AS A MINIMUM, WELD CONNECTIONS SHALL BE 6mm (1/4") FILLETS ALL AROUND.
- BECAUSE WHM STAFF ARE NOT WELDING EXPERTS AND ARE NOT TRAINED TO TEST FOR OR VISUALLY IDENTIFY FAULTY WELDING, WELD QUALITY AND CONFORMANCE TO INDUSTRY STANDARDS AND PROJECT-SPECIFIC SPECIFICATIONS ARE ENTIRELY THE RESPONSIBILITY OF THE WELDER.

**7. STEEL DECK:**

- SHALL BE ZINC COATED (Z275) FOR EXTERIOR EXPOSURE
- SHALL BE FASTENED WITH HILTI X-HIS24X-ENP19 1/8" PINS WITH A 36/7 PATTERN AND 150mm ON CENTRE AT PERIMETER. SIDE LAPS SHALL BE FASTENED WITH HILTI SL/C AT 150mm ON CENTRE
- THE CONTRACTOR SHALL ENSURE THAT ALL UNSHORED DECK SPANS DO NOT EXCEED THE MAXIMUMS PERMITTED BY THE MANUFACTURER'S CATALOGUES.
- SHALL BE CONTINUOUS OVER THREE SPANS WHEREVER POSSIBLE.
- SHALL HAVE AT LEAST 50mm (2") OF CONCRETE OVER ALL SUPERIMPOSED SPANS.
- ANY HANGERS FASTENED TO THE DECK TO SUPPORT NON-STRUCTURAL ELEMENTS MUST BE PRE-APPROVED BY THE DECK SUPPLIER FOR THE INTENDED LOAD.

## 8. SURFACES

- STRUCTURAL STEEL, WHICH WILL NOT RECEIVE A FINISH PAINT COAT AND IS REQUIRED TO BE PRIMED FOR INTERIOR EXPOSURE, SHALL BE CLEANED IN ACCORDANCE WITH CISC / CPMA STANDARD 1-73 AS A MINIMUM.
- STRUCTURAL STEEL TO BE PRIMED FOR EXTERIOR EXPOSURE SHALL BE CLEANED IN ACCORDANCE WITH SSPC SP6 "COMMERCIAL BLAST CLEANING" AS A MINIMUM.

- STRUCTURAL STEEL TO RECEIVE A SHOP OR FIELD PAINT FINISH SHALL BE CLEANED IN ACCORDANCE WITH THE ARCHITECTURAL SPECIFICATIONS OR SSPC SP6 "COMMERCIAL BLAST CLEANING", WHICHEVER PRODUCES A SURFACE WHICH HAS LESS RUST AND MILL SCALE.
- ANY STRUCTURAL STEEL THAT IS NOT PROTECTED FROM MOISTURE BY THE BUILDING ENVELOPE SHALL BE HOT-DIPPED GALVANIZED AFTER FABRICATION. WELDS, SCRATCHES, ABRASIONS, ETC., SHALL BE TOUCHED-UP WITH COMPATIBLE ZINC-RICH PAINT AFTER ERECTION.
- SEE THE ARCHITECTURAL DRAWINGS FOR ADDITIONAL REQUIREMENTS.

- THE FOLLOWING BEARING CAPACITIES HAVE BEEN ASSUMED (GEOTECH TO CONFIRM)

- a. **ULTIMATE LIMIT STATES BEARING CAPACITY:** 2000 psf  
b. **SERVICEABILITY LIMIT STATES BEARING CAPACITY:** 1500 psf

| Concrete Table: Reinforcement Cover |                                    |   |               |
|-------------------------------------|------------------------------------|---|---------------|
| COMPONENT                           |                                    | FIRE RESISTANCE RATING (SEE ARCH. FOR LOCATION AND EXTENTS) |               |
|                                     |                                    | 0 ~ 2 HOURS   | 3 HOURS       |
| FOOTINGS                            |                                    |   |               |
|                                     | BOTTOM                             | 3" (75mm)   | 3" (75mm)     |
|                                     | TOP                                | 2" (50mm)   | 2" (50mm)     |
|                                     | SIDES                              | 2" (50mm)   | 2" (50mm)     |
| SLABS ON GRADE                      |                                    | SEE PLAN  | SEE PLAN      |
| WALLS                               | EXTERIOR FACES                     | SEE PLAN  | SEE PLAN      |
| SUSPENDED SLABS                     | ALL SLABS BOTTOM REGULAR SLABS TOP | 1 1/2" (40mm)   | 1 1/2" (40mm) |

| <div>  <div> CITY OF<br/> <b>SURREY</b><br/> the future lives here </div> </div> |          |                        |
|---|----------|------------------------|
| No.   | DATE     | ISSUE                  |
| 6   | 30/09/16 | STRUCTURAL ADDENDUM #1 |
| 5   | 10/09/16 | RFO & SP SUBMISSION    |
| 4   | 16/08/31 | COORDINATION           |
| 3   | 16/08/15 | COORDINATION           |
| 2   | 16/08/05 | COORDINATION           |
| 1   | 16/07/23 | COORDINATION           |

PROJECT TITLE

**SURREY  
ARTS CENTRE  
HVAC  
UPGRADE**

**13750 88TH AVE  
SURREY, B.C.**

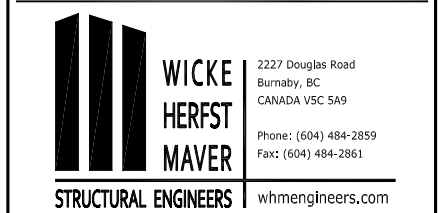
| SHEET TITLE                 |       |
|-----------------------------|-------|
| GENERAL NOTES<br>AND TABLES |       |
| PROJECT NO.                 | 16169 |
| PROJECT ENGR.               | PV    |
| PROJECT DRAFTER             | TV    |
| SCALE                       | N/A   |

# S1



|     |          |                           |
|-----|----------|---------------------------|
| 6   | 30/09/16 | STRUCTURAL<br>ADDENDUM #1 |
| 5   | 16/09/16 | RFG & BP<br>SUBMISSION    |
| 4   | 16/08/31 | COORDINATION              |
| 3   | 16/08/18 | COORDINATION              |
| 2   | 16/08/05 | COORDINATION              |
| 1   | 16/07/23 | COORDINATION              |
| No. | DATE     | ISSUE                     |

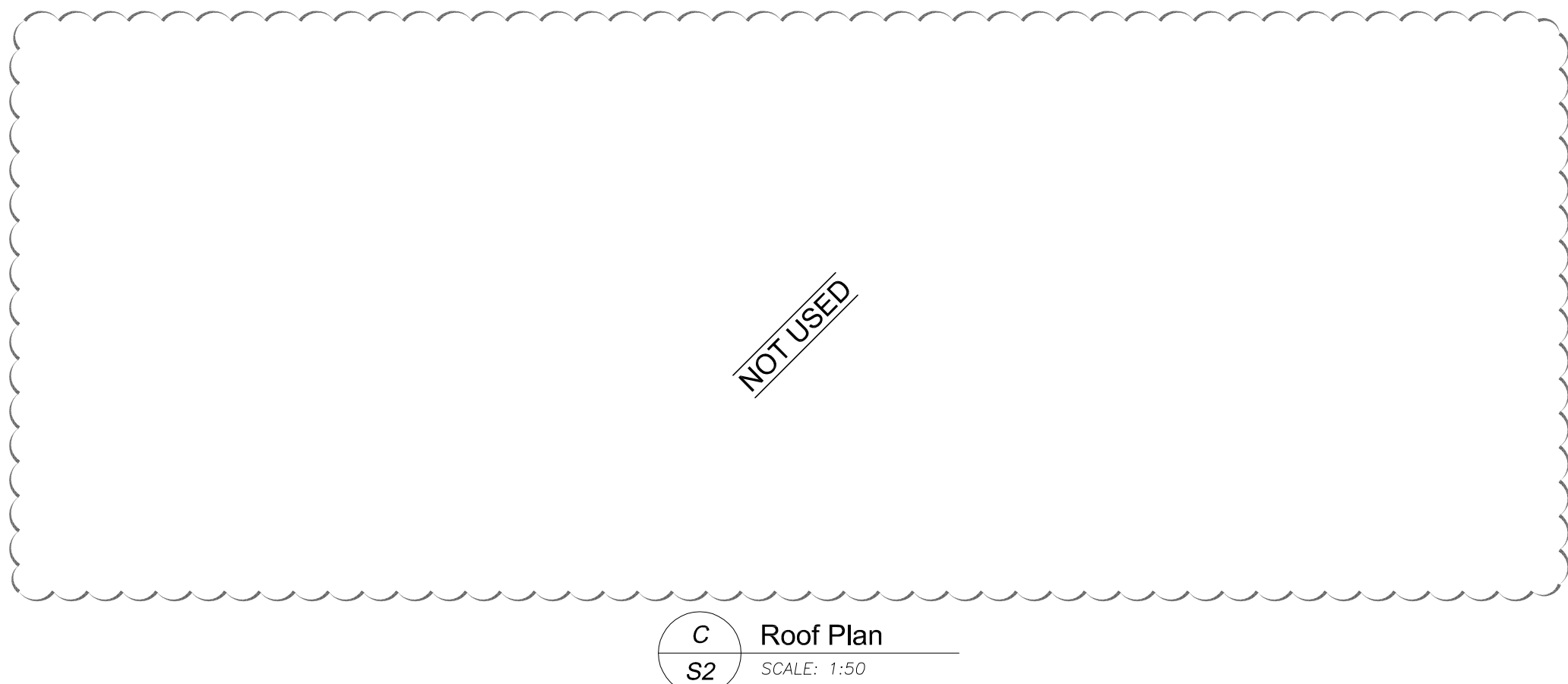
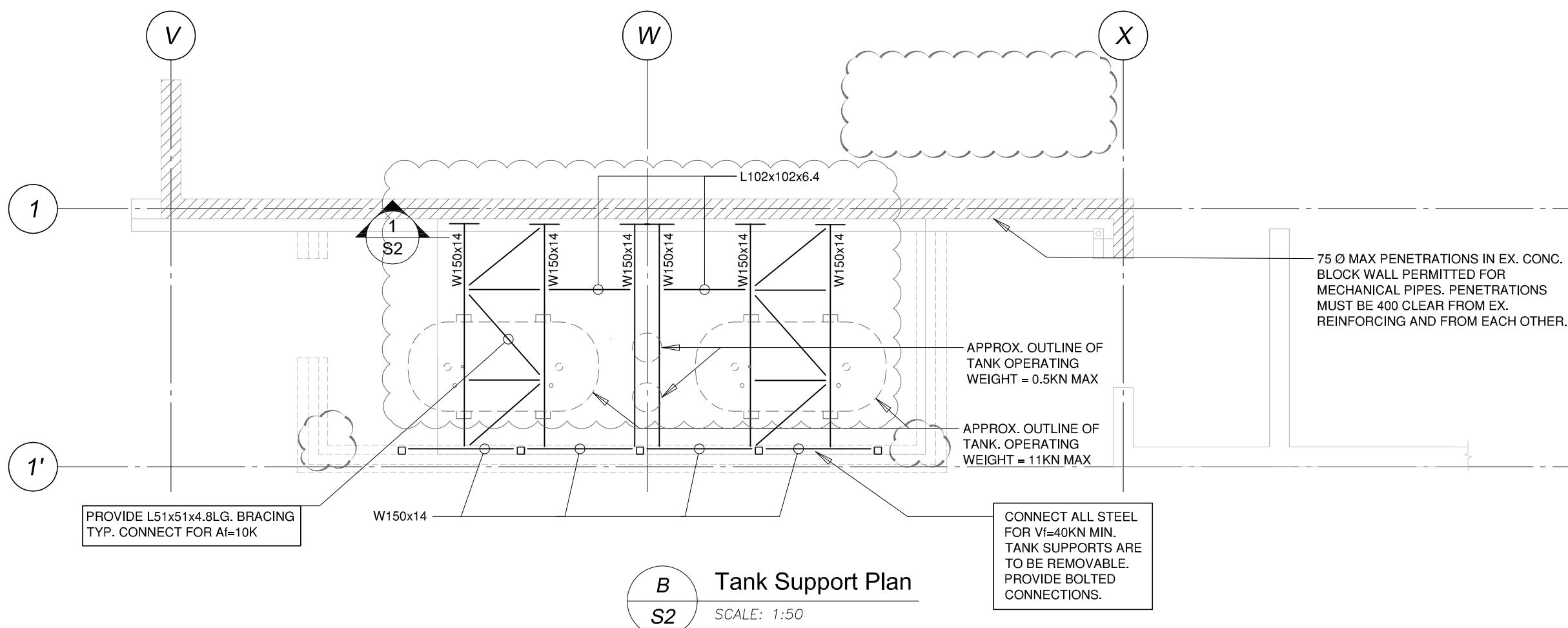
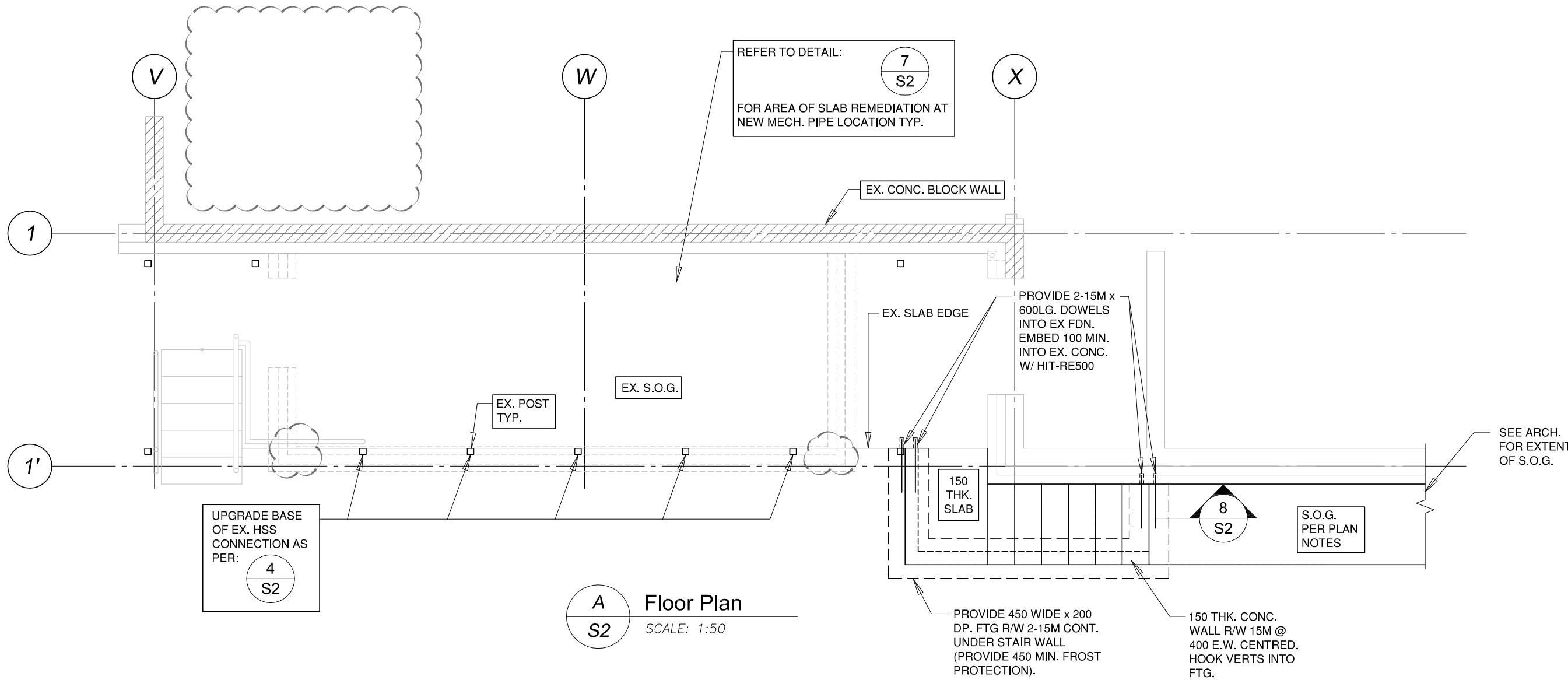
PROJECT TITLE  
**SURREY  
ARTS CENTRE  
HVAC  
UPGRADE**  
13750 88TH AVE  
SURREY, B.C.



SHEET TITLE  
**PLANS AND  
DETAILS**

PROJECT NO. 16169  
PROJECT ENGR. PV  
PROJECT DRAFTER TV  
SCALE AS SHOWN

SHEET NUMBER  
**S2**



#### Plan Notes

##### DIMENSIONS AND ELEVATIONS:

- CONTRACTOR TO THOROUGHLY REVIEW ALL DIMENSIONS AND ELEVATIONS SHOWN ON THIS DWG. COMPARE THEM WITH ARCH. AND REPORT ANY DISCREPANCIES TO WHM AND THE ARCH IMMEDIATELY.
- "MAX" OR "MIN" INDICATES STRUCTURAL REQUIREMENTS. BUILD TO THE ARCH. DIMENSIONS AND ELEVATIONS PROVIDED THE STRUCTURAL REQUIREMENTS ARE MET.

##### SLABS ON GRADE:

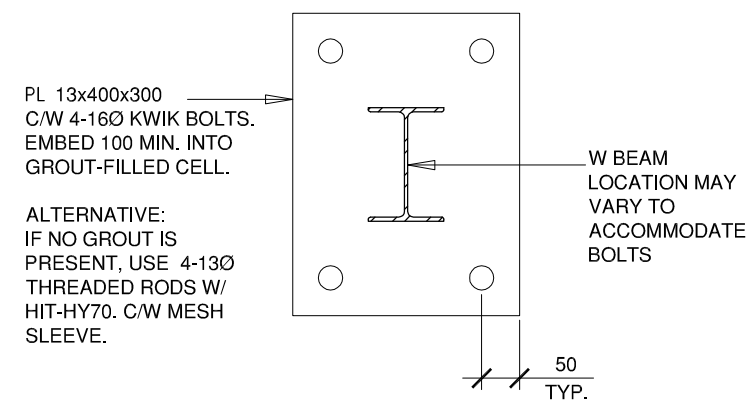
- 100 THK. S.O.G.
- R/W 10M @ 400 EA. WAY AT MID-DEPTH.
- PROVIDE CONTROL JOINTS @ 1200 O/C MAX. EACH WAY WITHIN 18 HOURS OF FINISHING SLABS. ZIP STRIPS MAY BE USED BUT MUST BE APPROVED BY THE ARCHITECT PRIOR TO USE.
- PREPARATION OF UNDERLYING SOILS AND SUB-BASE DESIGN PER GEOTECH.

##### EXISTING CONDITIONS:

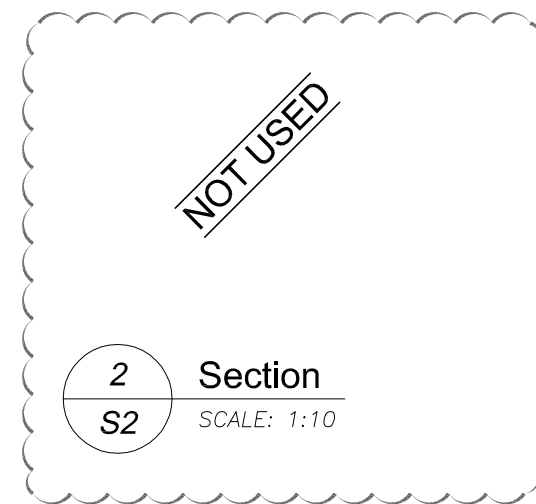
- CONTRACTOR TO SITE VERIFY ALL EXISTING STRUCTURE NOTED ON PLAN AND REPORT TO WHM, IF DIFFERENT, PRIOR TO CONSTRUCTION.
- WHERE EXISTING STRUCTURE IS NOT NOTED ON PLAN, CONTRACTOR TO SITE CONFIRM AND REPORT ALL EXISTING STRUCTURE IN THE VICINITY OF NEW WORK TO WHM PRIOR TO CONSTRUCTION.

##### FOOTINGS:

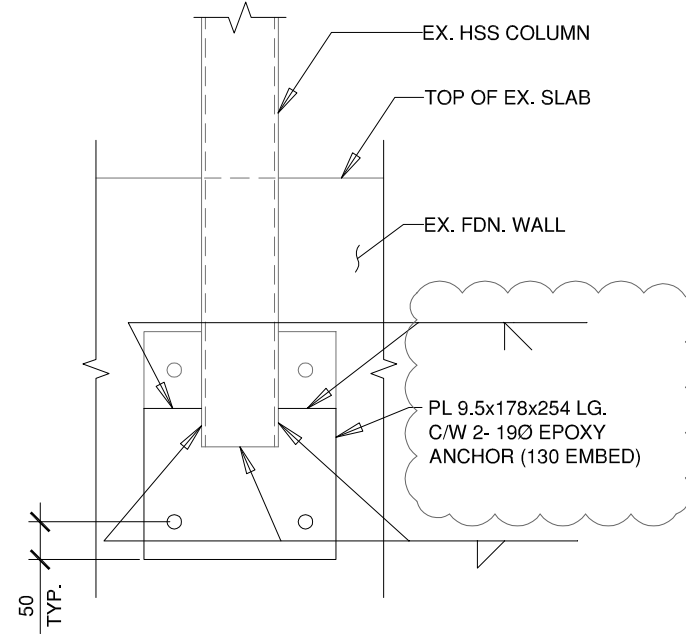
- FOOTINGS HAVE BEEN DESIGNED FOR BEARING CAPACITIES NOTED IN GEN NOTES.
- FOOTINGS TO BE CENTRED ON WALLS AND COLUMNS UNLESS SHOWN OR NOTED OTHERWISE.



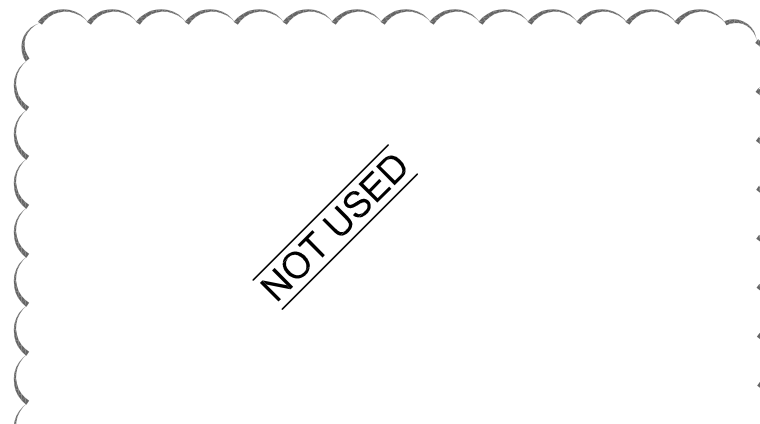
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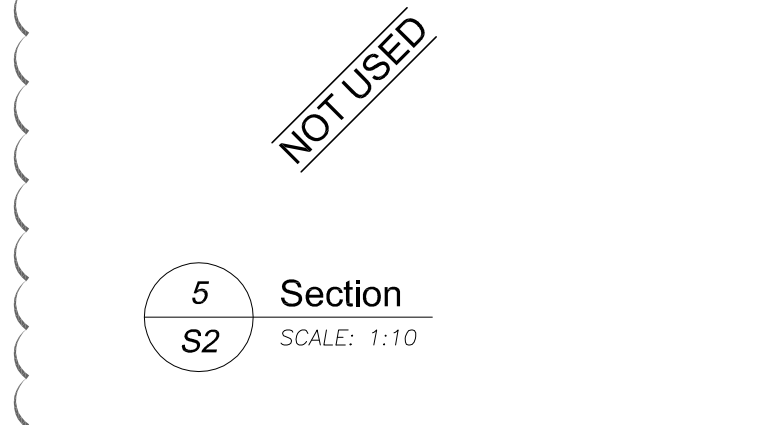
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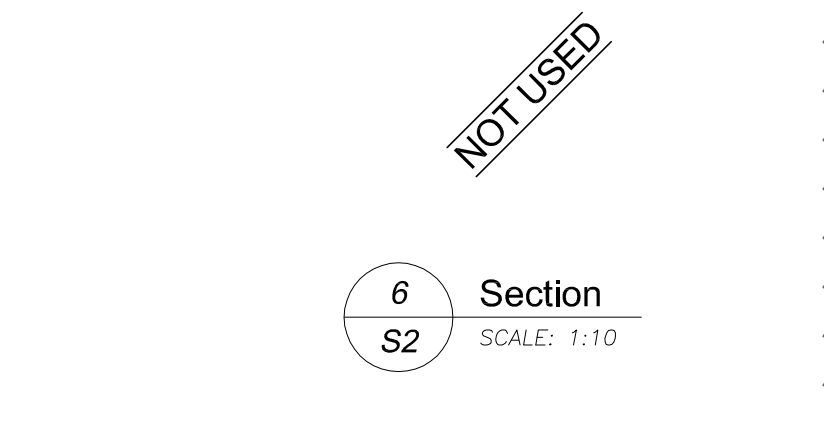
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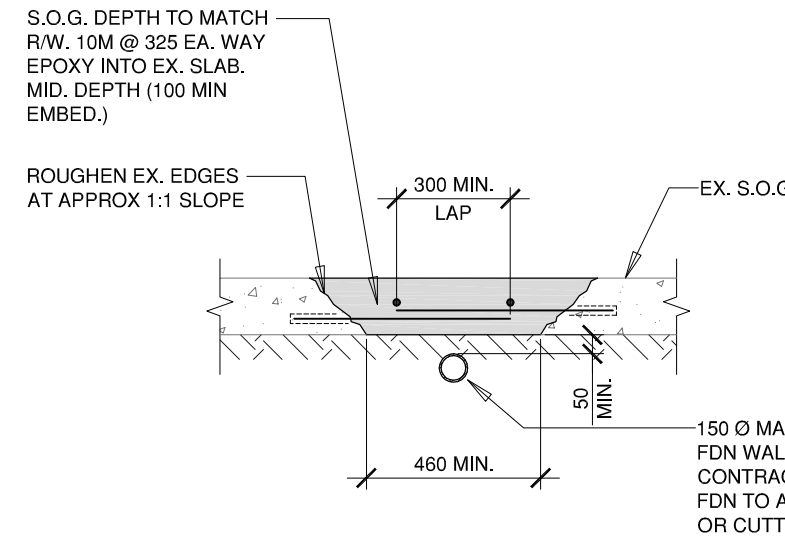
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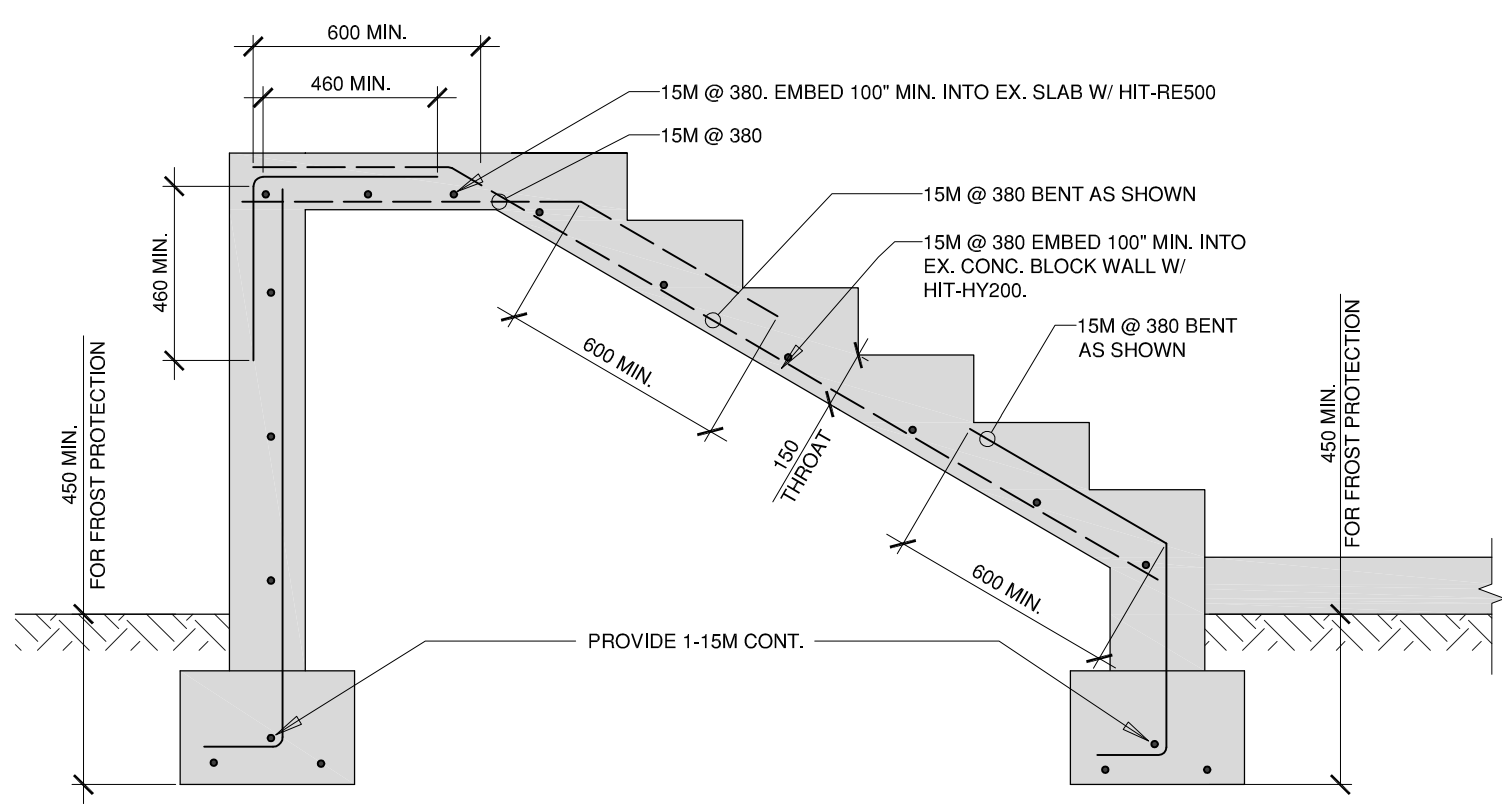
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**6 Section**  
**S2** SCALE: 1:10



**7 Section**  
**S2** SCALE: 1:20



**8 Section**  
**S2** SCALE: 1:20